Government of the People's Republic of Bangladesh

Ministry of Water Resources

Bangladesh Water Development Board

Flood Plan Coordination Organization

COMPARTMENTALIZATION PILOT PROJECT

MITIGATION MEASURES FOR FISHERIES IN THE TANGAIL AREA

REVISED VERSION

Technical Note 94/07

MAY 1994

Euroconsult/Lahmeyer International/Bangladesh Engineering & Technological Services/House of Consultants

under assignment to

DIRECTORAAT GENERAAL INTERNATIONALE SAMENWERKING
Government of the Netherlands

and

KREDITANSTALT FÜR WIEDERAUFBAU
Federal Republic of Germany

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The first draft of Mitigation Measures for Fisheries was circulated in June 1993. This was commented on by various experts. Finally revised version was made and discussed at the FPCO on 29th January 1994. During this meeting, the revised version was approved for implementation.
The cost of the Mitigation Measures are provided in the revised TAPP approved in March 1994.

January 1995

iii. SUMMARY

0.1 The CPP will execute the mitigation measures in order to restore 97 tons of the fish estimated to be lost annually due to the introduction of a new water management scheme. The proposed plan comprises the following actions:

* **Increased natural recruitment**, to the floodplain by restoration of the migration routes from the Dhaleswari river. The sand rim, which is blocking the intake of the Lohajang river will be removed. This will facilitate the first flood water to come in without obstruction and more hatchlings will enter the CPP area.
If this measure is proved to be successful then the introduction of culture based fisheries will not be needed.

  Culture based fisheries, the floodplain will be stocked with fingerlings in order to enhance fish production. Free access to water bodies will be maintained as production costs will be covered by the operation and maintenance of the whole scheme. The introduction of culture based fingerlings can result in an incremental production of 30 T/year if compared with the without case.

* **Aquaculture development**, the production of fish through aquaculture will be increased through improvement of the existing polyculture of carp and through the development of aquaculture in pagars and homestead ponds. The development in pagars and homestead ponds will create income earning activities for landless, marginal farmers and women. The development of aquaculture will be mainly done through extension of known techniques and provision of credit. The program can result in an total incremental production of 105t/year, as compared with the with out case.

  Fingerling availablity is a major constraint for the improvement of aquaculture. At full implementation approximately 2 million fingerlings will be needed annually. The renovation and establishment of nursery ponds (total pond area 4 ha) spread over the CPP area is proposed and they should be operated by pond owners.

* **The Beel concept**,the results of the Special Fisheries Study indicated that the reproduction of Beel resident fish as Puti (*Puntius sophore*) is triggered by an increase of more as one meter in water level in the beel during the pre-monsoon. It is therefore proposed to guarantee this watelevel rise in the beel through the introduction of a sill level in the drainage system, 1-1.5m above the average minimum dry season water level.

0.2 It can be concluded that the proposed mitigation measures can restore fully the losses arisen from the introduction of a new water management. The total production of fish will increase with approximately 105 t/year. A summary of the estimated production under existing situation and for the with case combined with mitigation measures is presented below.

HABITAT	At present	With project intervensions	With project & mitigation
	Production(Ton/Year)		
River	44	44	44
Beel	127	57	57
Floodplain	183	156	213
Pits & derelict ponds	26	26	26
Aquaculture	142	142	287
Total	522	425	627

1 INTRODUCTION

1.1 The bengali expression " Mache Vathe Bangali", "Rice and Fish makes a Bengali" reflects well the importance of fish in Bangladesh. The fisheries sector accounts for 3% of the GDP(Gross Domestic Product), 11 % of export earnings and 70 % of the animal protein intake of the population. Inland fisheries and aquaculture are the major contributors of fish covering respectively 50% and 22% of the total production.

1.2 The Tangail district and consequently also the CPP area is one of the lowest inland fish producers of Bangladesh providing approximately 1 % of the total inland fisheries production. As a consequence the per capita availability of fish is 1.83 kg/yr only. The major part (85%) of the fish consumed in the rural area of the CPP consists of the so called "small" or "miscellaneous" species, most of them originating from the Beel areas.

1.3 Fishermen in the project area can be divided in:

Professional, their main occupation is fishing throughout the year and their number in the CPP area is estimated at 460.

Part time professional, these fishermen have next to fishing an alternative occupation and approximately 930 are active in the CPP area.

Subsistence, the majority of the fish, in Bangladesh and in the CPP area, is caught by this group. The catch is mainly meant for home consumption. The fisheries household survey estimated their number at 17,290.

1.4 Aquaculture is carried out on a relatively low level within the CPP area. The pond owners are not familiar with the aquaculture concept and they are still following the traditional pond culture system. The major constraints for aquaculture in the CPP area are the lack of technical knowhow and high quality stocking material.

1.5 The Aquaculture Survey indicated the existence of approximately 650 culturable ponds and 400 suitable pagars within the CPP area. The main species cultured are: major or Indian carp, Silver carp, Common carp, Tilapia and Grass carp. The actual production level is estimated at 142 t/year, with an average pond size of 0.243 ha and a production level not exceeding 1,200 kg/ha/year.

1.6 The total fish production through fisheries and aquaculture is estimated at 522 t/year and the distribution over the different habitats and type of fishermen is presented in Tables 1 and 2. The data in Table 2 shows the significance of the subsistence fisheries.

Table 1: The 'at present' fish production within the CPP-area and its distribution over the different habitats.

HABITAT	PRODUCTION (TON/YEAR)
River	44
Beel	127
Floodplain	183
Pits & Derelict ponds	26
Aquaculture	142
TOTAL	522

Table 2: The distribution of the fisheries output of the CPP area among the types of fishermen and different habitats

HABITAT	CATCH (ton/Yr)by different group of fisherman		
	SUBSISTENCE	OCCASIONAL	PROFESSIONAL
River	36	1	7
Beel	70	8	49
Floodplain	78	15	90
Burrowpit & Derelict ponds	23	0	3
TOTAL	207	25	149

1.7 Improved water management for agriculture, usually have an adverse impact on fisheries due to the fact that the water needs of both production systems are, in principle, different. The scope of the project is to limit the adverse impact on fisheries of new water management schemes and to stabilize or increase the total production through the development of appropriate mitigation measures.

1.8 In this report, the impact on fisheries of the water management as proposed by the project is summarised and the mitigation measures needed in order to restore the losses are presented.

2. THE IMPACT ON FISH PRODUCTION

2.1 Water management affects fisheries[1] in four ways:

(a) Drainage of rain water around the beels causes a reduction in water level during the pre-monsoon. Consequently, reproduction and recruitment of" beel" fish is hampered, resulting in a decreased production.

(b) The total fish production of the floodplain is determined by its flooded area and productivity, reduction of this area consequently leads to a reduction in total fish production

(c) Retardation of the incoming river-flood affects the migration of carp hatchlings and adults to the flood plain.

(d) A shortening of the inundation period reduces the grow out period of carp spp, as most of them are caught when the flood water recedes to the river.

2.2 Water management as proposed for the CPP-area involves peripheral control by a regulator in the Lohajang river, improvement of the drainage condition and internal water control. The main regulator in the Lohajang river has been designed in such a way that with the actual knowledge it can be stated that it is more or less 'fish friendly'. The minor regulators are be based on the principle of under-shot water entry and are designed in such a way that free flow of water through these structures is possible during the month June/July when the first flood enters the project area. This fish friendliness however means only that the in-flowing riverine fish hatchlings are not damaged and that they can enter the flood plain when their density in the river is maximal.

2.3 The construction of the regulators has however a significant impact on fisheries. Due to their construction all waterways are throttled and less water will enter the flood plain, resulting in; lower influx of hatchlings and a reduced inundation area. As a consequence fish production of the area will be reduced. Complete 'fish friendly' structures, in which all options could be tested with gated regulators as wide as the existing water ways, is not a realistic concept.

2.4 The results of the hydrological model for the with project case were used in a new three step analyses and the predicted losses are presented in Table 3 (details are given in the annex 6 of the Interim Report, 1992)

[1] Fisheries refers to captured fisheries only

Table 3: The estimated fish production figures in the CPP area before and after the implementation of the proposed water management.

Scenario	Fish Production (t/year)	Loss (t/year)	Total Value Tk/year (lac)	Loss Tk/year (lac)
At present situation	522		261	
With project intervensions	425	97	212	51

The full implementation of the proposed measures will result in an annual loss of 97 tons (18.5%). The major part of the loss takes place at the beel, where production will be reduced from 127 to 57 t/year. Estimates are based on detailed Special Fisheries Studies.

3. PROPOSED MITIGATION MEASURES

3.1 The mitigation measures are aiming at the restoration of the fisheries losses estimated to occur after the implementation of the proposed water management schemes. The losses are found in captured fisheries only, with the highest impact at subsistence fisheries level.
It is realised that these losses are of utmost importance for the people concerned, mainly landless and marginal farmers, it is their main source of animal protein and the nature of free access to the common resources guarantees access to this relatively cheap source of protein. Within this respect it has been decided to aim the mitigation measures not only at the restoration of fish on a kilogram basis but to include a principle that mitigation measures must aim at those people who suffer the most.

3.2 The proposed mitigation measures will take place in the two production systems; fisheries and aquaculture. From a philosophical point of view the actions under taken within fisheries can be considered as "real" mitigation measures as within this production system the losses take place. Action undertaken in the aquaculture production system will increase the production of fish but in the real sense it is not a mitigation measure as it does not affect the natural fish stocks. The development of aquaculture can be considered as a potential source which until now not used at its full extent within the CPP area. The following mitigation measures are proposed and discussed in the coming chapters;

* **Increased natural recruitment**; the enhancement of the floodplain by restoration of the migration routes for the riverine species to the floodplain.

  Or

  Culture based fisheries; the enhancement of the floodplain through the stocking of fish.

* **Pond culture**; the improvement of semi intensive carp farming in existing ponds.

* **Pagar/Ditch culture**: the introduction of "Thaiputi" rearing in Pagar and homestead ponds.

* Integrated farming; the combined farming of rice and fish.

* **The Beel concept**; the protection of reproductive area of 'beel' fish in order to guarantee recruitment of this group.

A.1 Increased natural recruitment

a. Introduction

3.3 The floodplain fish production depends largly on the recruitment of hatchlings. the source is either beels or river. The riverine fishs, such as major carps(Rui, Catla, Mrigel) spawn upstream in the Jamuna river at the begeninig of the rainy season. The eggs,larvae, fingerlings and some adults of these species flow downstream with the water current into the Dhaleswari and Pungli river, finally entering the floodplains of the project area from the north side, through the Lohajong river at the end of June. In order to know the present situation of the recruitment the project conducted a two year study on the hatchling migration under Special Fisheries Study (SFS).

3.4 The SFS study only studied the hatchling migration in the Lohajang river but in order to get a complete picture, events happening outside the project area are essential and data provided by FAP 17[2] are also used. During the season of 1992 the river started to rise late. The hydrologic connection between the Dhaleshwari river and the Lohajong river was made on 29th of June and sampling started on the 2nd/3rd of July. In 1993 the flood came in the normal expected period and the Lohajong got connected with the Dhaleswari river on the 10th of June and monitoring started soon after on the 12th of June.

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[2] The data of FAP 17 are preliminary as complete analyses has not yet been finalysed

3.5 The results clearly indicate that hatchlings are coming **"in waves"** and the peaks of the hatchling waves are closely related to peak levels of the river. This phenomena shows that the adult fish in the upper catchment area respond immediately on increased water level by spawning and large number of eggs are released and are drifting downstreams. As a result the hatchling density in the Lohajang river increases. In both the years the majority of the carp hatchlings are found within the first waves and they are not found any more after mid august. In both the years the hatchling density does not exceed 1.5 hatchlings/m^3. In this respect it is of importance to use the data of the Dhaleswari river during the same period. Figure 1 and Figure 2 presents the combined data of the Lohajong (CPP) and the Dhaleswari (FAP 17) during 1992 and 1993.

Figure 1: Hatchling migration of 1992, Lohajong (CPP) and Dhaleswari (FAP 17)

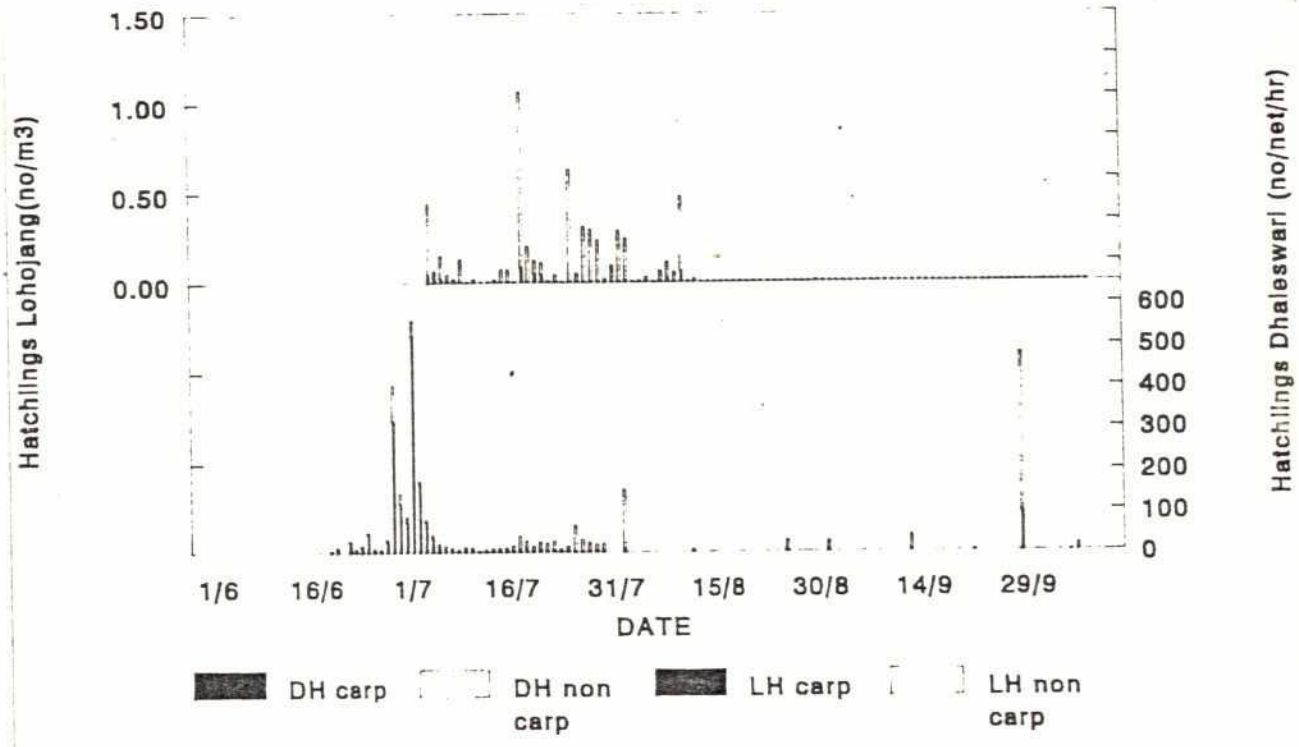
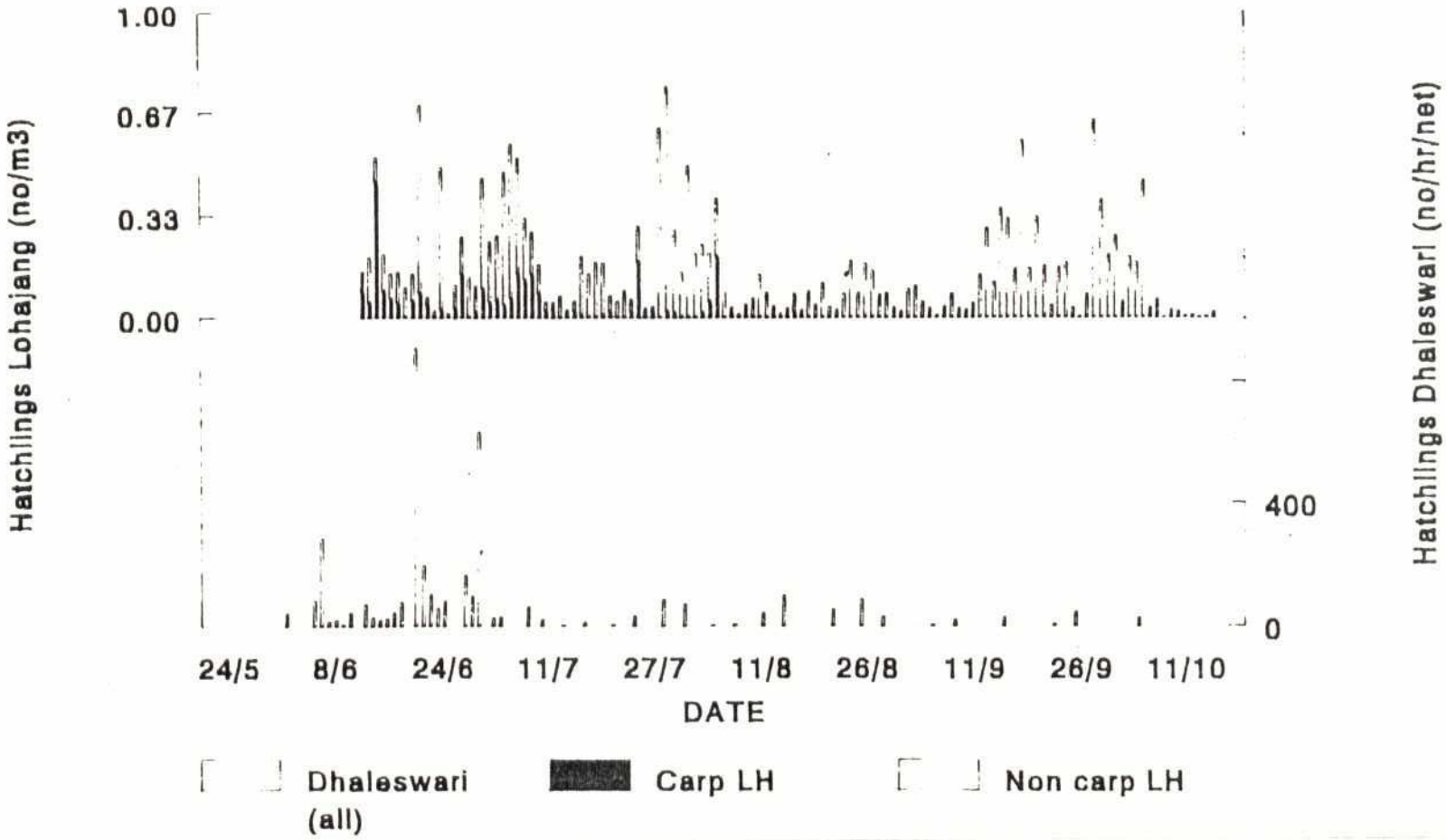


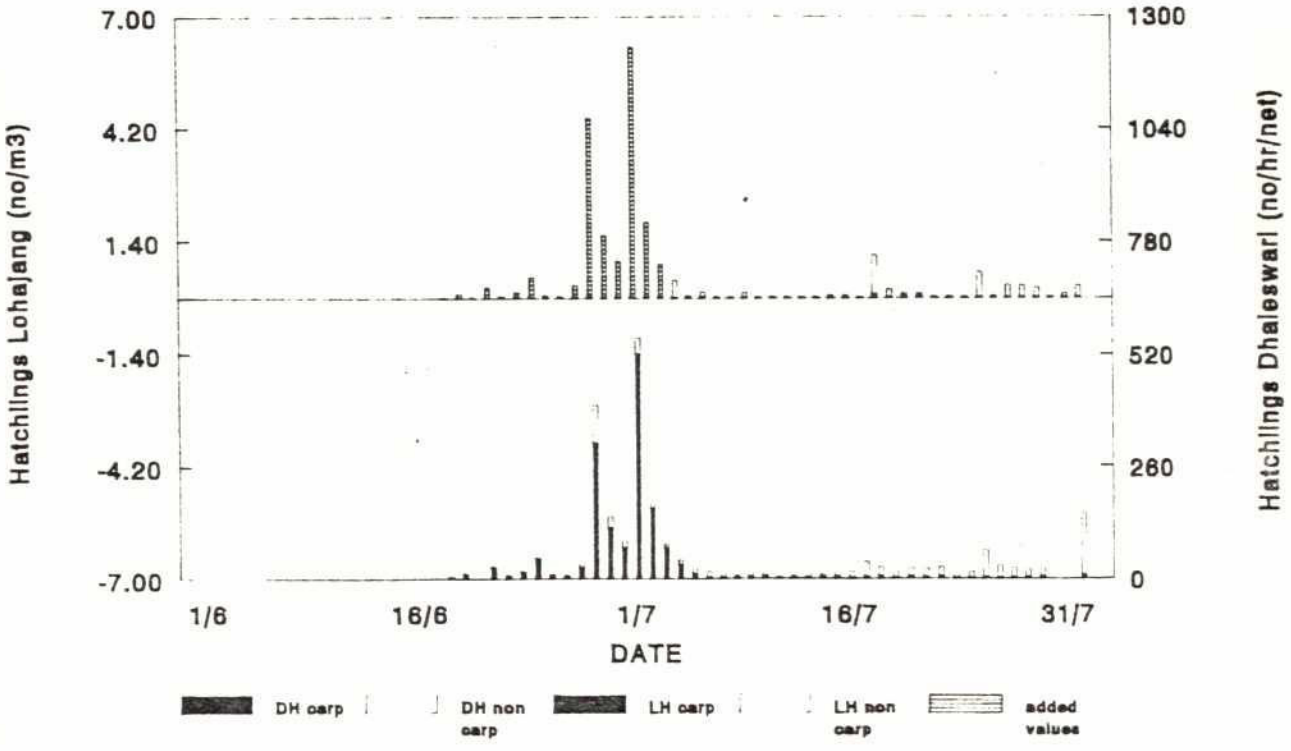
Figure 2: Hatchling migration of 1993, Lohajong (CPP) and Dhaleswari (FAP 17)



3.6 In 1992 the hatchling density in the Dhaleswari river starts increasing mid June with a maximum peak level on the first of July. Sampling of the Lohajang river started just after this peak level, as complete hydraulic connection between Dhaleswari and Lohajong river and flowing of the Lohajang river took place between 29th and the 2nd of July, it can be stated that the peak was missed by the Lohajang river in 1992.

3.7 The hatchling densities are expressed differently for the two rivers: the Dhaleswari densities are expressed in No of hatchlings/hour/net where as the densities in the Lohajang are expressed in hatchlings per m^3 of water. A comparison of the different data is possible as in both places the density follows a similar pattern during the first peaks. In Figure 3 the real values of the Dhaleswari are presented in combination with real values of the Lohajang and extrapolated data for the first days of July. It indicates that a density of 6-7 hatchlings/m^3 could be expected if the hydraulic connection between the two rivers occurs earlier.

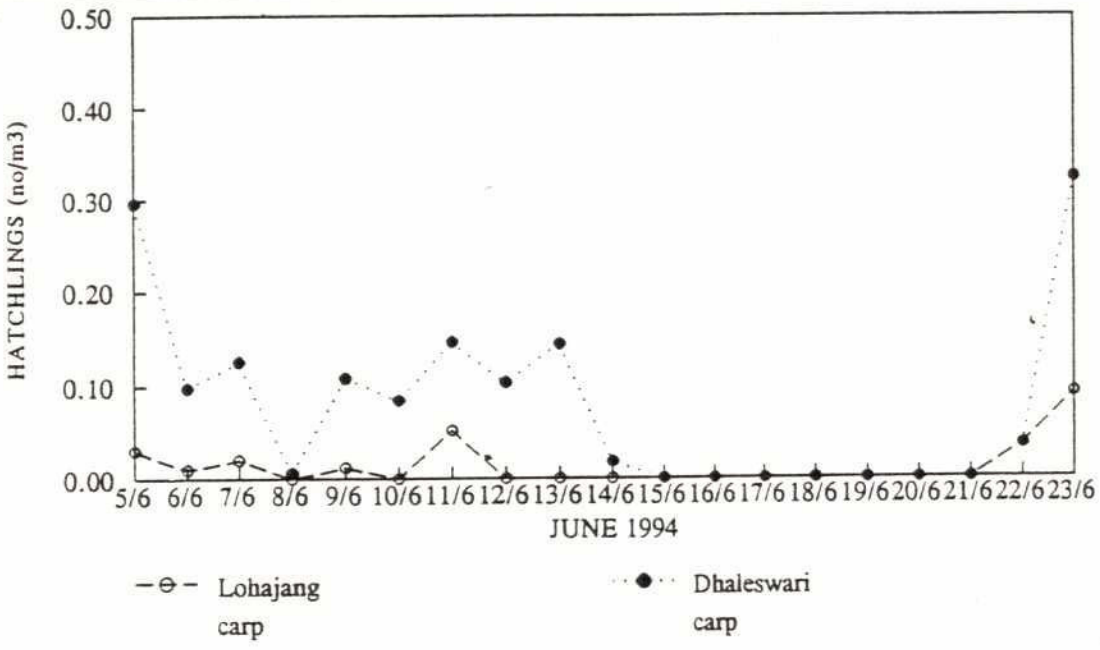
Figure 3: Hatchling migration of 1992 with extrapolated values for the Lohajong river



3.8 In 1993 the hatchling density in the Dhaleswari river starts increasing on the 5th of June and a maximum peak level is reached on the 19th of June. From the 12th of June hatchlings were sampled from the Lohajang river and thus this peak period was also covered in the Lohajang. In June and the beginning of July the pattern of hatchling densities in both rivers is similar. After mid July several waves are observed in the Lohajang river while they are absent in the Dhaleswari river. The main reason is probably the fact that sampling of the Dhaleswari was not done daily after mid July. The maximum peak level in the Lohajang in 1993 is more or less the same as in 1992, which is surprising, as sampling took place during the entire period of hatchling migration and theoretically a density of 6-7 hatchlings/m^3 could be expected. This means that the hatchling density (in no/m^3) is lower in the Lohajang river if compared with the Dhaleswari river.

3.9 This phenomena was checked during the first weeks of June 1994 when the first flood entered the project area. Both rivers were sampled with identical nets following the same procedure. The results are presented in Figure 4 and it indicates that the carp hatchling density is 5 times higher in the Dhaleswari river ($P \leq 0.001$). For the hatchling densities of all larvae the difference is 1.6, the difference is caused by a high influx of the so called E1 hatchlings[3] in the Lohajang during the low water phase of the flood when the flow rates are minimal

Figure 4: Hatchling concentration in the Dhalesawri and Lohajong river

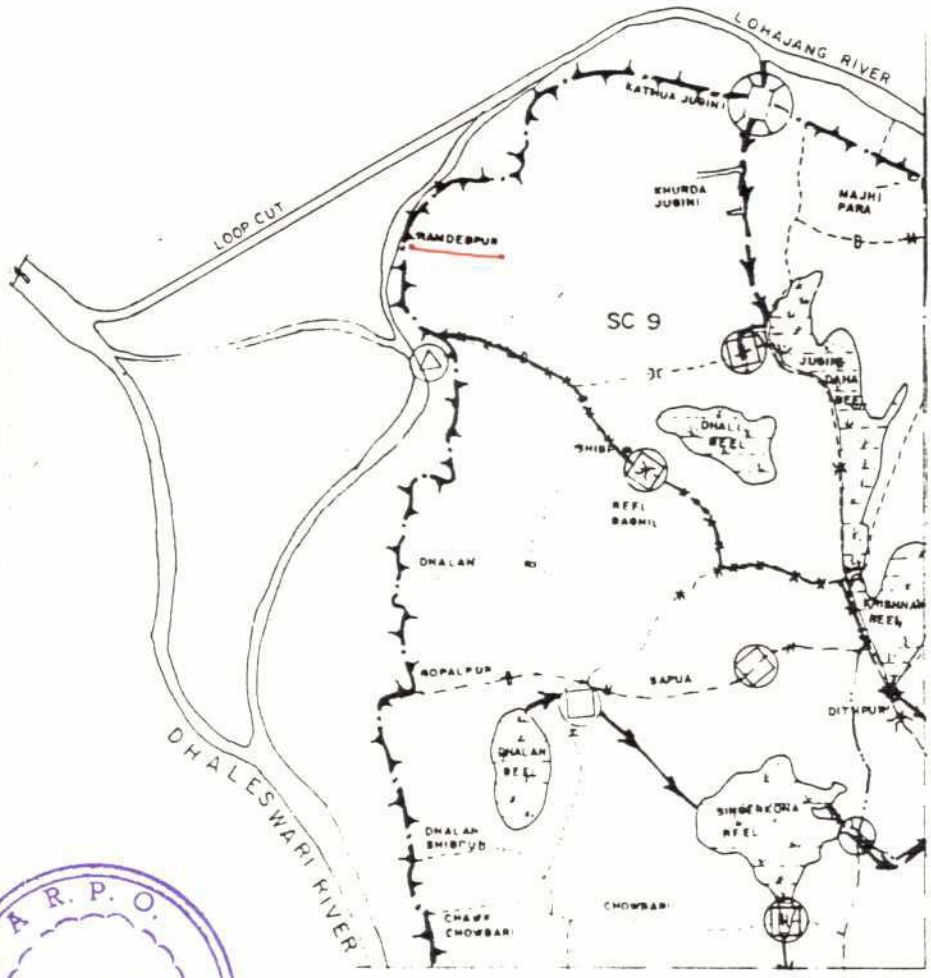


[3]Unknown species but for later classification it was called E1

3.10 This phenomena can be explained by the fact that the intake of the Lohajang river is blocked by a sand rim, siltation of the bed of the Lohajong river from Paikmuril to Ramdebpur are probably the cause (Figure 5). This rim either is a direct physical blockage or hydrologic pattern is created in such a way that distribution patterns of hatchlings are disturbed, resulting in the fact that the major part of the hatchlings are over shooting the Lohajang intake. The above mentioned part of the Lohajong river are surveyed. Sand rim and bed sand will be removed in the dry season of 1995 to create a funnel shaped intake and the hatchling concentration in both the river will be monitored in the following monsoon.

If the results are positive, e.g. the hatchling density increases, then it could be decided not to carry out culture based fisheries as is proposed below.

Figure 5: The sand rim and silted part of the Lohajong river, proposed to be rexcavated.



A.2 Culture based fisheries

a. Introduction

3.11 The stocking of the floodplain with reared carp fingerlings has been introduced recently in the Third Fisheries Program and the Second Aquaculture Project. The idea behind culture based fisheries is to enhance the natural fish production by stocking the water bodies with fast growing fish species (450-500 fingerlings/ha). The stocked fish will grow under natural condition in the floodplain and are caught by the fishermen, estimated incremental production is 100-150 kg/ha. The main species stocked at present are: Catla, Ruhi, Silver carp and Common carp. The main problem encountered during the first year of the stocking program was the availability of stocking material and therefore the beels were stocked with rather large size fingerlings (average size 15-20 g). Preliminary results from the Second Aquaculture Project indicates that production could be increased with approximately 50 %.

3.12 The introduction of culture based fisheries is technical feasible but realisation of the investment is the problem which questions the sustainiblity of the production. If the investment are to realise from the production then there will be a shift from the common excess to limited excess to the floodplain, is the bottleneck of the system.

b. Culture based fisheries in the CPP area

3.13 After implementation of the project approximately 8500 ha of floodplain will be inundated by river flood water every year. This flood plain will be stocked with fingerlings just before or just after the flood enters the project area. Earlier stocking of the beel/floodplain will be not possible due to the fact that rainwater congestion will be drained off during this time period and consequently the stocked fish would be drained off.
Free access to the floodplain will be maintained which means that harvesting of the fish will take place throughout the monsoon resulting in the fact that some of the fish will be caught at a small size and others later in the season.

b.1. *Stocking parameters*

3.14 It is proposed to stock the floodplain around the 10 th of June at a density of 100 fingerlings/ha floodplain. The stocking density is lower as compared to similar other projects. The reason is that the grow out period within the CPP area is limited to 150 days. In mid November the floodplain disappears when the water recedes to the river and before this date the fish should be harvested. Lower stocking densities will give a higher availability of food and consequently the growth rate can be expected to be maximal, resulting in an acceptable size of the fish at harvest. The percentage composition of the stocking will be as flowed in the third fisheries project.

b.2. *Production parameters of culture based fisheries*

3.15 Production figures are estimated considering the stocking and biological parameters. The fish yield obtained from the stocked fish only is estimated at 7 kg/ha/year or 58 ton/year when a survival rate of 20 % is assumed. The final yield obtained from the flood plain will be the natural production and the incremental production obtained through the stocked material. The natural production of the floodplain is estimated at 18.3 kg/ha/year[4]. With a maximum inundated floodplain area of 8500 ha the following production can be expected:

Incremental production with culture based fisheries: 7 kg/ha/year
Natural production with culture based fisheries: 18 kg/ha/year
Total production with culture based fisheries : 213 Ton/year
Total production in the without case (10,000 ha): 183 Ton/year
Total incremental production: 30 ton/year

b.3. *Cost estimates and product value of culture based fisheries*

3.16 In principle the introduction of culture based fishers consists of; purchase of fingerlings, the transport of the fingerling to the floodplain and convincing the population not to fish within the period of fingerling release and the arrival of the flood. Table 4 presents the estimated yearly production costs for 8500 ha of floodplain.

Table 4: Annual operational costs for culture based fisheries in 8500 ha of floodplain (project costs excluded).

Item	No. of unit	Unitprice (Tk.)	Total costs (Tk. in thousands)
Fingerlings	850,000	1.5	1275
Labour	10 (M/M)	10000	100
Fuel	500 (ltr)	15	8
Extension material	5000	4	20
Miscellaneous (10%)			140
TOTAL			1543

[4] Calculated with a maximum inundated area of 10,000 ha

b.4. *Conclusions*

3.17 Culture based fisheries is an alternative option to be introduced within the CPP only if the natural recruitment is not successful.

B. Aquaculture Development Plan

a. Introduction

3.18 Within the CPP area 650 culturable ponds and 400 suitable pagars can be found which are or can be used for the rearing of fish. The actual rearing method is based on traditional methods with production levels of 800-1200 kg/ha/year . From the burrow pits the trapped natural fish is caught by subsistence fisheries (production 300 kg/ha/year). The production from these systems is low and there is a scope for improvement.

3.19 During the last decade, aquaculture production increased substantially in Bangladesh through the "silver revolution" or the introduction of chinese carps. Gradually the polyculture concept of major and chinese carps was developed by several research stations and implemented in large areas of Bangladesh. The implementation of the rearing techniques has been carried out mainly through extension programs. The Mymensingh Aquaculture Extension Project (MAEP), is an example of such a program.

3.20 The objective of the MAEP is; "***To develop an extension system which will spread the results of aquaculture research to fish farmers in order to increase the production of fish and create employment***". It can be concluded that the MAEP attained its objectives: the aquaculture production increased from 700 kg/ha/year to an average of 2000 kg/ha/year, all implemented systems were profitable for the farmers and the recovery rate of given credits was 93%. It has been therefor decided to use the MAEP extension model as a guideline for the aquaculture development plan of the CPP area.

b. The aquaculture extension model for the CPP area

3.21 In order to enhance the present fish production and there by mitigate the loss due to the water management interventions, the project has designed an extensive **Aquaculture extension program** for fish culture in the ponds and pagers of the project area. It involves two different type of fish culture, in the ponds carp poly culture and thai puti culture in the pagers. The project, to involve the women community in the program,emphasizes on to culture fish in the homestead ponds and pagers. The total extension program is scheduled to operate in three phases in line with the physical implementation of the project (Table 5).

Table 5: Aquaculture extension in different Sub-compartments of Tangail.

Year of extension activity	Sub-compartments	Approximate number ponds and pagers	Approx. water area (Ha)
94/95	SC 9,10 & 11	400	48
95/96	SC 1 to 8	400	60
96/97	SC 12 to 15 and 16	400	50
	Total	1200	158

In order to implement the program, a complete inventory of the ponds and pagars is a prerequisit and done in three steps before going for extension. The inventorisation will be followed by motivation, training, demonstration of ponds, pagars and duckweed cultivation.

b.1. *The target groups*

3.22 The target group are specified as follows;

* **Contact farmers**, These farmers own more as 2 acres of land and they will receive technical information only. The results of the aquaculture survey of the Special Fisheries Study indicates that approximately 70 % of the at present pond owners are belonging to this group.

* **Credit Farmers**, These farmers own less as 2 acres and have no money to invest and they will receive technical assistance and credit channelised through the Janata Bank as per the deed of agreement with the Janata Bank.

* **Demonstration farmers**, Two types of demonstration farmers are categorised:
  Category I are farmers who are functionally landless and have a homestead only where demonstration of Thai Puti will be demonstrated.
  Category II are farmers with ponds bigger as 500 m^2, which are not flooded. The rearing of indian carp will be demonstrated through those farmers.

Demonstration farmer will receive technical assistance,supervision, fingerlings and lime free of cost from the project.

b.2 *The extension service*

3.23 During the inventory of the ponds additional informations on the ponds and pond owners are collected and include ownership status of the pond, average area, stocking time, density, species composition, food supply and production of the ponds. The data on the socio economic condition of the owner are also collected. There is question about the assistance they require to come up with the semi intensive aquaculture.

3.24 The pond owner of the area are motivated by organizing group meeting and then door to door visit by the trained extension officers. In the meetings and visits, the pond owners will be explained regarding Aquaculture extension program. They are informed of the package i.e.availability of both training and credit support. The pond owners are provided with cost and benefit analysis for their ponds. During this phase of the motivation, the names of the willing trainees are registered on the basis of the locality to organize training for them on the desired dates and sites. Inclusion of the women operator for the homestead ponds are discussed with the male owner and try to motivate both male and female to bring under the program.

3.25 The transfer of technology from the project to the individual farmers are done through extension officers and on the spot training. Extension officers have been trained by the project and are assigned to a specific area. The training are designed to offer in three sessions followed by visit to, trainees own and demonstration ponds over the year. Session I and session II will be emphasizing the training on the pond preparation and pond management respectably while session III is to review the whole training program. In order to provide the trainees with write-up materials, the project has produced a booklet on the simplest techniques of fish culture and record book in Bangla. In the training sessions flip chart, transparencies and posters on the fish culture will be used. The training materials are also collected from BAFRU and DOF.

3.26 The extension workers employed under contract by the fisheries project have a pond resource of their own and will in this way have an interest in learning all the technology needed for proper pond culture. These are the demonstration ponds and pagars to be established in each of the sub compartments. The extension officers will visit all farmers on a regular basis, provide technical assistance, organises demonstrations and serves as a liaison between the farmers and the project.

3.27 The extension officers will also take care of a duckweed demonstration ditche in each of the subcompartments. Semi intensive culture program includes the species like Raj puti and Grass carp. These species depends largely on the vegetation. Duckweed are ideal supplementary feed because of it's high protein value. The excrete of the harvivourus species are excellent compost for the pond. Duckweed can easily be cultured in small, shallow, de-shaped and dirty ditches. With a few initial cost and no running expenses duckweed can be produced. Aim of the duckweed demonstration is to promote the idea in the area and there by enhance the fish production and restore the environment.

3.28 All credits must be channelled through local banks but the project will carefully supervise the selection procedures and ensure that loans are invested for aquaculture practices. Credits will be always linked with a willingness of the recipient to cooperate in the training and extension service program. The project has initiated the process of establishing a credit facility for the pond owner. In this regard a proposal was prepared (CPP Working Paper 94/01) and submitted to the Bangladesh Krishi Bank and Janata Bank. Finally a proposal for the establishment of credit facilities has been agreed on by the Janata Bank. The Janata Bank has agreed to provide credit to the fish pond owners against guarantee money provided from the project. The provisional agreement between the bank and CPP is yet to be

endorsed. The terms and condition of the credit line is at per norms of the Bangladesh Bank The interest rate is 12.5% and initial cost for a loaner is about 150 Tk.(Stamp charge and Photograph). DOF will also be cooperating in loan appraisal.

c. The poly culture of carps in large ponds

c.1. *Culture parameters*

3.29 The poly culture of carps is based on the principle that different fish species are using different parts of the food web for feeding and consequently all available nutrients will be used in optimal way for the production of fish. This kind of natural balance means that the species composition at stocking must be in such a way that no competition for food will occur. The proposed stocking densities, size at stocking and expected growth rate are presented in Table 6.

Table 6: Proposed stocking densities, size and expected growth rate of carp polyculture.

SPECIES	% STOCKED	STOCKING RATE (No/ha)	WEIGHT AT STOCKING (gm)	AVERAGE GROWTH RATE (gm/day)
Catla	30	2,040	2.5	1.7
Silver carp	10	680	2.5	2.8
Ruhi	25	1,700	2.5	1.5
Mrigal	20	1,360	2.5	1.5
Grass carp	10	680	2.5	2

3.30 Polyculture can only be done in properly maintained ponds with a year round water depth of 1-1.5 mtr. The fish are stocked at a density of 6,800 fingerlings/ha, fed daily with agriculture waste products as rice bran and mustard oil cake and are harvested after approximately 1 year (except silver carp which can be harvested after six month). The survival rate of the fingerlings is estimated at 70 % under normal rearing conditions. Table 7 presents the production parameters as are estimated with the above mentioned culture figures.

Table 7: Estimated production figures of carp polyculture in large ponds.

SPECIES	NO HARVESTED	WEIGHT AT HARVEST (Kg)	PRODUCTION (Kg/ha/year)
Catla	1,420	0.90	1,290
Silver carp	476	0.63	300
Ruhi	1,190	0.45	530
Mrigal	952	0.45	425
Grass carp	476	1.85	875
Total	4,760		3,420

3.31 An average production of 3,420 kg/ha/year can be expected from polyculture of carps under optimal conditions in the field. It is realised that higher productions up to 5,000-6,000 kg/ha/year have been obtained with polyculture but most of these productions are obtained from small ponds at research stations where conditions differs from the field. The average production of 3,420 kg/ha/year is also to optimistic for planning purposes as it will be obtained only under optimal field conditions, which is often not the case. The results of the MAEP reflects this reality: the average production of the farmers who received only technical assistance was in the range of 2,000 kg/ha/year, the production of farmers who received technical assistance and credit was 3,500-4,500 kg/ha/year within the time span of this project. It can be expected that credit farmers will have the same socio economic problems in a post project situation as the contact farmers had during the project period resulting, in a decline of the achieved productions towards 2,000 kg/ha/year. An average production of 2,000 kg/ha/year is comparable with the productions obtained in the rural areas of other south east asian countries.

c.2. *Production costs and product value*

3.32 The major components of the production costs are dewatering or rotenone (needed to eliminate wild fish), feed, fertilizers and labour and a division of the costs is presented in Table 8.

Table 8: Estimated production costs of polyculture of carps

ITEM	UNITS	UNIT PRICE (Tk)	COSTS (Tk/ha)	% OF TOTAL COSTS
Fingerlings	6.800	1	6800	19.5
Chemicals	20(Kg)	300	6000	17
Lime	400 (kg)	5	2000	5.5
Fertilizers	400 (kg)	7.5	3000	8.5
Compost	10000(Kg)	0.3	3000	8.5
Feed	3000 (Kg)	3	9000	26.5
Labour	50 (M/D)	40	2000	5.5
Miscellaneous	10 %		3200	9
Total			35000	100

3.33 The total production cost are estimated at 35,000 Tk/ha(875 US$/ha) or at 17 Tk/kg(0.4 US$/kg). The price of the fingerlings is estimated at 1 Tk/piece, the actual price of fingerlings in the CPP area is much lower (0.3-0.5 Tk/piece). The difference is made up by:

* A difference in quality: the at present available fingerlings are bought from the fishermen and the survival rate will not exceed 40 %.

* A difference in size: within the future larger size fish (4"-5") will be obtained from local nurseries.

3.34 The average wholesale price of reared species is estimated at 43 Tk/kg (1.1 US$/kg) and with an expected production of 2,051 kg/ha/year it would give a Gross Product Value (GPV) of 92,295 Tk/ha. After subtracting the production costs (17 Tk/kg) a gross benefit of 57,295 Tk/ha (1,432 US$/ha) or 230 Tk/decimal[5] remains which is an acceptable profit (see annex I).

c.3. *Total production of the CPP project area*

3.35 The total quantity of fish obtained through the poly culture of carp in large ponds can be increased substantially within the CPP project area. As mentioned before it is expected that a sustainable production level of 2,050 kg/ha/year (or 60% of the maximum level)

[5] 1 decimal = 40 m²

can be obtained by the farmers in the field. With the existing number of ponds the total future production is estimated at 287 T/year which means an incremental production of 145 T/year. Some details are given below and in Annex I:

* Total number of ponds: 750
* Total number of culturable ponds: 650
* Extension expected in 80% of culturable ponds:520
* Average pond size: 0.243 ha
* Total pond area covered by the project :126 ha
* Actual production: 900 kg/ha/year
* Future production: 2,050 kg/ha/year
* Actual total production: 142 t/year
* Future production 20% ponds (not covered by the project): 28 t/y
* Future production 80% ponds (covered by the project): 259 t/y
* Future total production: 287 t/year
* Incremental production: 145 t/year

d. The rearing of Thai Puti (*Puntius gonionotus*) in burrow pits and small homestead ponds.

3.36 Within the CPP area approximately 600 pagars and homestead ponds with an average size of 300 m^2 (8 decimal) can be found. These waterbodies are not suitable for the rearing of carp as the waterlevel fluctuates from 1-1.5 mtr in November to 0.4 mtr in May and because of the fact that a large number get flooded every year.

3.37 Several rearing methods have been developed in Bangladesh for the utilization of these small ponds. In principle the rearing technique is based on the use of quick growing fish species who can complete a rearing cycle within 6 month and who can withstand the low waterdepth and high water temperatures occurring in the ponds during the month of May. Traditionally the nile tilapia (*Oreochromis niloticus*) and the common carp (*Cyprinus carpio*) were used but the last year they are gradually replaced by "Thai puti" (*Puntius gonionotus*) imported from Thailand several years ago, which has a higher consumer preference.

3.38 This type of aquaculture is almost completely absent within the CPP project area, although some experiments have been carried out by BARI. This type of aquaculture is of importance for the functional landless, marginal farmers and women as in general the operational cost are low and it is carried out in the vicinity of the house.

d.1. *Culture parameters*

3.39 The fingerlings with an average size of 4-5 gram are stocked in November/December at a stocking density of 16,000 fingerlings/ha. The fish are fed daily with rice bran, mustard oil cake, duck weed and chopped leaves. The pond can be harvested after 6-7 month when the fish attain a weight of 150 gram. The production will be 1895 kg/ha/6 month cycle.

if the survival rate is estimated at 80 %. This is the maximal production obtained under optimal condition. The conditions in the field are sub optimal and it is assumed that the private farmers can reach 60 % of this production level or 1140 kg/ha/6 month cycle.

d.2. *Production costs and product value*

3.40 The production costs consists the purchase of fingerlings, feed, rotenone, fertilizers and the labour costs needed to harvest the fish. Table 9: presents the estimated production costs of " Thai puti" rearing.

Table 9: The estimated production costs for the rearing of "Thai puti" within the project area.

ITEM	UNITS	UNIT PRICE (Tk)	COSTS (Tk/ha)	% OF TOTAL COSTS
Fingerlings	16,000	0.5	8000	38
Chemicals	10(Kg)	300	3000	14
Lime	250(kg)	5	1250	6
Fertilizers	150(kg)	8	1200	5.5
Feed	1515(kg)	3	4545	21.5
Labour	30 M/D	40	1200	5.5
Miscellaneous	10 %		1920	9.5
Total			21115	100

3.41 The total production cost are estimated at 21,115 Tk/ha/cycle(528 US$/ha/cycle) or at 18.5 Tk/kg (0.46 US$/kg). The wholesale price of "Thai puti" is estimated at 40 Tk/kg (1 US$/kg) and with an expected production of 1,140 kg/ha/cycle it would give a Gross Product Value (GPV) of 45,600 Tk/ha/cycle. After subtracting the production costs (18.5 Tk/kg) a gross benefit of 24,485 Tk/ha/cycle (612 US$/ha/cycle) or 100 Tk/decimal*/cycle remains which is acceptable considering the at present profit of 30-40 Tk/decimal obtain through fisheries.

* 1 decimal = 40 m²

d.3. *Total production of the CPP project area*

3.42 The total quantity of fish obtained through the aquaculture in the burrow pit can be increased substantially within the CPP project area. As mentioned before it is expected that a sustainable production level of 1,140 kg/ha/cycle (or 60% of the maximum level) can be obtained by the farmers in the field. With the existing number of suitable burrow pits (400) the total future production is estimated at 14 t/year which means an incremental production of 9 t/year. Some details are given below and in annex II:

* Total number of suitable burrow pits: 400
* Average size: 300 m^2
* Total burrow pit area: 12 ha
* Actual production: 300 kg/ha/cycle
* Future production: 1,140 kg/ha/cycle
* Number of cycles per year: 1
* Actual total production: 5 t/year
* Future total production: 14 t/year
* Incremental production: 9 t/year

e. Integrated Farming of Rice/Fish

3.41 The integrated farming of Rice/Fish has been discussed in Annex 6 of the Interim report of the CPP project. It was concluded that this option is technical feasible and could increase the total fish production. Major disadvantage of this type of production system is that the water level must be maintained at minimum 20 cm and that the use of pesticides is restricted. These two limitations will hamper the introduction of integrated farming of rice and fish:

* Experiments executed in the CPP area by BARI indicated that the production levels of fish were marginal and that the water retention was one of the major problems.

* Research of the Fisheries Research Institute in Chandpur indicated that 34 % of the farmers are using pesticides in overdoses and that 71 % of the farmers reported to have seen mortality of fish in the paddy fields after the application of pesticides. The same study showed that Diazinon based pesticides, which are widely used throughout the CPP project, causes significant mortalities at one-half to one-fourth of the recommended doses. Laboratory trials on Pyrethroid based pesticides showed that significant mortalities occur at one-tenth of the recommended doses.

3.42 It is believed that the introduction of rice/fish farming still has a prospect for Bangladesh but the day to day reality in the field makes it a risky enterprise. It will only have a future **if it is directly combined with Integrated Pest Management (IPM)**. These

management strategies have only been integrated to a limited extent in Bangladesh. It is therefore concluded only to promote integrated farming of rice/fish in the CPP project area once a IPM programme started in the project area.

f. Fingerling production

3.43 One of the major constraints for the development of aquaculture and culture based fingerlings will be the supply high quality fingerlings. The only source of fingerlings at present are the fingerlings caught from the natural source and marketed by the fishermen and nursing of imported hatchlings to fingerling by a hatchery/nursery complex in Tangail town which is operated by the Grameen Bank. A sustainable development of aquaculture can only be obtained if natural sources of fingerlings are replaced by hatchery produced fry/fingerlings and this will be a major component in the Fisheries Mitigation Plan. Approximately 2 million fingerlings will be needed annually for the aquaculture extension programme.

* Polyculture of carp: 1650,000
* the rearing of "Thai puti": 360,000

3.44 The needed fingerlings will be produced within the CPP area and two different sources of supply must be established:

* A Government/Institution owned hatchery-nursery which produces hatchlings and fingerlings.
* Privately owned nurseries, producing fingerlings from hatchlings purchased from the central hatchery-nursery.

3.45 The production of fingerlings, especially out of the season, requires some skills which makes it difficult to depend from the beginning of the Fisheries Mitigation Plan on private entrepreneurs. Trained aquaculturists will be needed to start the first production of fingerlings. This centre will supply the hatchlings once the project is ongoing and private entrepreneurs are willing to produce fingerlings. Such a system prevents that private people have to maintain an expensive broodstock and provides the opportunity of income generating activities through the production of fingerlings. This system is more ore less comparable with seed supply in rice cultivation.

f.1. *Artificial reproduction*

3.46 The artificial reproduction in a small scale is hard to organise because of the brood fish. It will be more practical to establish the nursery ponds at sub-compartmental level and buy hatchlings from the existing hatcheries (Mymensingh,Gajipur,Sirajganj or else where) at a price of average 10,000 Tk/kg or 0.015 Tk/piece.

f.2. *Nursery operations*

3.47 The nursery ponds are stocked with 3-4 days old hatchlings at a density of 100-200[7] hatchlings/m^2. Before stocking the ponds are treated with lime and fertilizers are added in order to create a phyto and zooplankton bloom. The ponds are either harvested after 15 days and fry is transferred to second stage nursery ponds where they will remain until harvest, or the complete cycle is done in the same pond. The total rearing period takes approximately 45 days and the survival rate from hatchling to a fingerling of 2.5 gram is estimated at 25%. This means that on the average 250,000 fingerlings/ha can be produced within one cycle or 500,000 fingerlings/ha/year as two cycles a year can be performed (details are given in annex V). Among the species to be cultured Rui, Catla and Mrigel(Category I) hatchlings are available only at the beginning of June after the water temperature has increased. The others species (Category II) are ready before this period. Two rearing cycles can executed in the same pond. For the CPP area approximately 1 million fingerlings of category I are required which can be obtained from 4 hectares of nursing ponds. The nursery-rearing complex units will be established with private entrepreneurs and at sub-compartmental level the requirements of fingerlings will be taken into consideration. In order to execute this program the following measures must be taken by the CPP;

* Identification of possible nursery ponds
* Motivation programme for the nursery pond owners
* Training for the nursery pond owners
* Initial renovation ponds.
* Provide the pond owners with credit facilities if required.
* Transportation of hatchlings from hatcheries out side the CPP area in order to indicate the farmers how and where they can collect hatchlings.
* Recruit one nursery supervisor (provided with a motor cycle available from SFS) in order to provide intensive supervision of nursery operations

3.48 The costs for the establishment of nurseries are estimated at 5 lakh (12,347 US$) and a summary of the costs is presented in Table 10 (for details see annex 4)

[7] Depending on the nursery system

Table 10: Estimated costs for the establishment of a nursery complex in the CPP area.

SUBJECT	COSTS IN Tk	COSTS IN US$
Dewatering	68000	1,700
Renovation	170000	4,250
Transportation of hatchling	20000	500
Training and extension material	40000	1,000
Training	40000	1,000
Miscellaneous	33800	845
TOTAL	341800	8545

3.49 The production cost for a nursery operation is presented in Table 11. The cost for the production of one fingerling is estimated at 0.18 Tk and the major cost components within nursing of carps are the hatchlings and the feed followed by labour. The main reason is the high quality of feed and hatchlings needed. Hatchlings obtained from local fishermen will be much cheaper but on the long run they are more expensive because of the low survival rates.

Table 11: Estimated production costs for one nursery cycle at a 1 ha nursery complex

ITEM	UNITS	UNIT PRICE (Tk)	COSTS (Tk/ha)	COSTS (US$/ha)	% OF TOTAL COSTS
Chemicals	20(Kg)	300	6000	150	13.3
Hatchlings	1.000,000	0.015	15000	375	33.3
Lime	250	4	1000	25	2.7
Fertilizers	150	8	1200	30	2.6
Feed	3750	4	15000	375	25
labour	75	40	3000	75	13.3
Miscel-laneous	10%		4120	103	9.8
Total			45320	1133	100

3.50 The wholesale price of fingerlings (2-3 gram) has been estimated at 1 tk/piece giving a GPV of 250,000 Tk/ha/cycle and a gross benefit of 205,000 Tk/ha/cycle or 830 Tk/decimal/cycle. It indicates that the production of fingerlings is highly profitable but it should be remarked that it can only be obtained by motivated and skill full operators as the day to day management of a nursery requires a lot of precision.

g. *Institutional aspects*

3.51 The proposed extension service does not exist at present within the CPP area or in the Tangail district. A sustainable development of aquaculture will require a duration of the proposed activities which will be longer (3-4 production cycles) as the implementation phase of the CPP. The Department of Fisheries will work in close cooperation with this program and philosophy is to hand over the total program to the Fisheries Department gradually in three years.

DOF / CPP	DOF / CPP	DOF / CPP

3.52 District Fisheries Officer has been trained on the 'Managing Rural Development in CPP' at the AIT Bangkok. He is a member of the Extended Project Team. One field staff of DOF has been trained by CPP on 'Water user group formation, group management and water management'. The DOF is entrusted to the task of loan application approval. Thus the DOF, local bank and NGO's will be incorporated and enforced where needed.

h. Conclusions

3.51 The development of aquaculture in ponds and burrow pits is a viable option and can increase the actual annual production of fish with 154 ton. A prerequisite for this development is the establishment of nursing facilities. The integrated farming of rice/fish is not recommended for introduction as the risks mainly due to the excessive use of pesticides is to high. The development "Thaiputi" rearing in pagars and homestead ponds creates the possibility to direct a part of the mitigation measures to the people who where effected the most by the implementation of the new water management scheme. Table 12 summarises the estimated results of the Aquaculture Development plan.

Table 12: Key para meters of the Aquaculture Development Plan for the CPP area.

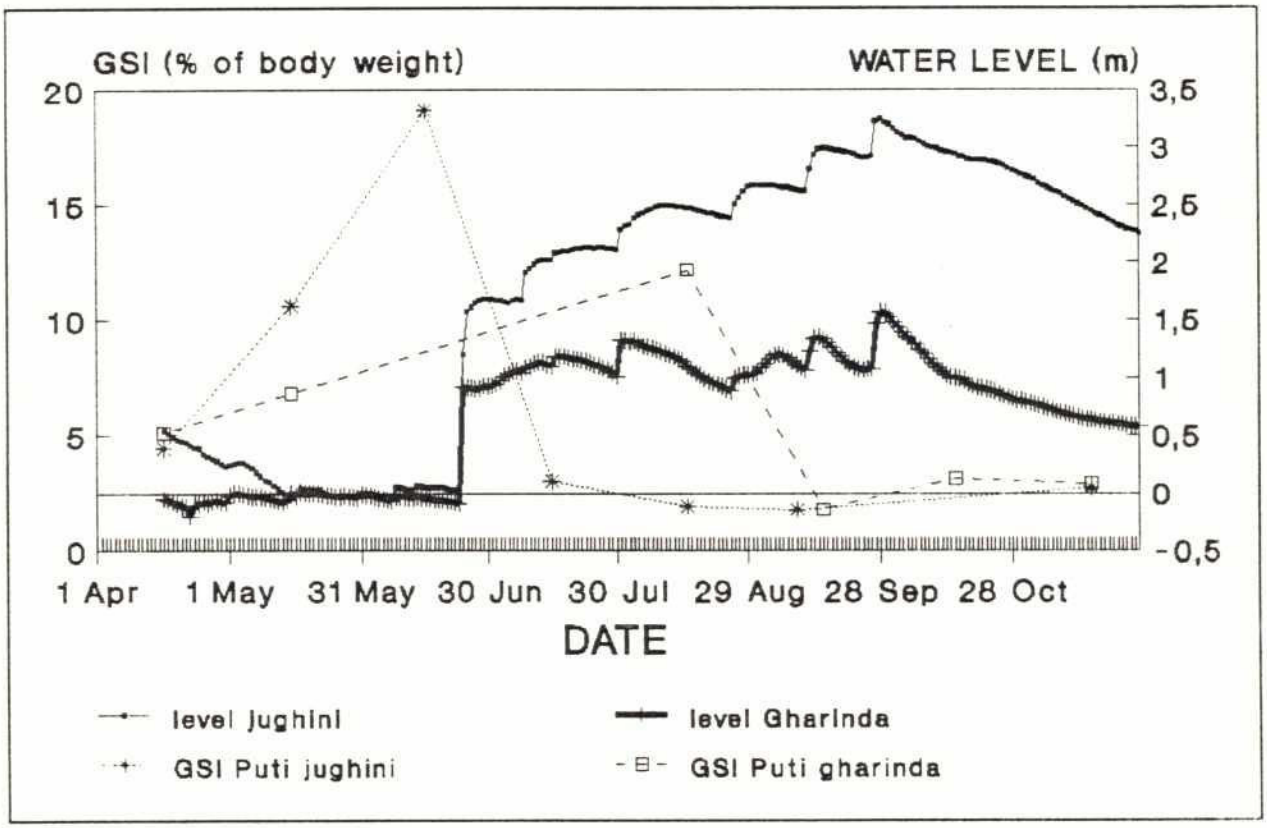
SUBJECT	CARP	THAIPUTI	NURSERY
Total number of ponds	650	500	17
Number of ponds covered by the project	520	400	
Total pond area covered by the project (ha)	126	12	4
Total area not covered by the project (ha)	32.5		
Actual production (kg/ha/yr or number)	900	300	-
Future production (kg/ha/yr or number)	2,050	1,140	2.000,000
Incremental production (ton/yr or number)	145	9	2.000,000
Gross Benefit farmer (Tk/decimal/year)	242	100	1,656
Gross Benefit farmer (US$/ha/year)	1,493	622	10,000
Direct Investments needed (US$)	-	-	8545

C. The Beel concept

3.52 The Special Fisheries of the CPP, covering the reproduction strategies of Beel resident fish indicated that the early water rise in the beel, due to rainwater congestion is the triggering factor for reproduction of "Beel" fish.

Figure 6 presents the reproductive stage[8] of *Puntius sophore*, within two beels located in the CPP area, during the period April 1992 - January 1993 together with the daily measured waterlevel.

Figure 6: The Gonado Somatic Index of *Puntius sophore* measured in Jugini Beel and Gharinda Beel during the 1992 season (n=1800) and the daily measured waterlevels.



Source: Special Fisheries Study, CPP.

Within the monsoon season of 1992 the river flood water did not entered the flood plain and the area can be considered as under complete flood protection. The rise in waterlevel on the 24th of June was caused by run off water from the surrounding area after the heavy rains on 23/24th of June. The further rise in water level during the monsoon had the same origin. In

[8] measured as Gonado Somatic Index (GSI)

Jughini beel the water rises on the 24th of June with 1.7 m followed by a second rise to 2.5 m in mid July. In Gharindha beel the water level rises only 0.9 m on the 24th of June fluctuates a little around 1 m till a further rise in September.

3.53 The reproduction of *Puntius sophore* took place in Jugini beel within the period mid June till mid July, as can be seen from the sharp decrease of the GSI (the eggs have been released). In Gharinda beel it seems that the reproduction of *Puntius sophore* has been delayed as they release their eggs only after mid August. The major registered difference be tween Jughini beel and Gharinda beel is the difference in the rise of the waterlevel.

3.54 From these first results it can be concluded that an early water rise indeed could be essential for the reproduction of "beel" fish and that a water rise of 1 m is not enough to trigger the immediate reproduction of *Puntius sophore*, which can be considered as a typical "beel" fish. It is therefore proposed to design and construct the drainage systems throughout the CPP area in such a way that a minimal water level rise of 1-1.5 m above average dry season beel water level is guaranteed.

3.55 The original proposed drainage system, without this mitigation measure, will result in a loss of 53 ton of "beel" fish or an annual loss of minimal 26,000 US$ (see annex 6, Interim report CPP). The "guaranteed" reproduction area covers approximately 800 ha which will be inundated with run off rainwater one month before it will be inundated by the river flood water. The fact that a one month inundation of 800 ha of land will safe guard the production of 53 tons of fish justifies the design and construction of the proposed Beel drainage concept. The additional investments will be limited and it should be realized that the taken measures are **completely reversible**.

4. PROJECT SUPPORT

A. The set up

4.1 The mitigation measures as increased natural recruitment /culture based fisheries and aquaculture must continue after completion of the project. Therefore an important part of the work will be to establish a sound basis for fisheries management in the project area. The institutional frame work growing at the moment and should be developed with all parties concerned. In order to avoid delays in the implementation of the proposed measures it is proposed that the CPP will initiate the Fisheries Mitigation Measure in close cooperation with existing institution of the CPP area. The first institutions to be considered are the Fisheries District Office and the local Banks. Depertment of Agriculture Extension (DAE) with assistence from FAO has started school on Integrated Pest Management(IPM),where CPP is working along with DAE.

B. Staffing

4.2 For the execution of all the proposed measures the following team should be assembled:

* An aquaculture/fisheries specialist, who will function as overall coordinator on fisheries and aquaculture and will train the extension workers and employees of the renovated hatchery on the technical matters.
* A junior fisheries biologist, who assist the aquaculture specialist within all matters
* Four extension officers, young and dynamic , all already involved in aquaculture will be trained by the programme. They will be provided with transport and extension material and will be working in the field. One extension officer should be female and she should work only with women.
* An expatriate associated expert, will enforce the team and will train the biologist in all matters concerned with aquaculture and fisheries.

The local institutions, who on the long term will continue with this operation must provide identical personal and it is proposed that within the duration of the project the gradually take over all the responsibilities and day to day management.

C. Investments and operational costs

4.3 The fisheries component must be provided with equipment and the major component is transport and training/extension material. Within the investments (see Annex 6) 4 motorcycles are included which are needed as transport for the Extension workers.

4.4 The major component of the annual operation costs is the salary of the team members followed by the cost for training (see annex 6). Training costs includes leaflets on the spot training and in house training.

4.5 The total investment and operational cost for a project with a duration of three years are summarised in Table 13.

Table 13: Total investments and operational costs for the supporting project .

SUBJECT	ANNUAL COSTS (Tk/year)	TOTAL COSTS (Tk)	TOTAL COSTS (US$)
Investments	717,150	717,150	17928
Salaries	1000,000	3,000,000	75,000
Extension	240,000	720,000	18,000
General	154,800	464,400	11,610
TOTAL		4,901,550	122,538

4.4 Cost of investment will be borne under FA and annual operation cost will be borne under TA for the first year only. The cost will be headed under the Mitigation measure budget(230 lac) in the revised TAPP for FA Tangail, Appendix A/11.

ANNEXES

AQUACULTURE DEVELOPMENT PLAN, FAP 20
ANNEX I POLY CULTURE WITH CARPS

LARGE PONDS		
Total pond no	650	
Average size	0.243	HA
Actual production level	900	kg/ha/year
Total actual Production	142	Ton/year
Maximum production level	3418	kg/ha/year
Development % of farmers	60	
Production level of farmers	2051	kg/ha/year
Future production area(80% of total)	126 ha.	
Total future production	287	Ton/year
Incremental production	145	Ton/year
GB farmers	57295	Tk/ha/year
GB farmers	230	Tk/decimal/year
CULTURE PARAMETERS		
Stocking density	6800	per Ha
Rearing period	360	day
Survival rate	70	%
TOTAL COSTS	35000	Tk/HA
COSTS	17	Tk/Kg
AVERAGE MARKET PRICE	43	Tk/kg
GPV	88193	Tk/Ha
GB	56810	Tk/Ha

AQUACULTURE DEVELOPMENT PLAN, FAP 20
ANNEX I POLY CULTURE WITH CARPS

Species stocked	% stocked	No stocked/ha	Weight (g)	Growth rate (%/day)
Catla	30	2040	2.5	1.65
Silver carp	10	680	2.5	2.8
Rui	25	1700	2.5	1.45
Mrigal	20	1360	2.5	1.45
Grass carp	10	680	2.5	1.85

Species Harvested	No Harve	Size at harvest (kg)	Production
		(kg)	(kg/ha/year)
Catla	1428	0.904	1292
Silver carp	476	0.625	297
Rui	1190	0.445	529
Mrigal	952	0.445	423
Grass carp	476	1.836	874
TOTAL			3418

ECONOMIC PARAMETERS

PRODUCTION COSTS	UNITS	UNIT PRICE (Tk)	COSTS (TK/HA)	COSTS (US$/HA)	% OF T.COSTS
Fingerlings	6800	1	6800	170	15
Chemicals	20	300	6000	125	11
Lime	400	5	2000	50	5
Fertilizers	400	7.5	3000	60	5
Compost	10000	0.3	3000		
Feed	3000	3	9000	409	47
Labour	50	40	2000	75	7
Miscelenous (10 %)			3200	128	10
TOTAL			35000	1017	

AQUACULTURE DEVELOPMENT PLAN, CPP
ANNEX II A THAI PUTI REARING IN PAGARS

BORROW PITS

Total no of borrow pits	600
Percentage of suitable ponds	60 %
Average size	0.03 HA
Actual production level	300 kg/ha/year
Total actual Production	4 T/year
Maximum production level	1895 kg/ha/cycle
Development % of farmers	60 %
Production level of farmers	1137 kg/ha/cycle
Total future production	13 T/year
Incremental production	9 T/year
GB farmers	24485 Tk/ha/cycle
GB farmers	100 Tk/decimal/cycle

CULTURE PARAMETERS

Stocking density	16000 per Ha
Rearing period	180 day
Survival rate	80 %

AQUACULTURE DEVELOPMENT PLAN, CPP
ANNEX II B THAI PUTI REARING IN SMALL PONDS

Species stocked	% stocked	No stocked/ha	Weight (g)
Thai puti	100	16000	5
Tilapia	0	0	8
Carps	0	0	2

Species Harvested	No Harvested (No/ha)	Weight (kg)	Production (kg/ha/year)
Thai puti	12800	0.148	1894
Carps	0	0.170	0
TOTAL	12800		1894

ECONOMIC PARAMETERS

PRODUCTION COSTS	UNITS	UNIT PRICE (Tk)	COSTS (Tk/Ha)	COSTS (US$/Ha)	% OF TOTAL COSTS
Fingerlings	16000	0.5	8000	400	46
Chemicals	15	300	3000	125	14
Lime	250	5	1250	50	5
Fertilizers	150	8	1200	30	4
Feed	1515	3	4545	189	22
Labour	30	40	1200	22.5	3
Miscelenous (5 %)			1920	40	5
TOTAL			**21115**	**857**	**100**

TOTAL COSTS 21115 Tk/Ha/cycle

AQUACULTURE DEVELOPMENT PLAN. FAP 20
ANNEX III INVESTMENT COST FOR THE NURSARY

ITEM	UNITS	UNIT PRICE (Tk)	COSTS (Tk)	COSTS (US$)
Dewatering	17	4000	68000	1700
Earthwork	3400	50	170000	4225
Training	20	2000	40000	1000
Training material	200	200	40000	1000
Transportation of Hatchling	L.S		20000	500
Salary	24	4000	96000	2400
Fuel	1000	15	15000	375
Miscelaneous (10%)			44900	1122
TOTAL			493900	12347

AQUACULTURE DEVELOPMENT PLAN. FAP 20
ANNEX IV, NURSERY OPERATION

CULTURE PARAMETERS

Stocking density	1000000	hatchlings/ha
Survival rate	25	%
Rearing cycle	45	days
weight fingerling	2.5	g
Production	625	kg/ha/cycle
Cycles	2	no/year

PRODUCTION COSTS PER CYCLE

ITEM	UNITS	UNIT PRICE (Tk)	COSTS (Tk)	COSTS (US$)
Chemicals	20	300	6000	150
Hatchlings	1000000	0.015	15000	375
Lime	250	4	1000	25
Fertilizers	150	8	1200	30
Feed	3750	4	15000	375
Labour	75	40	3000	75
Misceleneous (10%)			4120	103
TOTAL			45320	1133

TOTAL COSTS	45320	Tk/ha/cycle	1133	US$/ha/cycle
TOTAL COSTS	0.18	Tk/fingerling	0.0045	US$/fingerling
SELLING PRICE	1	Tk/fingerling	0.0250	US$/fingerling
GPV	250000	Tk/ha/cycle	6250	US$/ha/cycle
GROSS BENEFIT	204680	Tk/ha/cycle	5117	US$/ha/cycle
GROSS BENEFIT	829	Tk/decimal/cycle	21	US$/decimal/cycle

FISHERIES MITIGATION PLAN, FAP 20
ANNEX V PROJECT SUPPOI(Revised)
To be financed under FA

INVESTMENTS

ITEM	UNITS	UNIT PRICE(Tk)	COSTS (Tk)	REMARKS
Mopeds (75 cc)	6	75000	300000	2 available from SFS
Water analyses kit	1	50000	50000	
Dewatering & Renovation of Nursery ponds	17	14000	238000	
Microscope	3	5000	5000	2 available from SFS
Computer	1	100000	**	available from SFS
Office equipment	L.S		50000	
Sampling material	L.S		40000	
Contingency(5%)			34150	
TOTAL			717150	

To be financed under TA
ANNUAL OPERATION COSTS

SUBJECT	UNITS	UNIT PRICE (Tk)	COSTS (Tk)	
Salary aquaculturist	1	L.S	500000	To be paid from TA
Salary junior biologist	1	L.S	200000	
Salary extension officers	4	L.S	300000	
Fuel	2000	14	28000	
Extension & Training	1000	20	240000	
Miscellaneous (10%)			126800	
TOTAL			1394800	

Credit gaurantee(on fixed deposite with Janata Bank)	800000	Refundable with interest after deduction of bad debt with interes.

APPENDIX

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GOVERNMENT OF
THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF
IRRIGATION, WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN CO-ORDINATION ORGANIZATION
7, GREEN ROAD, DHAKA-1215
BANGLADESH

IN COMING MAIL	
Date 26/2/94	Sl. No. 2154
Team Leader	File : 1102
Copy To :	KU
Information :	RI AE
Action :	TL

PHONE 817038
TELEX 632215 JRC BJ
FAX 2813169

Memo.No. 283(9)/FPCO/A-020/90 Date: 14-02-1994

Sub: Minutes of the meeting held on January 29, 1994 in the Conference Room of FPCO on TOR of Special Support Studies (SSS) and Fisheries Mitigation Plan of Tangail Compartment in connection with FAP-20.

1. A meeting was held on January 29, 1994 in the Conference Room of FPCO, 7 Green Road, Dhaka in connection with TOR of Special Support Studies (SSS) and Fisheries Mitigation Plan of Tangail Compartment of Compartmentalization Pilot Project, CPP, FAP-20. The Chief Engineer, FPCO Presided over the meeting.

The list of participants attended the meeting is enclosed as an appendix.

Welcoming the participants, the chairman initiated the discussion and requested the participants to discuss the Fisheries Mitigation Plan first.

1. Fisheries Mitigation Plan

Mr. Obaidur Rahman, Project Director, CPP, Tangail wanted to know how and who would approve the overall ... ...

Mr. A.K.M. Halimur Rahman, Superintending Engineer, FPCO informed that Fisheries Mitigation Plan is not a separate issue from FAP-20, it is included in the overall FAP-20 programme.

The Chief Engineer, FPCO and Chairman of the meeting said that the Fisheries mitigation plan is within the framework of FAP-20 and it is included in the Inception Report and Interim Report of FAP-20.

The Team Leader, FAP-20, presented the Fisheries Mitigation Plan.

To a question of Mr. Jim Scullion of FAP-17, the Team Leader said that the DANIDA System is proposed in the Mitigation Plan.

Mr. A. M. Kamal Uddin of FAP-20, presented the detail of Mitigation Plan and all the participants took part in the discussion.

Discussion on Migration in Dhaleswari and Lohajong Rivers and Beel Concept in the CPP project areas were ... ...

The Project Director, CPP Tangail, said that for the maintenance of khals and other related structures Tk.16.00 lakhs would be required every year. The question was that how that amount would be recovered.

Mr. M. N. Huda, Chairman, POE, said that, the amount might be collected from the beneficiaries if possible.

The Chief Engineer, FPCO, and Chairman of the meeting said that provision should be kept in the O & M budget.

Then discussion on acquaculture was made.

The Chief Engineer that to catch the current year, the programme should start immediately.

Mr. M. N. Huda, Chairman, POE, FPCO, said that if money is available, the concerned authority ca go ahead with the programme.

After detailed discussion it was decided in the meeting that:

1) The methodology and suggestions etc. given in the report may be accepted in principle, subject to the provision of fund in the budget.

2) The concerned authority may contact directly (if necessary) the fisheries department and FAP-17 for implementation of the programme with intimation to FPCO.

II. Terms of Reference (TOR) of Special Support Studies (SSS) of FAP-20

Then discussion on TOR of special support studies of FAP-20 was held.

Mr. A.K.M. Halimur Rahman, Superintending Engineer, presented.

The Team Leader, FAP-20 mentioned that provision for (1) Tangail Town Integrated Water Management and [illegible]opment Study and (SSS_1) and (2) Tangail Transport and Marketing Study (SSS_2) all a. kept in the Revised project Document and Revised Project Report of CPP, FAP-20.

Mr. M. N. Huda, Chairman, POE, FPCO said that the TOR should mention the liaison with the Municipality, Public Health, LGRD etc.

Mr. A.K.M. Halimur Rahman wanted to know when the study report is to be submitted as it would take 6 months time.

The Chief Engineer said that the study and works would go concurrently. The consultants would submit the report to FPCO, through the project Director, CPP, Tangail.

In reply to the question of Mr. M. N. Huda, the Team Leader mentioned that the Transport Study was a support to the main study.

After detail discussion it was decided in the meeting that:

a) The Terms of Reference (TOR) of Special Supporting Study (SSS) of CPP, FAP-20.

(i)Tangail Town Integrated Water Management and Development (ii) Tangail Transport and Marketing Study may be accepted in principle. The studies may be started by sub-contracting after the approval of Revised Technical Assistant Project Proforma (RTAPP) (iii) The consultants would submit the study report to FPCO, through the Project Director, CPP, FAP-20, Tangail.

The meeting ended with a vote of thanks from Chair.

(M. H. Siddiqi, BU)
Chief Engineer, FPCO

Distribution:

1) Chief Engineer, Central Zone, BWDB, Dhaka
2) Director, Directorate of Fisheries, Motsya Bhaban, Dhaka
3) Project Director, CPP, FAP-20, BWDB, Tangail
4) Superintending Engineer-III, FPCO, Dhaka
5) Chairman, POE, FPCO, Dhaka
6) Team Leader, FAP-17, Gulshan, Dhaka
7) Team Leader, CPP, FAP-20, Tangail

cc:

1) P.A. to the Secretary, Ministry of Irrigation, Water Development and Flood Control
2) P.A. to the Chairman, Bangladesh Water Development Board, Dhaka

c:SUFI-2/wm/140294

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GOVERNMENT OF
THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF
IGATION, WATER DEVELOPMENT & FLOOD CONTROL
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Meeting of Compartmentalization Pilot Project (FAP-20) in the Conference Room of FPCO on 29th January, 1994 at 11-00 hrs.

LIST OF PARTICIPANTS

No.	Name of Participants	Organization	Designation	Tel.No.	Signature
1.	DAVID EDWARDS	FAP 17	TEAM LEADER	[illegible]	David Edwards
2.	Jim Scullion	FAP 17	Fishe & Ecologist	—	J Scullion
3.	MIR ABU SUFIAN	FPCO	E.E		
4.	Md. Obaidur Rahman	~~FPCO~~/ WDB.	PD/SE	Te 3350	
5.	A.K.M. Haliuzzaman Rahman	FPCO	SE	320353	
6.	M. N. Huda	~~FPCO~~/FPCO	POE	314654	
7	Hans Vissser	CPP	TL	0921 4129	
8	M R ISLAM	CPP	Agronomist	815556	
9	A. M. Kamaruddin	CPP	Fishi Biologist	405992	