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DEVELOPING A FISH POLYCULTURE FOR PEASANT CONSUMPTION AND CASH CROP

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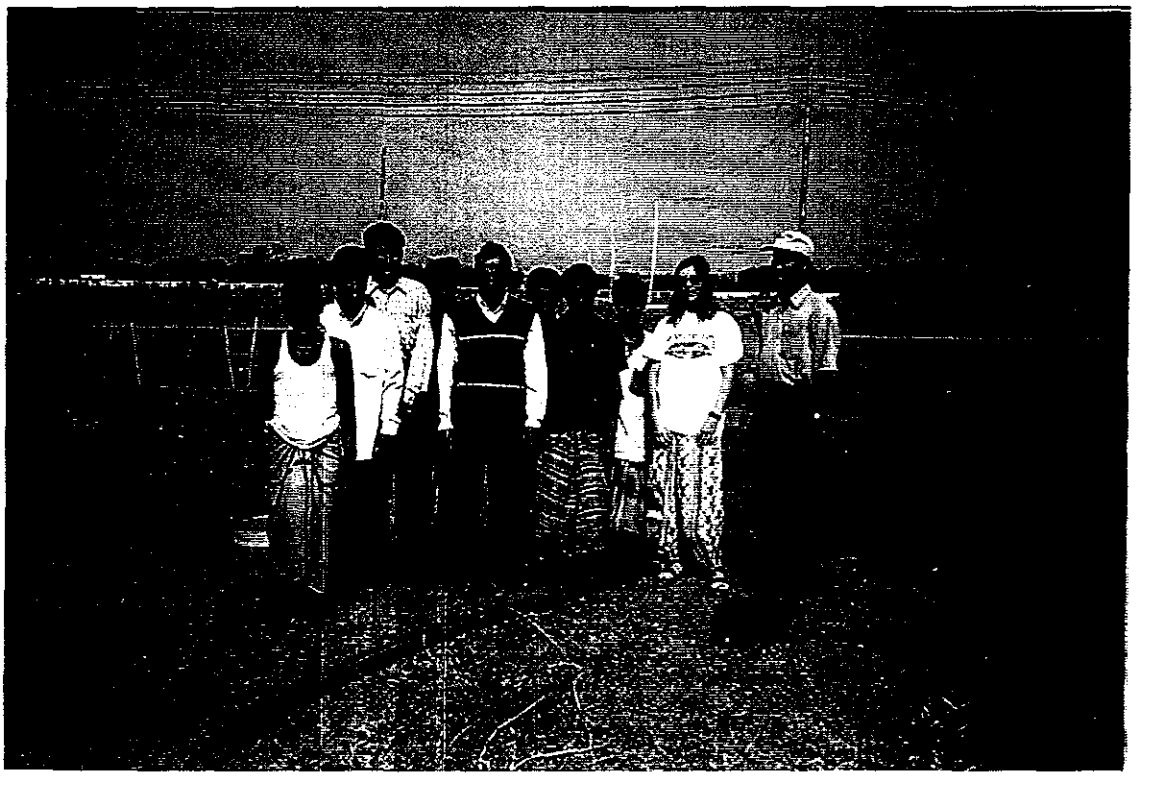

Ph.D. student M. A. Alim (5th from left to right), pond workers, students and Dr. Milstein at the Field Laboratory of the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh, during fish harvesting.

Executive Summary

The purpose of this project is to develop a viable fish polyculture technology under Bangladeshi conditions that allow simultaneous fish production of small indigenous species for peasant consumption and of large carp species as cash crop.

During 2002 two types of activities were carried out:

1- Polyculture experiment at BAU with the large carp rohu, catla and mirror carp (as cash crop fish), and the small indigenous fish punti and mola (as food for the peasant family). This year objectives were to further interfere in the ecology of the ponds through fish stocking manipulation and assess the effects of adding 20% large fish to the basic "cash" carp-small fish polyculture of the previous experiment.

The results of this preliminary analysis confirm the positive effect of common carp on rohu reported in the previous experiments, and show that a 20% increase in large carp stocking neither affect the survival of the large carps nor reduce harvesting biomass of the small fish for the farmer's family consumption. Increased stocking densities of each large carp species did not significantly reduce its own individual performance (harvesting weight and mean growth rate). Increased stocking densities of rohu and catla significantly increased their population performance (harvesting biomass and yield). Increased stocking densities of common carp did not significantly increase its population performance. The complex relations between species led to inter- and intraspecific competition, which in some treatments increased growth or yield of one species and in other treatments of other species. The gains on one species and the losses on the other led to no significant harvested biomass differences between treatments.

2- Parallel polycultures stocked last year in 28 household ponds in a nearby village. The farmers' families are managing the ponds themselves under supervision of the project personnel. These trials were stocked on 16-Jul-2001 and harvested on 15-Feb-2002, and are herein reported.

Collaboration between the project partners is carried out at all stages of the work. The research protocol for each trial is developed through discussion between the partners. The fieldwork and data input into computer files were carried out at BAU. Data and information was shared through frequent e-mail communication. Data analysis was partially done in Bangladesh and partially in Israel.

Section I

A) Research Objectives:

General objective:

To develop a viable fish polyculture technology under Bangladeshi conditions that allows simultaneous fish production of small indigenous species for peasant consumption and of large carps as cash crop.

4th year objectives:

a- Polyculture test at BAU

The polyculture experiment carried out at BAU campus concentrated on the small fish punti (*Puntius sophore*) and mola *(Amblypharyngodon mola)* and the large carp rohu (*Labeo rohita*), catla (*Catla catla),* and mirror carp (*Cyprinus carpio*). The specific objectives of this year experiment were to further interfere in the ecology of the ponds through fish stocking manipulation and assess the effects of adding 20% large fish to the basic "cash" carp-small fish polyculture of the previous experiment.

Criteria of comparisons include performance of each small and large carp species (yield, harvesting weight, growth rate and survival), and effects on environment (water quality parameters, plankton composition).

b- Polycultures under farm conditions.

The polycultures tested at BAU last year were also tested in 28 farm ponds in a nearby village. The farmers' families managed the ponds themselves under the supervision of the project personnel. These trial ponds were stocked on 16-Jul-2001 and harvested on 15-Feb-2002, and are herein reported.

B) Research Accomplishments:

a- Polyculture test at BAU

The experiment was conducted in 18 earthen fish ponds of 100 m^2 area and 1.5 m depth in the Field Laboratory of the Faculty of Fisheries, Bangladesh Agricultural University (BAU), Mymensingh. Before the experiment, ponds were drained to eradicate all the predatory fishes, embankments and slopes were repaired, and agricultural lime (CaCO3) at 250 kg/ha =2.5 kg/100 m^2 pond was applied. Ponds were filled up with pumped water and fertilized (urea and TSP each at 100 kg/ha =1kg/100 m^2 pond, manure at amounts equivalent to 150 kg dry weight/ha) to promote algae growth.

The experiment had 6 treatments with 3 replications per treatment. In all ponds 15,000 punti/ha, 15,000 mola/ha, 3300 rohu/ha, 3300 catla/ha and 3300 common carp/ha were stocked. The treatment ponds were stocked with additional 2000 large fish/ha, either all rohu, or all catla, or all common carp, or half rohu and half common carp, or half catla and half common carp, as detailed in Table 1. Ponds were stocked on 1-Jul-02 and harvested on 19-Nov-02. Fertilizer and manure were applied at 10 days intervals. Fertilizers were urea and TSP (1 kg/100 m^2 pond each). Manure (6.5 kg/100 m^2 pond) was applied wet in the four corners of each pond. Supplementary feed consisted of rice bran and soaked oil cake (2:1), given 6 times a week at a daily rate of 3% of the large carp body weight. Feeding was adjusted once a month, after fish weighing.

Environmental sampling was carried out at 10 days intervals, always at the same hour (9:00 AM). The parameters measured were: temperature, transparency, pH, dissolved oxygen, total alkalinity, phosphate, nitrogen compounds (NH_4, NO_3, NO_2), chlorophyll-*a*, and plankton composition.

The results were statistically analyzed through ANOVA. The null hypotheses tested were that each addition does not change fish performance (growth rate, yield, survival, harvesting weight and biomass) in relation to the control treatment.

Table 1: Stocking characteristics: fish species composition in each treatment, number per 100m^2 pond and mean weight.

Treatment:	Ctr		Rohu		Catla		C.carp		Rohu-C.carp		Catla-C.carp	
Fish species:	No. /100m^2	weight g	No. /100m^2	weight g	No. /100m^2	weight g	No. /100m^2	weight g	No. /100m^2	weight g	No. /100m^2	weight g
Rohu	33	12	**53**	11	33	11	33	15	**43**	12	33	12
Catla	33	15	33	14	**53**	15	33	16	33	15	**43**	15
Common carp	34	9	34	10	34	10	**54**	10	**44**	10	**44**	9
Punti	150	4.2	150	4.2	150	4.2	150	4.2	150	4.2	150	4.2
Mola	150	2.2	150	2.2	150	2.2	150	2.2	150	2.2	150	2.2
Total large fish	100		120		120		120		120		120	

Results and Discussion:

Results of fish performance are presented in Table 2 and Figure 1. Food conversion ratios calculated on total harvested biomass ranged between 1.3 to 1.7.

The additional stocking of 20% large carps mainly affected rohu parameters, while only harvesting biomass and probably yield (almost significant model) of catla presented differences between some treatments.

Effects on rohu:
Figure 1a shows that throughout the culture period rohu grew better when common carp was present in higher densities (treatments CC, Ct_CC and R_CC). When catla was in higher density (Ct) rohu grew better during the first three months, and from then on there was no difference with the control treatment. When rohu was stocked at 10% higher density together with 10% more common carp (R_CC) rohu still grew better than in the control pond. But when the 20% increase was only of rohu (R), after three months intraspecific competition led to decreased rohu growth in relation to the control treatment.

The statistical analyses performed on the harvesting results (Table 2) show that the addition of rohu or catla either alone or with common carp did not affect mean rohu daily growth rate over the culture period and harvesting weight, while the addition of 20% common carp alone improved them by 25%. When rohu was stocked at 10% increased amounts, its harvesting biomass and yield were about 50% higher than in the control treatment, and when rohu stocking was 20% higher those parameters increased only 38%. Survival of rohu was not affected by the addition of 20% large carp in any combination tested.

Effects on catla:
Figure 1b shows that during the first two months catla grew better when rohu and common carp were in higher densities (R_CC). From the third month on catla growth decreased in the treatments with increased catla density (Ct and Ct_CC) due to density dependent intraspecific competition, and to a lower extent also when rohu was in increased density (R). When common carp alone (CC) or with rohu (R_CC) were in increased density, catla growth was similar to the control ponds.

The statistical analyses performed on the harvesting results (Table 2) show that the addition of 20% large carps in any combination tested did not affect catla survival, harvesting weight or mean growth rate over the culture period. The addition of 20% catla increased catla harvesting biomass and probably yield by about 30%. This increase did not occur when only 10% catla was added.

Effects on common carp:
Figure 1c shows that common carp grew a little better when rohu was in 20% higher density (R) and the same as in the control when the addition was of catla (Ct). Common carp showed density dependent intraspecific competition during the first three months, with lower growth when its own density was increased (CC, R_CC and Ct_CC) than in the control ponds. By harvesting time this effect was evident only with 20% common carp increase (CC), while in the Ct_CC ponds its growth was the best.

The statistical analyses performed on the harvesting results (Table 2) show that the addition of 20% large carps in any combination tested did not affect any parameter of common carp.

Effects on punti and mola:
The addition of 20% large carps in any combination tested did not affect the harvesting biomass of both small fish species.

Effects on total harvested biomass:
The addition of 20% large carps in any combination tested did not affect total harvesting biomass. There were rather large variations within treatments in survival and harvesting weight and biomass, so that the differences observed were not significant.

The results of this preliminary analysis confirm the positive effect of common carp on rohu reported in the previous experiments, and show that a 20% increase in large carp stocking neither affect the survival of the large carps nor reduce harvesting biomass of the small fish for the farmer's family consumption. Increased stocking densities of each large carp species did not significantly reduce its own individual performance (harvesting weight and mean growth rate). Increased stocking densities of rohu and catla significantly increased their population performance (harvesting biomass and yield). Increased stocking densities of common carp did not significantly increase its population performance. The complex relations between species led to inter- and intraspecific competition, which in some treatments increased growth or yield of one species and in other treatments of other species. The gains on one species and the losses on the other led to no significant harvested biomass differences between treatments.

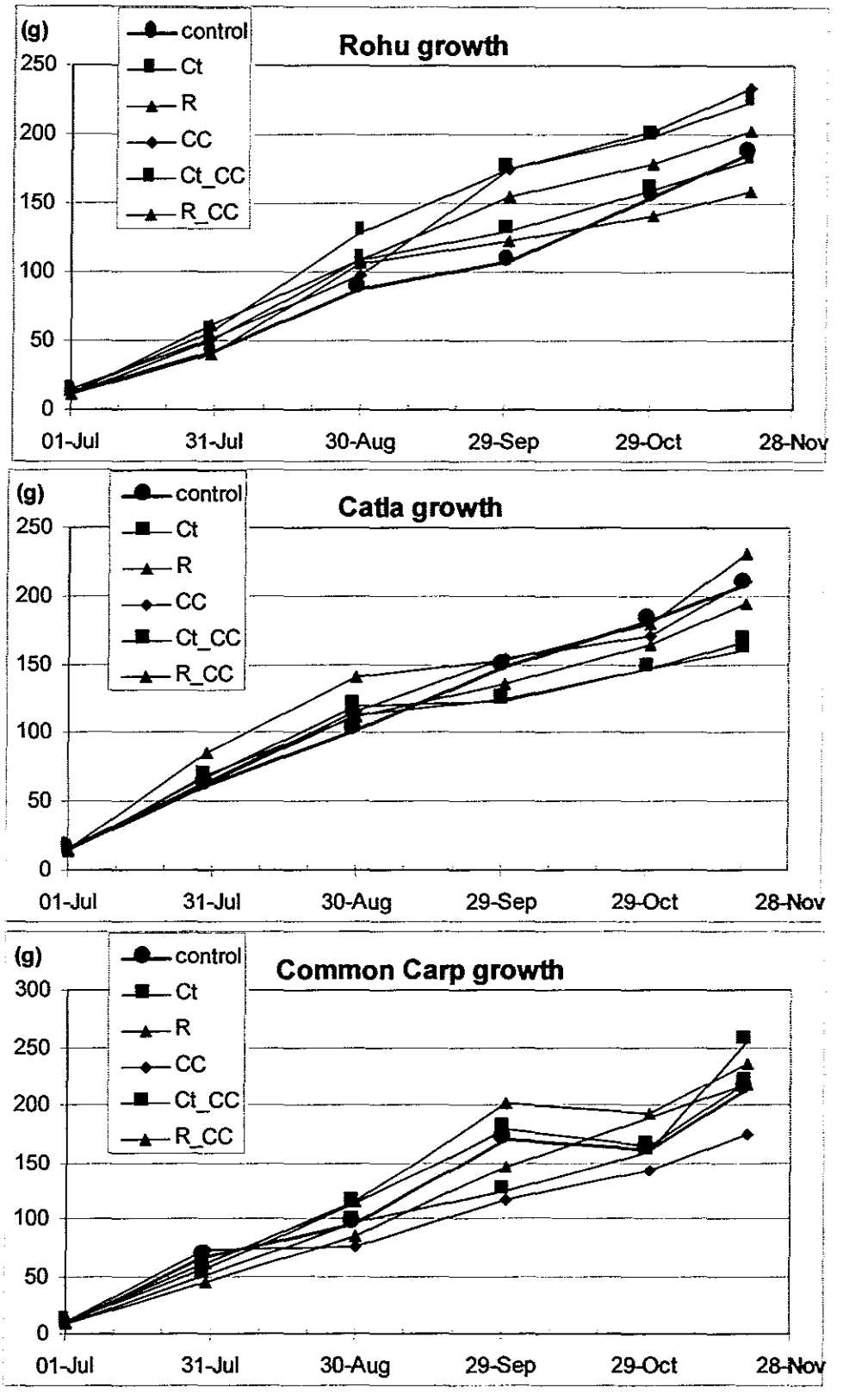

Figure 1. Growth of rohu, catla and common carp in the different treatments. Each line is the mean of three ponds.

Table 2. ANOVA and Duncan mean multicomparisons by treatment of each fish species parameters at harvesting. r^2= coefficient of determination. Significance levels: *= 0.05, (+)= almost significant (0.1), ns=not significant. Mean multicomparisons: same letters in each column indicate no significant differences at the 0.05 level. n= 18.

	Harvesting Weight	Harvesting Biomass	Survival	Growth rate	Yield (141 days)
	g	kg/100 m^2	%	g/day	kg/100 m^2
		ROHU			
ANOVA Sign. r^2	* 0.64	* 0.65	ns 0.11	* 0.63	* 0.64
Mean Multicomparisons					
Control	186 _bc	5.4 __c	88 a	1.23 _bc	5.1 __c
+20% Rohu	159 __c	7.5 ab	90 a	1.05 __c	7.0 ab
+20% Catla	182 _bc	5.3 __c	89 a	1.21 _bc	5.0 __c
+20% C.Carp	233 a	6.8 abc	88 a	1.54 a	6.4 abc
+10% Rohu +10% C.Carp	203 abc	8.0 a	92 a	1.35 abc	7.7 a
+10% Catla +10% C.Carp	223 ab	6.0 _bc	82 a	1.50 ab	5.7 _bc
		CATLA			
ANOVA Sign. r^2	ns 0.39	* 0.57	ns 0.23	ns 0.39	(+) 0.52
Mean Multicomparisons					
Control	208 a	6.3 _b	91 a	1.37 a	5.8 _b
+20% Rohu	195 a	5.5 _b	86 a	1.28 a	5.1 _b
+20% Catla	167 a	8.4 a	94 a	1.08 a	7.4 a
+20% C.Carp	211 a	6.2 _b	91 a	1.38 a	5.8 _b
+10% Rohu +10% C.Carp	210 a	6.4 _b	93 a	1.38 a	6.0 ab
+10% Catla +10% C.Carp	161 a	6.1 _b	89 a	1.04 a	5.5 _b
		COMMON CARP			
ANOVA Sign. r^2	ns 0.16	ns 0.42	ns 0.17	ns 0.16	ns 0.40
Mean Multicomparisons					
Control	213 a	5.8 ab	85 a	1.45 a	5.6 a
+20% Rohu	236 a	6.2 ab	80 a	1.60 a	5.9 a
+20% Catla	219 a	5.0 _b	71 a	1.48 a	4.8 a
+20% C.Carp	174 a	7.7 a	84 a	1.17 a	7.3 a
+10% Rohu +10% C.Carp	218 a	7.3 ab	79 a	1.48 a	7.0 a
+10% Catla +10% C.Carp	256 a	7.3 ab	74 a	1.75 a	7.0 a

	PUNTI Biomass	MOLA Biomass	TOTAL Biomass
	kg/pond	kg/pond	kg/pond
ANOVA Sign. r^2	ns 0.30	ns 0.25	ns 0.27
Mean Multicomparisons			
Control	1.57 a	1.14 a	20.2 a
+20% Rohu	1.61 a	1.07 a	21.9 a
+20% Catla	1.70 a	1.18 a	21.6 a
+20% C.Carp	1.42 a	1.12 a	23.3 a
+10% Rohu +10% C.Carp	1.44 a	1.10 a	24.3 a
+10% Catla +10% C.Carp	1.32 a	1.15 a	21.9 a

b- Polycultures under farm conditions.

The experiment was conducted in 28 rural farmers' ponds of different size ($200m^2$-$1600m^2$).

The experiment, parallel to last year's BAU experiment, had 4 treatments with 7 replications per treatment. Ponds were stocked on 16-Jul-2001 at a stocking density of 10,000 large carp/ha and 0 or 30,000 small fish/ha, as detailed in Table 3. Pond pre-treatment before stocking and fertilization and manuring throughout the culture season were carried out as indicated for the BAU experiment (see 3rd Annual Report). Together with this, fish feeding was about 15-20% from that at BAU corresponding experiment and the culture period was longer (8 months).

Table 3. Fish stocked/$100m^2$ in each treatment.

Treatment	Ctr		PMM		PM		PPM	
Fish species	No. /$100m^2$	weight g	No. /$100m^2$	weight g	No. /$100m^2$	weight g	No. /$100m^2$	weight g
Catla	33	14	33	14	33	14	33	14
Rohu	33	15	33	15	33	15	33	15
Mirror Carp	33	15	33	15	33	15	33	15
Punti			100	2.3	150	2.3	200	2.3
Mola			200	1.4	150	1.4	100	1.4
Total Small Fish	0		300		300		300	

Results and Discussion:

ANCOVA to test differences between treatments corrected by pond area, were run for each large carp species harvesting density, weight, biomass, yield, growth rate and survival (Table 4), as well as for total large carp harvested biomass and yield and small fish harvested biomass (Table 5).

Rohu performance was not affected by pond size, and the small fish in any proportion did not affect rohu survival. The presence of punti and mola in the proportion 1:1 did not affect rohu performance, but when one of the small fish species was present in higher amounts than the other, its harvesting biomass, weight, growth rate and yield were reduced by 10-15% in relation to the control ponds.

Catla performance was not affected by the small fish in any proportion, but its harvesting weight and marginally its growth rate improved in larger ponds (positive correlations with covariate).

Common carp performance was not affected by the small fish in any proportion, but its survival decreased in larger ponds (negative correlations with covariate).

Total harvested biomass per $100m^2$ pond was not affected by pond size and was 9% higher when punti and mola were stocked at 1:1 ratio than in the control (no small fish) and other small fish proportions ponds.

Large carp yield per $100m^2$ pond was not affected by pond size, was not affected when punti and mola were stocked at 1:1 ratio, and was reduced by 6% when one of the small fish was stocked at higher densities than the other.

Punti and mola harvested biomasses were negatively affected by pond size, and were lower when stocked at lower density.

In the farm experiment, with less feed the growth rates of rohu catla and mirror carp were about 30% lower than in the main experiment reported in the 3rd Annual Report (around 0.8 g/day and 1.3 g/day respectively). As in the main experiment, in the farms the addition of 30000 small fish/ha in all the proportions tested did not affect the large carp performances. The only exception was a 12% reduction in rohu performance when one small fish was stocked in higher density than the other small fish (1:2 and 2:1 ratios). Both small fish species resulted in lower harvesting biomass when its own species was

stocked at the lowest density. In the farms there was an effect of the pond size. Catla had higher growth rates in larger ponds, common carp had better survival in smaller ponds, and the harvested biomass of both small fish species was higher the smaller the pond size. These results reconfirm our previous conclusions that small fish stocking together with large carp (cash crop) should be encouraged as food source for the farmers' families.

Table 4. Farms experiment: ANCOVA and Mean multicomparisons of several parameters of each large carp species. Sign= significance level: ns= not significant, *= 0.05, **= 0.01, ***= 0.001. %=percentage of total sum of squares. C= covariate (pond size) sign of correlation. Means in the same column with the same letter are not significantly different.

	Biomass	Weight	Survival*	Growth	Yield
	kg/100m^2	g	%	g/day	kg/100m^2
ROHU					
ANCOVA Sign.	**	*	ns	*	**
r^2	0.47	0.35	0.20	0.36	0.49
	Sign % C	Sign % C	Sign % C	Sign % C	Sign % C
treatment	** 100	* 100	ns	* 100	** 100
pond size	ns	ns	ns	ns	ns
Mean Multicomparisons					
Control	a 5.7	a 207	a 83	a 0.80	a 5.3
PMM	c 4.7	b 183	a 79	b 0.70	c 4.4
PM	ab 5.3	ab 195	a 83	ab 0.75	ab 4.9
PPM	bc 5.1	b 187	a 83	b 0.72	bc 4.7
CATLA					
ANCOVA Sign.	ns	*	ns	ns	ns
r^2	0.19	0.32	0.32	0.32	0.21
	Sign % C	Sign % C	Sign % C	Sign % C	Sign % C
treatment	ns	ns 50	ns	ns 50	ns
pond size	ns	* 50 +	ns	* 50 +	ns
Mean Multicomparisons					
Control	a 6.1	a 230	b 81	a 0.90	a 5.7
PMM	a 5.7	ab 214	b 80	ab 0.84	a 5.3
PM	a 6.0	ab 221	ab 82	ab 0.86	a 5.6
PPM	a 5.8	b 209	a 84	b 0.82	a 5.4
COMMON CARP					
ANCOVA Sign.	ns	ns	*	ns	ns
r^2	0.25	0.15	0.41	0.15	0.24
	Sign % C	Sign % C	Sign % C	Sign % C	Sign % C
treatment	ns	ns	ns 22	ns	ns
pond size	ns	ns	*** 78 -	ns	ns
Mean Multicomparisons					
Control	ab 5.6	a 210	a 80	a 0.82	ab 5.1
PMM	ab 5.4	a 202	a 81	a 0.78	a 5.0
PM	a 5.8	a 215	a 82	a 0.83	a 5.4
PPM	b 5.2	a 197	a 80	a 0.76	b 4.8

* testperformed on transformed data, means given untransformed.

Table 5. Farms experiment: ANCOVA and Mean multicomparisons of Total and small fish harvesting biomass. Sign= significance level: ns= not significant, *= 0.05, **= 0.01, ***= 0.001. %=percentage of total sum of squares. C= covariate (pond size) sign of correlation. Means in the same column with the same letter are not significanlty different.

	Total harvested biomass	**Large carp yield**	**Punti harvested biomass**	**Mola harvested biomass**
	kg/100m^2	kg/100m^2	kg/100m^2	kg/100m^2
ANCOVA Sign.	*	*	**	**
r^2	0.38	0.36	0.548	0.55
	Sign % C	Sign % C	Sign % C	Sign % C
treatment	* 100	* 100	** 50	** 58
pond size	ns	ns	** 50 -	** 42 -
Mean Multicomparisons				
Control	b 17.4	a 16.2		
PMM	b 17.5	c 14.7	b 0.85	ab 0.81
PM	a 19.0	ab 15.9	a 1.00	a 0.93
PPM	b 17.8	bc 15.0	ab 0.95	b 0.72

C) Scientific Impact of Collaboration:

The field work and data input into computer files were carried out at BAU. Data and information was shared through frequent e-mail communication. Data analysis was partially done in Bangladesh and partially in Israel.

In the framework of this project Ph.D. student M. A. Alim and Masters students Mohiuddin and Shahena Ferdous conducted the main experiment and the farm trial. The project allowed their training in experimental and laboratory work, data analysis and report writing, as well as on writing papers. Mr. Alim presented the results of last year experiment in Malasya during his study visit to the University of Putra.

A two-day workshop on the Small Indigenous Species of Fish (SIS) in Bangladesh has been organized at the Bangladesh Agricultural University, Mymensingh in October 2001. Dr. Wahab organized the workshop and he presented the present status of knowledge on the biology and culture potentials of small fish in Bangladesh. Alim, Ph.D. student, working in the project, presented other paper on our joint research findings.

This year Dr. Milstein was in a sabbatical leave. While in Holland, at the Wageningen Agricultural University, she met several students of Dr. Wahab, and will be a PhD promoter of one of them (M.Mustafizur Rahman). During her stay in Wageningen Dr. Milstein had trained up two Bangladeshi students on the various aspects of research design and especially trained up Dr. Ekram ul Azim with the multivariate analyses. There has been opportunity of preparing some joint papers with Drs. Wahab and Azim on the relevant aspects of aquaculture, water quality and pond dynamics. One of the most important contributions of Dr. Milstein is to summarize the water quality, periphyton and fish production data of a recently completed EC-funded project and to develop a high quality manuscript elucidating causal relationships among various parameters using advanced statistical techniques.

D) Description of Project Impact:

As reported last year, this project exerts positive impacts on the attitude of fish farmers in the adjacent villages towards the joint culture of large carp as cash crop and small fish as family food. In response to the farmers' desire, the activities of the project have been extended to include trials in their ponds. Furthermore, the project impact is going beyond the nearby farmers. Last year, an international NGO,

ITDG-Bangladesh made an agreement with the Department of Fisheries Management (Dr. Wahab and his team) to co-operate with them to take the Carp-Small fish technology available to wider areas of the country. This year, the aquaculture team of the Institute of Aquaculture, University of Stirling has been also collaborating with the BAU's team to make further extension of the technology to wider areas in Bangladesh, and a DANIDA supported project has come forward to collaborate with the CDR project team to extend the programme to a wider scale in other parts of the country.

E) Strengthening of Developing Country Institutions:

A large portion of the Field Laboratory of the Faculty of Fisheries is being maintained by this project. A total of 28 ponds are being renovated each year following the damage caused by the common carp and monsoon rains and floods. These facilities are being guarded and daily supervised by the project personnel. This has been a practical training place for the undergraduate students of Fisheries.

Laboratory equipment are all in working condition and sufficient consumables have been purchased to allow the laboratory to continue providing services to the post-graduate and under-graduate students. A lap top computer with printer, an OHP, CD writer and zip driver have been purchased and widely used. Our water quality laboratory has earned reputation for its high level analytical facilities and is being used to provide support services to the aquaculture industries in the adjacent areas. Three young teachers and about 20 post-graduate students are the direct beneficiaries of the ongoing project.

F) Future Work:

Fieldwork has been completed and data are being analysed. Our PhD student Alim has been carrying out some indoor experiments using aquaria to explore the food and feeding habits of small fishes, and the dietary competition between mola and punti. This work will continue during early 2003. The rest of the months will be dedicated to write the papers as well as data analysis and report preparation.

This project is reaching its end. The Final Report will be duly prepared and submitted by June 2003. With the tremendous success of the project in terms of its scientific outputs and on-farm application, the Israeli-Bangladeshi research team has been encouraged to continue their fruitful cooperation and therefore applied for a new CDR funding program.

Section II

A) Managerial Issues:

There have been no major changes made in the management of the project either in Bangladesh or Israel. Under this project worked in Bangladesh the Ph. D. student Alim and the Masters student Mohiuddin (Shamim) and Mrs. Shahena Ferdous. A female technician, Poppy, has been working for smooth running of the laboratory and maintenance of the equipment.

B) Budget:

Last year problems on timing of money expenditure have been solved.

C) Special Concerns:

No special concerns.

D) Collaboration, Travel, Training and Publications:

Fluent communication between partners and students is carried out through e-mail.

The papers submitted last year to Aquaculture Research are already printed or in press, and the paper on 2001 experiment is almost ready and will be submitted next month.

Wahab, M. A., M. M. Rahman and A. Milstein (2002).
The effect of common carp, *Cyprinus carpio* (L.), and mrigal, *Cirrhinus mrigala* (Hamilton), as bottom feeders in major Indian carp polycultures.
Aquaculture Research, 33:547-557.

Milstein, A., M. A. Wahab and M. M. Rahman. (2002).
Environmental effects of common carp, *Cyprinus carpio* (L.), and mrigal, *Cirrhinus mrigala,* (Hamilton) as bottom feeders in major Indian carp polycultures.
Aquaculture Research, 33:1103-1117.

Wahab, M. A., M. A. Alim and A. Milstein (in press)
Effects of adding the small fish punti, (*Puntius sophore*), and/or mola, (*Amblypharyngodon mola*), to a polyculture of large carp
Aquaculture Research,

Wahab, M. A., M. A. Alim and A. Milstein (in preparation, almost ready for sending to press)
Effects of adding different proportions of the small fish punti (*Puntius sophore*) and mola (*Amblypharyngodon mola*) to a polyculture of large carp

Dr. Wahab's training visit to the Auburn University Alabama of the United States has been very fruitful for establishing collaboration with the US aquaculture scientists and academics. He has presented two lectures to the Faculty and Graduate students of the University, made extensive visits to farms, and gathered knowledge on the US aquaculture system. He has long discussion periods and company with Prof. Boyd and Prof. Grover (Prof. Grover has recently completed his tenure with Bangladesh ICLARM). Moreover, Dr. Wahab established very good linkages with PD/A CRSP team especially with Prof. Jim Diana of the Michigan University. Through this link he was invited to participate in a panel of experts for the Asia region in the World Aquaculture Society (WAS) conference held in Beijing last April.

E) Request for A.I.D. or BOSTID Actions:

No special actions requested.