Culture of Mola (*Amblypharyngodon mola*) in Polyculture with Carps - Experience from a Field Trial in Bangladesh

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Abstract

Studies were carried out during May 1997 to January 1998 in Kishoreganj district in Bangladesh to investigate the production potential of carp polyculture in combination with *Amblypharyngodon mola* in seasonal ponds. The preliminary results indicate that *A. mola* can be successfully cultured in small seasonal ponds in polyculture with carp. This practice can result in an increase in the households' consumption of small fish which have a very high content of calcium, iron and vitamin A. In addition to the nutritional benefits, it can also provide additional income through the sale of carp and surplus small fish.

Introduction

Small indigenous fish play an important role in the Bangladeshi diet, not only as a source of animal protein but also as a source of a range of other essential nutrients, such as calcium, iron and vitamin A. Deficiency of vitamin A is widespread in Bangladesh, particularly among women and children. Calcium is an important nutrient for growth in young children, foetal growth and milk production. Analyses of a number of Bangladeshi fish species have shown great variation in vitamin A and calcium content (Thilsted et al. 1997 and unpublished data). Some small indigenous fish, including mola (*A. mola*) are rich in vitamin A as compared to carps. Since small fish are normally consumed with bones, they are an important source of calcium. The large number of small seasonal ponds in Bangladesh is an underutilized resource for fish production. Cultivation of small fish, alone or in combination with carps, in these ponds can play an important role in improving the food and nutrition security of rural populations. Small fish are defined as those species which attain a maximum length of 25 cm or less. Many small indigenous fish species (SIS) of Bangladesh attain a length of less than 10 cm (Felt et al. 1996).

A number of experimental trials have been undertaken for the culture of these small fish in experimental ponds but the same has not been done under farmers' pond conditions. Hence, studies were undertaken in Kishoreganj district in Bangladesh, during May 1997 to January 1998, to investigate the production potential of carp polyculture in combination with *A. mola* in seasonal ponds as well as the nutritional impact of this production on the farmers' families. The preliminary results of these studies are presented in this paper.

The Field Trial

Farmers with access to small seasonal homestead ponds were selected from four thanas (sub-districts) in Kishoreganj district. They were selected from a target group owning less than 0.8 ha land and having an annual income of less than Taka 35 000[1]. A total of 59 seasonal homestead ponds ranging in size from 212 to 850 m^2, with an average of 396 m^2 were used in the trial. The selected farmers owned 0.56 ha land on an average, including the homestead. The farmers were trained in pond management and received extension services through the Mymensingh Aquaculture Extension Project (MAEP), a DANIDA (Danish International Development Assistance) funded project, which is being implemented in Mymensingh and surrounding districts since 1989.

A four species carp polyculture was selected based on the experience gained in the MAEP. Two production models: the mola pond model and the mixed pond model, were tested. Thirty four ponds were treated with rotenone for eradication of the existing stock and were stocked with *A. mola*, along with carps (mola pond), while 25 ponds were not treated with rotenone, the natural stocks of the different SIS were left in the pond (mixed pond) and carps were stocked. The stocking densities of the various fish species are shown in Table 1.

Pond conditions were taken into consideration while categorizing a pond as either a mola pond or a mixed pond. Some ponds were completely dry at the time of selection (March/April 1997) and some had less than 0.5 m of water depth. Ponds which were dry at the time of selection were preferred for the mola pond model. Ponds which were known to contain stocks of small fish and ponds with inflow from catchment areas were chosen for the mixed pond model. Bigger fish, e.g., carps, were removed from the mixed ponds by repeated drag

[1]US$1=Tk44.8.

netting using a net with a big mesh size (>4 cm) to allow the small fish to survive. Before stocking, all ponds were treated with lime and a phytoplankton bloom was developed by application of cattle dung and commercial fertilizers.

STOCKING OF PONDS

A. mola are fragile and sensitive to handling. Broodfish were used for stocking since *A. mola* spawn and multiply in ponds. The average weight of the broodfish was 1.6 g, with a range of 0.8-4.0 g. The broodfish were collected from local ponds which had natural stocks, using a drag net (mesh size 0.5 cm). High mortality occurred if big fish were netted along with *A. mola*. If many big fish were present in the pond, they were first separated from *A. mola* by dragging with a big mesh net (>4 cm), before using a small mesh net to capture *A. mola*. The fish were collected from the drag net using a cup, while keeping the fish constantly under water. Fish that were stocked in the experimental ponds were counted individually.

TRANSPORT OF BROODSTOCK

For stocking 34 mola ponds, 80 batches of *A. mola* were transported by bicycle from the brood ponds to the trial ponds in aluminum pots at a density of 5-55 fish/l. Transport was done before 10 a.m. and lasted for up to 60 min. Mortality during transportation was 0-41%. High mortality occurred in few cases: mortality was <15% in 85% of the cases and <1% in 45% of the cases. There was no relation between the mortality rate and the transportation duration or density. On several occasions, *A. mola* were transported in plastic bags for up to 5 hours without mortality and indicated that they are not particularly sensitive to low oxygen levels. However, *A. mola* are extremely sensitive to rough handling and special care must be taken to ensure gentle netting during collection of broodstock.

POND MANAGEMENT

Rice bran was given as supplemental feed at approximately 3% of the estimated carp biomass, excluding grass carps. Urea and triple super phosphate (TSP) were applied as fertilizer in the pond, at the rate 60 g and 90 g per pond fortnightly, respectively, or when the phytoplankton bloom was low as estimated by the color of the water. TSP was replaced by single super phosphate (SSP), depending on local availability and price. Compost was made in a corner of the pond, using water hyacinth, cattle dung and kitchen waste, with the addition of lime and urea. Table 2 shows the average input and expenditures for the two production models for an average size pond (400 m^2), during an average rearing season of 7 months. Carp fingerlings accounted for approximately 50% of the expenditure and the cost of *A. mola* broodfish and their transport accounted for 13% of the expenditure in the mola ponds.

For the purpose of this field trial, partial monthly harvesting of *A. mola* and other small fish was done to reduce the biomass. *A. mola* spawned in most ponds within a few weeks after stocking and one or two generations of *A. mola* matured during the rearing period. Silver carp was harvested twice (two crops) within the season and other carps at the end of the rearing period. After the final harvesting of fish using a drag net, rotenone was applied to collect all remaining fish in the pond for the estimation of total fish production.

Results

TOTAL FISH PRODUCTION

There was no significant difference in the total fish production between the two production models. The total fish production was 2.8 t/ha in both the mola and the

Table 1. Stocking densities (number of fingerlings/ha).

Fish species	Mola pond (n=34)	Mixed pond (n=25)
Silver carp (*Hypophthalmichthys molitrix*) or catla (*Catla catla*)	8 000 in two crops	8 000 in two crops
Grass carp (*Ctenopharyngodon idella*)	2 000	2 000
Mrigal (*Cirrhinus mrigala*) or common carp (*Cyprinus carpio*)	2 000	2 000
Rohu (*Labeo rohita*)	500	500
Mola (*Amblypharyngodon mola*)	25 000	-
SIS	Removed by rotenone	Native stock

Table 2. Input and expenditure for an average size trial pond of 400 m^2 during an average culture period of 7 months.

Input	Mola pond			Mixed pond		
	n	Quantity	Cost (US$)	n	Quantity	Cost (US$)
Silver carp fingerlings	34	293 ±83 no.	11.0±4.6	25	364 ±126 no.	12.4±4.9
Other carp fingerlings	34	179 ±33 no.	9.6±5.1	25	198 ±64 no.	9.4±5.1
Mola	34	1 095 ±202 no.	4.3±2.0	-	-	-
Rice bran	34	151 ±81 kg	5.9±4.2	23	131 ±85 kg	5.0±3.1
Urea	34	19 ±10 kg	2.5±1.4	23	15 ±5 kg	2.0±0.9
Other fertilizers (TSP, SSP, cattle dung)	34	-	5.4±2.6	23	-	6.8±2.9
Mola transport	19	-	1.4±0.6	-	-	-
Other expenses	22	-	3.2±2.2	5	-	3.2±3.6
Total			**43±10**			**36±10**

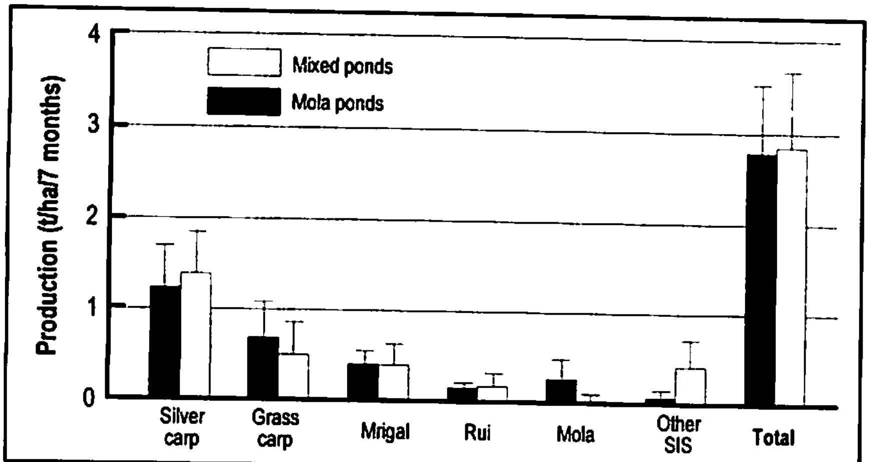

Fig. 1. Average production of different species in mola ponds and mixed ponds.

mixed ponds, over a period of 217 days and 210 days, respectively. Fig. 1 shows the average production of each fish species during a growing period of 7 months. Since seasonal ponds change in water spread area during the season, the area was calculated as the average of the maximum pond size and the pond size at the time of the final harvesting.

CARP PRODUCTION

The carp production was 2.5 t/ha/7 months in both the mola and mixed ponds, with a nonsignificant higher production of silver carp in the mixed ponds and a nonsignificant higher grass carp production in the mola ponds. The variation in stocking density of carps between ponds can be partly explained by the changing pond size during the growth season. The pond size at the time of stocking might be different from the average pond size used for calculating the area for input and output parameters.

A. MOLA PRODUCTION

The average *A. mola* production was significantly higher in the mola ponds compared to the mixed ponds ($p<0.001$), while production of other small fish was significantly higher in the mixed ponds ($p<0.001$). The highest *A. mola* production obtained was 0.8 t/ha/7 months. However, the total average production of all small fish was not significantly different at 0.34 t/ha/ 7 months in the mola ponds and 0.44 t/ha/7 months in the mixed ponds. Small fish production in the mixed ponds was dominated by puti (*Puntius* ssp, mainly *P. sophore*) and darkina (*Esomus danricus*), though many other species were recorded.

On an average, *A. mola* contributed 10.3% to the total fish production in the mola ponds. Other small fish which entered the pond after rotenone treatment, most probably along with duckweed collected from rice fields, contributed 2.9%. In the mixed ponds, *A. mola* contributed 2.7% of the total fish production and other small fish 13.5%.

Carps were harvested once or twice in the rearing season, when they had grown to a marketable size. The majority of carps harvested were sold, providing income for the households (Table 3). Approximately 50% of the small fish produced in the trial ponds was consumed by the farming households themselves. The proportion of small fish used for home consumption might have been greater if the farmers were not restricted to monthly harvesting. Since *A.. mola* and other small fish reproduce in the pond continuously, small amounts can be harvested more frequently (biweekly or weekly) for home consumption.

By culturing small fish in the homestead ponds in combination with carps, the households can get double benefits: increase their nutrient intake by consuming the small fish and at the same time increase their income by selling the carps and some of the small fish. As they are rich in a range of minerals and vitamins, a steady consumption of small fish will significantly improve the nutritional quality of the diet.

Table 4 shows the contribution of *A. mola* and silver carp production from a small seasonal pond to the intakes of vitamin A and calcium for a family of 6 persons, based on the assumption that all fish produced are consumed by the family. Values for *Puntius* sp. are also included as it is among the most commonly consumed small fish and is often found in seasonal ponds. *A. mola* production from small seasonal ponds can contribute

Table 3. Value of sales, consumption and net benefit from 400 m² ponds in 7 months from mola and mixed ponds (US$).

	Mola pond			Mixed pond		
	Value of sale	Value of home consumption	Total value	Value of sale	Value of home consumption	Total value
Silver carp (or catla)	23.80	2.00	25.80	27.0	4.90	31.90
Grass carp	15.70	3.00	18.70	10.6	2.40	13.10
Mrigal (or common carp)	11.20	1.40	12.50	11.0	1.60	12.60
Rohu	4.60		5.40¹	5.2	0.60	5.80
Mola	5.00	3.70	8.70	0.8	1.60	4.40
SIS, other than mola	0.80	1.70	2.60	4.1	4.20	8.30
Gross benefit	**61.10**	**12.60**	**73.70**	**58.70**	**14.50**	**73.30**
Expenditure			**43.00**			**36.00**
Net benefit			**30.70**			**37.30**

Table 4. Intake of vitamin A and calcium from A. mola, Puntius *sp. and silver carp production.*

	Family of 6 persons[1]: Total recommended dietary intake/d[2]	% of recommended dietary intake per year for a family of 6 persons[1]			
		11 kg mola[4]	32 kg mola[5]	32 kg puti (edible parts)[6]	52 kg silver carp (edible parts)[7]
Recommended Dietary Allowance[2]	Vitamin A: 4 275 RE[3]	11-18 %[8]	32-51%	0.8%	0.6%
	Calcium: 4.9 g	7%	19%	19%	8%

Notes:
[1] A family with 2 adults and 4 children: 1 male age 15-50 years, 1 lactating female age 15-50 years, 1 child in each of the age groups: 0-12 months, 1-3 years, 4-6 years and 7-10 years.
[2] NRC (National Research Council). 1989. Recommended Dietary Allowances. National Academy Press, USA.
[3] RE - retinol equivalent.
[4] The total production with an average production rate (0.46 t/ha/yr) in an average size pond (396 m^2) with an average culture period (217 days).
[5] The total production with maximum production rate (1.34 t/ha/yr) in an average size pond with an average culture period.
[6] Puti (*Puntius* ssp.) is a very common SIS in seasonal ponds and one of the most commonly consumed fish species in Bangladesh.
[7] The total production of silver carp with average production rate (2.2 t/ha/yr) in an average size pond with an average culture period.
[8] The range covers cleaned (intestines totally removed) and uncleaned fish. In the most recent analysis of vitamin A in *A. mola* (September 1997, unpublished data), we found 2 500 RE/100 g in raw, uncleaned *A. mola* and 1 570 RE/100 g in, cleaned *A. mola* (intestines and liver removed). The degree of cleaning depends on the size of the fish and the person cleaning the fish.

significantly to the vitamin A intake of a household, whereas silver carp and other species contribute very little. *A. mola* can also contribute to the calcium intake, which is not the case with carps.

Conclusion

The conclusion, based on the field experience and preliminary data analysis of this field trial is that *A. mola* can be cultured successfully in small seasonal ponds in polyculture with carps. The farmers are interested in culturing *A. mola* because of its taste and good market price. A follow up trial in 1998 showed that of the 59 farmers who participated in the trial in 1997, 30 farmers had continued with *A. mola* production.

For encouraging successful culture of *A. mola* with carps in small seasonal ponds, certain conditions must be met. Good quality *A. mola* broodfish must be available to the farmers. In this field trial, broodfish from local wild stocks were used successfully but in order to expand this production technology, it is necessary to ensure availability of local broodstock. Simple guidelines for the management of local broodfish ponds in the dry season must be developed and disseminated to the farmers. Improved knowledge on species combination and stocking density is needed as well as simple methods for the estimation of the biomass of small fish in a pond. Efficient and cheap technology for frequent netting and partial harvesting of *A. mola* is also required. The use of traditional fishing gear (e.g., scoop net, cast net and fish trap) or sharing of drag net among neighboring farmers will help to reduce the cost of netting. Farmers should be trained in "gentle handling" and "gentle netting" of *A. mola*.

There is great potential for integrating *A. mola* and other small indigenous fish species in the further development of aquaculture in Bangladesh. This new approach in aquaculture can play an important role in ensuring greater diet diversity and increased intake of vitamin A, calcium and other essential nutrients among rural populations.

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References

Felt, R.A., F. Rajts and D. Akhteruzzaman. 1996. Small indigenous fish species culture in Bangladesh. Dhaka: Integrated Food Assisted Development Project (IFADEP). Project ALA/92/05/02:1-41.

Thilsted, S.H., N. Roos and N. Hassan. 1997. The role of small indigenous fish species in food and nutrition security in Bangladesh. Naga, ICLARM Q. 20 (3 and 4) (Supplement): 82-84.

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