Pangasiid Catfish *Pangasius hypophthalmus* Farming in Bangladesh: a Rural Survey in the Mymensingh Region

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Abstract The status of recently expanded exotic pangasiid catfish *Pangasius hypophthalmus*, Pangasiidae farming in rural Bangladesh has been studied for finding research needs, through knowing the culture methods, associated activities and problems, to make the farming sustainable. Data were collected using participatory rural appraisal (PRA) tools in nine villages in three upazilas (sub-district) of Mymensingh district. The farmers have not got any formal training and have developed their knowledge on farming the fish through practice over years and sharing of knowledge among fellow farmers. Linked industries, e.g. hatcheries, nurseries, feed mills, trading of feed and fish etc. have developed that created employment opportunities. Most of the farmers produce two crops a year. About 90% of the farmers were found to practice monoculture of pangasiid catfish at high stocking density. The feeding rates started from 10-15% of the body weight per day at fingerling stage that reduced to 4-6% with growth. The average yield was found to be 25 tons/ha/year. The livelihood of the farmers has been improved through farming the fish. Women and children were rarely engaged in the activities. The identified major problems in farming the fish were water quality deterioration, high feed costs and declining consumer demand and market price.

Key words : Pangasiid catfish, *Pangasius hypophthalmus*, aquaculture, Bangladesh, Mymensingh

Introduction

Pangasiid catfish (*Pangasius hypophthalmus*, Pangasiidae) is an important exotic fish species for aquaculture in Bangladesh. The culture of this species contributes significantly in the annual fish production as well as livelihood of the rural people of the country. Since its inception, monoculture of the fish is widely practiced. The culture of this species expanded rapidly due to its fast growth, wide environmental tolerance, easy rearing and seed production, high consumer demand, advantage of long distance transportation in live condition and farmers' opportunity to get higher economic gain than in culturing some other species.

Though freshwater aquaculture has traditionally been practiced throughout the country, it is more advanced and intensive in some regions, the Mymensingh is one of them. It may be due to higher productivity of soil and water conducive to aquaculture, better awareness development of the farmers due to the activities of different organizations in the region, e.g. Faculty of Fisheries, Bangladesh Agricultural University (BAU), Mymensingh, BAU extension project, Bangladesh Fisheries Research Institute (BFRI), Mymensingh, Department of Fisheries (DoF), Danida funded Mymensingh Aquaculture Extension Project etc. Good road communications in the region made the extension activities as well as management and marketing of aquaculture products easy. Mymensingh is situated north to Dhaka, the capital city, and have good road and train linkages with the neighbouring districts as well as with the northern districts of the country. The

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land of this region is comparatively high and the ponds do not flood by normal monsoon rain which also encouraged the farmers in aquaculture. The district covers about 3% of the land area of the country but is producing more than 4% of the freshwater aquaculture crops annually.

The culture of pangasiid catfish started in Mymensingh in 1990, the year when the fish was imported from Thailand. The fish is cultured in all 12 upazilas (sub-district) of the Mymensingh district, but it is very intense in the Sadar, Trishal and Bhaluka upazilas. It is reported that 19,203 metric tons of pangasiid catfish are annually produced in the district of which 703.12 metric tons are produced in Sadar, 5022.06 metric tons in Trishal and 7033.96 metric tons in Bhaluka upazila (District Fisheries Officer, personal communication). Many farmers - marginal to large are involved in this fish farming. Many small and large industries and support services e.g. large commercial feed industries, small domestic feed mills, fry producing hatcheries, fingerling nurseries, fry, fingerling and adult fish transportation and marketing facilities, fish harvesting groups, mechanically filling of water in transport vans etc. have developed. These activities created many employment opportunities for the rural poor. High production of this fish made it available to the poor and it became common peoples' fish and contributing significantly in the animal protein nutrition of the people of the country. The culture of this species was flourished mainly by the innovative farmers but the simultaneously needed research on its culture, management, environmental impacts etc. was not conducted as a result the farmers are not getting required suggestions or solutions of the problems they are presently facing. High feed cost, aquatic pollution due to sedimentation of unused feeds and fish metabolic wastes, microalgal blooms, oxygen depletion, off-flavour both from the environment and in fish-flesh are the major impediments in the sustainability of this industry. The present study was conducted to know the status of pangasiid catfish farming at field levels and to formulate future research programmes to find out probable solutions of the problems encountered by the farmers.

Materials and Methods

Study areas

The study was conducted in nine villages under three upazilas (sub-district), Sadar (villages: Barera, Gopal Nagar and Maziihati), Trishal (villages: Vouliapara, Zilki and Boilor) and Bhaluka (villages: Bhaluka purba para, Rangchapra and Mirka), out of a total of twelve upazilas of Mymensingh district (Fig. 1). Three upazilas and the surveyed villages were selected as representative of the region on the basis of prior information on farming of the fish.

Data collection

Data were collected using participatory rural appraisal (PRA) tools, such as focus group discussion (FGD), matrix scoring and semi-structured interviews with pangasiid catfish farmers. The PRA was conducted by a group of facilitators. The villages were selected by interviewing the key informants and taking information from the local Upazila Fisheries Officers. At the village level, older and better-educated people who are the residents of the village and know more about the farms and the farmers were chosen as key informants. The key informants classified the pangasiid catfish farmers into three different categories based on certain explained criteria, e.g. farm area, source of income other than fish farming etc. (Table 1).

The farmers' preference on pangasiid catfish over

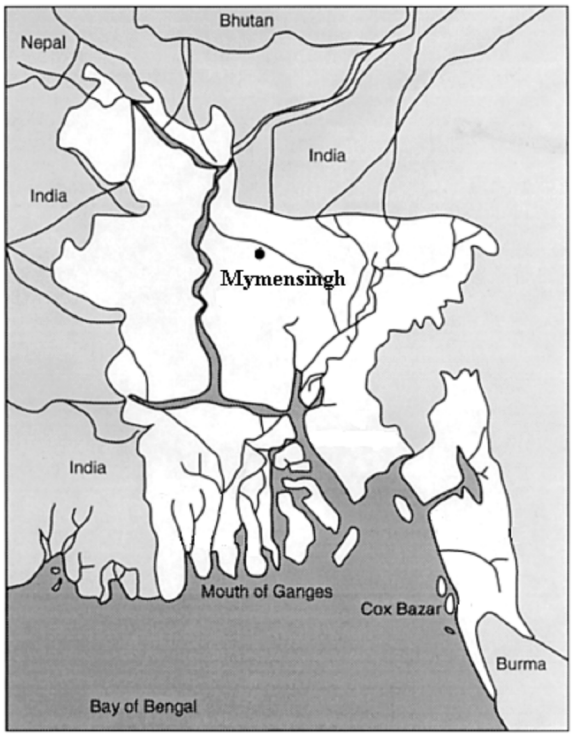

Fig. 1. Map of Mymensingh district showing the study area.

Table 1. Criteria used for classification of pangasiid catfish farmers into three different groups

Farmers category	Farm land area and relative wealth		
	land area	Other resources	Sources of other income
Small	<1.0 ha	Other resources minimum or insignificant	Have small income from crop farming
Medium	1.0 - 2.5 ha	Have medium sized business and other resources	Have other profession or source of income (crop farming + service + small business)
Large	> 2.5 ha	Have large business or other resources	Have other large sources of income (crop farming + large business + service etc.)

some other commonly cultured fish species was investigated through matrix ranking on different characteristics. It was obtained through participation of local men and women in the studied villages. Bean seeds were used in the matrix ranking. Participants through discussion were asked to put a maximum of 10 bean seeds as 10 points for a single criterion of a species in comparison to others. The criteria used for the comparison were: yield, taste, household consumption, price, market demand, profit, availability of fry/fingerling, feed cost, fertilizer cost, water quality problem, disease problem etc. The fish species were: rohu (*Labeo rohita*, Cyprinidae), catla (*Catla catla*, Cyprinidae), mrigal (*Cirrhinus mrigala*, Cyprinidae), silver carp (*Hypophthalmichthys molitrix*, Cyprinidae), silver barb (*Barbodes gonionotus*, Cyprinidae), common carp (*Cyprinus carpio*, Cyprinidae), pangasiid catfish (*Pangasius hypophthalmus*) and grass carp (*Ctenopharyngodon idella*, Cyprinidae).

Semi-structured interviews were conducted with individual pangasiid catfish farmers (n = 65) from three upazilas. The study was carried out to understand the individual pond management, resource use and farmers opinion on pangasiid catfish. Each pangasiid catfish farmer was asked to explain their opinion on pangasiid catfish culture method, advantages and disadvantages of the species in comparison to some other species.

Results and Discussion

History of pangasiid catfish farming in the surveyed areas

In the year of its introduction in 1990 the culture of this fish was started to a small scale in some places including Mymensingh of Bangladesh. During the PRA study, it has been known that the culture of pangasiid catfish started first at Trishal and Bhaluka upazilas of Mymensingh region by some rich people (mainly construction contractors) in leased ponds. Observing fast growth, high yield and net profit, many local farmers and young educated people became motivated and started pangasiid catfish farming. In this way pangasiid catfish farming expanded in the region within a few years. Presently pangasiid catfish are cultured in all upazilas of the Mymensingh district and extensively in Trishal and Bhaluka upazilas. Similar phenomena about the spread of fish farming practices in Bangladesh was reported in some survey reports. ADB (2005) reported from their survey in Kishoreganj, Bangladesh that the fish farming practices over there were originated locally, mostly through information and advice on fish farming from other farmers, and from friends and neighbours [1]. Among the pangasiid catfish farmers in the studied areas, 30% was found to be small, 60% medium and 10% large farmers. The number of small farmers was found highest (56%) in Mymensingh Sadar and lowest (15%) in Bhaluka. The number of medium farmers was highest (70%) in Bhaluka and lowest (38%) in Mymensingh Sadar. Similarly the number of large farmers was highest (15%) in Bhaluka and lowest (6%) in Mymensingh Sadar.

Family size, education and social status of pangasiid catfish farmers

The family size of most of the pangasiid catfish farmers was large and consisted of 5 to 11 members. The family size did not differ significantly among the three surveyed upazilas. The average family size of the farmers was found to be bigger (6.23) than the national average of 4.9 members (BBS, 2003) with 52% male and 48% female [2].

The interviewed pangasiid catfish farmers were found literate with four levels of education; around 35% of the farmers had education up to primary level, 25% up to secondary level, 23% up to higher secondary level, and 17% up to graduate level. Among the rural fish

farmers, the pangasiid catfish farmers were found to be relatively better educated, solvent and enjoyed higher socio-economic status in the local community in comparison to traditional carp fish farmers [3]. This was possibly due to the reason that comparatively educated, innovative and rich farmers came forward first to culture this highly productive exotic fish. The poor farmers who normally culture planktivorous carps could not avail this opportunity due to requirement of very high input costs (feed and fingerlings).

Training and experience of pangasiid catfish farmers

A very few farmers in the study areas received formal training on pangasiid catfish farming. Among the 65 surveyed farmers only 14 (22%) received short training (1-3 days) from local Upazila Fisheries Officials. The Upazila Fisheries officers in the three surveyed upazilas have graduation in Fisheries and have field experiences on aquaculture. Most of the farmers learned the pangasiid catfish culture technology themselves through learning by doing i.e. culture in successive years and sharing of knowledge among the fellow farmers. Most of the training offered to the fish farmers throughout the country are project based implemented either by the Department of Fisheries or by the Bangladesh Fisheries Research Institute of the Government of Bangladesh, and there is no regular programmes of these organizations (Mazid, 2002) though it is thought to be very important as fisheries and aquaculture have already been identified as an important means of poverty alleviation and livelihood security of the rural poor [9].

In the study areas most of the farmers have had years of pangasiid catfish farming experience. About 54% of the farmers were found to have one to five years of farming experience; 25% have five to 10 years experience; 12% have experience for more than 10 years; and 9% of the farmers have less than one year experience or they were beginner. Technology based training to the farmers is necessary for sustainable pangasiid catfish farming in the region.

Types of pangasiid catfish culture

In the study areas most of the farmers mentioned that without getting any culture guideline/culture technology from any institution they started pangasiid catfish culture according to their own way. Around 90% of the farmers cultured pangasiid catfish as a single species (monoculture) and only 10% cultured the fish together with some other fish species (polyculture), especially rohu, catla and silver carp without maintaining any specific stocking ratio and density. In monoculture practice, farmers stocked pangasiid catfish at high density (30,000 to 60,000 fish/ha) for getting higher yield and profit without thinking the negative effects on the environment, fish growth and quality.

Preference on pangasiid catfish over other species

In the study areas most of the farmers showed positive response and described the advantages of pangasiid catfish farming. Fast growth, high yield, high profit, easy rearing at high stocking densities, availability of seed and feed, disease resistance, easy harvesting and scope of marketing in live condition etc. are important advantages that made the fish a preferred species for aquaculture. In the scored matrix pangasiid catfish was highly ranked in terms of overall desirability as a species to culture in comparison to other commonly cultured species irrespective of farm size (Fig. 2). Overall, pangasiid catfish ranked at par with the native major carps, catla and rohu and exotic silver carp in level of preference for pond culture.

Pond management and inputs used in pangasiid catfish farming

Pond preparation before stocking of fish fingerlings is an important part of pond management. About 90% of the surveyed farmers made necessary preparations

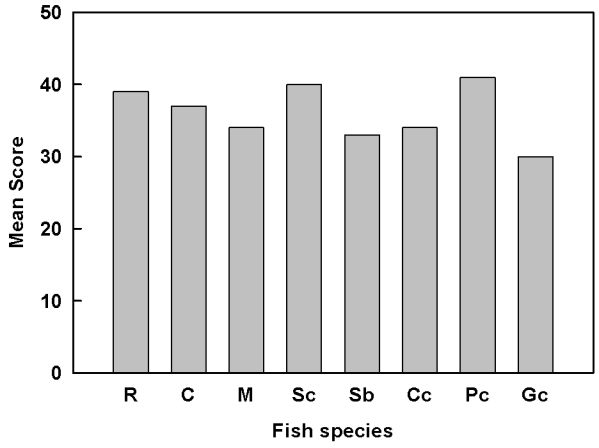

Fig. 2. Mean score allotted by the farmers to different cultured fish species (Rohu, Catla, Mrigal, Silver carp, Silver barb, Common carp, Pangasiid catfish and Grass carp) during PRA to explain the preference for pond culture.

before stocking of fish fingerlings. More than half of the farmers dried-up their ponds, removed weeds and repaired dykes before stocking for the first crop of the year. The pond dykes were repaired to protect the ponds from flooding. The unwanted fish, mainly small indigenous species (SIS) were removed from most of the surveyed ponds. All farmers (100%) were found to use lime in their ponds at the rate of 250 kg/ha during the pond preparation, one to two weeks prior to the release of fish fingerlings. Only a few farmers (9%) reported to have removed organic deposits from pond bottom during pond preparation in every alternate years. Around 50% of the pangasiid catfish farmers were found to have used potassium permanganate and about 20% farmers used common salt (NaCl) solution for bathing pangasiid catfish fingerlings as a preventive measure of diseases during transfer from one pond to other ponds for stocking (Table 2). The farmers have not found to use either organic or inorganic fertilizer in pangasiid catfish ponds. To avoid poaching farmers employed guards or guarding themselves; large farmers, in addition to guards, fenced their farms.

After stocking, fishes were fed (either commercial pellet feed or farm made pellet feed) daily by all farmers (Table 3). Only a few farmers (5%) in the study areas were found to use antibiotics (local brand name "doxicap"; Renata Ltd., Bangladesh) with the feed during infestation of disease. No algaecide or herbicide was found to use in pond for controlling phytoplankton in the study areas. Some farmers (35%) were found to use lime each month at the rate of 25 to 50 kg ha^{-1} for controlling excessive growth of phytoplankton. Around 15% of the pangasiid catfish farmers were reported to pull a harrow locally called *hara* (Beveridge et al., 1994) for removing harmful gases from the pond bottom [3]. In the study areas only 11% farmers exchanged pond water irregularly for flushing out nutrients and phytoplankton from the ponds to prevent excessive phytoplankton blooms. None of the farmers was found to use mechanical aerator for maintaining dissolved oxygen in the ponds. Only a few farmers were found to flush water directly from pump into ponds as alternative to aerator.

In pangasiid catfish farming participation of women was found minimum. In large and medium farms there was no participation of women or minor children, but in small or marginal farmers case women and children were found to feed the fish. In the study areas, the participation of women and children in pangasiid catfish culture activities was limited only among marginal farmers and only in feeding the fish. Though the participation of women in aquaculture is slowly increasing in Bangladesh, the limited participation of women in pangasiid catfish farming was mainly due to their inadequate knowledge on fish farming, sociocultural bar-

Table 2. Pre-stocking management and inputs used in pangasiid catfish farms in the study areas. Figures in the parentheses indicate percentages

Description of works and inputs used	Number of farmers surveyed			Total (n = 65)
	Mymensingh Sadar (n =16)	Trishal (n =22)	Bhaluka (n = 27)	
Pond drying	12 (75)	9 (41)	16 (59)	37 (57)
Dykes repair	12 (75)	15 (68)	19 (70)	46 (71)
Removal of bottom mud	0 (0)	2 (9)	4 (15)	6 (9)
Liming	16 (100)	22 (100)	27 (100)	65 (100)
Use of potassium permanganate	7 (44)	11(50)	13 (48)	31 (48)
Use of common salt (NaCl) solution	2 (13)	5 (23)	6 (22)	13 (20)

Table 3. Post-stocking management and inputs used in pangasiid catfish farms in the study areas. Figures in parentheses indicate percentages

Description of works and inputs used	Number of farmers surveyed			Total (n = 65)
	Mymensingh Sadar (n = 16)	Trishal (n = 22)	Bhaluka (n = 27)	
Commercial feed pellets	12 (75)	19 (86)	24 (89)	55 (85)
Farm made feed pellets	4 (25)	3 (14)	3 (11)	10 (15)
Periodic liming as disease preventive	4 (25)	8 (36)	11 (41)	23 (35)
Pulling of hora	2 (13)	3 (14)	5 (19)	10 (15)
Water exchange	-	3 (14)	4 (15)	07 (11)
Use of antibiotics	-	-	3 (11)	03 (05)

riers and availability of male labourer in minimum wages. Involvement of rural women in aquaculture activities and their contribution to the rural economy have been reported in the neighbouring country India [12,15]. Such involvement showed an improvement of social and economic situations of women. In rural Bangladesh increased involvement of women in pangasiid catfish farming activities is desirable to improve their economic condition and to advance their social position.

Sources of pangasiid catfish fingerlings

Traders were the main source of supplying pangasiid catfish fries/fingerlings to the farmers. Eight nine percent of the farmers collected fries/fingerlings from the fry traders, 6% from the government farms and 5% from the local private farms or nurseries. The traders transported fish fries and fingerlings in the studied areas from private nurseries in Bogra, Rajshahi, and Jessore districts. Some farmers stocked fish fingerlings from more than one source. The fry traders transported pangasiid catfish fingerlings in PVC drums on pickup vans. The fish fingerlings quality has a major impact on production and profitability in pangasiid catfish farming. Therefore, the farmers were reported to be always eager to select good quality fingerlings to ensure profitable harvest. Farmers complained about the low quality fingerlings sometimes supplied by the traders. The quality of the fingerlings depends on brood fish used in the hatchery. So the farmers asked about the motivation and monitoring of pangasiid catfish hatcheries by the government and non-government organizations to ensure supply of high quality fish seeds.

Stocking frequency and density

In the study areas 95% of the pangasiid catfish farmers whether large, medium or small stocked pangasiid catfish fingerlings in their ponds twice a year, for the first crop during February to March and for the second crop during June to July. In both cases culture period ranged from 120 to 150 days. Only few farmers (5%) stocked fingerlings once a year during May to June. Majority of the pangasiid catfish farmers stocked pangasiid catfish directly to grow-out ponds, while a few large farmers stocked fingerlings in rearing ponds and then after about 20 days to one month into grow-out ponds. Most of the farmers stocked 7.6 to 12.7 cm sized fingerlings in their ponds.

The farmers were found to stock their ponds with varied number of fish fingerlings, from 30,000 to 60,000 per hectare per crop and used pelleted feed at high rates. The stocking density used in pangasiid catfish farming was much higher (4 to 5 times) than the density normally being used in carp polyculture in Bangladesh. Consequently, leftover feed along with faecal matter accumulated in the pond bottom which resulted in poor water quality in pangasiid catfish ponds especially during the summer months. In the same way in USA channel catfish ponds with high feeding rates had poorer water quality than ponds with low feeding rates [4].

Feed and feeding management applied for pangasiid catfish farming

Both commercial and farm made pelleted feed were found to be used for pangasiid catfish. About 85% farmers used commercial pelleted feeds and 15% farmers used farm made feed for their fish. Commercial pelleted feed produced by the different feed industries, such as Saudi Bangla, Quality feed, National feed, Sunny feed etc. were available in the study areas. Most of the farmers mentioned that the quality of the available feeds differs from company to company and within the same company as a result they sometimes do not get expected result. In the study areas farmers found FCR (feed conversion ratio) ranged from 1.75 to 2.50 for different feeds with an average of 2.0. Four different sizes of commercial pelleted feed were found to fed pangasiid catfish, e.g. starter 1 (smallest size), starter 2, grower 1 and grower 2 (largest size) for different growth stages of fish (Table 4). Feeding rate of pangasiid catfish was reported to start with 10-15% of the

Table 4. Size of commercial pelleted feed and feeding rate of pangasiid catfish in grow-out ponds

Sl. No.	Commercial pelleted feed categories	Feeding period	Feeding rate (% biomass)	Average size (in weight) of fish
1	Starter 1 (1.8 mm diameter)	1-15 days	10-15%	5-50g
2	Starter 2 (2.5 mm diameter)	16-30 days	10-12%	50-100g
3	Grower 1 (3.5 mm diameter)	31-90 days	8-6%	100-500g
4	Grower 2 (5.0 mm diameter)	>90 days	4-6%	500-1000g

body weight per day at the beginning, i.e at fingerling stage which was gradually reduced to 4% when the fish become above 500 g.

In farm made feed, farmers used mustard-oil-cake, rice bran, wheat bran, wheat flour, soybean meal, fish meal and bone meal as major ingredients. Only 11% farmers had their own feed mills for producing pelleted feed. In the study areas pangasiid catfish were fed at high rates. Some farmers were found to adjust the feed quantity based on visual observation of fish growth and some others by measuring the weight of a small number of stocked fishes. Most of the farmers fed their fish normally two times a day, the others three times a day.

Credit facilities for pangasiid catfish farmers

Institutional credit facility for the pangasiid catfish farmers was found to be very limited. Only 15% pangasiid catfish farmers were found to have access to institutional credit. Two nationalized banks, the Bangladesh Krishi Bank (BKB) and the Sonali Bank, and the Department of Fisheries, Government of Bangladesh was found as the major sources of institutional credit for the pangasiid catfish farmers in the studied areas. The large feed traders supplied feeds to some reputed farmers on credit and realized the money after sale of the fish crop, but the resource poor marginal farmers were rarely offered this opportunity. The traders have not taken any interest. Easy access to institutional and non-institutional credit facility is needed for sustainable pangasiid catfish production. The bank credits are collateral based, therefore the landless poor farmers who farmed fish in leased ponds found it difficult to get bank loans. Mazid (2002) suggested bankers to adopt a model of "Pay as you Earn" for micro-credit to fish farmers [9].

Yield from the pangasiid catfish farms

Yield of pangasiid catfish ranged from 20 tons to 45 tons per hectare per year with a mean of 25 tons per hectare per year in the surveyed farms. This production is 6 to 8 times higher than the production (about 3-4 tons/ha) in carp polyculture ponds [6,8,10,14]. The high yield was one of the reasons for rapid adoption of pangasiid catfish farming in Bangladesh.

Harvesting and marketing management of pangasiid catfish

The farmers were reported to harvest their farmed fish when it reached around 500 g to 1 kg in size. Normally all the fish of a crop in a pond were harvested at a time and then the ponds were made ready for the second crop of the year. Those who do only one crop a year harvested fish when it reached about 1.5 to 2.0 kg in size in 10-11 months. Some large farmers reported to have their own fishing net (seine net) and fisher group formed by the farm labourers. In the community there are separate fishers group with nets formed by rural poor who fish in farmers ponds on contract basis. Farmed pangasiid catfish are very susceptible to seine nets. More than 95% fishes come out in 2 - 3 successive hauls.

The small farmers reported to sell their fish mostly to small traders and occasionally to large traders. The small traders sell the fishes to retailers in local markets and in neighbouring districts, sometimes to large traders. The medium and large farmers sell their fish to large traders who transport the fish in live condition to Dhaka, the capital city, and in the northern districts of the country. Before harvesting, the farmers contact with the traders over phone about price, fishing time and loading in transport vans. The fish are transported in PVC drums with freshwater. The fishing and loading in transport vans are settled through discussion between farmers and traders considering the time required to transport the fish to the destination market.

Problems facing in farming the fish and farmers expectation

The pangasiid catfish farmers were reported to face a number of technical and social constraints. Eutrophication with massive microalgal blooms, off-flavour in fish-flesh, high feed costs, reduced fish growth comparing earlier years, gradual fall in consumer demand due to off-flavour development in fish etc. were reported as the most important problems facing by the pangasiid catfish farmers. In USA, polyculture of channel catfish, *Ictalurus punctatus* with planktivorous fishes resulted in reduced problems associated with eutrophication while increasing growth of channel catfish and total fish yield [5,11,13]. The effects of the addition of planktivorous carps in pangasiid catfish farms on fish growth and environmental management have not been evaluated. Occasional poaching of fish was found as one of the social problems. The farmers urged for the development of cheap but good quality feeds using indigenous ingredients, maintenance of genetic quality of

fries/fingerlings and management protocols or culture technologies to reduce the pollution and off-flavour of fish to sustain the industry.

Considering the significant contribution of pangasiid catfish farming to annual fish production, employment generation and livelihood improvement of the rural people, it is very urgent to conduct research to improve the existing culture methods to solve the above mentioned problems.

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