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ENVIRONMENTAL FACTORS AFFECTING FISH SPECIES AND POND WATER IN BANGLADESH

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ABSTRACT

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Studies were conducted on environmental factors affecting fish species and pond water to know the vital parameters of pond water environment required for agro-technology adoption, and to identify the fish input utilization for improved technologies involving profitable species. The studies were conducted in different Agro-Ecological Zones (AEZ) of Bangladesh river systems. The variables were AEZ sites and response of different categories of farmers, fishers and stake holders. The results obtained showed that the size of ponds were within 30-50 decimal range. The local carps were the main species. Seasonal fishes should also get more priority for development with government support. Rearing of fingerlings is practiced mostly in Atrai Korotoa Zone. Locally mixed farming materials were mostly used in Meghna Zone (Comilla-Brahmanbaria). Meghna river system has more potentials for aquaculture followed by Atrai- Korotoa river system. Atrai-Korotoa Zone retains higher percentage for seasonal and cat fishes, specially Shing (*Heteropneustis fossilis*), and seasonal species in Barind areas. So the bigger size ponds should be considered as a favourable system considering environmental concerns. It was recommended that the river systems and bigger size ponds have more potentials for fish and fisher developments in Bangladesh. This set of recommendations have been made involving maintenance of water quality, propagation of high value fishes, enforcing legal monitoring and introduction of microfinance based on the present research findings.

Key words: *water quality, pond fish agro–technologies, NATP, environment, pond management*

INTRODUCTION

The gradual increase of productivity in culture water bodies, namely ponds, ox-bow lakes, shrimp farms and flood plains, from about 874 kg/ha/annum in 1998-99 to 2,377kg/ha/annum in 2012-13 amply exemplify the aquaculture suitability of the waters of Bangladesh (DoF 2013). With the introduction of improved technologies culture intensity is also increasing. To sustain the increased productivity of the cultivable water bodies it is imperative that adequate measures are taken to offset negative impacts of intensification. (Dey *et al*. 2008 and Dey *et al.* 2008a).

Government of Bangladesh (GOB) has been implementing, since 2007, the National Agricultural Technology Project (NATP) with the financial assistance from the World Bank (through IDA credit) and International Fund for Agricultural Development (IFAD) to address the upcoming issues and emerging challenges in agriculture, particularly food security. NATP-1 is the first 5-year phase of a long term (15 years) program to support GOB's strategy to increase national agricultural productivity and farm incomes. Its focus is on revitalizing the agricultural technology system that includes agricultural research, extension and development of supply chain. The Project has four components *viz.* agricultural research support component, agricultural extension support component, supply chain development component and project coordination and management component. These components are being implemented through 7 implementing units. These are: i) Project Coordination Unit (PCU), Ministry of Agriculture (MoA); ii) Project Implementation Unit (PIU), Bangladesh Agricultural Research Council (BARC); iii) Project Implementation Unit (PIU), Department of Agriculture Extension (DAE); iv) Project Implementation Unit (PIU), Department of Fisheries (DoF); v) Project Implementation Unit (PIU), Department of Livestock Services (DLS); vi) Krishi Gobeshona Foundation (KGF); and vii) Hortex Foundation (Hortex). The activities of the extension units initially concentrated on i) formation and mobilization of Common Interest Groups (CIG) with the help of grass-root level extension agents like Sub-Assistant Agricultural Officers (SAAO), Local Extension Agents for Fisheries (LEAF) and Community Extension Agent for Livestock (CEAL), ii) decentralization of extension services; and iii) enhancing institutional efficiency of the national institutions involved in agricultural extension. During the year 2008-2009 the extension components initiated their activities to CIG identification, LEAF and CEAL selection, micro-plan development, establishment of FIAC (Farmer's Information and Advice Centre) in their extension activities. The continued evolution of social mobilization approach in extension activities developed better understanding between farmers and extension agents and facilitated the process of new media of dialogue. CIG is a powerful instrument to pursue extension and business development approach. CIG is being utilized to develop micro-extension plan and subsequent implementation of the developed program. The project components (Research, Extension, Supply Chain Development and Project Management and Coordination support) of which the extension and the supply chain development components are mostly related to technology transfer through social mobilization of farmers into CIG and their federations, the Producers' Organizations (PO).(NATP-DoF, 2013).

The project has a broad understanding of the issues likely to coup up in the three components, namely: research, extension and supply chain. Research issues related to: (i) crop/cropping pattern changes leading to higher agro-chemical use and thereby polluting pond water and soil, (ii) over exploitation of ground water resulting in salinity and arsenic contamination and (iii) loss of biodiversity and natural habitats; and bio-prospecting of biotic products, including genetic enhancement and transgenic products. The extension issues relate to: (i) handling and application of agro-chemicals, (ii) water management, ground water depletion and water quality; and (iii) food safety. Key issues in respect of supply chains were: (i) phyto-sanitary conditions and related safety measures, (ii) agro-chemical (fertilizers, medicines, etc.) handling and their application related to quality and health hazards (PCU-NATP, 2011).

In the context, the present piece of research program has been formulated to get information as per following objectives such as. to know the vital parameters of pond water environment required for agro-technology adoption, and to identify the fish production inputs related to the utilization of improved NATP technologies as per profitable species.

MATERIALS AND METHODS

The methods included in the studies here were formulated as per recommendations given by (Khan 2008; Bene and Neiland, 2003 and Kuperan *et al.* 2006).

Study Design

Sampling: Selection Of sites: 20 Districts and 30 Upazila taking at least 3 from each Division. The categories of respondents were Pond owner, Field worker, Fish businessman and Social elites. Selection of ponds and input houses were done at the Upazila level.

Questionnaire Guideline

Personal information were collected covering name of person and farm with address: District, Upazila, Site. The description of the farm included area and type (Pond / Doba / Lake / dead river-canal).

Main fish species of the farm covered were: Local carp, Exotic carp, Cat fish, Seasonal spp, Pungas spp, High value spp, and Voracious spp.

Description of establishments contained Type of establishment- Dealer shop/fry nursery/feed mill, Materials - Local/imported/mixed, Nursery fries available: Quantities as large (L), Medium (M) and Few (F), of the species.

Questionnaire research questions

1. Vital parameters of pond water environment required for agro-tech adoption:
    a. Water pH, Water pOH, water oxygen level, Water color, Water turbidity
    b. Water transparency, Depth of water, Shade on water, Water nutrient content
2. Fish production inputs related to the utilization of improved National Agro-technology Transfer Project (NATP) techs as for profitable species.
    a. Fish-biotic: Fish feed local organic, Fish feed factory made, Lime, Pesticides Aerator, Fertilizers, Recommended Fish Fry
    b. Fish-abiotic: Social security, Labour-Market, Process centers, Arats Transport, Legal monitoring, Training
3. Priority focus for pond fish culture management needed in the community
    a. Cooperative system for land- pond lease
    b. Personal system for Bank loan/ financial assistance
    c. NGO linkage for field level microfinance
    d. Govt. agency level technical service delivery

Study Sites

The sites selected for the studies as identified as per criteria are given in the Figs. 1 to 5.

Specific Sites of the studies were:

Rajshahi Division-Bogra Natore (Figs. 1 and 2)

- Agro-Ecological Region 4: Korotoa Bangali Floodplain
- Agro-Ecological Region 5: Atrai Basin

Rangpur Division: Dinajpur (Fig. 3)

- Agro-Ecological Region 1: Old Himalayan Piedmont Plain
- Agro-Ecological Region 27: North Eastern Barind

Dhaka Division: Gazipur Tangail (Fig. 4)

- Agro-Ecological Region 8: Young Brahmaputra Floodplain
- Agro-Ecological Region 28: Madhupur Tract

Chittagong Division: Comilla Brahmanbaria (Fig. 5)

- Agro-Ecological Region 16: Middle Meghna Floodplain
- Agro-Ecological Region 19: Upper Meghna Floodplain

Floodplain Characters of areas as studied here are given in the Figs. 1 to 5

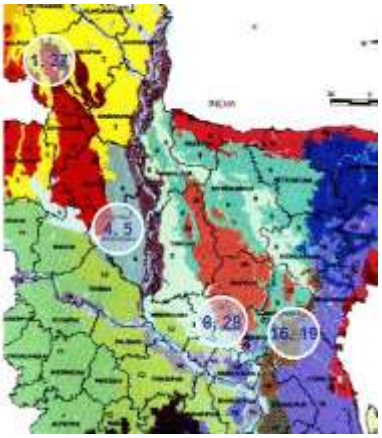

Fig. 1. Study sites encircled in the Agro-Ecological Zone (AEZ) map showing floodplain characters

Fig. 2. AEZ 4 and AEZ 5. Floodplain characters-Typical Chalan Beel Area, becoming seasonal (Natore, Bogra)

Fig. 3. AEZ 1 and AEZ 27. Floodplain characters- Sandy Soil, Low Water Retention Capacity, Greater Dinajpur

Fig. 4. AEZ 8 and AEZ 28. Floodplain characters- Embankment high, Water flow less, heavy flood can inundate (Gazipur, Tangail)

Fig. 5. Floodplain characters- Sandy Soil, water holding capacity low and water pollution (Comilla, Brahmanbaria, Gajaria)

RESULTS AND DISCUSSION

The results obtained from the studies are illustrated and described here. The results are given in the Tables and Figures here.

Description of the farms: Percent response

The percent on the vital parameters of pond water environment required for agro-technology adoption are given in the Table 1 and Figs. 6 and 7. The results show that 63.5% respondents reported the size of ponds were within the range of 30-50 decimal followed by more than 50 decimal being 48.3% ponds of size less than 3 decimal are being reduced. The mean response found for water body for fish culture were dead rivers and lake-like structures being 51.3%, river flood plain being 30.8% as lowest.

Table 1. Information of farms studied

Parameters	Pond owner	Field worker	Fish businessman	Social elites	Mean
< 30 decimal	68	32	23	24	36.8
30-50 decimal	63	67	58	66	63.5
> 50 decimal	28	49	62	54	48.3
Water body type					
Pond/Doba	72	26	31	27	39.0
River Floodplain	21	35	32	35	30.8
Lake/dead river	19	59	58	69	51.3

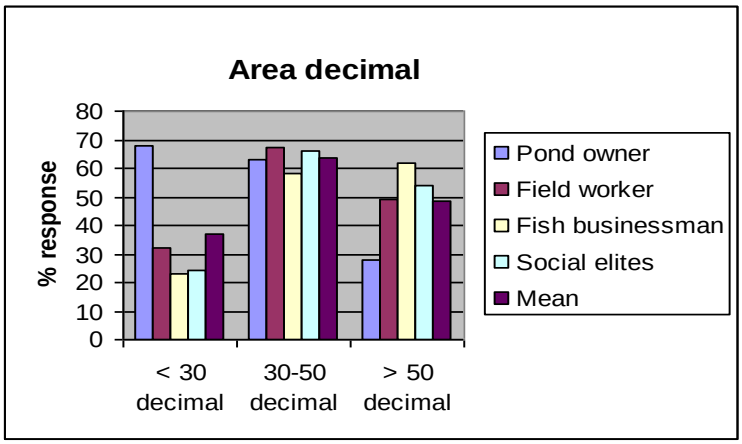

Fig. 6. Farm area in decimal as per its sizes

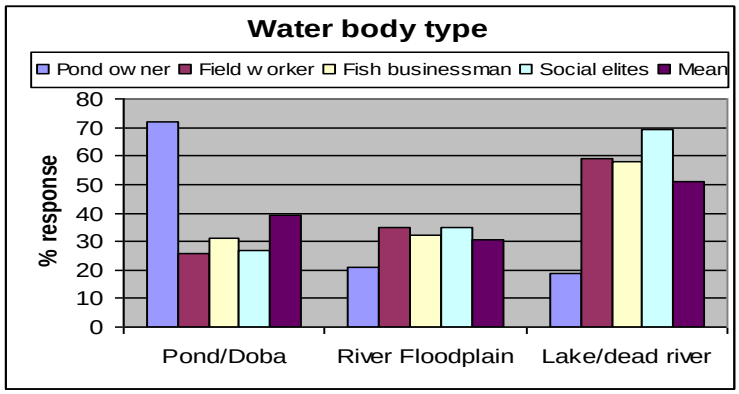

Fig. 7. Farm area in decimal as per its water body types

The results indicate that the old small ponds are diminishing which may be due to gradual siltation. Water body siltation was found to be and important environmental factor controlling the production of fishes which also previously reported by many workers (Copes 1988 and Haque *et al.* 2013). The current finding support that the dead rivers and lakes were highlighted by all the categories of respondents promising for fishing.

Main fish species cultured in the farm

Percent response of the different category of participants as per district is given in the following Table 2. The results show that local carps were the main species as responded by 63.5% followed by exotic carp being 61.25%. Bogra–Natore regions of AEZ 4 and 5 dominated carp and seasonal fishes.

Table 2. Fish species in different Division and AEZ

Parameters	Rajshahi Bogra Natore	Chittagong Comilla Brahmanaria	Rangpur Dinajpur	Dhaka Gazipur Tangail	Mean
Local carp	82	73	57	42	63.50
Exotic carp	79	52	53	61	61.25
Cat fish	31	25	31	21	27.00
Seasonal species	56	27	38	51	43.00
Pungas species	37	33	32	54	39.00
High value species	41	53	37	14	36.25
Mean	54.3	43.8	41.3	40.5	45.0

Description of establishments

The result shows that (Table 3) rearing of fingerlings is higher (74%) in Atrai Korotoa Zone (Bogra-Natore) followed by Meghna Zone (Comilla-Brahmanbaria) lowest in Piedmont Barind is 29%. Farming materials local mixed used higher in Meghna Zone (Comilla-Brahmanbaria) 65%, lowest in Atrai-Korotoa (46%). Seed Nursery available at medium level varying from 31-39 which is at the lower rank. This type of findings were found to vary in respect of fish establishment with the previous suggestions but those were done in different Agro-Ecological Zones: Hossain *et al.* (2007) and Rahman *et al.* (2013). The results given in the Table show that Meghna river system have more potentials followed by Atrai- Korotoa river system, the Barind Piedmont zones being lowest.

Table 3. Fish establishment as per AEZ and River floodplains (% response as status)

Parameters	Atrai-Korotoa river system	Brahmaputra-Jamuna river system	Piedmont Barind	Meghna river system	Mean
Type of establishment: Rearing nursery	74	61	29	67	57.7
Farming materials: Local mixed	46	59	62	65	58.0
Seed nursery available: Medium	39	34	31	34	34.5
Mean	53.0	51.3	40.6	55.3	50.0

Fish Species and eco-groups: demanded for future

The result given in the Table 4 shows that high value species culture is 76.7% and local carp is the lowest 39.0%. Atrai-Korotoa Zone retains higher percentage for seasonal and cat fish specially cat fish or Shing (*Heteropneustis fossilis*) and seasonal species in Barind areas. This type of results were previously recommended by Hussain (1995) and Jul-Larsen and van Zwieten (2002) but for Africa and Bangladesh coasts, now it is specifically found for the inland fisheries river systems.

Table 4. Fish species demand for future culture

Parameter	Atrai- Korotoa river system	Brahmaputra-Jamuna river system and Madhupur	Piedmont Barind	Meghna river system	Mean
Local carp	31	42	38	46	39.25
Exotic carp	52	58	67	54	57.75
Cat fish	81	63	48	49	60.25
Seasonal species	82	58	72	51	65.75
Pungas species	47	40	57	41	46.25
High value species	82	83	69	73	76.75
Mean	62.5	57.33	58.5	52.33	57.67

Pond water environment required for agro-technology adoption

The result shows in the Table 5 that the water color and turbidity rank highest (63%), however other parameters were closer to it. Red water color was treated to be non-favorable for fish culture specially in the Barind and Madhupur areas. The respondents of Barind zone facing scarcity of water due to low water retention capacity of soil. The finding given here were highly significant but found less important by many workers in Bangladesh and other countries. Hossain *et al.* (2007); Hussain (1995); Jul-Larsen and van Zwieten (2002).

Table 5. Pond water environmental parameters

Parameters	Atrai- Korotoa	Brahmaputra-Jamuna Madhupur	Piedmont Barind	Meghna	Mean
Water pH and lime	43	67	72	51	58.25
Water nutrients oxygen level	61	63	69	53	61.5
Water color / water turbidity	54	81	65	52	63
Depth of water/bottom soil	47	63	70	60	60
Mean	51.25	68.5	69	54	60.69

CONCLUSION

It may be concluded that 63.5% respondents reported that the size of ponds were within the range of 30-50 decimal. So the bigger size ponds should be considered as a favourable system as regards environmental concern. The local carps were the main species as responded by most of the farmers. On the other hand, seasonal fishes should also get more priority for development with government support. Rearing of fingerlings is higher in Atrai Korotoa Zone. Farming materials (local mixed) use is higher in Meghna Zone (Comilla-Brahmanbaria) 65%. Meghna river system has more potentials followed by Atrai- Korotoa river system. High

value species culture is 76.7% and local carp is the lowest 39.0%. Atrai-Korotoa Zone retains higher percentage for seasonal and cat fish specially cat fish or Shing (*Heteropneustis fossilis*) and seasonal species in Barind areas. Important conclusions include: Proper liming with appropriate material and methods should be done to keep the water condition favourable (pH). High value species Pabda: (*Ompak pabda*), Shing (*Heteropneustis fossilis*), Mahashol (*Tor tor*), Gulsha (*Mystus cavasius*), Galda (*Macrobrachium rosenbergii*) etc., should be extended to other similar agro-ecological domain. Legal monitoring should be enforced enacting appropriate laws in favour of fish farmers, and Program based microfinance along with required cooperative and individual enterprises with the assistance of government financial institutes or international donors.

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