

Please provide the following details on the origin of this report

Contracting Party	BANGLADESH
<i>National Focal Point</i>	
Full name of the institution:	Ministry of Environment and Forest
Name and title of contact officer:	Mr. Mamun-Ur-Rashid Secretary
Mailing address:	Ministry of Environment and Forest Building No. 6 Bangladesh Secretariat Dhaka, Bangladesh
Telephone:	88-2-8610481
Fax:	880-2-8619210
E-mail:	<u>moefgob@bttb.net</u>
<i>Contact officer for national report (if different)</i>	
Name and title of contact officer:	Not applicable
Mailing address:	Not applicable
Telephone:	Not applicable
Fax:	Not applicable
E-mail:	Not applicable
<i>Submission</i>	
Signature of officer responsible for submitting national report:	Md. Shawkat Ali
Date of submission:	12.10.2000

Please provide summary information on the process by which this report has been prepared, including information on the types of stakeholders who have been actively involved in its preparation and on material which was used as a basis for the report

The focal point of CBD for Bangladesh-The Ministry of Environment and Forest (MOEF) has formed a technical committee with the representative from concerned Govt. and non-govt agencies (stakeholders) in order to prepare thematic report on alien species. The questionnaire received from the convention secretariat was communicated to concerned agencies for their inputs. Collected information was examined and synthesized by the technical committee during the preparation of thematic report. The committee also has gone through the relevant case studies, policies and legal instruments of the country.

Article 8h Alien species

1. What is the relative priority afforded to implementation of this Article and the associated decisions by your country?					
a) High		b) Medium		c) Low	X
2. To what extent are the resources available adequate for meeting the obligations and recommendations made?					
a) Good		b) Adequate		c) Limiting	
				d) Severely limiting	X

3. Has your country identified alien species introduced?	
a) no	X
b) only major species of concern	
c) a comprehensive system tracks introductions	
4. Has your country developed national policies for addressing issues related to alien invasive species?	
a) no	X
b) yes – as part of a national biodiversity strategy (please give details below)	
c) yes – as a separate strategy (please give details below)	
5. Has your country assessed the risks posed to ecosystems, habitats or species by the introduction of these alien species?	
a) no	X
b) only some alien species of concern have been assessed	
c) most alien species have been assessed	
6. Has your country undertaken measures to prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species?	
a) no measures	X
b) some measures in place	
c) potential measures under review	
d) comprehensive measures in place	

Decision IV/1 Report and recommendations of the third meeting of SBSTTA

7. Is your country collaborating in the development of projects at national, regional, sub-regional and international levels to address the issue of alien species?	
a) little or no action	X
b) discussion on potential projects under way	
c) active development of new projects	

8. Does your national strategy and action plan address the issue of alien species?	
a) no	Not applicable
b) yes – limited extent	
c) yes – significant extent	

Case-studies

9. Has your country submitted case-studies on the prevention of introduction, control, and eradication of alien species that threaten ecosystems, habitats or species, in response to the call by the fourth meeting of SBSTTA?	
a) no – please indicate below whether this is due to a lack of available case-studies or for other reasons	X - lack of available case studies
b) yes – please give below any views you may have on the usefulness of the preparation of case-studies for developing a better biological understanding of the problem and/or better management responses.	
10. How many case-studies are available that could be used to gain a better understanding of the issues surrounding alien species in your country?	
a) none	
b) 1-2 – limited understanding	X
c) >2 – significant information available	

Transboundary issues

11. Are known alien invasive species in your country also a problem in neighbouring or biogeographically-similar countries?	
a) not known	X
b) none	
c) a few – but in general alien invasive species problems are specific	
d) more than a few - in general we share common problems with other countries	
12. Is your country collaborating in the development of policies and programmes at regional, sub-regional or international levels to harmonise measures for prevention and control of alien invasive species?	
a) little or no action	X
b) discussion on potential collaboration underway	
c) development of collaborative approaches for a limited number of species	
d) consistent approach and strategy used for all common problems	

Further comments

Some relevant information so far available on alien species in Bangladesh are given in the attached sheet.

Attached Sheet

3. There is yet any organized program to identify the alien species in Bangladesh. However, the following species are known to be alien in the country:

Common Name	Scientific Name
<i>Flora:</i>	
Teak	<i>Tectona grandis</i>
Gamar	<i>Gmelina arborea</i>
Dhakijam	<i>Syzygium grande</i>
Sissoo	<i>Daldergia sissoo</i>
Mahogany	<i>Switenia macrophylla</i>
Acacia	<i>Acacia auriculiformis</i>
Kassos tree	<i>Cassia siamea</i>
Ipil Ipil	<i>Luecacia leucocephala</i>
Eucalyptus (Red gum)	<i>Eucalyptus camaldulensis</i>
Water hyacinth	<i>Eichhornia crassipes</i>
<i>Fauna:</i>	
Siamese Gourami	<i>Trichogaster pectoralis</i>
Goldfish	<i>Carassisus auratus</i>
Tilapia	<i>Tilapia mossambica</i>
Guppy	<i>Lebistes reticulatus</i>
Common Carp	<i>Cyprinus carpio</i>
Grass Carp	<i>Ctenopharyngodon idellus</i>
Silver Carp	<i>Hypophthalmichthys molitrix</i>
Nilotica	<i>Oreochromis niloticus</i>
Thai Sarpunti	<i>Puntius gonionotus</i>
Mirror Carp	<i>Cyprinus carpio</i>
Bighead Carp	<i>Aristichthys nobilis</i>
Black Carp	<i>Mylopharyngodon piceus</i>
African Magur	<i>Clarias grandis</i>
Pangas	<i>Pangasius sutchi</i>
Gaint Pangas	<i>P. giganticus</i>

4. The Government has undertaken a project for preparation of Biodiversity Strategies and Action Plan (BSAP). GEF has approved the project for funding. The project will be placed for implementation soon. Strategies and actions for taking measures on the alien invasive species in Bangladesh will be incorporated in the BSAP.

Though Bangladesh is yet to undertake effective and systematic measures to prevent the introduction of, control or eradicate alien species threatening ecosystems, habitats or species, but there are some independent initiatives by the Government NGOs and International organization like IUCN for eradication or control of alien species in Bangladesh. Government of Bangladesh has already implemented some events regarding control of alien species in Bangladesh. IUCN Bangladesh has prepared two case studies on alien species of which one is in the form of workshop paper (draft copy attached). Besides IUCN Bangladesh has recently conducted a study on the impact of alien fish species in a freshwater wetland. The report of this study is under preparation.

DEVELOPMENT OF GUIDING PRINCIPLES FOR THE PREVENTION OF IMPACTS OF ALIEN SPECIES

Professor Mahmud-ul-Ameen
Department of Zoology, Dhaka University

Introduction:

Biodiversity is the basic biotic resource that sustains all human life-support systems on this earth (Kim 1993). Continuance of rich biodiversity is an assurance for our survival. However, it is declining rapidly and is a cause of alarm and distress all over the world. The major causes for this decline are:

1. Habitat degradation and habitat loss.
2. Over exploitation of biotic resources.
3. Invasion of alien species.
4. Pollution.
5. Climate change.

This workshop will address the problem of invasive alien species and try to develop some guiding principles for preventing negative impacts of such invasion. Before proceeding further, let us examine the definitions of a couple of relevant terms developed by IUCN.

Alien species:

"is a species, subspecies of lower taxon occurring as a result of human agency in an area or ecosystem in which it is not native."

This is equivalent to what was known as **exotic species**. Dictionary meaning of 'exotic' is

- "Belonging by nature or origin to another part of the world; brought in from abroad; foreign; strange".

Invasive species:

"is an alien species which colonizes natural or semi-natural ecosystems, is an agent of change, and threatens native biological diversity". It should not, however, be confused with those species which in nature colonize newly forming ecosystems in succession, subordinating the previously dominant species.

Invasive species are the agents of 'species and biodiversity loss' in ecosystems all over the globe. Alteration to ecological communities caused by alien invasive plant and animal species influence the functioning and overall health of the affected ecosystems. Negative effects of biological invasion include fall in production (e.g. fishery) and cost of controlling invasives. The overall guiding principles for the prevention, introduction and mitigation of impacts of alien species development by IUCN are based on the following:

1. Precautionary approach as the pervading principle.
2. Sharing of relevant information.
3. Research and management of invasives.

At first, I shall present some information relevant to Bangladesh freshwater aquatic ecosystems and indicate some research needs and management interventions on the basis of precautionary approach.

Table I lists the alien fishes which were introduced into Bangladesh excluding the decorative aquarium species. The ecological and biodiversity consequences of the introductions were not taken into consideration, neither the economist balance sheet was assessed properly. There were strong oppositions against introduction of some of the exotics by local scientists in various seminars, symposia and workshops and also in print (Ameen 1987). But overseas expert opinions prevailed without weighing the arguments of the local experts.

Introductions of alien species are meant to serve one or more of the following purposes:

1. Utilization of a vacant niche in the native ecosystem(s).
2. Increasing food production.
3. Quality improvement of sport, like fishing and hunting.
4. Control of undesirable species considered as pest, pestilence, weed, etc. as a tool for biological control.
5. Decorative or ornamental species as pets, aquarium fish, etc.

The rationale for introduction of the listed alien or exotic fish into Bangladesh was to augment fish production in the country as a means to increase the per capita fish consumption. Let us discuss some of the fishes in Table 1. Some of these were treated in a chapter: "Prospects of Exotic Fish Culture in Bangladesh" of the book on fisheries Resources by Ameen (1987, pp. 184-209)

Tilapia and Nilotica

The arguments in favor of the introduction were:

1. They spawn in confined waters (i.e. ponds), annual stocking can be avoided.
2. They are highly fecund and produce a large number of fry.
3. They grow quickly, So, production is high.
4. They can be cultured in shallow, seasonal water bodies and ditches.
5. Said to be resistant to pesticides and other toxicants.
6. Tolerant to a wide range of temperature and salinity.

The arguments against are:

- I. Their prolific breeding surpasses the carrying capacity of the waterbody leading to stunting of individuals. Thus points I and 2 above negates point 3.
- II. There are many indigenous species which grow in shallow, seasonal waterbodies and ditches. These do not require annual stocking. They, in addition, control many pests.
- III. That they grow quickly and the argument that tilapia production is higher is disputed and evidence is scarce (Ameen et al. 1984, Ameen 1985a, b; 1987).

- IV. Population of many indigenous small fish species has declined due to the invasion of tilapia and nilotica in our water bodies.
- V. Comparative production: Ameen et.al. (1984) demonstrated that in miniponds and small water bodies production of small indigenous fishes are at par with tilapia production.
- VI. Genetic erosion and loss of species diversity: Replacement / suppression of indigenous fish species has made our "gene rich" fish population "gene poor". Even species diversity is threatened. Some 57 species out of c.300 freshwater fish species have become vulnerable / endangered / critically endangered in Bangladesh (IUCN, 1999: in press).
- VII. In fish landings from Kaptai lake tilapia had no contribution between 1976 and 1985 (ARG 1986), but in recent years they are contribution c.9% of the total landing while the contribution of major carps has declined (C.U 1999: M.Sc. Thesis of 1995 Exam., Department of Zoology).
- VIII. The consumable weight relative to total weight of indigenous fishes is higher than tilapia. Hard bony part is relatively high in tilapia. The soft bones of small indigenous species are consumed and are source of nutritive vitamins.

Tilapia may be recommended for those areas where native species are scarce or absent, e.g., in countries like Israel. In a country like Bangladesh which is rich in fish biodiversity, introductions should be very restricted.

African magur

Predation and voracity of this catfish is legendary. People do not like the meat of larger-sized fish of this species. Now there are attempts to keep its size smaller for easy marking. Production per unit area of a carnivore is much less than a herbivore (theoretically as much as 80-90% less) from food chain computations. African magur escaped to the open waters during the floods and reported to have consumed even ducklings, let alone other fishes. This will lead to great reduction of population of the indigenous species, endangering their future existence. Therefore, increasing fisheries production to meet the national demand emphasis should be on the culture of dominantly herbivore species rather than on carnivores.

Deshi magur (*Clarius batrachus*)

Culturable, popular and high-priced. Not extensively cultured because of secrecy of fry. Breeding through hypophysation achieved. But survival after yolk-sac stage critical and large scale mortality occur after this stage. Remedy: Supply of proper food (of the required size).

Research needs:

- Development of proper feed of the early fry: rotifer culture (?) for *C. batrachus*.
- Explore the possibility of culture of gang magur / kani magur (*Plotosus canius*).

Chinese carps

A. Grass carp: Able to feed on a variety of aquatic weeds. It feeds "as cow feeds on land grasses" (Ling 1977).

Advantages:

- Grows very fast, if provided with adequate grass and other vegetable food.
- May be used effectively for aquatic weed control.
- Its faecal matters manure ponds.
- Does not compete with other cultured species.

Disadvantages:

- Scarcity of grass during dry months
- Competes with cattle in Bangladesh where natural cattle feed is in very short supply.
- Response to hypophysiation unpredictable.
- Apprehension of grazing on rice plants if escapes to open waters. (Corroborated by news of its destruction of paddy fields in media). However, cannot be a permanent nuisance because the possibility of its breeding in natural waters of Bangladesh is negligible because of high ambient temperature.

2. Common carp (*Cyprinus carpio var. Communis*)

Advantages:

- Breeds naturally in confined waters in Bangladesh conditions.
- Hardy and disease resistant.
- Release nutrient by turning bottom mud.
- P.G. is more potent and extensively used for hypophysation.
- Suitable for cage and pen culture.

Disadvantages:

- Destroys pond embankments, makes water turbid by turning up mud.
- Attains maturity early, thereby growth retarded
- Tend to study at high density.
- Eggs are easily infected by fungus.
- Difficult to harvest with s' ,et.

3. Silver carp (*H. molitrix*)

Fast growing, planktivore and does not breed in ponds. They are easy to harvest. Silver carp feed mainly on small phytoplankton, as small as 30-40 µ, which catla can not consume. Do not spawn in confined waters, but respond well to hypophysation.

Disadvantages

- Competes with catla.
- Long distance transportation of fry needs special care.

At present the problem with silver carp, to my experience, is stocking it in densities higher than its niche can support and thereby putting catla to unnecessary competition. The rate and ratio of different species in composite culture should be carefully assessed.

Stock enhancement schemes for the open water fisheries provides some important information. Tsai & Ali (1987) reported that contribution of major carps in the beels of Sylhet-Mymensingh basin decreased considerably between 1963 and 1984. The major carps contributed 67% of the total in 1967, 50% in 1973, and 4% in 1984. Consequently DoF undertook several projects to enhance stocks in the openwaters by releasing fry of major carps and chinese carps into them. Some computed data from the reports on Hail haor project is shown in Table 2 and for five beels in Fig. 1.

Recommendations:

1. Information on the biology of alien species and their probable impact on the indigenous biodiversity has to be evaluated on a pilot scale before listing as probable for introduction.
2. Strict quarantine before entry into a new country / region.
3. Dominantly herbivore species should get preference in selection for culture.
4. No pesticide should be allowed in any openwater / natural aquatic ecosystems.
5. Indigenous species should be preferred for stocking and given similar treatments as given to exotics.
6. The term "trash fish" in polyculture should be dropped. They should be included in the production system and not belittled,
7. Rate of stocking should be appropriately revised according to the carrying capacity (enhanced due to inputs), which should be determined if not know already. (For details see Ameen 1984, 1993).
8. The ratio of stocking surface, column and bottom feeders should be relevant to the natural carrying capacity of these niches. (For details see Ameen 1984, 1993).

Table 1 - List* of exotic fishes brought into Bangladesh, their origin and year of introduction

Name of Species	Common Name	Natural Habitat	Country of Origin	Year of Introduction	Source of Information
<i>Trichogaster pectoralis</i> Regan	Siamese Gourami	Thailand	Singapore	1952	Rahman, 1984
<i>Carassius auratus</i> (L)	Goldfish	Europe Asia	Pakistan	1953	Rahman, 1984
<i>Tilapia mossambica</i> (Peters)	Tilapia	Africa	Thailand	1954	Rahman, 1984
<i>Lebistes reticulatus</i>	Guppy	S. America	Thailand	1957	Aminul Haque and Habibur Rahman, 1967
<i>Cyprinus carpio</i> var. <i>communis</i> (L)	Common carp/scale carp	Temperate Asia, Europe	Not known (India?)	1960 1965	Karim, 1975 Rahman, 1984
<i>Ctenopharyngodon idellus</i> (Cuvier & Valenciennes)	Grass carp	China	Hongkong Japan Nepal	1966 1970 1979	Rahman, 1984 Rahman, 1984 Rahman, 1984
<i>Hypophthalmichthys molitrix</i> (Cuvier & Valenciennes)	Silver carp	China	Hongkong Japan	1969 1970	Rahman, 1984 Rahman, 1984
<i>Oreochromis niloticus</i> (L) <i>Puntius gonionotus</i>	Nilotica Thai Sarpunti/ Rajpunti	Africa Indonesia Thailand Malaysia Philippines	Thailand Thailand	1975 1986 1977?	Rahman, 1984 S.N. Roy, DoF P.C/ Ahmed, 1993
<i>Cyprinus carpio</i> var. <i>specularis</i> (L)	Mirror carp	Temperate Asia, Europe	Nepal	1979	Rahman, 1984
<i>Aristichthys nobilis</i> (Richardson)	Bighead carp	China	Nepal	1981	Rahman, 1984
<i>Mylopharyngodon piceus</i>	Black carp/sanil carp	China	China	1983	Rahman, 1984
<i>Clarias gariepinus</i>	African magur		Thailand	1989	S.N. Roy, DoF, PC
<i>Pangasius Sutchi</i>	Pangas	Thailand Indochina	Thailand	1990	S.N. Roy, DoF, PC
<i>P. giganticus</i>	Giant Pangas	?	?	?	S.N. Roy, DoF, PC

Does not include decorative aquarium species.

DoF =Department of Fisheries

P.C. = Personal communication

Table 2. A few computed data on stocking major carps and Chinese carps in Hail haor under Second Aquaculture Development Project (Source: Working Document 16, 1992 and unpublished DoF Report).

Stoking	Major carps	Chinese carps	
Rate (kg/ha)	0.827	2.621	(Table 8)
% by weight	24.0%	76.0%	(Table 8)
Rate (no./ha)	68.0	148.8	(Table 8)
% by number	31.4	68.6%	(Table 8)
Proportion in catch among all carps	78.2%	21.8%	(Table 9)
Growth (times initial stocking weight)	35.8-56.8 times	8.9-28.0 times	(Table 11)

- For details the Tables will be found in Ameen 1994 (Limnology and Fish Management)

References:

- Ameen, M. 1985a. Fish culture in miniponds and its potential in Bangladesh. *Proc. Workshop on Farming System Development*. NIRDP/DANIDA, Noakhali. June 1985: 68-75 pp.
- Ameen, M. 1985b. Social Fishery: A new Concept. *Bangladesh Quarterly*. Dhaka 5(3): 44-45.
- Ameen, M. 1987. *Fisheries Resources and Opportunities in Freshwater Fish Culture in Bangladesh*. PAT, NRD-II/DANIDA, noakhali.xx+244ppp.
- Ameen, M. 1993. *How to Grow More Fish: The Noakhali Experience*. NEPHP, C/o. Dept. of Zool., Univ. of Dhaka, Dhaka, 143 pp.
- Ameen, M., Islam, K.R., Ahmed, K & Mustafa, G. 1984. Indigenous small fish culture in miniponds. *Bangladesh J. Zool.* 12(1):1-10.
- ARG (Aquatic Research Group, Inst. Marine Sci., University of Chittagong). 1986. *Hydrobiology of Kaptai Reservoir. Final Report: FAO/UNDP Contract No. DP/BGD/79/015-4/FI*.
- Kim, C.K. 1993. Biodiversity, conservation and inventor: why insects matter. *Biodiversity and conservation*. 2:191-214.
- Ling, Shao-Wen. 1977. *Aquaculture in Southeast Asia*. (A Washington Sea Grant Publication). College Fisheries. University of Washington Contribution no. 465. Seattle.xv+108 pp.
- Tsai, Chua-Fa & Ali, L. 1987. The changes in fish community and major carp population in beels in the Sylhet-Mymensingh basin, Bangladesh. *Ind. J. Fish.* 34(1): 78-88.

The Status of Alien Invasive Species in Bangladesh & Their Impacts in the Ecosystem

**Shuvashish P. Barua
M. Monirul Hasan Khan &
Mahmud-ul Ameen***

**IUCN Bangladesh
House # 3A; Road # 28 (old)
Dhanmondi, Dhaka 1209, Bangladesh**

***Department of Zoology
University of Dhaka, Dhaka 1000, Bangladesh**

Abstract

The invasive species of flora and fauna were deliberately introduced in Bangladesh mainly in order to increase productivity. The two most controversial genera of flora introduced in Bangladesh are *Acacia* and *Eucalyptus*. On the other hand, a total of 15 species of fishes were introduced in Bangladesh; most of them are carps. The most 'disastrous' invasive species of fishes are *Clarias gariepinus*, *Pangasius sutchi*, *Pangasius giganticus*, *Tilapia mossambica* and *Oreochromis niloticus*. As a country of wetlands, Bangladesh is very rich in fish diversity. Even then, many species were indiscriminately introduced and these invasive species rapidly spread into the wetlands as "biological explosives" due to recurring flooding. This has caused 54 indigenous fishes to become threatened (IUCN Bangladesh, 1999) within a very short period of time. The long-term, and even short-term, adverse effects were not considered while introducing these invasive species. Combating the invasive species in Bangladesh will be very difficult because of lack of awareness and proper initiatives. However, by influencing excessive harvest and discouraging cultivation of these species may reduce the impact.

INTRODUCTION

An alien invasive species colonizes in the natural or semi-natural ecosystems, is also an agent of change, and threatens native biological diversity. Unfortunately, there was no consideration of adverse effects in introduction of any alien invasive species.

As a sub-tropical country, Bangladesh is exceptionally rich in biodiversity. Geographically, the country is located at the transition of Indo-Gangetic and Indo-Malayan Subregions between the Himalayas and the Bay of Bengal. We have almost all major types of flora and fauna characterized by high growth rate, high economic value, high market demand, etc. It would be wise if the authority could try to improve and popularize these indigenous species instead of indiscriminate introduction of alien species.

BACKGROUND

The invasive species of flora and fauna were intentionally introduced in Bangladesh mainly in order to increase productivity to support the needs of 130 million people in an area of only 147,000 sq km. That's why almost all of the invasive species in Bangladesh are characterized by high growth rate i.e., high turn-over rate. However, some species were introduced for decorative or ornamental purposes.

Introduction of alien species has a long history in Bangladesh. Perhaps the first widely introduced species in Bangladesh is Water Hyacinth, *Eichhornia crassipes*, which was brought from Brazil in the British period. The British ladies were fond of its flowers and brought for decorative purposes. In that time, nobody visualized how vigorously this species can turn into an aquatic weed. Now almost all the wetlands of Bangladesh are covered by Water Hyacinth. Almost the same process and attitude is continued till date. The mushrooming growth of population and urbanization forced the Government to think only about the immediate future. But at the time of introduction of every alien species there were some people who protested against it but the authority didn't care.

PRESENT SCENARIO

The two most controversial genera of flora recently introduced in Bangladesh are *Acacia* and *Eucalyptus*. These were introduced during 1980s from Australia. All the species of these two genera are proven to be rival to the endemic flora and found not friendly to the environment of Bangladesh. On the other hand, a total of 15 species of fishes were introduced in Bangladesh; most of them are carps. The most 'disastrous' invasive fishes are *Clarias gariepinus*, *Pangasius sutchi*, *Pangasius giganticus*, *Tilapia mossambica* and *Oreochromis niloticus* these were brought from Thailand between 1953 and 1990. The predatory habit of the first three species is well known and legendary. Although the rest two are not predatory but their fecundity and growth rate are extremely high and they are able to breed naturally.

Acacia and *Eucalyptus* trees produce leaves that are not easily degradable. So the soil becomes less fertile and the existence of thousands of humus-dependent species including herbs and earthworms become threatened. These trees are said to absorb large amount of water and hence even the indigenous trees cannot properly grow around it. These trees cannot support any wildlife because these do not produce edible fruit or nectar for them. The monoculture of these species always found as lifeless as a desert. The tall and slender stem of these species are not storm tolerant and hence they

cannot shelter any fauna during storm. Moreover, the spores produced by the flowers of these trees create allergic diseases to the respiratory tracts of human beings.

As a country of wetlands, Bangladesh is very rich in fish diversity where 266 species of inland fishes and 442 marine fishes are found. Even then, many species were indiscriminately introduced and these invasive species rapidly spread to the wetlands as "biological explosives" due to severe flood. Some introduced species were prescribed only for restricted cultivation in closed ponds but nobody succeeded to maintain in that way due to flood. This caused 54 indigenous fishes to become threatened (IUCN Bangladesh, 1999) within very short time. Many of them will go extinct if the process is continued. *Clarias gariepinus* and introduced *Pangasius* spp eat almost everything whichever they encounter. They not only feed on indigenous fishes and domestic ducklings but also on snails and birds that are killed and supplied by the cultivators. Moreover, the vulture population of the country is threatened because all the carcasses are collected and supplied to these fishes. On the other hand, *Tilapia mossambica* and *Oreochromis niloticus* are competing with the small indigenous fishes and gradually occupying their niches. In case of carps, some interesting data have been collected. The major carps contributed 67% of the total stock in 1967 in Sylhet-Mymensingh haor (huge marshland) basin that rapidly declined to 50% in 1973 and only 4% in 1984 (Tsai & Ali, 1987).

CONCLUSION

It is quite unfortunate that the long-term, and even short-term, adverse effects were not considered while introducing these invasive species in Bangladesh. The excessive fecundity and growth rate of these species created pressure on the carrying capacity of the habitat, and the ecosystem balanced itself by reducing the indigenous species diversity and population. Even the grand economic balance concerning invasion was not properly assessed.

All over the world the invasive species have been identified as an agent of the loss of native biodiversity. According to Ameer (1999), alteration of ecological communities caused by alien invasive plant and animal species influence the functioning and overall health of the affected ecosystems. Negative effects of biological invasion include fall in production (e.g., fishery) and cost of controlling invasives. The overall guiding principles for the prevention, introduction and mitigation of impacts of alien species developed by IUCN are based on the following:

1. Precautionary approach as the pervading principle
2. Sharing of relevant information.
3. Research and management of invasives.

Combating the invasive species in Bangladesh will be very difficult because of lack of awareness and proper initiatives. However, by influencing excessive harvest and discouraging the cultivation of these species may reduce the impact. No species should be introduced without evaluating their detailed life history, probable impacts, and probable benefits in Bangladesh. No predatory species should be introduced. And lastly, people should be motivated to cultivate indigenous species. The indigenous species of an ecosystem evolves after a long history of evolutionary process. Hence, it is extremely inter-linked and balanced with all the local biotic and abiotic factors. The indigenous species in no way replaceable with the alien invasive.

References

- Ameen, M. 1999. Development of guiding principles for the prevention of impacts of alien species. *Paper presented at a consultative workshop in advance of the 4th meeting of SBSTTA to the CBD, organized by IUCN Bangladesh at Dhaka on 25 May 1999.*
- IUCN Bangladesh. 1999. *Red book of threatened fishes of Bangladesh.* IUCN Bangladesh, Dhaka, Bangladesh. (In press).
- Tsai, C., and Ali, L. 1987. The changes in fish community and major carp population in beels in the Sylhet-Mymensingh basin, Bangladesh. *Ind. J. Fish.* 34(1):78-88.