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for Comments

Environmental Impact of Trade Liberalization and Trade-Related Policies on the Marine Fisheries Sector in Bangladesh

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I. INTRODUCTION

Amongst the developing countries, Bangladesh has been one of the forerunners in the area of trade liberalization. As a matter of fact, barring Columbia, Bangladesh has been the fastest reformer in the developing world in terms of pace of tariff reduction. Trade reforms in Bangladesh primarily entailed: (a) reduction in the tariff levels; (b) narrowing of dispersions in the tariffs; (c) import bans; and (d) withdrawal of import quota restrictions. Average tariff rates came down from 85 percent in 1991/92 to about 17 percent in 2000/01 and the number of commodities under quota restrictions came down from about 620 to 100. In order to stimulate exports and promote investment in export-oriented activities, the *Government of Bangladesh* (GOB) has also provided a number of fiscal and financial incentives over the recent years and has put in place institutions to implement the incentive schemes and extend trade facilitatory services.

The shift in the trade policy regime in Bangladesh towards liberalization has contributed to a significant growth of the export sector of Bangladesh over the last decade. Real growth of the export sector was about 14 percent in the 1990s, which is about three times the average real GDP growth rate over the same period. Bangladesh's *Export Policy* over the past decade has enabled the country to achieve important structural shifts in the sector – both product-wise and market-wise. The share of non-traditional exports that include readymade garments, frozen foods and shrimps and leather products registered a secular rise compared to traditional exports that include raw jute, jute goods, tea and leather. The ratio between traditional and non-traditional exports changed from 40:60 to 10:90, between 1991 and 2001.

Among the non-traditional exports, *export of frozen fish* is increasingly emerging as a prominent economic activity in Bangladesh. Exports of frozen fish amounted to $360 million in the fiscal year 2000-2001 (FY01) accounting for 7 percent of total exports from the country. The frozen fish exports draws on the production base of the fisheries sector of the country. Total volume of fish production in Bangladesh is currently (2000) to the tune of 1.7 million metric tonne (mln MT) per annum.

Within the fisheries sector, the *marine fisheries* currently accounts for about 20 percent of the total fish production in Bangladesh. Marine fish production grew at an average rate of about 4.2 percent during the 1990s.

There is a perception prevailing amongst many observers of Bangladesh's fisheries sector that the sector is being overexploited. It is often held that distortionary public policy package has further aggravated the environmental balance in this area. However, there is a dearth of evidence and comprehensive studies in Bangladesh to pass any reliable judgment on the appropriateness of such observations. An earlier study on environmental impact of trade liberalization policies on the Bangladesh *shrimp farming industry* by the authors of the present report revealed that shrimp fisheries exhibit a considerable amount of income notwithstanding negative environmental impact in a number of few areas. The study also indicated that the estimated environmental costs can be internalized by sustainable management of the sector using appropriate measures and tools (UNEP: 1999).

The issue of how trade-related policies are linked to depreciation or appreciation of fishing stock has also not been adequately researched. The hightened global debate on trade-induced environmental consequences of fisheries subsidies and the subsequent inclusion of the fisheries subsidy in the WTO Work Programme have provided added dimension to the concerned issue in the context of Bangladesh. As Bangladesh seeks to promote the export of its marine fisheries product in the coming years, it is pertinent for the country to find out whether these efforts comply with the obligations of the country under WTO agreements and are in consonance with the commitments under various multilateral environmental agreements (MEAs).

In consideration of the concerns relating to depreciation of marine fishery resources and also given the importance of the sector in terms of its export potential and employment opportunities, an evaluation of implications of various trade related policies on the marine fisheries sector is of both academic and practical interest to Bangladesh. In this context the present study seeks to address the attendant issues and identify a set of policy

measures geared to promoting sustainability of the exhaustible marine resource in Bangladesh as well as sustainable livelihood of the poorer sections of the country whose lives and livelihoods are associated with the future of the sector.

II. APPROACH OF THE STUDY

2.1 Overview of Issues

Natural resource subsidy as part of the trade liberalization policy plays significant role in the resource allocation as well as management. It distorts the market by reducing the private costs to the producer, and this cost does not reflect the social cost of environmental externalities associated with the production. This results in excessive consumption of the environmental good which causes environmental degradation.

Subsidies on natural resource have negative impact on the environment in a number of ways. The impact can be categorized in terms of the effects they have on the resource, such as overcapitalization effect, technology effect, over consumption effect and public resource deprivation effect (Porter, 1998a). The *overcapitalization effect* occurs when more investment is made because of subsidies to a natural resource based industry than would have been made in an undistorted market. Similarly, the *technology effect* of subsidies is revealed when it is more attractive for an industry to switch to technologies that have greater impact on the environment than the existing technologies. The *resource inefficiency effect* happens by artificially depressing the prices of natural resources and thus removing the incentive for efficient use of resources. On the other hand, when the marginal cost of extraction of a natural resource is reduced by a subsidy, it encourages producers to extract more of the resource and thus makes the *over harvesting effect.* The *over consumption effect* of subsidies to natural resource industries is the resultant low price of the resource due to subsidy leading to excessive consumption of the good. Subsidies to natural resource also diverts resources from the public domain by selling them at a cheaper rate, and thereby deprive the use of financial resources in other programmes such as enforcement of laws and regulations for protecting natural resources and promoting their management. This is how the *public resource deprivation effect* occurs.

Subsidies and Fishing Practice

In the face of lack of proper management system, global fishing stocks tend to suffer either from full exploitation, over-fishing, depletion or from near depletion. Concerns

about the unsustainability of fisheries sector in the context of such outcomes have led experts and policymakers to investigate the causal factors that stimulate and promote overexploitation of natural resources. There is a consensus as regards excessive fishing capacity being one of the major problems responsible for overexploitation of fish resources (FAO: 1999). The issues of over capacity and overfishing have also been linked to fisheries subsidies along with the basic characteristic of fisheries. In an open access fishery, subsidy, targeted to increase revenue or reduce cost, increases the marginal profit at each level of fishing effort leading to the increase in the overall fishing effort.

The negative impact on the fisheries sector occurs due to various types of subsidies which are similar to the effect of subsidies described earlier. This could be due to border instruments i.e. trade measures such as tariffs, import quota, export subsidy, tax reduction etc. which raise the domestic prices received by the producers. Domestic instruments also play negative role by reducing the cost of the producers and thus increasing their income. Domestic instruments include five types of subsidies such as subsidies to output, subsidies to intermediate input, subsidies to the use of capital, subsidies to the use of fish resources and subsidies given indirectly. *Subsidies to output or idle capacity* provides direct income support, thus subsidizing all or part of the producer's fishing output which is, in other words the producer's idle capacity. *Intermediate input subsidy* reduces the variable costs of producers which results in investment into the industry. *Subsidies to the use of capital* have effect on technological improvement in the fishing industry. *Subsidies to the use of fish resources* is provided by giving fishing fleets access to fisheries at costs that are only a very small fraction of the commercial value of the catch. *Indirect subsidies* are those interventions that benefit the fishing industry indirectly while benefiting other industries as well.

The case of fisheries sector has been the focus of a number of discussions relating to subsidy. This issue also received heightened attention during the Fourth WTO Ministerial meeting held in November 2001 in Doha. The issue of fisheries subsidies form a part of the work programme provided for in paragraph 28 of the *Doha Declaration* which relates to the negotiations aimed at clarifying and improving disciplines under the Agreements

on Implementation of Article VI of the GATT 1994. These issues are also dealt in the Agreement on Subsidies and Countervailing Measures. The related provisions urge the member countries to clarify and improve the existing WTO disciplines on fisheries subsidies, taking into account the importance of this sector to the developing countries. The issue of fisheries subsidies has been cross-referred in the work programme relating to "Trade and Environment" (WTO: 2001).

During the recent past, a wide-ranging discussion has been taking place at various levels, which deals with the implications of fisheries subsidies for fishing and overfishing. It has been broadly recognized that this relationship is a complex one and it has to be understood in the overall context of fisheries management as well as the factors that impact on it. The inadequacies o f a proper definition of "subsidies" for a comprehensive analysis of the effect of subsidies is a recurring theme of such discussion and were repeatedly articulated at various forums. The *UNEP Fisheries Subsidies Workshop* (UNEP: 2001) expressed concerns regarding the social dimensions of subsidies. It was observed at the workshop that while categorizing the subsidies their implications for sustainable development need to be taken cognizance of. The need for defining a list of "Sustainability Criterion" applicable to fisheries subsidy has also been repeatedly underscored. The definition of "subsidy" has also been debated. In a report on the *Expert Consultation on Economic Incentives and Responsible Fisheries*, it was maintained that subsidies do not inevitably contribute to resource depletion and the effects of subsidies will depend on the extent to which fishing effort is controlled (FAO: 2000).

Empirical Evidence

The impact of trade liberalization and trade-related policies on the marine fisheries sector has been explored, to some extent, in the literature. Most of the studies examine the impact of subsidies and other modernization process on the *fisheries sector as a whole* and not exclusively on the marine fisheries sector. Studies covering a number of countries reveal that there is a positive link between subsidy and over-fishing. Box 2.1 presents the results of these country studies.

The case of *Canada's* Northwest Atlantic fishing fleet is a case in point where fishing stocks were depleted as a result of subsidies during the period 1954 and 1968. The capacity of offshore fleet increased by eighteen times which was twice the capacity that could be used for a sustainable level of catch (Porter: 1998a). Further, by 1989 the catching power needed to fish annual quota increased by five times due to increased capacity, which in turn was underwritten by subsidies extended for construction and improvement of Canadian vessels during 1970s–1980s. This caused a collapse in Canadian cod stocks (Porter: 1998a; OECD: 1995; Schrank: 1997).

Between 1970 and 1987 both the *European Commission* and *member states* provided grants for modernization of the member states' fleets, doubling the gross registered tonnage and tripling the engine power of the combined fleets. This led t o drastic decline in population of most of the major commercial fish species in European waters (Holden: 1994).

The *USA* used low-interest loans and loan guarantees in the 1980s to help its fishing industry finance the construction of a large fleet of factory trawlers for the Alaska Pollack fishery of the Eastern Bering Sea, Aleutian Islands and the Gulf of Alaska. This helped the fleet to develop four times more the capacity compared to what could have been supported from the perspective of sustainable fisheries. It was only through the closure of the fishing for most of the period of year which prevented the collapse of the sector (Milazzo: 1998; Porter: 1998a).

The OECD study on subsidies to the *member countries* and resource sustainability confirms that subsidies contributed to overcapacity in the case of *New Zealand* in the 1970s and early 1980s, *Spain's* Galician fisheries in the 1980s, Norway in the 1960s, the *United States* in the late 1970s and early 1980s, and the *European Union* during the 1980s (OECD: 2000a).

A 1990-91 vessel withdrawal program in *Japan's* Shimane prefecture, funded by both central and prefectural government as well as by vessel owners who remained in the

fishery, reduced the number of vessels in the fleet by 22 percent, but accelerated the replacement of aging vessels with new, more powerful ones (OECD: 2000a).

Box 2.1

Summary of Findings from Country Studies

Country	*Study*	*Type of Subsidy*	*Findings/Impact*
Canada	Porter (1998a) OECD, (1995) Schrank (1997)	▪ Subsidies for vessel construction and modernization through grants and low-market loans or loan guarantees during 1954 and 1968 ▪ Subsidies for vessel construction and improvement through grants and low-market loans or loan guarantees in the late 1970s -1980s	▪ Increase of offshore fleet capacity, over capitalization of fleet in 1970 ▪ Catching power increased by five times; collapse of cod stocks
EC and member states	Holden (1994)	Provide grants for modernization of fleets between 1970 and 1987	Drastic decline in population of major commercial fish species in European water
USA	Milazzo (1998) Porter (1998a)	Low-interest loans and loan guarantees in the 1980s to construct large fleet	Fleet capacity increased by four times-more than the sustainable capacity. Fishery closed for most of the year
Japan	OECD (2000)	Decommissioning programme for vessel withdrawal in 1990-91	Reduced the number of vessels in fleet by 22 percent, but replaced with new and more powerful ones
Taiwan	Chuang and Zhang (1999)	License back programme after 1990	Number and tonnage of vessels decreased; total engine power continued to increase
Norway	OECD (2000a)	Support for the fishing industry in the late 1970s and early 1980s in forms of loans and grants led to subsidies for withdrawal of capital	Decline in fish catches; increase in the number of vessels, fisheries and fleet engine power
Argentina	Onestini (2001)	Fuel tax subsidies, environmental subsidies, export promotion etc	Increase in production, export, employment, income etc, but also led to degradation of fisheries biomass, increase in operation cost, corruption, overcapitalization etc.

Senegal	Dahou and Démé (2001)	▪ During 1970s: Govt. policy support in forms of project like tax-free sale of engines & in easy terms ▪ During 1980s: Export subsidies, fisheries agreement, devaluation programme etc ▪ At present: Fuel subsidies, export subsidies, tax reduction on equipments, support on trade, fishing agreements, assistance to small-scale processing etc	▪ Extension of vessel capacity, migration of small-scale fishermen etc ▪ Consequences in terms of fisheries sustainability are ambiguous ▪ Maximum growth in small-scale fishing ▪ Unprecedented growth of landings, technological effects, imbalance between domestic and export market etc

The buy-back programme carried out in Taiwan after 1990 allowed vessel owners not only to use withdrawal premiums to upgrade other boats, but also absorb the crew from the withdrawn vessel, thus more than offsetting the positive effect of the subsidy. Although the number and tonnage of vessels decreased after the programme went into operation in 1990, the total engine power continued to increase (Chuang and Zhang: 1999).

The case of the increased *Norwegian* support for the fishing industry in the late 1970s and early 1980s is an extreme example of high level support that masked the decline in fish catches and net value added and resulted in increase in the number of vessels, fisheries and fleet engine power (OECD: 2000a). This kind of support thus effectively obscures the signals from the fishery, calling for capacity adjustment. To overcome this type of situation subsidies on withdrawal of capital were offered.

The experience of subsidies aimed at reducing capacity and adjusting fleet capacity through decommissioning schemes by retiring vessels or licenses is also not quite satisfactory unless it is combined with appropriate management measures. Though in the short run decommissioning schemes are successful in reducing fishing capacity, the decommissioning premiums make the fishery profitable for those who stay back in the fishery sector which in turn attracts more investment in fishing capacity and thus increase the pressure on the resource.

Concerns of the Developing Countries

A number of developing countries have been experiencing serious overcapacity in their national fleets for many years (Porter, 1998b). If these countries are exempted from the elimination of subsidies or the process of elimination is stretched out in line with the "special and differential treatment" given in *Subsidies and Countervailing Measures* (SCM) Agreement and *Agreement on Agriculture*, the fisheries sector in a number of developing countries may become unsustainable. Prohibition of subsidies assumes fully exploited or overexploited fisheries.

But in some developing c ountries fisheries sector may also suffer from inadequate fund, and therefore, financial and other support may be needed as the resource is still under-exploited. In such circumstances, a clear distinction should be made between the overexploited and under-exploited fisheries and subsidies can be provided only to those fisheries that has under-capacity. However, the continuation of subsidies has to be complemented by effective management measures.

2.2 Design of the Study

Scope of the Study. The scope of the study constitute of reviewing the existing trade policies of Bangladesh that relate to the marine fisheries sector and their impact on this sector. In the absence of a comprehensive quantitative study on the trade-related impact on marine fisheries in Bangladesh, an attempt has been made to assess the state of the marine fisheries sector in Bangladesh's in quantitative terms. On the basis of the results from the quantitative measurement, the study seeks to evolve a set of practical and implementable policy packages towards the promotion of sustainable management of fisheries in the context of Bangladesh.

Methodology. With a view to address the objectives of the present exercise, the study follows both a *descriptive* and *analytical approach*. The descriptive part includes a discussion on the policy evolution, the intervening factors and the consequences of trade liberalization policies for marine fisheries in Bangladesh. A select of review studies on

the relationship between trade policies and overfishing, country experiences and concerns of developing countries precedes this discussion.

The analytical part deploys quantitative techniques, which examine sustainability of the marine fisheries sector. The level of sustainable yield is estimated using a *bio-economic model* developed by Schaefer (1954; 1957). Sustainable economic rent is also estimated from this exercise.

The study also attempted to follow a *participating approach* by interacting with a broad cross-section of stakeholders in the course of information generation.

Data Base. Information for the study have been collected both from primary and secondary sources. Secondary data were collected from the published documents of the relevant ministries and departments of the government and other sources. The dearth of adequate information from the secondary sources led the study to rely to a great extent on the primary sources.

Primary information have been collected through field visits to four marine fishing sites in Chittagong, the coastal district of Bangladesh as well as by debriefing key informants, such as the exporters, trawler owners and fishermen. Furthermore, consultations took place with key stakeholders, such as the policy makers and officials of the *Ministry of Fisheries, Department of Fisheries*, and leaders of the trade bodies, *Bangladesh Marine Fisheries Association* and *Bangladesh Frozen Food Exporters Association.*

Structure of the Study. Following the introductory section (*Section I*), *Section II* provides a brief literature review on the concerned issues and lays down the approach followed by the design of the study in this context. A profile of the marine fisheries sector of Bangladesh and the trade policy framework within which it performs have been discussed in *Section III*. *Section IV* provides an analytical insight on the state of the marine fishery in Bangladesh in terms of sustainable yield and the required effort level. Finally, *Section V* puts forward a set of policy recommendations for sustainable management of marine fisheries resources in Bangladesh.

III. MARINE FISHERIES SECTOR IN BANGLADESH AND THE TRADE POLICY FRAMEWORK

3.1 Profile of the Marine Fisheries Sector

The water body of Bangladesh is very well suited for the production of fish – the most important resource of the freshwater ecosystem. Preceded by China and India, Bangladesh ranks third among the world's *inland fish* producing countries. In 1999, Bangladesh produced 1655 thousand MT of fish. The fish production in the country experienced an average growth of 9.4 per cent per annum during the 1990s. Accordingly, the sector's contribution in the country's GDP increased from 2.7 per cent in FY91 to more than 3.3 per cent in FY99 (see Table 3.1 and 3.2).

Table 3.1
Fisheries Sector in Bangladesh: Contribution to GDP

Year	*Marine (million Taka)*	*Marine (million US $)*	*Inland (million Taka)*	*Inland (million US $)*	*Total (million Taka)*
1990	2308	70.11	11591	352.10	13899
1991	2361	66.17	12438	348.60	14799
1992	2435	63.83	13344	349.78	15780
1993	2508	64.08	14637	373.97	17145
1994	2684	67.10	16119	402.98	18803
1995	2696	67.06	17218	428.31	19914
1996	2928	71.69	18698	457.84	21626
1997	3180	74.47	20305	475.53	23485
1998	3446	75.80	22006	484.07	25452

Source: Statistical Yearbook, Bangladesh Bureau of Statistics; Various Volumes.

The potential for *marine fisheries* sector in Bangladesh is considered to be enormous in view of the fact that the country has a 710 kilometer long coastline and an *Exclusive Economic Zone* (EEZ), which spread over an area of 1,64,000 square kilometres (sq. km.). There are mainly *four fishing areas* within the marine boundary of Bangladesh: (i) *South patches* with an area of 6200 sq. km.; (ii) *South of South patches* with an area of 2538 sq km; (iii) *Middle ground* with an area of 4600 sq. km.; (iv) *Swatch of no ground* with an area of 3800 sq. km. The number of fish species available in this area is 475; there are also 25 shrimp species.

Table 3.2
Marine Fish Production in Bangladesh

Year	*Total Fish Production (00,000 MT)*	*Annual Growth Rate of Total fish Production*	*Marine Fish Production (00,000 mt)*			*Share of Marine Fish in Total Fish Production (%)*
			Industrial	*Artisanal*	*Total*	
1990	8.96	6.25	0.09	2.33	2.42	27.0
1991	9.52	7.25	0.10	2.36	2.46	25.8
1992	10.21	6.76	0.11	2.39	2.50	24.5
1993	10.90	7.52	0.14	2.45	2.59	23.9
1994	11.72	7.25	0.11	2.53	2.64	22.6
1995	12.57	8.19	0.12	2.57	2.69	21.4
1996	13.60	7.65	0.14	2.61	2.75	20.2
1997	14.64	6.01	0.15	2.58	2.73	19.2
1998	15.52	6.64	0.16	2.94	3.10	20.0
1999	16.55	6.64	0.16	3.17	3.33	20.1

Source: Unpublished data from the Depart of Fisheries, Government of Bangladesh.

In 1999, Bangladesh produced 333 thousand MT of marine fish resulting from a growth of about 4.2 per cent per annum during the 1990s. However, as Table 3.1 indicates, because of faster growth of the inland fisheries, the share of marine fisheries in total fish production of Bangladesh experienced a decline during the past decade from its peak level of about 28 per cent recorded in 1989. In 1999 marine fish accounted for a little above 20 per cent of the total fish production of the country in which 95 per cent came from artisanal fishing and only 5 per cent came from industrial (trawl) fishing.

Production in the marine sector in Bangladesh is generally carried out by mechanized and non-mechanized small boats, the capacity of which ranges between 1-40 horsepower. The *Ministry of Fisheries* (DOF) has been quoting a constant number of mechanized (3317) and non-mechanized (14014) boats operating between 1987 and 1998. A current estimate suggests that there are a total of about 21,830 mechanized and 28,707 non-mechanized boats engaged in fishing in the country. In addition to that, 67 officially approved trawlers are doing industrial fishing. Out of these trawlers, 48 are engaged in shrimp catching and the rest 19 are in other fishing (GOB: 2001a).

According to the *Department of Marine Fisheries* of Bangladesh, marine fisheries sector is a source of *employment* and *income* to a large number of people, particularly in the rural areas. It has been estimated that currently 917 thousand people are employed in the sector (GOB: 2001a). Over the past one and a half decade, employment in the sector has increased at an average rate of 5 per cent annually.

Table 3.3
Total Export of Fish and Percentage Share in Total Export Earning

Year	Total Export of Fish and Fish-products				Percentage of Total Export Earning
	Quantity (MT)	Growth Rate %	Value (mln Taka)	Value (mln US $)	
1990	26109	10.61	5266.2	147.59	8.64
1991	22080	-18.25	5243.4	137.44	6.91
1992	26607	17.01	7002.9	178.91	7.57
1993	31835	16.42	9209.6	230.24	9.12
1994	41686	23.63	13069.4	325.10	9.38
1995	38929	-7.08	13409.4	328.34	8.44
1996	41549	6.31	14574.1	341.31	7.75
1997	30158	-37.77	13878.1	305.28	5.93
1998	28477	-5.90	13793.3	287.00	5.41
1999	35134	23.14	17813.2	354.07	6.28

Source: GOB, 2001b.

Fish is a major source of protein consumption in Bangladesh. It accounts for about 11.4 per cent of total protein consumption of the people (i.e. 64 grams per capita per day).

The contribution of fisheries sector in total export earnings of the country is also significant – more than 6% (see Table 3.3). Regrettably, no direct estimate on the country's export of marine fish is available readily available. Fish from Bangladesh are exported to a large number of countries. The fish export basket is dominated by shrimp (almost 90 per cent). Japan is the largest importer of marine shrimp, while Thailand is a major importer of marine 'white fish'. Only 2-3 species of white fish are exported to Europe and USA, where the major consumers are the Bangladeshi diasporas living abroad.

There are only two joint ventures in Bangladesh in the fishing sector – one with Japan and the other with Thailand.

3.2 Legal and Regulating Framework of the Fisheries Sector

The marine fisheries sector in Bangladesh is governed by a number of international, regional and national covenants and legislations. Bangladesh is a signatory to the *United Nations Convention on Law of the Sea* (1982). Maritime cooperation is also envisaged under the *South Asian Association for Regional Cooperation* (SAARC) as well under the *Bangladesh, India, Myanmar, Sri Lanka, Thailand Economic Cooperation* (BIMST-EC), although no specific guidelines have been formulated as yet in this regard. The Marine Fisheries Ordinance is the basic legislation which provides the management guidelines for the sector in Bangladesh.

International Agreements: The Third United Nations Convention on the Law of the Sea (UNCLOS III) held in 1982 adopted a "Declaration of Principles" to which Bangladesh is a signatory. Regarding fisheries, the Convention (1982) lays special emphasis on regional and international cooperation in studies, research programmes and exchange of information. However, no studies were implementation in connection with the Convention in Bangladesh and/or on Bangladesh.

WTO Provisions: The *Agreement on Subsidies and Countervailing Measures* (SCM) from the WTO Uruguay Round has a number of provisions for “special and differential treatment” (S&DT) of developing countries (Article 27). According to these provisions Bangladesh, as a least developed country (LDC), is *exempt* from the prohibition on export subsidies. Even if Bangladesh ceases to be an LDC in the near future, it may continue to enjoy such S&DT similar to the countries listed in Annex VII (b) of SCM Agreement which are also exempted from that prohibition until their GNP per capita reaches $1,000 per annum. (Other developing countries will have eight years to phase-out such subsidies, except for a developing country that has achieved “export competitiveness” in the product, which has two years to phase-out export subsidies). Subsidies granted by developing countries including Bangladesh cannot be challenged on the allegation of “serious prejudice”, but only on the basis of positive evidence that they “nullify or impair benefits” accruing under the 1994 Uruguay Round Agreement or that cause injury to a domestic industry in the market of an importing member country.

Regional Arrangements: Bangladesh is a member of two major regional cooperation initiatives, namely the *SAARC* and *BIMST-EC.* Recently, Bangladesh is seeking active engagement in the recently launched *Indian Ocean Rim* (IGOR) initiative. It should be noted here that maritime cooperation, more specifically, joint exploitation of marine fisheries resources, has been identified as one of the major areas of collaboration amongst the participating countries in the BIMSTEC.

Amongst the regional arrangements with Bangladesh's participation, the SAARC remains to be the most matured one. As the countries in South Asia including Bangladesh is discussing its transition from *South Asian Preferential Trade Arrangement* (SAPTA) to *South Asian Free Trade Agreement* (SAFTA), it may be expected the fisheries sector will be placed under a broad general duty structure to stimulate cooperation within the framework of the regional organizations.

National Legislation: The Government of Bangladesh through an act of the parliament enacted the *Territorial Waters and Maritime Zones* Act 1974 (Act no XXVI of 1974). The Act provides for declaration of the following maritime zones:

i. Territorial waters: The government may declare the limits of the sea beyond the land territory and internal waters of Bangladesh which shall be the territorial waters of Bangladesh specifying in the notification of the baseline-

- From which such limits shall be measured; and
- The waters on the landward side of which shall form part of the internal waters of Bangladesh.

Under the Act, the Government declared that the limits of the sea beyond the land territory and internal waters of Bangladesh should be the territorial waters. Limits of the sea shall be 12 nautical miles.

ii. Contiguous zone: The zone of the high seas contiguous to the territorial waters and extending seawards to a line of 6 nautical miles measured from the outer limits of the territorial waters was declared to be the contiguous zone of Bangladesh.

iii. Economic zone: The Bangladesh Government declared that Zone of the high seas extending to 200 nautical miles measured from the baseline to be the Economic Zone of Bangladesh.

iv. Conservation zone: According to the Act (1974), the Government may establish conservation zones in areas adjacent to the territorial waters as may be specified in the official Gazette notification.

v. Continental Shelf: The continental shelf of Bangladesh comprises of (a) The seabed and subsoil of the submarine areas adjacent to the coast of Bangladesh and (b) The seabed and subsoil of the analogous submarine areas adjacent to the coast of any island, rock or any composite group constituting part of the territory of Bangladesh.

Even though the Bay of Bengal is reported to be rich in marine resources, the marine fishery sector lacks proper management policy for harvesting as well as conservation of the marine fishery resources. *The Marine Fisheries Ordinance (1983)* of Bangladesh made provisions for the management, conservation and development of marine fisheries only for water bodies with a depth of more than 50 meters. The area of the sea up to 50 meters of depth is reserved for small-scale fisheries. However, this distinction is hardly observed by industrial fishing vessels. Moreover, due to lack of enforcement capacity of national agencies, fishing trawlers from India, Myanmar and Thailand regularly intrude into territorial water of Bangladesh.

All trawlers are required to obtain a fishing license for a year on payment of requisite fees to fish in the sea within the maritime boundary of Bangladesh, which is 200 nautical miles in the Bay of Bengal. Each trawler has to take sailing permission for each and every voyage from the Directorate of Fisheries. Though mechanized boats have been brought under licensing system with the *Amendment 93* of the Marine Fisheries Ordinance (1983), the process is complicated and slow. Since January 2001, all kinds of non-mechanized boats have also been included under licensing system. However, due to cumbersome in the registration system, issuance of licenses is not progressing smoothly.

3.3 Trade Related Policies for the Fisheries Sector

Marine fishery in Bangladesh does not receive any special benefit package from the government. The only identifiable incentive given to the sector is a *Value Added Tax* (VAT) refund from fuel at the rate of Taka 1.9 per litre (i.e. less than US$ 0.04) subsequent to export. However, the sector enjoys the incentives given to the export sector in general which include duty free imports of capital machineries and raw materials, fiscal incentives for export, income tax rebates, duty drawback facilities, speedy customs clearance and subsidized credit. Such incentives are part of the trade liberalization policies aimed at boosting the export performance of the country (See Box 3.1).

Box - 3.1

The General Export Incentives Provided in Bangladesh

1. *Assistance to gross value added or returns to primary factors:*
   a) Duty free import of capital machineries for *industries exporting at least 75% of their output*
   b) simplified tax payment
   c) 50% tax exemption on export earnings
   d) soft loan for export oriented industries
   e) provision for export credit in local currency a concessional rate of interest within a band (the % band is 8-10%)
   f) provision for export credit in foreign currency under EDF at a concessional rate of interest (the rate of interest applicable LIBOR+1%)
   g) export oriented industries are exempted from paying local tax and VAT
   h) provision for sale of 20% of products of the 100% export-oriented industries in the local market on payment of duties and taxes
   i) industries in the EPZ get the advantage of-
      - tax holiday for 10 years
      - exemption of interest on borrowed capital
      - relief from double taxation
      - duty free export of goods
2. *Assistance to inputs or intermediaries:*
   a) provision for back-to-back letter of credit for importation of raw materials for export production, on deferred payment basis
   b) bonded ware house facility for all 100% export oriented industries
   c) provision for duty drawback on imported inputs for export, if the bonded warehouse facility is not available
   d) provision for duty-free import of samples in exporting industries
   e) facilities for backward linkage industries
   f) industries in the EPZ get the advantage of-
      - duty free import of machinery, equipment and raw materials
      - duty free import of materials constructing factory buildings
      - expeditious import of raw materials on Document Acceptance basis

- import of goods from the Domestic Tariff Area (DTA)

3. *Assistance to output:*
    a) assistance under cash compensation scheme to some "thrust sector" *(does not include fisheries)*
    b) retention in foreign currency up to 40% export receipts
    c) export diversification support through Matching Grant Facility (MGF)
    d) simplified export credit guarantee scheme
    e) special rebate on the premiums on fire and marine insurance
    f) Lower rate of interest on loan from commercial banks for export processing
    g) enhancement of time limit for export credit from 180 days to 270 days
    h) industries in the EPZ gets the advantage of selling 10% of output to the DTA under certain conditions
    i) market development assistance (10%) for export certain products (*does not include fisheries).*
4. General incentives
    a) Recognition of industries exporting at least 80 % of their products as 100% export oriented industries
    b) Enhancing the final limit of dispatch for export samples abroad
    c) Provisions for product and market development support under Export Development Fund
    d) National Trophy for export
    e) Reduced air freight for export of all crash program items including fruits and vegetable
    f) Withdrawal of royalty to facilitate the use of cargo services of foreign airlines for export purposes

However, exporters in Bangladesh stress that fishing is different from other export oriented industries, and that treatment accorded to these sectors, which are similar to the other sectors, will not generate equal benefits. For example, in case of a readymade garments exporting factory, the producer and exporter may be the same person who can benefit from a lower bank rate. In case of marine fisheries, the exporter and fisherman are two different entities. Subsequently, the beneficiary of incentives is the exporter but not the fisherman who is the primary producer. As a matter of fact, the fisherman needs the support more than the exporter, especially for the procurement and preservation of exportable fish.

It is maintained by the leaders of the trade bodies that government support is urgently needed for developing infrastructural facilities such as cold storage and transport having cooling facility. In the absence of any government fish procurement centres, the fish farmers have to sell their fish immediately after the catch to the middlemen at relatively low prices. The present procurement system is segmented as well. Due to lack of

security, most of the exporters do not buy fish on site from the fishermen. The existence of a class of middlemen delays the procurement process by 6 to 8 hours due to which the freshness of the fish deteriorates which sometime lead to decay of the fish. Bangladesh is not being able to access the Japanese market for her inability to supply fresh fish. Similarly, Bangladesh has failed to enter into the market of Eastern Asia, where live fish are popular, due to lack of appropriate technology to keep the fish alive for longer period.

The exporters maintain that due to lack of proper infrastructural facilities, a large amount of relatively cheap fish is being wasted. It is a very common practice in Bangladesh that when the fishermen catch high priced fish, they throw away all the low-priced fish as there are no cold storage facilities near the beaches. According to the *Bangladesh Frozen Food Exporters Association*, the amount of low priced fish wasted in such a way ranges from 35,000 to 40,000 metric tonnes a year.

3.4 Effects of Trade Policy

The overall export supportive policy framework of the 1990s as was mentioned earlier did create a conducive environment for export oriented activities in Bangladesh. However, in view of the negligible GOB assistance, which is targeted to the promotion of export oriented marine fisheries sector in Bangladesh it is highly unlikely that such support may have any major social, environmental or economic impact either on the sector or on the country. Moreover the nature of the commodity is also such that the trickle down effect of the general trade supportive policies is not very significant. The subsidy given to the fuel may have impacted on technological development by encouraging boat owners to use more fuel and use more powerful engines by which it is possible to fish in the sea for a longer period and go deep into the sea. This is likely to have positive impact on the effort and catch. However it is difficult to assess the actual impact of such initiatives. Information from official sources indicates that such assistance did not have any real impact either on the fishing effort or on the harvest as is evident from the yield and effort data in Table A1 in the Annex. However, attempt has been made here to estimate the sustainability of the marine fisheries of Bangladesh with a standard bio-economic model to provide insights on the current state of the sector in terms of fishing practices, fishing capacity, economic rent and sustainability.

IV. EXPLOITATION STATUS OF THE MARINE FISHERIES SECTOR

4.1 Sustainability in the Fisheries Sector: Theoretical Approach

Fish is a renewable resource which, similar to other renewable resources, can yield a harvestable surplus indefinitely when exploited on a sustainable yield basis. On the contrary the resource will dissipate if it is overexploited. Sustainable yield for any given stock size is the yield that can be harvested each year without affecting the fish stock since the yield would be equal to the rate of growth of the fish stock. Fish is also predominantly an open-access resource which is operated on a common property basis. Consequently, this gives rise to major economic problems including the possibility of inefficient use of factor inputs, low returns to fishing industries, overfishing and extinction of fish species. This calls for some sort of regulation in the fishing industry.

In a sustainable fishery the relationship between effort and yield is such that the total yield will increase with the increase in the effort up to the point of maximum sustainable yield (MSY) which can be obtained without impairing the capacity of the resource to renew itself. Any fishing effort beyond MSY leads to a decline in total yield because the fish stock declines due to overfishing. In Figure 4.1 it can be observed that two different levels of fishing effort can produce the same yield Y_1. Fishing effort at level E_1 is the situation where there is underfishing. Net growth of Y_1 can be obtained with a small population. But fishing effort E_2 represents overfishing as this level is beyond MSY. Here the growth can be obtained with a large population.

Best possible allocation of resources is achieved when the value of fish that a marginal unit of effort produces is equal to the value that a marginal unit of effort would produce in its best alternative use. The total revenue curve is of the same shape as the sustainable yield curve in Figure 4.2. If it is assumed that the total cost for the fishery increases in proportion to the effort, then the total cost curve for the fishery will be a straight line as shown in Figure 4.2. There is a linear relationship between fishing effort and income earned, and as effort increases total income also increases. The point of maximum profit to the industry per unit of effort is the point of maximum equilibrium yield (MEY), since the difference between total cost and total revenue i.e. economic rent is the highest here. It can be seen

that MEY occurs at a significantly lower level of effort than MSY. If the fishery is owned by a sole proprietor it would be rational for him not to put in additional fishing effort once MEY is attained. Resources are properly allocated at this level since the value of the last fish caught (marginal revenue) just balances the cost of producing it (marginal cost).

However, since fishery is an open-access resource fishermen will continue to enter it as long as they can make a profit in doing so i.e. as long as the average revenue of the individual fisherman is higher than the average cost. As fishing effort continues to increase, total revenue will increase up to MSY. Beyond MSY the average yield per unit of effort will fall as there are now more fishermen exploiting a smaller fish stock. Fishermen in an unregulated fishery will continue to enter it until they fail to earn any surplus over their variable costs. This point is usually called the open-access equilibrium yield (OAEY). At this point, total cost equals total revenue implying that rent to the fishery equals zero and economically rational firms will not expand any effort beyond this point.

The point OAEY represents a misallocation of natural resources since increases in fishing effort beyond MEY will bring in diminishing returns and declining profit margins as costs will increase more than the revenue. Increases in fishing effort beyond MEY mean that inputs are being diverted from producing other goods of higher value to society, assuming that capital and labour are freely mobile between alternative employments. Unregulated fishing effort in an open access fishery will not only generate less rent than it could but its aggregate yield and gross income would also be lower than it should be. It is clear that well before OAEY is reached, the fish stock will be overexploited both economically and biologically.

At the equilibrium OAEY, fishermen can earn no pure profit after covering the opportunity costs of all inputs. Thus society earns no rent from the fish resource. Given that fish resources are scarce and need to be conserved, society should charge fishermen a rental for the use of the resource. The rental added to existing input costs would increase the total cost per effort and thus force the fishermen to reduce effort. This will result in conservation of the resource and maintaining it at a level which maximizes net economic benefits to society. The above discussion is based on the assumption that the future value of resources

are not discounted and industries are perfectly competitive so that each firm in the industry takes all prices, including factor prices, as given and constant over time. The theoretical framework discussed here provides the basis for computing costs, total effort, returns per unit of effort, catch per unit of effort and economic rent over time in the fisheries sector.

Fig:4.1 Sustainable Yield Curve

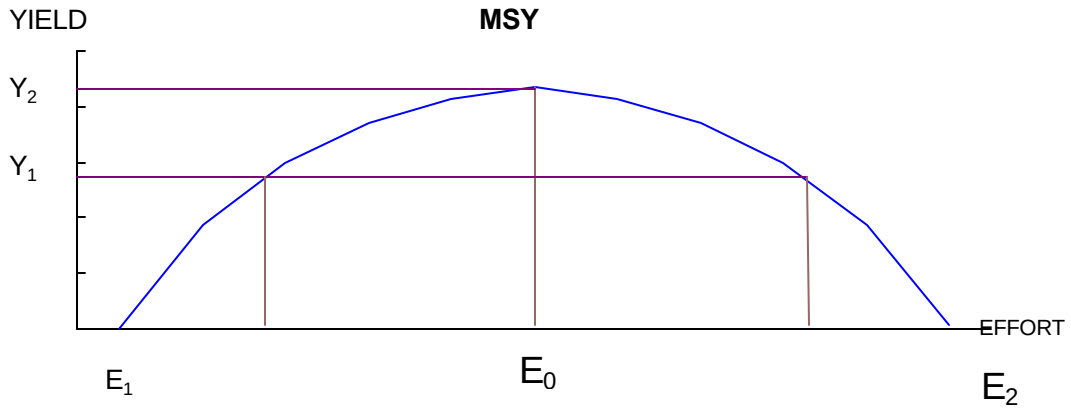
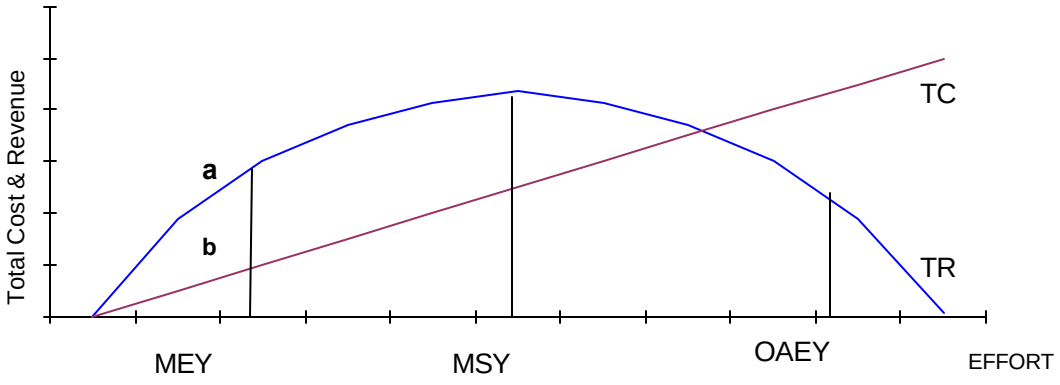


Fig: 4.2 Revenue & Cost in an Open Access fishery



The Model

There are a number of biological models on fishery. The model used in this study is the Schaefer model (Schaefer, 1954, 1957) since the advantage of the model is that it can be applied to deal with the fishery sector even with a limited set of data. The analytical framework presented above shows that in the Schaefer model catch per unit of effort is a linear function of effort. If *Y* is the sustainable yield, *f* is the effort and *a* and *b* is constants the yield function can be expressed as:

$$Y/f = a - bf \quad (4.1)$$

Alternatively,

$$Y = af - bf^2 \quad (4.2)$$

Differentiating Equation (4.1) with respect to *f* and setting dY/df = 0 the level of effort (f_{msy}) giving maximum sustainable yield can be derived:

$$dY/df = a - 2bf = 0$$
$$a = 2bf$$
$$f_{msy} = a/2b \quad (4.3)$$

The maximum sustainable yield (Y_{msy}) can be obtained from Equations (4.2) and (4.3).

$$Y_{msy} = a(a/2b) - b(a^2/4b^2)$$
$$= a^2/2b - a^2/4b$$
$$= a^2/2b(1 - 1/2)$$
$$= a^2/4b \quad (4.4)$$

The parameters *a* and *b* has been estimated in the next section by a linear regression of the yield function using time series data for the period 1984 to 1998.

4.2 Estimation of the Yield Curve

Fishing Effort

The variety of fishing efforts gives rise to the problem of aggregation of inputs. The difficulty can be overcome by converting the inputs into units of time, for example, hours, days and months of fishing since different types of fishing efforts are complementary to each other. That is, a larger number fishermen also reflects the fact that a larger number of nets and boats are used and vice versa. Thus any of these inputs expressed in units of time could serve as a proxy for the fishing effort. The number of fishing boats could serve as

another estimate o f the effort. In this study the effort is measured in terms of fishing crafts though the calculation of effort in terms of boats is somewhat complicated. Three types of fishing crafts trawlers, mechanised boats (MB) and non-mechanised boats (NMB) with various efficiency levels which are used in the Bangladesh marine fisheries have to be converted into one unit. The engine capacity of the trawlers varies between 250 to 1250 horse power (HP), most of them are having a capacity of 400 HP. The engine capacity o f MBs is around 2 to 40 HP. It may be mentioned here that available data show that except for the period 1984-1986 the number of MBs and NMBs remained the same throughout the period under study which could be due to the absence of a recent survey on the fishing efforts.

On the basis of field visits, and debriefing of the concerned stakeholders, the average horse power (HP) of fishing trawlers in Bangladesh is assumed to be 400 and of mechanised boats 10 HP. Though the NMBs are manually operated and do not have any engine we assume a capacity of 1 HP for these types of boats on the basis of the efficiency of NMBs relative to the MBs. Total fishing effort in terms of horse power is presented in Table A1 in the Annex. For convenience, other means of fishing i n Bangladesh such as trammel net and other gear fishing have been grouped together with NMBs since they are also non-mechanized and the amount of catch by them is not significant to make any difference in the estimation.

Yield, Total Costs and Total Revenue

Using catch and effort data for the period 1984–1998 the yield per unit of effort is calculated from Equation (4.1). Regression results are shown in Table A3 in the Annex. The values of $a = 3.165$ and $b = 0.0000078$ estimated from the regression are used to derive the yield per unit of effort, sustainable yield function, maximum sustainable yield and the required effort as follows.

$$Y/f = 3.165 - 0.0000078f \qquad (4.5)$$

$$Y = 3.165f - 0.0000078f^2$$

$$Y_{msy} = (3.165)^2 / (4 \times 0.0000078)$$
$$= 642{,}130 \text{ tonnes}$$

f_{msy} = 3.165/ (2 ×0.0000078)
= 101,442 horse power

This means that with the maximum effort of 101,442 HP a maximum sustainable yield of 642,130 tonnes of fish can be landed.

The corresponding cost and revenue can also be estimated using the cost and price data of the marine fisheries sector. The cost of fishing efforts has been calculated on the basis of field visits which are presented in Table A4 of the Annex. The cost can be estimated from the cost of any type of fishing crafts engaged in fishing since we need to know the cost per unit of horse power. In this study we, however, take the average cost of all three types of fishing boats so that the cost of all types of boats are reflected. The annual average cost of a trawler is estimated to be Tk. 15.7 million which means that the average cost per HP is TK 0.0393 million. Costs of boats were provided in terms of the cost per trip. The mechanised boats go for a 10 days long trips for fishing while the non-mechanised perform single day trips. For a mechanised boat each trip costs Tk. 42,500 and for a non-mechanised it costs Tk. 1000 on an average. Assuming that the fishermen fish for 300 days a year the mechanised boats make 30 trips and the non-mechanised boats make 300 trips annually. Therefore, the yearly cost of a mechanised boat amounts to Tk. 1,275,000 and of a non-mechanised one, Tk. 300,000. Dividing by the average engine capacity of each type of fishing boat the cost per horse power is estimated as Tk 0.128 million and Tk. 0.3 million for a mechanised and a non-mechanised boat respectively. Adding the cost of all types of fishing effort, the cost in terms of horse power is estimated to be Tk. 0.47 million. Thus the average cost per horsepower is Tk. 0.16 million. So total cost expressed as a function of the effort measured in terms of horsepower takes the following form.

TC = 0.16f
= Tk. 0.16 million × 101,442 HP
= Tk. 16.23. billion

The revenue (PY) function in terms of efforts will be:

TR = $P(3.1651f - 0.0000078f^2)$

Price data for different types of fish is difficult to obtain as two types of prices exist, one is the export price and the other is the local price which is substantially lower than the export price. Moreover information on the volume of various types of marine fish exported are not available. It is assumed that 80 percent of all shrimp and 20 percent of other fish caught in the marine fishery are exported. The price of marine fish used here is the weighted average of the export price of shrimp, other exportable fish and the local price of other marine fish (Table A5, Annex). With the estimated price of TK 129.47 per kg the total revenue function takes the form of:

$$TR = \text{Tk. } 129470\ (3.165 \times 101{,}442 - 0.0000078 \times 101{,}442 \times 101{,}442)$$
$$= \text{Tk. } 31.18 \text{ billion}$$

Thus,
Economic Rent = TR – TC = Tk. 14.95 billion (US$ 310 mln)

In other words, Bangladesh may safely double its exports of marine fisheries without jeopardising sustainability of its fish stock.

4.3 Analysis of the Results

With an yield of 642,130 tonnes and effort 101,442 HP at the point of MSY in this model, the estimated yield per unit of effort (HP) will be 6.33 tonnes while economic rent per unit of effort will be Tk. 205 million (US$ 4.27 mln). The results of this exercise suggest that the yield level of marine fisheries sector has not reached the point of MSY as the actual yield is below the estimated MSY. *The level of effort that is being applied at present is also lower than the estimated effort level at MSY.* The derived maximum sustainable economic rent is Tk. 14.95 billion which is much higher than the estimated total cost.

This indicates that *the sector has not reached the open access equilibrium level and the marine fishery is not overexploited. In the absence of any evidence of overfishing or overcapacity the potential for the marine fisheries sector in Bangladesh is tremendous*

since there is still a large scope for applying more efforts in the exploitation as well as development of the sector.

Table 4.1
Estimation Results

Maximum Sustainable Yield (MSY)	642,130 tonnes	Actual Yield, 1998 310,000 tonnes
Effort at MSY	101,442 horsepower	Actual Effort, 1998 71,000 horsepwoer
Total Cost at MSY	US$ 337.7 mln	
Total Revenue at MSY	US$ 648.77 mln	
Economic Rent at MSY	US$ 310 mln	More than 4 times higher than marine fisheries GDP (US $79.95 mln), 1998

V. POLICIES TO PROMOTE SUSTAINABLE MANAGEMENT OF MARINE FISHERIES IN BANGLADESH

Bangladesh is a country where fisheries sector does not receive almost any targeted support beyond the general incentives allowed to export-oriented industries. The only one which could be identified relates to the marginal VAT refund on fuel. The sector does not receive any "cost reducing" or "revenue enhancing" subsidies in addition to the general export promotion incentives which have been introduced basically to reduce the anti-export bias otherwise prevailing in the *effective rate of* protection (ERA) structure in Bangladesh economy. Thus, the study reveals that the general incentive package initiated under the trade liberalization programme, till date, did not have any detrimental effect on the country's fishing capacity and fishing practice. Rather it is evident from the analysis that the sector needs proper management so that the huge resource potential which the sector holds can be exploited on a sustainable basis to the benefit of a large number of people whose livelihood are related to this sector.

In this context, following are some of the specific measures which may be considered.

i. The management of the fisheries sector of Bangladesh should be informed by a holistic approach which takes into account all factors (economic, social and environmental) affecting its fish supply, fish stock and fishing capacity. Such an approach should also take the country's obligations under various international agreements as well as regional cooperation arrangements.
ii. Bangladesh needs to improve its management information system (MIS) relating to the fisheries sector in order to dynamically assess the state of the sector, and the costs and benefits resulting from adjustments in fishing capacity.
iii. Bangladesh needs to strengthen its monitoring, control and surveillance (MCS) capacity with a view to stopping the illegal and often unidentified intrusion in its territorial water for fishing. Unrecorded catches may affect sustainability assessment.
iv. Bangladesh needs to improve its system of maintaining records of all vessels and current owners and operators authorized to undertake fishing. This effort should be

coupled with relaxation of the licensing procedure currently in operation which militates against small fishermen.

v. Bangladesh should encourage dissemination of improved fishing practices to minimize by-catch, waste and discard. To this end, investment should be supported to develop necessary trade-supportive infrastructure, including construction of cold storages.

vi. In order to avoid overfishing induced by segmentation and rent-seeking behaviour in the market structure, Bangladesh needs to undertake procurement, processing and marketing support programme for the small and marginal fishermen involved in marine fishing.

vii. Bangladesh should seek international support in order to strengthen its institutional capacity relating to management of marine fishing activity.

Bangladesh is a classical example which *supports the counter-factual proposition* that in the absence of market distorting subsidies or preferential fishing agreements, a country may improve its foreign revenue from exports and still maintain its sustainable fish stock. It goes without saying that the countries which provide enormous subsidies to its fishing sector are by design violating the "rules of the game" of the market place to penalize development efforts of low income countries like Bangladesh. *In fact, the findings of the present study, call for redirection of the resources currently channeled as fisheries subsidies in the developed countries as concessional assistance to LDCs like Bangladesh for promotion of globally sustainable fisheries which would maximize public welfare*.

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Annex

Table A1

Fishing Efforts in Marine Fisheries (in horse power)

Year	*Fishing Crafts Used in Marine Fisheries*			*Horse Power of Fishing Boats*			
	Trawler	*Mechanised Boats*	*Non-Mechanised Boats*[*]	*THP = Number of Trawlers ´ 400*	*MBHP = Number of MB ´10*	*NMBHP = Number of NMB ´1*	*Total Horse Power*
1984	67	3300	6200	26800	33000	6359	66159
1985	45	3137	6559	18000	31370	6559	55929
1986	49	3132	6461	19600	31320	6461	57381
1987	52	3317	14014	20800	33170	14014	67984
1988	50	3317	14014	20000	33170	14014	67184
1989	52	3317	14014	20800	33170	14014	67984
1990	54	3317	14014	21600	33170	14014	68784
1991	60	3317	14014	24000	33170	14014	71184
1992	49	3317	14014	19600	33170	14014	66784
1993	51	3317	14014	20400	33170	14014	67584
1994	53	3317	14014	21200	33170	14014	68384
1995	53	3317	14014	21200	33170	14014	68384
1996	55	3317	14014	22000	33170	14014	69184
1997	61	3317	14014	24400	33170	14014	71584
1998	60	3317	14014	24400	33170	14014	71184

Source: GOB, 1999 and own calculation.

THP Trawler horsepower

MBHP Mechanised boat horsepower

NMBHP Non-mechanised boat horsepower

Table A2

Actual and Estimated Yield of Marine Fish

Year	*Y (000)*	*f(000)*	*Y/f*	*Est Y/f*	*Est Y (000)*
1984	188	66	2.84	2.65	175.25
1985	207	56	3.70	2.73	152.62
1986	218	57	3.80	2.71	155.93
1987	227	68	3.34	2.64	179.12
1988	233	67	3.47	2.64	177.43
1989	239	68	3.52	2.64	179.12
1990	242	69	3.57	2.64	178.70
1991	242	71	3.40	2.61	185.77
1992	250	67	3.74	2.64	176.58
1993	260	68	3.85	2.64	178.28
1994	270	68	3.95	2.63	179.96
1995	279	68	4.08	2.63	179.96
1996	275	69	3.97	2.63	181.63
1997	273	72	3.81	2.61	186.59
1998	310	71	4.35	2.61	185.77

Table A3
Regression Results

R square = 0.0095
Standard Error = 0.376
Number of Observation = 15
Intercept = 3.165
X Variable = 0.0000078

Table A4
Expenditure of Fishing Boats

Expenditure	Cost
Annual expenditure of a fishing trawler (TK mn)	**15.7**
Fuel	5.5
Salary and Wages	2.0
Repair and Maintenance	1.5
Selling Expenses (container, freight, packing, inspection fee)	2.0
Interest on Bank Loan	0.6
Inter-company Interest	0.9
Insurance Premium	0.4
Depreciation	1.0
Administrative Expenses (Shore Office Expenses)	1.6
Miscellaneous	0.2
Expenditure for a 10 day trip per mechanised boat (Tk)	**42500**
Fuel	17500
Stationary	5000
Ice	5000
Food	3500
Boat Rent	5000
Maintenance	1500
Miscellaneous	5000

Source: Field visit.

Table A5

Price of Marine Fish, 1998

	Q (tonnes)	P (TK/kg)	P×Q (TK mn)	Weighted price (TK/kg)
Exported Fish	25394	578	14.68	
Other exportable fish	55611	123	6.84	
Other fish	228792	60	18.59	
Total	309797	638	60.55	129.47

Source: GOB, 2001

Table A6
Estimated Total Costs and Total Revenue (Billion)

Year	*Total costs*		*Total revenue*		*Rent*	
	Taka	*US $*	*Taka*	*US $*	*Taka*	*US $*
1984	10.58	0.42	22.69	0.91	12.11	0.49
1985	8.94	0.34	19.76	0.76	10.81	0.42
1986	9.18	0.31	20.19	0.68	11.01	0.37
1987	10.88	0.36	23.19	0.76	12.31	0.40
1988	10.75	0.34	22.97	0.74	12.22	0.39
1989	10.88	0.34	23.19	0.72	12.31	0.38
1990	10.85	0.33	23.14	0.70	12.30	0.37
1991	11.39	0.32	24.05	0.67	12.66	0.35
1992	10.69	0.28	22.86	0.60	12.18	0.32
1993	10.81	0.28	23.08	0.59	12.27	0.31
1994	10.94	0.27	23.30	0.58	12.36	0.31
1995	10.94	0.27	23.30	0.58	12.36	0.31
1996	11.07	0.27	23.52	0.58	12.45	0.30
1997	11.45	0.27	24.16	0.57	12.71	0.30
1998	11.39	0.25	24.05	0.53	12.66	0.28