ANALYSIS OF FISH CONSUMPTION AND POVERTY IN BANGLADESH

Kazi Ali Toufique

Bangladesh Institute of Development Studies
www.bids.org.bd

BIDS-REF Study Series No.15-01

ANALYSIS OF FISH CONSUMPTION AND POVERTY IN BANGLADESH

Kazi Ali Toufique

Bangladesh Institute of Development Studies (BIDS)
E-17 Agargaon, Sher-e-Bangla Nagar
GPO Box No.3854, Dhaka-1207
Bangladesh

Analysis of Fish Consumption and Poverty
in Bangladesh

Kazi Ali Toufique
Research Director, BIDS

Published by

The Bangladesh Institute of Development Studies
E-17 Agargaon, Sher-e-Bangla Nagar
GPO Box No.3854, Dhaka-1207

E-mail: publication@bids.org.bd
Fax: 880-2-8141722
Website: www.bids.org.bd

First Published March 2015

Price: Tk. 100.00; US$ 12

Typesetting and Layout

Ms Amena Khatun

Printed in Bangladesh at Panguchi Color Graphics, 117 Fakirapool, Dhaka

CONTENTS

List of Tables and Figures

FOREWORD

This research study was funded by the BIDS Research Endowment Fund (REF) which provides a window for the BIDS researchers to conduct policy oriented research on priority development challenges facing Bangladesh.

In 2009, BIDS received Tk. 200 million from the government to create the REF to carry out policy research at the Institute. The creation of BIDS-REF has significantly enhanced our scope of conducting institutional research. Under the BIDS-REF, several research studies have been initiated with the expectation that this will enable the researchers to bring their knowledge into the mainstream of development research and evidence-based policy making in the country through conducting policy relevant works.

These research studies are included in the Annual Research Programmes (ARPs) of BIDS which are prepared every year through a rigorous and participatory process in consultation with the government, civil society, private sector and other concerned stakeholders. As such, several of these studies are undertaken in response to emerging challenges and/or at the request of the government and other agencies.

This is for the first time that BIDS is publishing the BIDS-REF study reports as a part of its commitment to establishing transparency and accountability to its stakeholders including fellow researchers and policymakers who are working towards promoting evidence based policies in Bangladesh. I hope the study report will be useful to all stakeholders concerned with the theory and practice of development in general and of Bangladesh in particular.

I would like to express my deep appreciation to all my colleagues in BIDS who have cooperated and contributed to the preparation and publication of these research studies. I would also like to express my deep gratitude to the Hon'ble Minister of Planning and Chairman of BIDS Board of Trustees and its distinguished members who are providing continuous guidance and support to BIDS in the effort to further concretising its long term vision of being part of a process that places BIDS firmly on the level of engagement in furthering better research and better policy leading to better Bangladesh.

March 2015

Mustafa K. Mujeri
Director General

ABSTRACT

Aquaculture has grown in leaps and bounds in the last couple of decades in Bangladesh. This is welcomed by most as increasing fish production is expected to contribute to enhancing food security in a country becoming more vulnerable by fragile fisheries resource systems where catches from the wild have been steadily declining. This transformation characterised by the domination of non-farmed by farmed fishes is poorly understood in terms of changes in production, consumption and livelihoods and as a result often misguides towards adopting inappropriate strategies. Several questions remain insufficiently answered. What are the major changes in consumption pattern in terms of fish species? Are households increasingly consuming more farmed species? Which ones? Is the growth in aquaculture helping the poor consume more fish? What is the extent and pattern of substitution of non-farmed species by farmed? Some attempts have already been made in the literature to answer these questions but they are limited in scope as they are based either on unrepresentative or on dated or on cross-section data. This report attempts to answer these questions by analysing fish consumption data collected in Household Income Expenditure Surveys carried out in 2000, 2005 and 2010 in Bangladesh. We have found that rapid expansion of commercial aquaculture pegged down fish prices, resulting in increased rates of fish consumption by extreme poor and moderate poor consumers and those in rural areas. The capture fisheries still play a very important but unrecognised role in terms of consumption although this role is fast declining. Aquaculture has helped the poor households to increase fish consumption although they continue to consume proportionately more non-farmed fishes as compared to the non-poor households. These outcomes are closely linked to the pro-poor nature of national economic growth during this period. However, the impact of this growth in farmed fishes on capture fisheries still remains unclear. Aquaculture growth has been encroaching common fishing rights and perhaps stunting the growth of small-indigenous species (SIS) which are vital source of rich nutrients for the poor. Steps should be taken not only to develop the aquaculture sector in a planned way but also to manage the capture fisheries which are increasingly under threat from several strains.

CHAPTER 1
INTRODUCTION

The fisheries of Bangladesh have gone through a fundamental transformation. While capture fisheries used to provide most fish for consumption to the households, the aquaculture sector now fuels fisheries growth in Bangladesh. Between 1984 and 2011, the culture fisheries sector grew at a rate of almost 10 per cent per year, whereas the capture fisheries grew at 3 per cent. However, the implications of this change are pervasive and not only very thinly studied but also poorly understood. This transformation has changed the nature of livelihoods based on fisheries, the type and complexity of fishing gears traditionally used in diverse, complex fisheries systems and above all the composition of fishes consumed by the households. Most importantly, we do not know how this transformation has changed the supply of nutrition to the households (Kawarazuka and Béné, 2010,2011, Roos *et al*. 2007) or the extent the poor has benefited from increased production of farmed fishes. It has been found that income and price elasticity of fish consumption are higher for the poor households as compared to the rich (Dey *et al*. 2010). Thus, if population growth and per capita incomes in Bangladesh increase as anticipated and increases in fish production fail to keep pace, poorer sections of the population will be disproportionately negatively affected by rising prices (Dey *et al*. 2010).

While there are convincing reasons to believe that growth in capture fisheries helps reduce poverty, no such persuasive argument can be made for growth in aquaculture. The benefits derived from capture fisheries are relatively straightforward; they are routed mainly through access. If access of the fishers to fishing grounds is ensured, other things remaining constant, the well-being of the fishers would improve. It is therefore important to check whether the growth that is taking place in the aquaculture sector in Bangladesh is helping the poor.

Unlike the capture fisheries, the benefits from growth in aquaculture spread indirectly through different channels or pathways and cannot be easily ascertained (Belton and Azad 2012, Belton *et al*. 2012). Stevenson and Irz (2009) have identified as much as four channels through which aquaculture can affect the poor. First, the poor can consume more fish because of higher growth and lower price of fish. This is the direct impact of aquaculture growth on poverty, food security and consumption. Second, new resources are employed for the production of fish (for example rice fields in Mymensingh converted to fishponds, see Ali and Haque 2011). Third, there would be new entrants in the sector (Belton *et al.* 2012). Finally, more factors of production will be used across the two ends of the value change. People will be employed in the seed and feed markets, and in the distribution linkages generated by the input and output markets.

In this report we analyse fish consumption data collected by the Bangladesh Bureau of Statistics for its Household Income and Expenditure Survey (HIES) in 2000, 2005 and 2010. The households are classified into various poverty groups such as extreme, moderate and non-poor households. The fishes are categorized into those coming primarily from the inland capture, primarily from inland culture and primarily from marine sources. This interface between poverty groups and sources of fish helped us to determine whether the growth of the aquaculture sector has been pro-poor. This analysis is unique in utilising a nationally representative dataset for this purpose, and in drawing explicit links between the outcomes of aquaculture growth and wider changes in a national economy, and contributes to debates in Bangladesh and more widely on whether the effects of aquaculture's growth have been pro-poor.

CHAPTER 2

SPECIFIC RESEARCH QUESTIONS

This report makes an attempt to answer the following questions:

- Are the poor households benefiting from the structural transformation which is characterised by the fact that more fish is now coming from culture fisheries as against the capture fisheries in Bangladesh?
- Are they consuming more fish now as compared to the past?
- Are prices of fish becoming lower?
- What species of fish are contributing most towards consumption of fish by the poor households? Are relatively cheaper fishes such as Pangas or Exotic Carps increasingly consumed more by the poor?

The research questions raised above are, of course, addressed in the literature (Belton *et al*. 2011) but these studies have some limitations. For example, they are often done in the context of impact evaluation of aquaculture development projects (Jahan *et al*. 2010), or from case studies (Rand and Tarp 2009). Often, the differentiation amongst the poor is ignored and fish consumption is compared at various income and expenditure levels rather than poverty or other socio-economic groups (Dey 2000). This study has several advantages over the studies mentioned above. First, by using HIES data, the results will be nationally representative and hence will not be limited to any specific part of Bangladesh. Second, data from three consecutive HIES surveys (2000, 2005 and 2010) will be used and hence we will be able to capture changes in consumption over the decade of the 2000s. Third, we will be classifying the households in terms of their poverty status (extreme poor, moderate poor and non-poor) not by income quartiles. This categorisation of the households is analytically more meaningful than categorisation by income quartiles.

CHAPTER 3

IMPORTANCE OF FISH IN BANGLADESH

Bangladesh performs poorly on a range of indicators of food and nutrition security (HKI 2011), and malnutrition is estimated to cost the country $1 billion per year in terms of economic productivity forgone (Howlader *et al.* 2012). In this context, changes affecting supply and consumption of fish, whether positive or negative, can have major public health implications. Fisheries are the most important supplier of high quality protein, essential fatty acids and micronutrients in Bangladesh (Roos *et al.* 2007b).

Fish provides about half of animal source of calorie (Table 3.1) and more than half of animal source of protein in Bangladesh (Table 3.2). It also provides proportionately more calorie and protein to rural households than the urban households. Also, between 2005 and 2010, the contribution of fish to animal source of protein has been increasing in absolute and relative terms in both national and rural areas.

Table 3.1

Relative Contribution of Fish to Total Calorie Intake, 2005-2010

	National		Rural		Urban	
	2010	2005	2010	2005	2010	2005
Meat/Poultry/eggs	26.6	22.9	23.9	21.3	31.3	26.2
Fish	51.9	48.2	53.4	48.8	49.3	46.9
Milk/Milk Produce	21.5	28.9	22.6	29.9	19.4	26.9
Total animal sources	100.0	100.0	100.0	100.0	100.0	100.0

Source: HIES reports 2005 and 2010.

Table 3.2

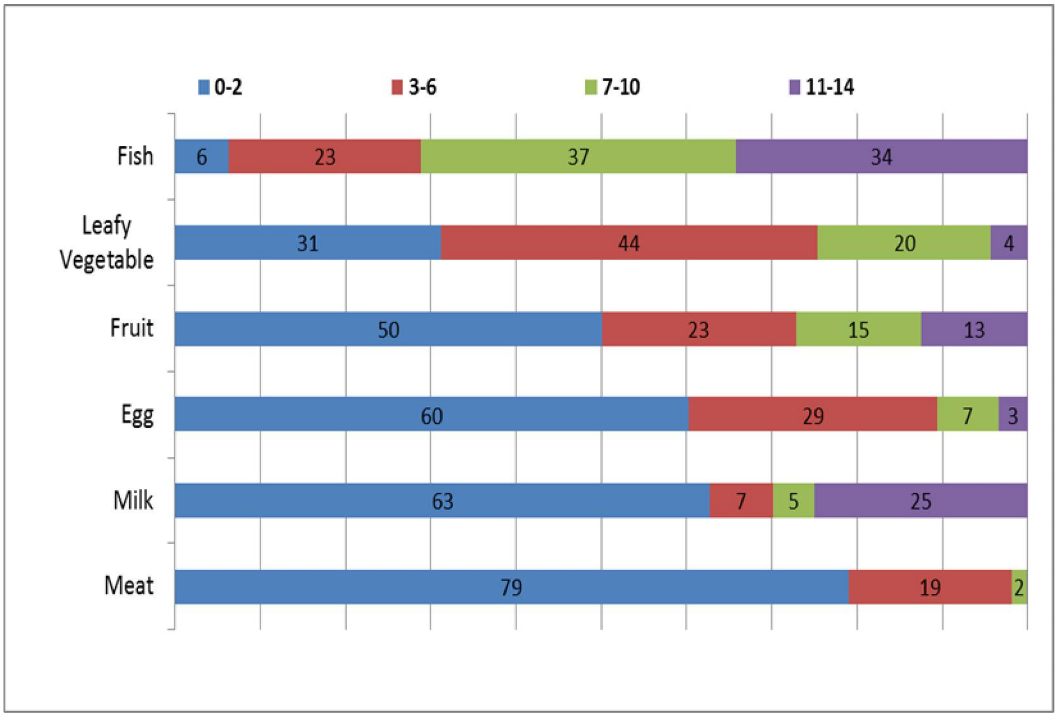
Relative Contribution of Fish to Total Protein Intake, 2005-2010

	National		Rural		Urban	
	2010	2005	2010	2005	2010	2005
Meat/Poultry/eggs	33.8	32.1	29.9	29.5	40.9	37.7
Fish	58.9	62.4	62.5	64.9	52.3	57.2
Milk/Milk Produce	7.3	5.5	7.6	5.6	6.8	5.2
Total animal sources	100.0	100.0	100.0	100.0	100.0	100.0

Source: HIES reports 2005 and 2010.

Fish accounts for the second highest share of food expenditures after rice (Minten *et al.* 2010), and is the most frequently consumed animal-source food across all social strata, as well as the most frequently consumed nutrient rich food (Figure 3.1). In addition to providing micronutrients which are difficult to obtain from plant-based foods in adequate quantities (Murphy and Allen 2003), consumption of fish and other animal-source foods increases the bioavailability and absorption of nutrients from plant-based components of the diet (Neumann *et al.* 2001). The very high frequency of fish consumption in Bangladesh, as compared to intakes of all other animal-source foods, makes this dietary function "irreplaceable" (Kent 1987). Given this context, in the following analysis we consider increases in individual consumption of fish to be de facto positive as, unlike many other foods, there are very few negative effects associated with high levels of consumption (Tacon and Metian 2013).

Figure 3.1: Percentage of Households Consuming Nutrient Rich Foods on 0-2, 3-6, 7-10, or 11-14 days within a Two Week Period



Source: Derived from *Household Income and Expenditure Survey 2010* Dataset.

CHAPTER 4

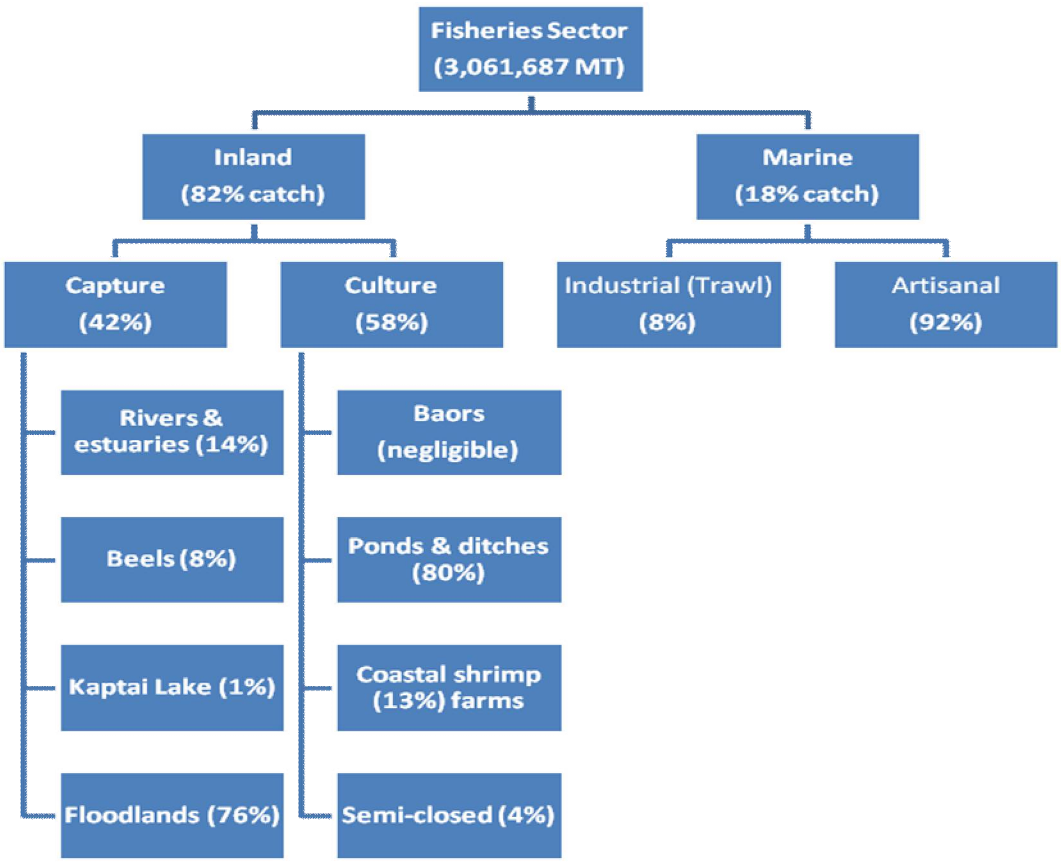
FISHERIES IN BANGLADESH

Bangladesh's fisheries sector (capture fisheries and aquaculture combined) contributed 4.4 per cent to national gross domestic product (GDP) and 25 per cent to agricultural GDP in 2012 (MoF 2012), with a total output of 32.62 million tonnes (DoF 2013). The value of Bangladesh's aquaculture products alone amounted to $3.37 billion in 2011 (FAO 2013).

Shrimp, grown mainly from brakishwater aquaculture, constitutes the bulk of the exports from Bangladesh but white fish is also exported to meet the demands of the Bangladeshi expatriates. Hilsha is exported to India. About 8 per cent of the total population depends on this sector for livelihood (Planning Commission 1978) and about 73 per cent of households were involved in subsistence fishing in the floodplains in 1987/88 (DOF 1990). Around 10 million people are also involved in fish marketing and fish processing (Capistrano *et al.* 1996). Thus the involvement of a large section of the population on this sector is clear. Besides, the significance of fresh water fishes as a major source of micronutrients for the poor has been emphasized (Kawarazuka and Béné 2010, 2011, Roos *et al.* 2007). If the growth of this sector is hindered, it will not only affect the livelihoods of a large number of rural populations but it will also affect nutrition of many poor households.

Bangladesh, like most tropical countries, derives fish from a large number of complex natural systems. These are related, intertwined, and affect each other and produce not only fish but also other eco-system services. This sector is endowed with more than 260 species of fish (Rahman 1989) and about 56 species of prawn (Kibria 1983). Estimates range to over 500 species when the close offshore river dependent fishes of the Bay of Bengal are considered (Minkin *et al.* 1997). These sources of fish are classified broadly into three categories: capture fisheries, culture fisheries and marine fisheries (Figure 4.1). The term capture (open) fishery is used to refer to the harvesting of "fish and prawn populations in the open inland water systems (that are) self-reproducing and self-sustaining" under ideal conditions (Ali 1989:38). Capture fisheries in Bangladesh are generally characterised by labour intensive small-scale activities, organised at household or community level (Islam and Chuenpagdee 2013). Seasonal fishing in flooded areas is an important component of marginal and landless household's livelihoods (Lewis 1997), with more than 70 per cent of rural households reported to participate in fishing for subsistence, income, or both (Halls *et al.* 2008, Shankar *et al.* 2004, Thompson *et al.* 2002). Participation in fisheries is high and the bulk of the catch is consumed locally. By-catch is insignificant as practically all fish caught are used. This means that their benefits are more accessible and widely spread (Welcomme *et al.* 2010:2118). The key issue with the inland capture fisheries is to ensure that this "self-reproducing and self-sustaining" property is maintained after human intervention over time. This "self-reproducing and self-sustaining" property of the resource system has been threatened since long. Aquaculture, on the other hand, refers to the breeding, rearing and harvesting of plants and animals in all types of water environments including ponds, rivers, lakes and the ocean (http://www.nmfs.noaa.gov/aquaculture/what_is_aquaculture.html, last accessed on 27 December, 2012).

Figure 4.1: The Fisheries Sector of Bangladesh (2010-2011)



In 2010-11, 3,061,687 MT of total fish were produced in Bangladesh, of which 82 per cent came from inland sources. Of the inland sources, 58 per cent of the total catch came from the culture sector and the rest from the capture fisheries. Catch from the capture fisheries comes from at least four sources: river and estuaries, Beels, Kaptai Lake and the Flood Lands.[1] It is important to note that more than three-quarter of capture fish

[1] DoF also reports catches from the Sunderbans. The amount of fishes caught from the Sunderbans and we have included it in the total catch.

comes from the flood lands and it grew at an annual rate of 5.24 per cent during 1984-2011.

There are four sources of fish from the culture sector: baors, ponds and ditches, commercial shrimp farms and semi-closed flood plains. Baors or oxbow lakes account for a negligible amount of fish catch. The source of most fishes in the culture sector is ponds. In 2011, 80 per cent of total inland culture fish came from the ponds. Commercial shrimp farms account for about 13per cent of total culture fish catch. These are mostly exported. A new category of resource system has been included in 2009-2010. This has been named Semi-closed (Flood Plain). This represents what Toufique and Gregory (2008) have termed Flood Plain Aquaculture (FPA) which involves closing the outlets of fish in the flood plains and then stocking the enclosed water with fingerlings of Exotic and Indian Major Carps. FPA has been developing very fast in various parts of Bangladesh (Sultana 2012, Dey *et al.* 2012). Although the rapid growth of aquaculture has resulted in large increases in the aggregate volumes of fish produced, much of their areal expansion has taken place through the enclosure of seasonal floodplains which formerly supported open access fisheries during the monsoon. These changes have resulted in reductions of wild fish biodiversity and biomass, as well as exclusion of poor fishers from access to them (Sultana 2012). The intensification of agriculture, water control initiatives, road building, urban encroachment, pollution and increasing fishing effort have also been responsible for major declines in the productivity of inland capture fisheries (Sultana 2012, Belton *et al.* 2011, Halls *et al.* 2008, Lewis 1997, Ali 1989).

Marine fisheries represented about 18 per cent of total catch. Most of it comes from marine artisanal source (92 per cent).

CHAPTER 5

METHODOLOGY AND DATA

This report is based on the analysis of unit record data of the three Household Income and Expenditure Surveys (HIES) conducted in 2000, 2005 and 2010. HIES is a five yearly nationally representative living standards measurement survey, conducted by the Bangladesh Bureau of Statistics (BBS). Food consumption data constitutes the central part of this exercise.

Sampling design for the HIES of 2000 was slightly modified from that of the HIES 1995-96 sampling design. A two-stage stratified random sampling technique was followed under the framework of Integrated Multipurpose Sample (IMPS) design developed on the basis of Population and Housing Census 1991. This design consisted of 372 Primary Sampling Units (PSU) throughout the country. There were 252 rural and 120 urban PSUs. The PSU was defined as contiguous two or more enumeration areas (EA) used in the Population and Housing Census 1991. Each PSU comprised around 250 households. The number of PSUs in the Statistical Metropolitan Areas (SMA's) was doubled in the HIES-2000 making it 140 instead of 70 as considered in the HES 1995-96. At the same time, the number of households of each of these PSUs was made half i.e. only 10 (in 1995-96 it was 20) households were selected from each of these PSUs. Thus the number of sample households remained the same for both the surveys, but the number of PSUs was increased from 371 to 442 in the HIES 2000.

For the HIES of 2005, the IMPS design consisted of 1,000 Primary Sampling Units (PSUs) throughout the country. There were 640 rural and 360 urban PSUs in the sample. Each PSU comprised of around 200 households. In the first stage, about a half, 504 to be exact, of the total 1,000 IMPS PSUs were drawn. These PSUs were selected from 16 different strata. There were 6 rural, 6 urban and 4 SMA strata. In the second stage, 20 households were selected from each of the rural PSUs and also PSUs located in the municipal areas and SMAs. Thus, the HIES is a sub-set of the IMPS.

In the 2010 HIES, several changes were made as compared to the procedure followed for sampling for the HIES 2005. There were 1,000 PSU in total, out of which 640 were rural and 360 were urban. In the first stage, about one half, 612 to be exact, out of the total of 1,000 IMPS, PSUs were drawn**.** These PSUs were selected from 16 different strata. There were 6 rural, 6 urban and 4 PSUs located in the municipal areas and SMAs. The survey was completed in one complete year (1 February 2010 to 31 January 2011) to capture the seasonal variations in a cycle of one year in income, expenditure and consumption pattern. This entire period was divided into 18 terms. In each term, a total of 34 PSUs were covered to collect data from a total of 680 sample households. In the HIES 2010, 12,240 households selected - 7,840 from rural area and 4,400 from urban area. The number of sample PSUs, Households and Population covered in HIES of 2000, 2005 and 2010 is shown in Table 5.1.

Table 5.1
Distribution of Sample Households in HIES 2000, 2005, 2010

	2000	2005	2010
Rural	5,040	6,400	7,840
Municipally/ Urban	1,000	2,780	4,400
SMA/ National	1,400	400	12,240
Total	7,440	10,080	24,480

Source: Various issues of HIES.

In 2010, each enumerator collected information on food consumption of the households for 14 days by paying 7 visits. Information on food consumption of previous two days was collected during each visit. Female facilitators were recruited from the resident of the area where enumeration was taken place. Her task was to ease the work of the enumerators. Engagement of female enumerators yield very effective results as access to the household became easier for collection of data, particularly of food consumption data, from the housewife of the sample household.

Food has been categorised into several units: cereals (rice, wheat), potato, vegetables (leafy vegetables), pulses (masoor, khesari), milk/milk products, edible oils (mustard, soybean), meat, poultry and eggs (mutton, beef, chicken/duck, eggs), fish, condiments and spices (onion, chillies), fruits, sugar/gur, miscellaneous (tea, soft drinks, bread, biscuits, betel nut, betel leaf, etc.).

Food consumption data constitutes the central part of this exercise. All the data presented in this report on fish consumption was extracted from the survey's food consumption module for each of the three HIES surveys.

5.1 Classification of Fish Species

The relative decline of inland capture fishes in the fish consumption basket of the households in Bangladesh requires further analysis. For this, we need to separate out fishes that belong to various sources such as marine or inland capture or aquaculture. We also need to do this classification for understanding whether the growth in aquaculture has been pro-poor.

Any classification has advantages as well as disadvantages and the classification done by the HIES is no exception. In most cases, the classification done by the HIES surveys, the species are combined from a biological perspective and follows more or less a standard practice (e.g. Indian Major Carps or Exotic Carps or combined and not mixed between them or with other species). In other cases, they are grouped on the basis of comparability in terms of consumption (e. g. Puti/Big Puti/Tilapia/Nilotica). Whatever be the case, the sources of fish (inland capture or aquaculture) are often merged without any specific reason. In some cases, some of the species that are combined can be found in inland capture fisheries as well as in the culture fisheries (e.g. Indian Major Carps). If, therefore, one is interested to purely and completely classify fish in terms of its origin (capture or culture), this is not possible from HIES data. Some species such as koi (climbing perch) are now almost entirely grown in fish farms but this was not the case a decade ago. Thus even when some form of classification principle is determined or not required (in the case of koi, for example), it has to be time-contingent. Koi, for example, should be considered as coming only from capture fisheries before its farming started in full scale in Bangladesh. As a result, different studies have classified fishes differently, depending on purpose and availability of data (Dey 2000, Dey *et al.* 2008). In primary surveys, where the researcher has relatively more control over the information collected and has a well-defined objective, classification becomes less of a problem. This problem is more acute with secondary data such as the HIES. Having said this, it has to be emphasized that the main advantage of HIES data, however, is that the classification of fishes has not changed in the survey years considered in this report. The analysis would have been otherwise impossible if this were not the case.

Based on a review of literature, most of the categories of fish listed by HIES can be identified as containing fish originating primarily from either aquaculture or inland capture fisheries, or marine/estuarine capture fisheries (Hossain *et al.* 2013, Ali *et al.* 2012, DoF 2012, Belton *et al.* 2011, Mome 2007, Rahman *et al.* 2006, Thompson *et al.* 2002) (Table 5.2).

Table 5.2

Re-classification of Fish Reported in HIES Surveys

Primarily inland capture	Primarily aquaculture	Inland capture and aquaculture	Primarily marine
1. Baila/ Tapashi (Medium catfishes and gourami) 2 Shoal/ Gajar/ Taki (Snakeheads) 3. Mala-kachi/ Chala-chapila (Small indigenous fishes) 4. Tangra/ Elfish (Small catfishes and eels) 5. Shrimp (Prawn/shrimp) 6. Other ***7. Pangas/ Boal/ Air*** (Large catfishes) ***8. Koi*** (Climbing perch)	1. Rui/ catla/ Mrigel/ Kal baush (Indigenous carp) 2. Silver carp/ Grass carp/ Miror carp (Exotic carp)	1. Puti/ Big Puti/ Tilapia/ Nilotica (Barbs and tilapia) 2. Koi/ Magur/ Shinghi/ Khalisha	1. Sea fish 2. Hilsha 3. Dried fish

5.1.1 Primarily Inland Capture

Baila/Tapashi, Shoal/Gajar/Taki, Mala-kachi/Chala-chapila and Tangra/ Elfish are almost entirely found in capture fisheries. HIES survey uses the word shrimp but actually they represent primarily prawn caught from the wild. Shrimp is very largely comprised of small shrimp/prawn from capture sources; the contribution of the farmed part (freshwater Golda or saline water Bagda) can be ignored. We have also observed the distribution of consumption of shrimp by districts from the HIES data and have found that this is widely consumed by households from a large number of districts. In DoF data, the category "others" represents only 1.47 per cent of all fish from ponds (where only a handful of species are farmed) but, as already mentioned, it makes a very large proportion for capture fisheries. Ponds account for almost half of all inland fishes and 83 per cent of inland culture fishes. Thus "other" fishes reported in HIES data originate mainly in the capture fisheries.

Technological and market developments over the period during which the three surveys were conducted mean that several species of fish that originated primarily from inland capture fisheries in 2000 were also farmed in large quantities by 2010. Pangas and Koi (written in bold and italic) were almost entirely available from capture sources in 2000 and hence we have considered them as primarily capture fish in 2000. Koi was introduced towards the beginning of 2000 (Hasan *et al.* 2010). For the later years of 2005 and 2010, we have defined Pangas and Koi as primarily aquaculture fishes as production from the fish farms slowly made up most of these fishes. They are considered as capture fishes only for the year 2000.

5.1.2 Primarily Inland Culture

Silver carp/ grass carp/ miror or exotic carps are almost entirely produced in the fish farms. Rui/ katla/ mrigel/ kal baush or the Indian major carps are now primarily produced in the fish farms. DoF production figures show that only 13 per cent of Indian major carps come from the capture fisheries (rivers, beels, etc.). As already mentioned, we will also consider Pangas and Koi as primarily culture fishes for the two survey years of 2005 and 2010.

5.1.3 Primarily Capture and Culture

We have described the fishes that comprise the group of fishes called Puti/ Big Puti/ Tilapia/ Nilotica. This group comprises a very significant part of capture fishes comprising of Jat puti although its position is increasingly supported by Tilapia/Nilotica and Thai Sarpunti which are farmed. Puti is the single most widely consumed capture fish, and much of it is caught using push nets in the floodplains so it is probably underrepresented in catches from major landing centres. It would be safe to assume that all puti is capture fish and large puti/Sarpunti and tilapia are culture fish. We will therefore consider this group as inland capture and aquaculture.

Koi/Magur/Shinghi/Khalisha is not easily separable because it has unknown amount of farm and non-farm component. It represents a very small part of total fish consumption, about 1 per cent in 2010. According to DoF data, most of Shinghi and Magur (82 per cent) in 2010 originated in pond (the rest from beel and Kaptai Lake). Khalisha is a capture fish not reported separately in DoF data. The species Koi is not popularly known. Since we could not find the individual weights of this group of fishes from DoF or other secondary data, based on the limited information given above we have considered this group as representing both inland capture and aquaculture fishes.

5.1.4 Primarily Marine Capture

In this study we are interested mainly in inland fresh water fishes coming either from inland capture or aquaculture. However, consumption of some marine species is also reported by HIES data. Most of the marine fishes are uniquely classified as selfish. Dried fish in Bangladesh is mainly comprised of marine fishes. Fish drying is carried out in some selected coastal areas and inland depressions of Bangladesh where modern preservation facilities and good infrastructure for transportation are absent (Banglapedia, http://www.bpedia.org/D_0282.php, last accessed on 18/12/2012). Eighty per cent of the "dry fish" is assumed to originate from marine sources, and 20 per cent from freshwater (Belton *et al.* 2011b:60). Hilsha is problematic in terms of classification. Hilsha is an anadromous fish and caught both in freshwater and in the seas. According to DoF data, the capture component of Hilsha has only once reached half of total Hilsha catch and on the average it represents around a third of total Hilsha catch between 2000 and 2010. We will consider Hilsha as unclassified fish. Thus fishes of primarily marine origin comprise of seafish, hilsha and dried fish.

5.2 Categorisation of Poverty

Since 1995-96, Bangladesh Bureau of Statistics has been using the Cost of Basic Needs (CBN) method as the standard method for estimating the incidence of poverty. This method defines two poverty lines: (i) Lower poverty line and (ii) Upper poverty line.

In order to categorise poverty, the BBS further defines a food and non-food poverty line.

i. Food poverty line

1. A basic food basket of eleven food items (including fish) is selected.
2. The quantities in the basket are scaled according to the nutritional requirement of 2,122 k.cal per person per day.
3. The cost of acquiring the basket is calculated.

This estimated cost is considered as the Food Poverty Line (FPL)

ii. Non-food poverty line

A non-food poverty line is calculated by estimating the cost of consuming non- food items by the households close to the food poverty line. An *upper poverty line* is also estimated by adding together the food and non-food poverty lines.

The extreme poor households are defined as those households whose total expenditures on food and non-food combined are equal to or less than the food poverty line.

The moderate poor households are those households whose total expenditures are equal to or less than the upper poverty line but above the food poverty line.

The non-poor households are those households whose total expenditures are above the upper poverty line.

In the literature the extreme poor households are distinctly categorized as those who need social protection as they are characterised by households headed by female or adverse sex ratio or by presence of disable/ill members. They are “rarely able to take advantage of the productive opportunities emerging from economic growth” (Homes *et al.* 2008:2). On the other hand, the moderate poor households and those just above the upper-poverty line are considered as vulnerable as they can become poor from a small shock or get out of the poverty line threshold because of favourable outcomes. They are often considered as transient poor. There can be movements of the households from each type of poverty to another over a longer term for a many reasons including death of an earning member, illness, bad harvest or sudden loss of entitlements and so on.

Food poverty lines for each successive year is adjusted by the BBS by taking into account food price inflation and the non-food poverty lines are also re-estimated by taking into consideration of the changes in non-food food expenditure.

CHAPTER 6

ANALYTICAL FRAMEWORK

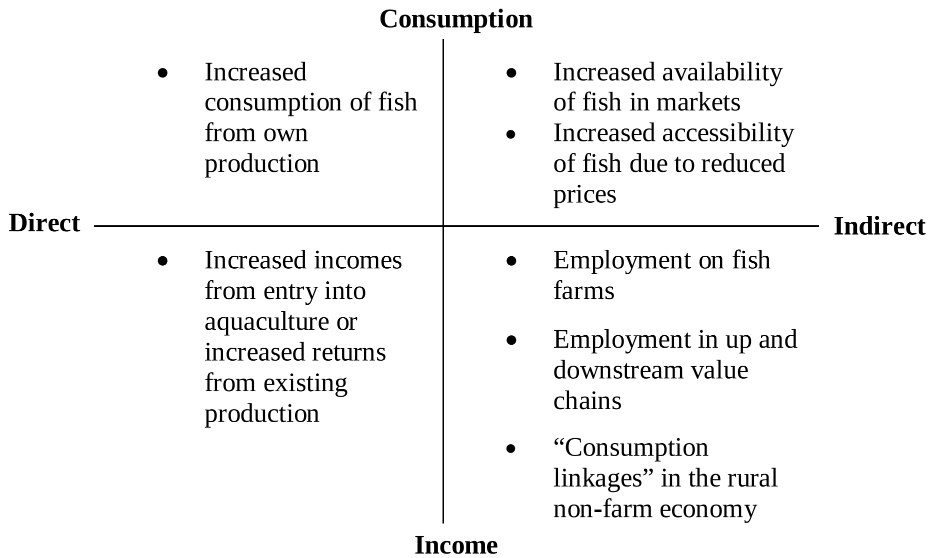
We will first describe the link between poverty and aquaculture and then explain what is meant by pro-poor aquaculture growth.

6.1 Aquaculture-Poverty Linkages

Although aquaculture is widely held to contribute to both poverty reduction and food security (Belton and Little 2011), evidence for this is patchy (Arthur *et al.* 2013), there have been few specific studies of how increases in farmed fish availability affect access and use by poor consumers (Beveridge *et al.* 2013), and the effects of the structural transition in fisheries on low income consumers are poorly understood (Allison 2011). This is apparent in Bangladesh, where it has recently argued that the food and nutrition security implications of the on-going substitution between wild and cultured fish remain unclear (Belton *et al.* 2014b), and where the capacity of aquaculture to meet the consumption needs of poor consumers has long been questioned (Lewis 1997).

Aquaculture has attracted considerable interest as a vehicle for reducing poverty and food insecurity, and a variety of pathways via which the poor might gain from the growth of aquaculture have been identified (Figure 6.1). The main potential benefits stem from improved food supply and/or increased incomes and employment. Benefits may be accessed directly (i.e. by a producer of farmed aquatic products), or indirectly (e.g. through employment in aquaculture value chains, or through increased availability of low-cost fish in local markets) (Edwards 1999). Ahmed and Lorica (2002) emphasise “income linkages”, “employment linkages” and “[food] consumption linkages” as means by which aquaculture can improve food security and reduce poverty. Again, these may be direct (e.g. sale and consumption of self-produced fish by farm households), or indirect (e.g. elasticity effects associated with rising incomes for households adopting aquaculture, or reduced consumer prices due to increased fish supply). Similarly, Stevenson and Irz (2009) identify entry into aquaculture by new producers, employment on fish farms and in associated value chains, and increased supply of fish for consumption by the poor as pathways via which aquaculture may contribute to poverty reduction. A final indirect pathway relates to “consumption linkages” generated by re-spending income from sales of farmed fish on locally produced “non-tradable” goods and services (Delgado *et al.* 2003, Stanley 2003, Kassam 2013).

Figure 6.1: Aspects of Links between Aquaculture and Poverty



Source: Stevenson and Irz 2009, Ahmed and Lorica 2002, Edwards 1999, Kassam 2013.

Ten multi- and bi-lateral donors invested $275 million in 24 aquaculture and capture fisheries projects in Bangladesh between 1990 and 2003 (Karim 1998), and numerous additional large sectoral investments have been made since this time. Development interventions such as these have typically promoted "small-scale" forms of aquaculture, and emphasised direct income and consumption effects on poverty reduction (Belton and Little 2011). Studies which have systematically attempted ex-post impact assessment of such projects have identified broadly positive, if rather modest, effects on household incomes, farm output and food security (Rand & Tarp 2010, Jahan *et al.* 2010, Thompson *et al.* 2006, Hallman *et al.* 2003). Lewis (1997) and Belton *et al.* (2012) have both argued, however, that the ability of the poorest to gain from this type of aquaculture is constrained in Bangladesh due to extremely high levels of landlessness.

Research exploring the relationship between private sector driven commercial aquaculture and poverty has tended to focus on indirect contributions to poverty reduction, with access to benefits by the poor conceptualised as deriving mainly from paid employment (Belton and Little 2011, Beveridge *et al.* 2010, Brummett *et al.* 2008). Belton *et al.* (2012) suggest that the development of commercial "quasi-capitalist" aquaculture in Bangladesh has enabled landless labour to access indirect flows of benefits through employment in ancillary services. Similarly, Toufique and Gregory (2008) report that poor and middle income households in Bangladesh have gained indirectly from the development of commercial aquaculture via new employment opportunities, but that most direct benefits are captured by wealthy landowners. In the Philippines, based on a

Gini decomposition, Irz *et al.* (2007) have found that commercial shrimp aquaculture reduced economic inequality in several coastal villages, again primarily as a result of employment generation effects.

Although these studies are instructive, their reliability and generalizability is somewhat compromised because they are based on case studies and/or limited in geographical scope, and are designed with variable degrees of methodological rigour (Arthur *et al.* 2013). With two exceptions (Irz *et al.* 2007, Hallman *et al.* 2003), the studies referred to above do not explicitly categorize households according to their poverty status, limiting their analytical precision, while the majority of the longitudinal analyses (Rand and Tarp 2010, Thompson *et al.* 2006, Hallman *et al.* 2003) compare data from two time periods only, and thereby fail to capture longer run trends.

Furthermore, no empirical study to date has addressed the indirect consumption pathway identified in the shaded upper right quadrant of Figure 6.1. This represents a major omission. We argue that since the capacity of the extreme poor to benefit directly from aquaculture is constrained by lack of assets, at least in Bangladesh, indirect linkages are likely to be more significant from a poverty reduction perspective. Although significant, the employment opportunities associated with aquaculture are finite and tend to be geographically concentrated. It is through indirect food consumption linkages, therefore, that aquaculture has the potential to impact the largest numbers of poor people. The 'indirect consumption' linkage is the focus of our analysis for the remainder of this paper. While we acknowledge the existence of local complexities and trade-offs in inter- and intra-household distributional impacts resulting from the on-going shift from capture to farmed fish production, our subsequent discussions of whether aquaculture is pro-poor relate principally to this- the "indirect consumption" relationship as expressed at the aggregate national level.

Dey *et al.* (2010) have shown that the income and price elasticity of fish in Bangladesh is greater for poor households than for better-off. This implies that a failure of production increases to keep pace with population growth and rising incomes will disproportionately negatively affect poorer sections of the population if they result in higher fish prices. Conversely, the poor stand to benefit most from any decline in fish prices (in real terms) associated with increasing fish production (Dey *et al.* 2010). Although this insight possesses some explanatory power, it reveals nothing about actual material changes in consumption which have taken place in Bangladesh over the last decade. The present study is therefore unique in addressing whether the growth of aquaculture has been pro-poor in terms of food consumption effects, and in doing so on a nationally representative scale using multi-period data.

6.2 Defining Pro-Poor Aquaculture Growth

There are a number of interpretations of the term “pro-poor growth”. Ravillion (2004) considers growth that reduces poverty by any amount to be pro-poor. Kakwani *et al.* (2004) label this definition “weak,” on the basis that some degree of poverty reduction is characteristic of almost all growth processes. Furthermore, they argue, Ravillion’s definition fails to take into account the proportions in which benefits are distributed between the poor and non-poor, with the result that “a growth episode that gives every rich person $1 million and just 1 cent to a single poor person” could still be conceived of as pro-poor (Grinspun 2009:6). Kakwani *et al.* (2004) propose an alternative two tiered “strong” definition. In this typology, only economic growth which benefits the poor proportionally more than the non-poor can be considered pro-poor. Strong pro-poor growth can be relative; where growth reduces poverty and relative inequality, or absolute; when the absolute benefits of growth received by the poor are equal to, or greater than, the absolute benefits received by the non-poor.

Osmani (2009) critiques both “weak” and “strong” approaches: the first, for similar reasons to Kakwani *et al.* (2004); the second, on the basis of its “potentially counterintuitive implications”, which mean that a low growth rate which benefits the poor proportionately more than the rich would be characterised as pro-poor, while a high growth rate under which the poor benefitted proportionately less but which reduced poverty to a greater extent would not, “even though the poor have actually done better in the latter!” (Osmani 2009:9). An alternative approach is to consider any growth conditions under which the poor fare better than they did relative to some historical “benchmark,” as pro-poor. In other words, in order for growth to be considered pro-poor “from the point of view of the poor, there must be an improvement over business as usual” (Osmani 2009:9). These definitions are summarised in Table 6.1, which also modifies them to fit the concept of “pro-poor aquaculture growth.” As each definition has certain advantages and disadvantages, rather than adopting a specific one, the following analysis evaluates how results correspond to each type of growth.

Table 6.1

Definitions and Characteristics of Pro-Poor Growth

Pro-poor growth type	Pro-poor economic growth characteristics	Pro-poor aquaculture growth characteristics
Weak	Any growth which leads to a reduction in poverty of any size	Growth in aquaculture which leads to an increase in fish consumption for households below the poverty line
Benchmarked	Growth which represents an improvement upon "business as usual" for the poor	Growth of aquaculture which results in fish consumption by the poor increasing at a faster rate than it did in the past.
Strong, relative	Growth under which the incomes of those below the poverty line increase at a faster rate than the incomes of those above it	Growth under which fish consumption among poor consumers grows at a faster rate than fish consumption among non-poor consumers
Strong, absolute	Growth under which the incomes of those below the poverty line increase by a larger amount than the incomes of those above it	Growth under which the quantity of fish eaten by poor consumers increases by a greater amount than the quantity fish eaten by non-poor consumers

CHAPTER 7

POVERTY TRENDS IN BANGLADESH

The following subsections present data on national poverty trends over the period 2000-2010 based on HIES data.

Bangladesh saw a dramatic reduction in the proportion of the population below the upper poverty line between 2000 and 2010, from 48.9 per cent to 31.5 per cent (Table 7.1). Over this period, the extreme poor segment of the population (those living below the lower poverty line) shrunk from 34.3 per cent to 17.6 per cent, while the proportion of the population classed as moderate poor (those between the upper and lower poverty lines) remained almost constant at around 14 per cent. Rural areas lagged behind urban in terms of the proportion of the population classified as poor (35.2 per cent and 21.3 per cent respectively in 2010) (Table 7.1). However, the extreme poverty rate declined slightly faster in rural areas than in urban areas.

Table 7.1

Extent of Extreme, Moderate and Non-poor Households in Bangladesh, 2000-2010

Poverty group	2000			2005			2010		
	Rural	Urban	National	Rural	Urban	National	Rural	Urban	National
Extreme poor (%)	37.9	20	34.3	28.6	14.6	25.1	21.1	7.7	17.6
Moderate poor (%)	14.4	15.2	14.6	15.2	13.8	14.9	14.1	13.6	13.9
Non-poor (%)	47.7	64.8	51.1	56.2	71.6	60	64.8	78.7	68.5

Source: BBS 2007 and 2011.

Bangladesh's wider economy is undergoing a structural transition (Zhang *et al.* 2013). Annual GDP growth averaging nearly 6 per cent throughout the decade 2000-2010 caused poverty to decline by 1.7 per cent per year (BBS 2011). The number of poor fell from 63 million to 47 million during this period. The depth of poverty (the poverty gap index) was also reduced by nearly half, allowing Bangladesh to attain this Millennium Development Goal target five years earlier than expected (World Bank 2013).

The average annual growth in real per-capita consumption was twice as large in rural areas (2.1 per cent) relative to urban areas (0.9 per cent) throughout the decade (World Bank 2013). Bangladesh experienced a modest decline in inequality at the national level over the course of the decade, as measured by the Gini index of real per capita consumption, and inequality in rural areas decreased from 2005 to 2010. As a result, Bangladesh's growth over the entire period was characterised not only by rapid poverty reduction, but by a gradually narrowing gap between rural and urban areas and a stabilised level of inequality relative to other countries in the region (World Bank 2013). Growth was pro-poor from 2005 to 2010, with households below the 70th percentile of the per capita consumption distribution experiencing the largest relative increases in per capita consumption. These improvements occurred in spite of food price shocks in 2007/2008.

The majority of this overall decline in poverty is attributable to increasing rural wages. According to Hossain *et al.* (2013), real agricultural wages approximately doubled between 2000 and 2010. Similarly, Zhang *et al.* (2013) report growth in real rural wages averaging approximately 10 per cent per annum from 2005 to 2010. They argue that this reflects a fundamental shift in the structure of the national economy, where “excess labour in rural areas becomes fully absorbed by the emerging nonfarm sector, initiating a rise in wages”; the “Lewis turning point” (Zhang *et al.* 2013:2). These conclusions are broadly supported by World Bank (2013), which indicates that while total labour income from agriculture grew by only 1.7 per cent per year from 2000 to 2005, it grew 9.8 per cent per year between 2005 and 2010. The same analysis suggests, however, that most of the rural income growth taking place in the second half of the decade came from the self-employed working on their own farms, while income growth among rural day labourers occurred at a more moderate rate (World Bank 2013), although it should be noted that, in practice, most rural households engage in both self- and wage employment (Sen 2003). Rather counter-intuitively, the World Bank attributes this change to the impact of the 2008 food price spike, stating that “higher commodity food prices permeated the economy by increasing the wages of agricultural workers” (World Bank 2013:27). Whatever the root causes of the increase in rural incomes from 2005 to 2010, the high income elasticity of demand for fish in Bangladesh (Dey *et al.* 2010) implies that these changes would be expected to have important implications for fish consumption.

CHAPTER 8

FISH CONSUMPTION TRENDS IN BANGLADESH

The following subsections present data on changes in fish consumption (quantity and frequency) and fish prices over the period 2000-2010. Analyses are differentiated by the poverty status (extreme, moderate and non-poor) and geographical location (urban and rural) of consumers and by the sources of fish (aquaculture, inland capture fisheries, etc.) consumed.

Table 8.1

Annual Per Capita Fish Consumption and its Growth, 2000-2005-2010 (in Kg)

	2000	2005	2010	% Change in consumption 2000-2005	% Change in consumption 2005-2010	% Change in consumption 2000-2010
Rural	13.8	14.5	16.7	5.0	15.3	21.1
Urban	14.9	18.1	21.8	21.2	20.8	46.4
National	14.1	15.4	18.1	9.4	17.6	28.6

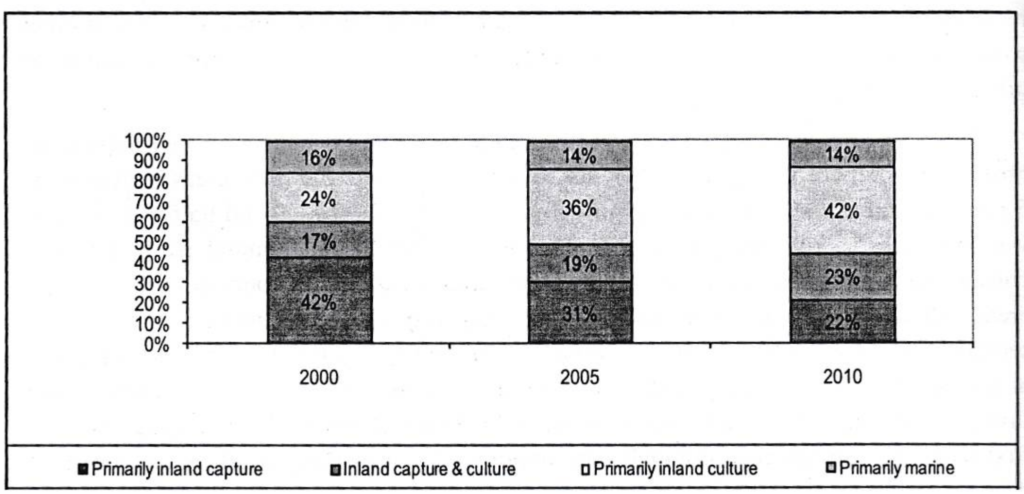
Annual per capita fish consumption has steadily increased over the period from 2000 to 2010. In 2000, annual per capita fish consumption was 14.1 kg and in 2010 it increased to 18.1 Kg – an increase by more than 4Kg in 10 years. Per capita consumption of fish during this period has increased by 29 per cent. During the same period per capita annual fish consumption in the urban areas increased by 46 per cent and in the rural areas it increased by 21 per cent. Thus growth in consumption of fish has been more than double in the urban areas as compared to the rural. This indicates an apparent consumption bias - most of the growth in fish production is consumed by the urban population. Or in other words, growth in fish consumption is fuelled by increasing demand for fish from the urban households.

When we break the decade down the decade of the 2000-2010 into two halves, we observe that between 2000 and 2005, consumption of fish in the rural areas increased by 5 per cent and in the urban areas it grew by 21 per cent. In the second half of the 2000s we observe a more balanced growth. During 2005 and 2010, annual per capita fish consumption increased by 15 per cent in the rural areas and 20 per cent in the urban areas. Thus while rural urban consumption inequality continued to persist during the second half of the 2000s, the rural population could improve on their consumption of fish at a faster pace during 2005-2010. Growth in consumption of fish in Bangladesh was favouring the rural households more in the second half of the 2000s as compared to the first half. We can say that although consumption of fish in Bangladesh is not pro-rural, there is a tendency for it to be pro-rural during the latter part of the 2000s.

However, whereas annual compound growth in urban fish consumption was steady at just over 4 per cent per annum from 2000 to 2010, average rural consumption growth increased sharply from 1 per cent per annum from 2000 to 2005 to just over 3 per cent from 2005 to 2010. This suggests that rising real wages and the faster rate of poverty reduction among rural households increased consumer spending power and resulted in a gradual narrowing of the urban/rural consumption gap. Thus, although growth in fish consumption was not pro-rural in either the “strong relative” or “strong absolute” sense, pro-rural consumption growth did occur between 2005 and 2010, if the first half of the decade is considered as a benchmark (Osmani 2009).

Narrowing of the rural/urban fish consumption gap and accompanying consumption growth occurred during a period when the proportionate and absolute contributions of inland capture fisheries to total fish production contracted sharply (Figure 8.1). Between 2000 and 2010, the share of fish originating primarily from inland capture fisheries fell from 42 per cent to 22 per cent of total consumption (a decline of 1.9 kg per capita). This pattern was reversed for fish from aquaculture, the share of which rose from 24 per cent to 42 per cent of total consumption (an increase of 4.3 kg per capita). The share of consumption of fish originating from the mixed category “inland capture and aquaculture” grew marginally, from 17 per cent to 23 per cent, representing an increase in consumption of 1.7 kg per capita. Given the trends described above, it is highly probable that this latter increase resulted from expanded aquaculture production, both masking and contributing to a decline in production of inland capture fish. On this basis, it can be assumed that aquaculture’s contribution to total fish consumption stood at more than 50 per cent in 2010.

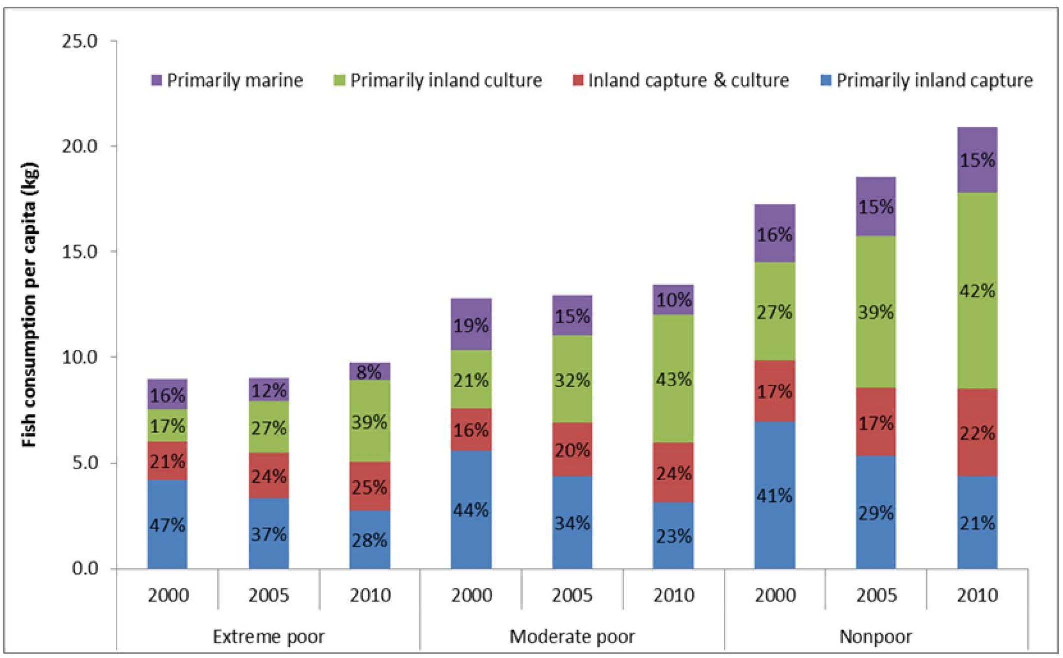
Figure 8.1: Composition of Fish by Source, 2000-2005-2010



8.1 Fish Consumption by Various Poverty Groups

Similar patterns are apparent when consumption data is disaggregated by poverty group. Consumption of farmed fish increased and consumption of inland capture fish declined across all poverty groups from 2000 to 2010 (Figure 8.2). Between 2000 and 2005, the majority of fish consumed by extreme and moderate poor households originated from inland capture fisheries. By 2010, the majority came from aquaculture. Poorer consumers were most heavily dependent on fish from inland capture fisheries in all years. Extreme poor households consumed proportionately more non-farmed fish than moderate poor households, and moderate poor households consumed proportionately more than non-poor. This reflects, in part, a correlation between poverty and self-provisioning of wild fish, as noted in Chapter 6. Extreme poor consumers obtained 24 per cent of the fish they consumed from non-market sources (primarily subsistence capture) in 2000. This fell to 15 per cent in 2010. Non-poor consumers obtained 18 per cent of fish from non-market sources in 2000, down to 10 per cent in 2010. This is indicative of declining access to inland fisheries resources, which has engendered greater dependence on the market and negatively affected poor consumers to a proportionately greater degree than non-poor.

Figure 8.2: Composition of Fish Consumed by Source and Poverty Group



Data on annual fish consumption per capita by poverty group is presented in Table 8.2. Total fish consumption by extreme poor and moderate poor households remained more or less constant from 2000 to 2005, at around 9 kg and 13 kg per capita, respectively. Non-poor households registered a consumption increase of 1.2 kg per capita over this period. Thus, although the expansion of aquaculture between 2000 and 2005 was sufficient to avert a decline in fish consumption among poor households, it was not large enough to bring about a substantial increase in their overall fish intake. This changed between 2005 and 2010. Total fish consumption grew 0.7 kg (8 per cent) for extreme poor households and 0.5 kg (4 per cent) for the moderate poor. Non-poor households again benefited the most in both absolute and relative terms, with consumption increasing by 2.4 kg (13 per cent). However, the rate of consumption growth was highest for the extreme poor (i.e. from 1 per cent to 8 per cent), followed by moderate poor and non-poor. Thus, although the non-poor gained most, the accelerating growth in aquaculture output over this period led to increases in fish consumption among all classes of consumer. From this perspective, aquaculture growth over the period 2005-2010 can be considered as pro-poor in both "benchmark" and "weak" terms, as it resulted in a definite improvement in the position of poor households in comparison to the first five years of the decade.

Table 8.2

Changes in Annual Fish Consumption Per Capita, 2000-2010

Poverty group	2000 consumption per capita (kg)	2005 consumption per capita (kg)	2010 consumption per capita (kg)	Change in consumption 2000-2005 (%)	Change in consumption 2005-2010 (%)	Change in consumption 2000-2010 (%)
Extreme poor	9.0	9.1	9.8	0.9	8.0	8.9
Moderate poor	12.8	13.0	13.4	1.5	3.8	5.3
Non-poor	17.3	18.5	20.9	7.4	12.9	21.2

This evaluation only accounts for total fish consumption however. Disaggregating by source (Table 8.3) reveals that the greatest relative increases in consumption of farmed fish took place between 2000 and 2010 accrued to the extreme poor, whose average consumption increased by 152 per cent over this period, while consumption among the non-poor increased by 88 per cent. Thus, considered alone, aquaculture growth from 2000 to 2010 was pro-poor in "strong, relative" terms.

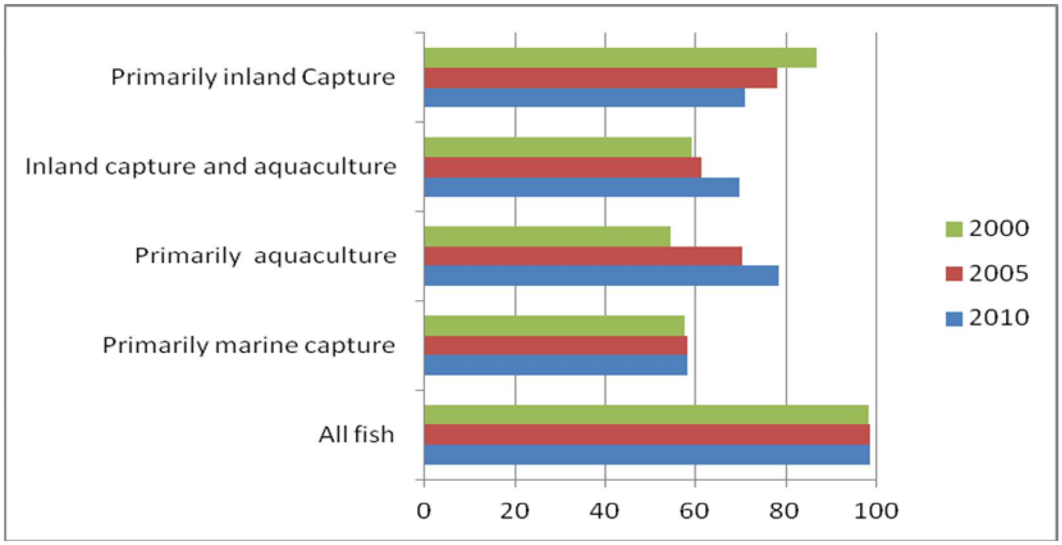
Table 8.3

Changes in Fish Consumption Per Capita by Poverty Group and Source, 2000-2010

Poverty group	Primarily inland capture		Inland capture & culture		Primarily inland culture		Primarily marine	
	Change (kg)	Change (%)	Change (kg)	Change (%)	Change (kg)	Change (%)	Chang e (kg)	Change (%)
Extreme poor	-1.4	-34.6	0.6	32.4	2.3	152.1	-0.6	-42.9
Moderate poor	-2.5	-44.1	1.1	54.6	3.1	114.0	-1.0	-42.4
Non-poor	-2.6	-37.2	1.8	64.1	4.1	88.2	0.3	11.4

Fish consumption frequency, defined as the percentage of households reporting consumption of fish within the 14 day reference period over which the survey was conducted, follows similar trends to those identified for fish consumption by quantity (Fogire 8.3). A reduction in the frequency of consumption of fish from inland capture fisheries took place from 2000 to 2010 (from 87 per cent to 71 per cent of households), offset by a rapid increase in frequency of consumption of farmed fish (from 54 per cent to 78 per cent). Consumption of all fish (irrespective of origin) remained extremely high across all three years, with close to 100 per cent of households in all poverty groups reporting some consumption.

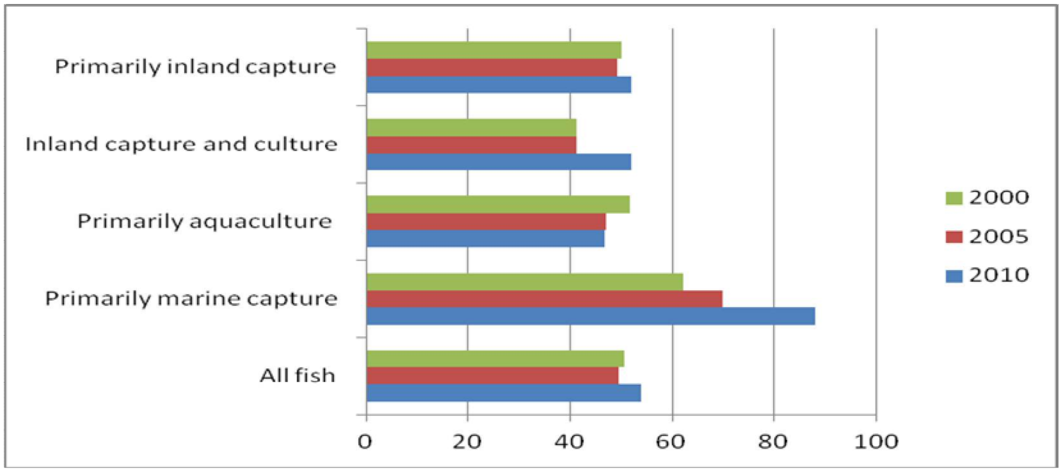
Figure 8.3: Frequency of Fish Consumption by Source (% of consuming households), 2000-2010



8.2 Fish Prices

Between 2000 and 2005, weighted real prices paid for fish originating from all sources except fish from marine capture fisheries fell or remained constant (Figure 8.4). The size of relative price changes was similar for all consumers, irrespective of poverty group (Table 8.4). The real price of farmed fish fell by 9 per cent - more than that of fish from any other source - while the price of inland capture fish fell 2 per cent, despite a contraction in supply per capita of 19 per cent. This suggests that substitution between farmed and inland capture fish took place, with rapidly expanding supply from aquaculture counteracting upward price pressure on inland capture fish. This finding is consistent that of Tveterås *et al.* (2012), who identify a similar pattern of interaction in the prices of farmed and wild fish traded in global markets. This effect was not apparent for primarily marine fish, the price of which increased by 12 per cent, against a decrease in supply per capita of just 1 per cent. This group is dominated by Bangladesh's most highly prized, culturally significant, and expensive fish, hilsha, which accounted for approximately half the budget share, and for which no farmed substitute exists.

Figure 8.4: Average Fish Prices at Constant 2000 Prices (BDT/kg)



Price trends from 2005 to 2010 were markedly different. Real prices paid for fish from all sources except aquaculture rose significantly for consumers in all poverty groups. Price increases were again high for capture fish of marine origin, which rose 26 per cent on average, despite an increase in per capita supply of 9 per cent. Fish originating from the mixed group "inland capture and aquaculture" also registered a large price increase (26 per cent), against an increase in per capita supply of 12 per cent. Real prices paid for inland capture fish rose 6 per cent, against an 18 per cent reduction in supply. The supply per capita of fish originating primarily from aquaculture grew 54 per cent over this period, but average prices remained static. Much of the contrast between the scenario apparent in the former and latter halves of the decade is likely to be attributable to the enduring effects of the price spike that occurred in 2007/8, which dramatically raised the price of most food commodities, including those used to produce feeds for aquaculture. Dramatic increases in feed prices during this period may have hemmed in the price reductions in which such rapidly expanding supply of fish might otherwise have been expected to result.

Table 8.4

Percentage Change in Real Fish Prices by Source, 2000-2005 and 2005-2010

Poverty group	Primarily inland capture		Inland capture & culture		Primarily inland aquaculture		Primarily marine		All fish	
	2005-2000	2005-2010	2005-2000	2005-2010	2005-2000	2005-2010	2005-2000	2005-2010	2005-2000	2005-2010
Extreme poor	-4	6	-1	25	-10	5	16	21	-4	8
Moderate poor	-2	4	-1	21	-9	0	12	25	-3	5
Non-poor	-3	4	-2	24	-11	-1	8	24	-4	8
All groups	-2	6	0	26	-9	0	12	26	-2	9

Table 8.5 places the effects of this event in context, by comparing changes in the nominal price of fish by source, with that of the national staple, coarse rice. From 2000 to 2005, increases in the average price of fish were approximately half those of coarse rice, probably reflecting the rapidly expanding supply of fish from aquaculture. This picture changed from 2005 to 2010, during which time average fish prices increased 13 per cent more than average rice prices. An upward trend in fish prices during this period, relative to those of rice, was also identified by Dey *et al.* (2012). Only the price of fish originating primarily from aquaculture increased more slowly than the price of rice. The reasons for these changes are not entirely clear, but it seems possible that increases in the price of marine capture fish (both absolute and relative to the price of rice), and perhaps also of fish in the mixed "inland culture and capture" category, several of which are high value species, reflected demand from an increasingly wealthy population post-2005, which expanded faster than moderate increases in per capita supply.

The role of aquaculture growth in keeping average fish price inflation fairly close to that of rice during this period is particularly significant. Had this growth not occurred, it is probable that prices of inland capture fish would have risen to much higher levels, with serious implications for consumption, particularly among the extreme and moderate poor who depend upon them most. It is also notable that the increase in the average price of fish was not large enough to reduce total consumption among any group, suggesting that the growth in real wages occurring at this time was sufficient to offset fish price inflation.

Table 8.5

Percentage Change in Nominal Fish and Coarse Rice Prices, 2000-2010

Year and change (%)	Primarily inland capture	Inland capture & culture	Primarily inland aquaculture	Primarily marine	All fish	Coarse rice
Change 2000-2005 (%)	23.2	24.8	12.8	36.8	21.6	41.4
Change 2005-2010 (%)	86.1	122.1	78.4	124.9	93.3	82.3
Change 2000-2010 (%)	129.3	177.3	101.3	207.6	135.0	157.8

CHAPTER 9

CHANGES IN FISH CONSUMPTION BY SPECIES 2000-2010

So far we have done our analysis on the basis of aggregated fish categories by sources such as inland capture, culture, marine and so on. This was necessary for understanding the changes in the sources of fishes consumed by households belonging to different poverty groups. We did find that the capture fishes were declining and aquaculture fishes were rising in the consumption basket of the households. We have also found that the poor still consume proportionately more capture fish, although this proportion has been declining over time. We will now look at the individual species level to see exactly which fish species are getting increasingly scarce and which are becoming more available to the consumers of Bangladesh. Obviously, the analysis carried out so far would indicate it is mainly the capture fish species that are consumed less and farmed fish species that are consumed more. Which species exactly are they? What are the implications in terms of nutrition and poverty? This information is also useful for policy makers to decide where exactly to invest, which species in particular need support from the government, etc. Table 9.1 provides information on fish consumption by all households by species in the three HIES survey years. The species are ranked by weights in descending order.

The fish group puti/big puti/tilapia/nilotica is the most consumed fishes in Bangladesh. It has held the top position in all the survey years. Consumption of this group of fishes has also been steadily increasing. Between 2000 and 2010, per capita annual consumption of this group of fishes has increased by about 43 per cent. We have also found that the frequency of consumption of this group of fishes is the highest and has also been increasing. In 2000, 57 per cent of the households reported consumption of these fishes, followed by 61 per cent in 2005 and 65 per cent in 2010.

The group of fishes comprising puti/big puti/tilapia/nilotica requires particular attention because, according to DoF data, Indian Major Carps top the list of fish species available in Bangladesh. This is also a widely believed view because freshwater aquaculture systems in Bangladesh mainly revolve around the polyculture of various species of carps (Ali *et al.* 2012, Hussain 2009). According to DoF data, more than a third of fishes available in Bangladesh are either Indian major carps or exotic carps. Fish consumption data suggest that the combined weight of this species of fish is higher than the amount of Indian Major Carps. We will have a closer look at each species included in this group.

Tilapia/Nilotica is almost entirely farmed. Tilapia, once considered as a "miracle species," is an exotic species brought to Bangladesh initially from Africa in the early 1950s (Anwar *et al.* 2011). Tilapia is now cultured at various densities and combinations from mono to polyculture in different containments. Tilapia is produced in a wide range of culture systems, including small-scale, low-input, rural ponds, semi-intensive, intensive and commercial operations (Ahmed 2009). At present, there are about 70 Tilapia hatcheries, whereas in 1992 there was only one mono-sex hatchery in Cox's Bazar (Nahid *et al.* undated). DoF data show unpredictable fluctuations in the production of Tilapia, which stands at 24,930 MT in 2010. However, Anwar *et al.* (2011) points out that the production of Tilapia is seriously underreported in DoF statistics. He estimates a production of 62,175 MT of Tilapia for 2010. Belton and Azad (2012) adjusts this figure to 143,000 MT. DoF data provides a figure of 1,24760 MT of Tilapia production in 2010 which possibly indicates that it is slowly revising their estimates upward.

The category of fish big puti is not defined but it is likely to be referring to Thai Sarpunti (silver barb) which is entirely a farmed species. Production of Thai Sarpunti, as reported in DoF statistics, has also increased from 2,749 MT in 2000 to 11,762 MT in 2010—an increase by more than fourfold. We do not have any alternative production figure for Thai Sarpunti.

Puti, also known as *Jat puti*, is an important non-farmed species. It is a flood plain dependent species and caught extensively by a wide range of fishing gears in diverse fishing environment. DoF data provide information on these species by source and reports catches from only the beels and the Kaptai Lake. If these figures are considered, then about 10 per cent of total catch in this group can be accounted for by puti. This is obviously not the case because production of Thai Sarpunti and tilapia is not large enough to take this group of fishes up to the first position. It is quite certain that DoF data is missing out information on wild puti. A large part of puti catch comes from very small gears such as push nets and goes straight to home consumption (along with many other SIS such as "gura mach" or Taki, etc.) without ever passing a landing centre or a market. As already mentioned, there is no report on catches of puti or for that matter any other SIS from the flood lands in DoF data. They are most likely accounted by the category "other inland fish," which make up 53 per cent of total fishes caught from the flood lands. This proportion remained more or less the same since 2000. DoF data provides information of total fish catch in Bangladesh by species and up to 2009 the category "other fishes" ranked the top. In 2010, it came down to the second position at 19.85 per cent, after major carp which represents 23.89 per cent of total catch. It has to be emphasized that the flood lands account for a third of inland catch (capture and culture fisheries combined) and 75 per cent of capture catch in DoF statistics. The contribution of flood land fishes is therefore as high as the contribution from Indian and exotic carps. If we assume that as low as 5 per cent of “other inland fish” is represented by puti then this group of fishes is dominated by this fish.

The importance of flood plain species in general and puti in particular in Bangladeshi diet comes up clearly in some studies on fish consumption in Bangladesh. A detailed monitoring of fish consumption over 5-7 years from 1999 to 2000 in three wetlands in Bangladesh established the overall importance of small native species such as puti and taki (Thompson 2002). Puti, taki other small-indigenous fishes (SIS) ranked first in one floodplain and second in others in the study. Belton *et al.* (2014b) analysed fish consumption from IFPRI panel data of 1996/97 and 2006/7. Puti ranked first in 1996/97 but its position came down to 5 in 2006/7. Roos *et al.* (2007) have also found that in Kishoreganj small indigenous fish species (puti, taki, mola, etc.) contributing 84 per cent of the total fish intake during 1997-98.

IFPRI panel data shows that the consumption of puti has come down between 1996 and 2007, indicating that share of puti in this group of fishes is likely to be declining. During 2000-2010 and particularly in the second half of the 2000s, Tilapia production has gone up dramatically (Anwar *et al.* 2011 and Belton and Azad 2012), while the production of Thai Sarpunti is likely to have increased manifold. These factors have helped to keep the cumulative total above all the other groups of fish reported in HIES data. We can assume that the contribution of Jat puti has been declining following the general trend in capture fisheries but it is still large enough to help this group of fishes retains the top position. In the later part of the 2000s, the top position of this group of fishes is supported more by the culture components of tilapia and Thai Sarpunti.

In 2010, the second position is taken by pangas/boal/air. Production of pangas first started in the early 1990s in Mymensingh district and has been spreading to an increasing number of districts (Ali *et al.* 2012). It is a bit surprising to see this group of fishes overtaking the Indian major carps in 2010. This is difficult to account for on the basis of the description of the aquaculture sector in Bangladesh (“polyculture of various species of carps”), where Indian Major Carps holds the top position in terms of production. However, in HIES, pangas is grouped with boal and air and the difference in consumption is only .09 Kg. Thus if we could take out the contribution of boal, air and also the non-farmed component of pangas, this group would come down below the Indian Major Carps (in terms of consumption). In 2008-9, 617,761 MT of Indian Major Carps were reported by DoF, which is far above any alternative projection of pangas production (300,000+) in Bangladesh (Edwards and Hossain 2010, Belton *et al.* 2011b). It is not possible to entirely explain the large gap in production and consumption of Indian Major Carps as found in DoF and HIES data.

Indian Major Carps retained the third position in all the survey years except for the year 2000 when it ranked second. Its consumption has been steadily increasing. It is again interesting to see exotic carps taking over the Indian Major Carps in 2005. This is again not easy to account for because, according to DoF data, twice as much of Indian Major Carps is produced against the exotic carps. It has to be pointed out that the farmed variety of Indian Major Carps has definitely increased more in the second part of the decade. Thus though the position of this group declined to the second from 2005, there has been a rapid increase in weight which is likely due to expansion of the farmed component.

In Table 9.1, primarily culture fishes are written in bold and primarily capture fishes are written in italics. An interesting pattern can be observed. As one moves from 2000 to 2010 through 2005, the number of farmed fishes increases towards the top of the list. For example, two out of the first five species consumed in 2000 were Indian Major Carps and the exotic carps. While the exotic carps are almost entirely farmed, Indian major carps are not. We can safely assume that the share of wild carps is likely to have fallen between 2000 and 2005. In 2005, three out of the top five species consumed are farmed species. The newcomer is Pangas, which had 14th position in 2000 when it was not farmed. When we look at the year 2010, three out of the top four fishes are produced in the farms: Exotic Carps, Indian Major Carps and Pangas/Boal/ Air. angas, which was not produced in farms in 2000 and was not recorded as farmed species before 2005 in DoF data, took the 5th position in 2005. Pangas was in the 14th position in 2000, just above koi and Baila/Tapashi. Within a short span of time it jumped to the fifth position in 2005 and finally to the second position in 2010. Nutritionally rich capture fishes such as the group Mala-kachi/ Chala-chapila (SIS) had the third position in 2000 but came down to the fourth in 2005 and finally to the fifth position in 2010. We observe that the non-farmed fishes have been concentrating at the lower end of the League Table.

Table 9-1

Per Capita Annual Fish Consumption (in kg): 2000-2005-2010

Rank of fish species in 2000	Kg/p/year	Rank of fish species in 2005	Kg/p/year	Rank of fish species in 2010	Kg/p/year
Puti/Big Puti/Tilapia/Nilotica	2.40	Puti/Big Puti/Tilapia/Nilotica	2.86	Puti/Big Puti/Tilapia/Nilotica	3.43
Rui/Katla/Mrigel/Kal baush	1.78	**Silver carp/Grass carp/Miror carp**	2.21	**Pangas/Boal/Air**	2.69
Mala-kachi/ Chala-chapila	**1.53**	Rui/Katla/Mrigel/Kal baush	2.11	**Rui/Katla/Mrigel/Kal baush**	2.60
Silver carp/ Grass carp/ Miror carp	1.49	*Mala-kachi Chala-chapila*	1.60	**Silver carp/Grass carp/Miror carp**	2.23
Shrimp	1.27	**Pangas/Boal/ Air**	1.27	*Mala-kachi/Chala-chapila*	1.80
Hilsha	1.17	Hilsha	0.99	Hilsha	1.45
Shoal/ Gajar/ Taki	0.92	*Shoal/ Gajar/Taki*	0.85	*Shrimp*	1.27
Other	0.76	*Shrimp*	0.85	Seafish	0.89
Seafish	0.57	Seafish	0.75	*Shoal/ Gajar/Taki*	0.74
Tangra/Elfish	0.53	*Other*	0.58	*Other*	0.73
Koi/Magur/Shinghi/Khalisha	0.36	*Tangra Elfish*	0.42	**Koi**	0.54
Dried fish	0.36	Dried fish	0.38	Dried fish	0.47
Pangas/ Boal/ Air	0.28	Koi/Magur/Shinghi/Khalisha	0.21	*Tangra/Elfish*	0.33
Koi	0.16	**Koi**	0.20	Koi/Magur/Shinghi/Khalisha	0.22
Baila, Tapashi	0.14	*Baila, Tapashi*	0.11	Baila, Tapashi	0.10
All fish	14.05	All fish	15.37	Puti/Big Puti/Tilapia/Nilotica	18.07

We notice that the prize fish hilsha has a stable rank of number six in the three survey years. The amount of Hilsha consumption varies by year, depending on the availability. It can be mentioned that Hilsha is probably the only fish for which Bangladesh has species-based management policy. There are specific Hilsha fishing zones where there is a fishing ban and the hilsha fishers are compensated for not fishing during that period.

9.1 Fish Consumption by Species by Various Poverty Groups

We have seen how various species of fishes ranked in the consumption basket of the consumers. As expected, in the past we look a dominance of capture fishes is clear and as we come to more recent times the dominance of cultured species becomes apparent. In particular, we have observed that the highly nutritious SIS species are consumed less by the households in the later part of the decade. We will now look at how these fish species rank in the consumption basket of various poverty groups and how this ranking is changed over time.

Table 9.2 provides information on average per capita annual fish consumption of top 10 fish groups by households belonging to different poverty groups. Note that we have only reported top 10 groups of fishes. In HIES data, the top 10 fish groups well above 95 per cent of all fishes consumed in all the survey years on the average.

What is notable about the group comprising of fishes Puti/Big Puti/Tilapia/Nilotica is that this is the most consumed fishes by *all* poverty groups in *all* the survey years. We have made an attempt to explain this at the beginning of this section. Households belonging to all poverty groups have also been steadily increasing their consumption over time, particularly the non-poor households. This shows the importance of this group of fishes in fish consumption basket of Bangladeshi households irrespective of their poverty status. We have seen that this has come up in some studies with limited geographic focus (Thompson *et al.* 2002) but that this is the case at the national level is now shown.

Exotic species were the main farmed species consumed by the extreme and moderate poor households. In 2000, exotic species ranked fourth for the extreme poor households and then onwards it retained the second position. While exotic species ranked third for the non-poor households in 2000 and 2005, its rank fell by one level in 2010.

Indian Major Carps did not take any place in the first five fish groups for the extreme poor households in 2000. However, from 2005 its consumption by the extreme poor increased and obtained the fifth position. It takes the fourth position for the moderate poor households and the second position for the non-poor households. The non-poor households consume more Indian Major Carps as compared to Exotic Carps. It is the opposite for the extreme and moderate poor households.

Pangas takes the third position for the extreme poor households in 2010, second position for the moderate poor and third position for the non-poor households in the same year. Thus Pangas is not really a fish of the poor as usually thought (Belton 2011b and Belton *et al.* 2014b). It is also a popular fish for the non-poor and moderate poor households and the extreme poor has started to consume it significantly from 2010. Before that it were the exotic carps which were the main farmed species consumed by the poor. In 2010, the three major cultured species (Indian and exotic carps and Pangas) obtained positions in the first five species consumed by extreme, moderate and non-poor households.

Over time, the role of capture fishes started to decline and that of culture fish started to increase for the extreme poor households. Consider the top five fishes only. In 2000, there was only one farmed species in the plate of the extreme poor households, the exotic carps. In 2005, the number increased to 2 (exotic carps and Indian Major Carps) and in 2010 to 3 (exotic carps and Indian Major Carps and Pangas). In 2000, a typical extreme poor household was consuming mainly puti, SIS, shrimp/prawn, i.e. mostly capture species and in 2010 it consumes mainly carps, both Indian and exotic and Pangas, i.e., mostly cultured species.

We can mention some other features. For example, the SIS, represented mainly by the group Mala-kachi/ Chala-chapila, held the second position for the extreme and moderate poor in 2000 but slowly it slide down to 3rd position in 2005 and to 4th (for the extreme poor) and 5th (for the moderate poor) positions in 2010. As mentioned, SIS has very high nutrition content and strongly recommended to pregnant and lactating mothers.

The popular fish Hilsha is mainly consumed by the non-poor households and to a very limited extent by the moderate poor households. The extreme poor households consumed some Hilsha in 2000 and it ranked 9. After that, from 2005 Hilsha does not take any position in the top 10 fishes consumed by the extreme poor households. Hilsha ranked 6th for the moderate poor households in 2000 and then its rank fell down to number 9 in 2005 and 2010. The amount of Hilsha fish consumed by the moderate poor households also fell consistently during the entire period under consideration. Hilsha ranked 5th in the consumption basket of the non-poor households in 2010 and the amount of Hilsha consumed by them has also increased over time. Thus the benefits of Hilsha management are reaped mainly by the non-poor households. Hilsha is still not affordable for the extreme and moderate poor households.

Table 9.2

Per capita Annual Fish Consumption by Fish Species and Poverty Groups (in kg): 2000, 2005, 2010

		Kg/p/year	Rank of fish species in 2005	Kg/p/year	Rank of fish species in 2010	Kg/p/year
EXTREME POOR	Puti/ Big Puti/ Tilapia/ Nilotica	1.85	Puti/ Big Puti/ Tilapia/ Nilotica	2.15	Puti/ Big Puti/ Tilapia/ Nilotica	2.17
	Mala-kachi/ Chala-chapila	1.17	**Silver carp/ Grass carp/ Miror carp**	1.33	**Silver carp/ Grass carp/ Miror carp**	1.54
	Shrimp	0.97	*Mala-kachi/ Chala-chapila*	1.18	**Pangas/ Boal/ Air**	1.53
	Silver carp/ Grass carp/ Miror carp	0.92	*Shrimp*	0.71	*Mala-kachi/ Chala-chapila*	1.15
	Other	0.72	**Rui/ Katla/ Mrigel/ Kal baush**	0.58	**Rui/ Katla/ Mrigel/ Kal baush**	0.7
	Shoal/ Gajar/ Taki	0.67	*Shoal/ Gajar/ Taki*	0.56	*Baila, Tapashi*	0.57
	Rui/ Katla/ Mrigel/ Kal baush	0.57	**Pangas/ Boal/ Air**	0.54	*Shoal/ Gajar/ Taki*	0.52
	Hilsha	0.56	*Other*	0.5	*Shrimp*	0.46
	Seafish	0.42	Seafish	0.44	*Other*	0.42
	Tangra/ Elfish	0.34	Dried fish	0.4	Dried fish	0.32
MODERATE POOR	Puti/ Big Puti/ Tilapia/ Nilotica	2.05	Puti/ Big Puti/ Tilapia/ Nilotica	2.55	Puti/ Big Puti/ Tilapia/ Nilotica	2.72
	Mala-kachi/ Chala-chapila	1.63	**Silver carp/ Grass carp/ Miror carp**	2.06	**Pangas/ Boal/ Air**	2.5
	Silver carp/ Grass carp/ Miror carp	1.51	*Mala-kachi/ Chala-chapila*	1.72	**Silver carp/ Grass carp/ Miror carp**	2.06
	Shrimp	1.44	**Rui/ Katla/ Mrigel/ Kal baush**	1.06	**Rui/ Katla/ Mrigel/ Kal baush**	1.2
	Rui/ Katla/ Mrigel/ Kal baush	1.19	**Pangas/ Boal/ Air**	1	*Mala-kachi/ Chala-chapila*	1.16
	Hilsha	1	Seafish	0.92	*Shoal/ Gajar/ Taki*	0.71
	Seafish	0.93	*Shrimp*	0.9	*Shrimp*	0.65
	Other	0.8	*Shoal/ Gajar/ Taki*	0.69	Seafish	0.53
	Shoal/ Gajar/ Taki	0.79	Hilsha	0.47	Hilsha	0.45
	Dried fish	0.42	*Other*	0.47	*Other*	0.41
NON POOR	Puti/ Big Puti/ Tilapia/ Nilotica	2.86	Puti/ Big Puti/ Tilapia/ Nilotica	3.22	Puti/ Big Puti/ Tilapia/ Nilotica	3.87
	Rui/ Katla/ Mrigel/ Kal baush	2.78	**Rui/ Katla/ Mrigel/ Kal baush**	2.98	**Rui/ Katla/ Mrigel/ Kal baush**	3.33
	Silver carp/ Grass carp/ Miror carp	1.88	**Silver carp/ Grass carp/ Miror carp**	2.61	**Pangas/ Boal/ Air**	3.01
	Mala-kachi/ Chala-chapila	1.76	Mala-kachi/ Chala-chapila	1.75	**Silver carp/ Grass carp/ Miror carp**	2.43
	Hilsha	1.62	**Pangas/ Boal/ Air**	1.63	Hilsha	1.68
	Shrimp	1.43	Hilsha	1.4	*Mala-kachi/ Chala-chapila*	1.58
	Shoal/ Gajar/ Taki	1.12	Shoal/ Gajar/ Taki	1	*Shrimp*	1.03
	Other	0.78	Shrimp	0.9	Seafish	0.89
	Tangra/ Elfish	0.69	Seafish	0.83	*Shoal/ Gajar/ Taki*	0.79
	Seafish	0.59	Other	0.63	*Other*	0.6

CHAPTER 10

POLICY IMPLICATIONS

The central finding of this report is that total fish consumption in Bangladesh increased in a situation where inland capture fisheries were declining. This was made possible because of the rapid growth in aquaculture in Bangladesh. Total fish consumption could have further increased if the decline of the capture fisheries could be halted or catches increased. But as Welcome *et al.* (2010:2118) have shown, “in Asia and Africa the capture fisheries are very intensely exploited and there is probably little room for expansion; it is here that resources are most at risk.” Though capture fisheries in Bangladesh are more at risk, we have seen that the extreme poor depend more on it. The resource is accessible and there is room to improve. Bangladesh should follow a fisheries policy that focuses both on the capture and culture fisheries. For the culture fisheries sector, the following has to be emphasized:

(i) Technical assistance with institutional and policy support should be continued for sustainable fish farming.

(ii) A basic technical knowledge of integrated fish farming should be provided to the farmers with the help of DoF and NGOs.

(iii) Future targets could be to integrate with other agricultural activities, especially dike cropping of fruits and vegetables and rice-fish farming.

(iv) A range of public-private partnerships, investments and initiatives are needed to realise this potential for further development of aquaculture in Bangladesh.

(v) Further research would be required to understand environmental impacts of aquaculture.

(vi) Amongst the farmed species, the government should support the growth of some specific species such as the exotic carps and pangas. These are species consumed most by the poor households.

Though this study does not aim at identification of the constraints to growth of the fisheries sector, some policy suggestions are made for the development of the fisheries sector in the following:

(i) Where appropriate, community based fisheries management should be pursued.

(ii) The Open Access Policies in open waters should be abolished and where possible they should be brought under community management.

(iii) A cautious approach to promoting Flood Plain Aquaculture (FPA) should be taken. It should be promoted where feasible, where households are least dependent on the flood plains and also where it does not affect the stock of wild fishes.

(iv) Public water bodies suitable for aquaculture should be leased on the basis of efficiency and growth rather than equity/poverty reduction.

(v) More resources have to be invested in the development of capture fisheries. This may include habitat restoration, enforcement of Fish Acts, etc.

(vi) Efforts must be made to increase the production of SIS or small-indigenous fishes either in natural environment or in fish farms.

(vii) The government should gradually take measures for controlling some environmental factors. For example, use of pesticides must affect the growth of some small fishes such as puti which is consumed most by all types of households. Other factors such as FCDI projects, pollution, setting barrier in open water bodies adversely affect the capture fisheries sector.

CHAPTER 11

SUMMARY AND CONCLUSION

This report has sought to broaden the debate on the contribution of aquaculture to poverty alleviation. This has been achieved by (1) advancing a theoretically grounded definition of pro-poor aquaculture growth with respect to the indirect food consumption linkages conceptualised in the aquaculture and poverty literature, and (2) analysing a robust, nationally representative time series dataset on fish consumption in Bangladesh over the period 2000 to 2010 including the disaggregation of results according to poverty categories based on national poverty lines. This entire analysis is located within the context of wider changes occurring in the national economy over this period, which have a crucial explanatory bearing on the results derived. The approach adopted represents an advance on many earlier studies which investigated the relationship between aquaculture and poverty reduction in a less systematic manner, using smaller and less representative datasets. By broadening the scope of enquiry beyond local contexts (e.g. specific project interventions or types of aquaculture) and short time horizons, this study has sought to achieve greater explanatory power. This effort is important because it helps to clarify some of the poverty and food security implications of the fundamental structural transition in global fish supply, from capture fisheries to aquaculture, which is currently underway; it helps to refine debate on whether, and under what circumstances, aquaculture can reduce poverty.

To recap, a number of key changes occurred between 2000 and 2010. Economic growth during this period was slightly pro-poor overall, but strongly pro-poor, and pro-rural, during the latter half of the decade, partly due to large increases in real rural incomes. This resulted in rapid poverty reduction throughout the entire period and lessening inequality during its second half. Fish consumption per capita grew sharply over this period – an average increase of 28.6 per cent at the national level. This can be inferred to have resulted almost entirely from increasing aquaculture production, as the contribution of inland capture fisheries to total fish consumption fell by 47.6 per cent over the period, while that of aquaculture grew by 75 per cent. In terms of fish species more carps and pangas are now consumed by the households as opposed to some capture fishes like the SIS. Changes in fish consumption frequency also reflect these shifts. As noted in Chapter 4, the enclosure and conversion of wetland habitat to aquaculture was a contributing factor in the reduced supply of fish from inland capture. Other factors that contributed to the decline of the capture fisheries had been pollution, silting up of the open water fishing grounds, building up of irrigation projects that put barriers to the movement of fish, overfishing and so on.

Overall consumption increases were largest in urban areas, but the average rate of consumption growth increased fastest among rural consumers during the second half of the decade. Fish consumption per capita also increased relatively more quickly for the extreme and moderate poor than for the non-poor during this latter period, although by a small amount in terms of absolute quantity. Non-poor (and urban) households made larger absolute gains. During the first half of the decade, average real fish prices fell by 2 per cent and the price of farmed fish fell 9 per cent. After 2005, average fish prices increased, in line with global peak food prices. Relative increases in the average price of fish were slightly higher than those for rice at this time. Real prices of fish from aquaculture did not increase during this period however, and substitution of aquaculture fish for those from inland capture fisheries appears to have lessened upward price pressure on the latter.

11.1 Was Aquaculture Growth Pro-poor?

Aquaculture's contribution to growth in total fish consumption was pro-poor in "weak" terms throughout the decade in question, since fish consumption by the extreme and moderate poor increased in absolute terms, but to a lesser degree than consumption by the non-poor. It was also pro-poor in "benchmark" terms for the second half of the decade, as the rate (and amount) by which fish consumption grew among extreme and moderate poor consumers from 2005 to 2010 was greater than from 2000 to 2005. In the absence of data for the period 1995-2000, it is not possible to determine whether consumption growth from 2000 to 2005 was also benchmark pro-poor.

Total fish consumption is an imperfect indicator of aquaculture's pro-poor status however, since the apparent decline in inland capture fisheries output per capita that occurred throughout the period partly offset consumption gains from aquaculture. Considered in its own right, aquaculture growth was pro-poor in "strong, relative" terms over the entire period. From 2000 to 2005 consumption of farmed fish by the extreme poor increased 64 per cent, against an increase of 36 per cent for non-poor households, and from 2005 to 2010 consumption grew by 40 per cent and 18 per cent for extreme and non-poor households respectively. Absolute consumption increases were largest for non-poor households, however.

Aquaculture's contribution to fish consumption was pro-poor because it more than exceeded lost inland capture fisheries production. Ceteris paribus, if aquaculture's contribution to per capita fish supply had remained constant at 2000 levels, average fish consumption per capita would have fallen by 4.7 kg, or 26 per cent, in 2010. Extreme and moderate poor households would have been most severely affected in both relative and absolute terms, each losing 23 per cent of their consumption (2.3 kg and 3.1 kg respectively), while non-poor households would have experienced an 11 per cent (2.0 kg) drop in fish intakes. Thus, although aquaculture was once considered "unlikely to benefit those with low incomes in Bangladesh" because of a tendency to produce large, high value fish (Lewis 1997:533), evidence presented here demonstrates clearly that this is no longer the case. In fact, the expansion of commercial aquaculture has tended to stabilise or reduce the price of fish, which has become relatively more affordable as incomes have risen.

Conversely, the contraction of apparent capture fisheries production negatively impacted the welfare of poor and non-poor consumers alike. Since the poor derived more fishes from the capture source and since its share in consumption has been declining, the poor households have suffered most from the decline in the capture fisheries sector. It is possible that, had inland capture fisheries output remained constant or declined at a lesser rate, aquaculture growth would have resulted even more favourable outcomes - perhaps even “strong, relative” pro-poor growth in overall fish consumption. This underlines strong complementarity between the two subsectors in terms of their role in food provisioning for all categories of consumer.

11.2 Pro-poor Aquaculture Growth: Wider Implications

Four key conclusions can be drawn from the evidence presented above. First, in this particular instance, aquaculture has proven unequivocally pro-poor in terms of the “indirect, consumption” pathway conceptualised in Figure 6.1. Second, this finding must be qualified in the context of wider changes taking place in the national economy between 2000 and 2010. Pro-poor economic growth and a gradual narrowing of the gap between rural and urban areas, particularly during the second half of the decade, appears to have translated very directly into pro-poor and pro-rural fish consumption growth. By the same token, had the growth process over this period resulted in widening economic inequality, it is likely that this would also have manifested in widening inequality in fish consumption.

Third, aquaculture growth was driven by the achievement of greater technical efficiencies. This conclusion is consistent with the observation that real prices of farmed fish fell, or remained constant over the entire decade, whilst increasingly intensive forms of aquaculture commanded progressively larger shares of output. Supply increases, which occurred as a result of the commercialisation of production, exerted downward pressure on relative prices, stimulating greater consumer demand and further efficiencies on the part of producers. Belton and Little (2008) and Tveterås *et al.* (2013) have identified similar patterns of aquaculture development in Thailand and at the global level, respectively.

Finally, a sharp decline in apparent capture fisheries output partially undermined the positive effects associated with aquaculture growth. Had it been possible to reduce, or even reverse, the downward trend in capture fisheries output (notwithstanding that this may itself have provided part of the stimulus for aquaculture development), it is likely that overall growth in fish consumption would have been more strongly pro-poor.

These findings lead to two overarching conclusions. First, with respect to fish consumption, the pro-poor nature of aquaculture growth is contingent on the interplay of two factors: the expansion of fish supply and its effect of dampening fish prices, and the extent to which growth processes in the wider economy reduce inequality. Pro-poor economic growth and distributional outcomes of growth scenarios for aquaculture are closely linked, but distinct. Evidence presented here suggests (although not completely conclusively) that pro-poor growth may be a necessary but not a sufficient condition for pro-poor aquaculture growth - defined in terms of indirect consumption linkages - to occur. Whether or not aquaculture is pro-poor in this respect depends not only and on the nature of economic growth however, but upon the nature of aquaculture itself. Aquaculture's rate of growth, capacity to reduce or maintain low prices relative to other commodities, mix of commodities produced, market orientation and the specific nature of its interactions with capture fisheries are all important in this respect. One inference to be drawn is that policies which encourage pro-poor growth may be at least as important in ensuring that aquaculture results in pro-poor outcomes as those which aim to promote aquaculture itself. Our final conclusion is that viable capture fisheries complement pro-poor aquaculture growth from the supply side. The likelihood that the global transition in fisheries will generate pro-poor outcomes will be much greater if the contributions of both sectors can be sustained.

REFERENCES

Ahmed, Mahfuzuddin, and Mylene H. Lorica. 2002. "Improving Developing Country Food Security through Aquaculture Development—Lessons from Asia," *Food Policy 27.2*: 125-141.

Ahmed, N. 2009. "Revolution in Small-scale Freshwater Rural Aquaculture in Mymensingh, Bangladesh." *World Aquaculture*, 40(4): 31-35, 54.

Ali, Hazrat, Mohammad Mahfujul Haque and Ben Belton. 2012. "Striped Catfish (Pangasianodon hypophthalmus, Sauvage, 1878) Aquaculture in Bangladesh: An Overview," *Aquaculture Research*, 44.6 : 950-965.

Ali, H. and M. M. Haque. 2011. "Impacts of Pangasius Aquaculture on Land Use Patterns in Mymensingh District of Bangladesh," *J. Bangladesh Agril. Univ*. 9(1): 169-178.

Ali, M. 1989. "Environment, Conservation and Fishery Resources in Bangladesh," In Agüero, Huq, Rahman and Ahmed (1989).

Ali, M. Y. 1967. "Induced Breeding of Major Carps in Ponds by Pituitary Hormone Injection," *Agric. Inform*, Serv.

Allison, E. H. 2011 "Aquaculture, Fisheries, Poverty and Food Security."

Anwar, E., K. S. S. Putri and S. Surini. 2011. "Novel Excipient for Matrix of Floating Tablet Containing Nile Tilapia Gelatin, Chitosan and Cellulose Derivatives," *Journal of Medical Sciences*, 11(4).

Arthur, R. C. Béné, W. Leschen and D. Little. 2013. "Fisheries and Aquaculture and their Potential Roles in Development: An Assessment of the Current Evidence," MRAG, Institute of Development Studies and University of Stirling.

BBS. 2011. *Household Income and Expenditure Survey 2010*. Dhaka: Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh.

BBS. 2010. *Household Income and Expenditure Survey Instruction Manual*. (In Bangla). Dhaka: Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh.

BBS. 2007. *Household Income and Expenditure Survey 2005*. Dhaka: Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh.

Belton, B. & A. Azad. 2012. "The Characteristics and Status of Pond Aquaculture in Bangladesh," *Aquaculture*, 358-359:196–204.

Belton, Ben, *et al*. 2011a. "Certifying Catfish in Vietnam and Bangladesh: Who will Make the Grade and will it Matter?" *Food Policy*, 36.2 : 289-299.

Belton, B. *et al*. 2011b. "Review of Aquaculture and Fish Consumption in Bangladesh, Studies and Reviews, 2011-53," The World Fish Center, November.

Belton, B., M.M. Haque and D.C. Little. 2012. "Does Size Matter? Reassessing the Relationship between Aquaculture and Poverty in Bangladesh," *Journal of Development Studies*, 48(7): 904-922.

Belton, B. and D. C. Little. 2011. "Immanent and Interventionist Inland Asian Aquaculture Development and its Outcomes," *Development Policy Review*, 29(4):459-484.

Belton, B. and D. Little. 2008. "The Development of Aquaculture in Central Thailand: Domestic Demand Versus Export-Led Production," *Journal of Agrarian Change*, 8(1):123-143.

Belton, B. and S.H. Thilsted 2014. "Fisheries in Transition: Food and Nutrition Security Implications for the Global South," Global Food Security. http://dx.doi.org/10.1016/j.gfs.2013.10.001i.

Belton, B., van I.J.M. Asseldonk, S.H. and Thilsted. 2014. "Faltering Fisheries and Ascendant Aquaculture: Implications for Food and Nutrition Security in Bangladesh," *Food Policy*, 44: 77-87.

Beveridge, M., M. J. Phillips, P. Dugan and R.E. Brummett. 2010. "Barriers to Aquaculture Development as a Pathway to Poverty Alleviation and Food Security: Policy Coherence and the Roles and Responsibilities of Development Agencies. OECD 2010," In: *Advancing the Aquaculture Agenda. Proceedings of a Workshop*, Paris, 15-16 April, pp. 199- 209, Paris, OECD.

Beveridge, M.C., S.H. Thilsted, M.J. Phillips, M. Metian, M. Troell and S.J. Hall. 2013. "Meeting the Food and Nutrition Needs of the Poor: The Role of Fish and the Opportunities and Challenges Emerging from the Rise of Aquaculture," *Journal of Fisheries Biology*, 83(4):1067-1084.

Brummett, R. E., J. Lazard and J. Moehl. 2008. "African Aquaculture: Realizing the Potential," *Food Policy*, 33:371-385.

Capistrano, A., M. Hossain, and M Ahmed. 1996. Poverty Alleviation, Empowerment and Sustainable Resource Use: Experiences in Inland Fisheries Management in Bangladesh.

Delgado, C.L., N. Wada, M.W. Rosegrant, S. Meijer and M. Ahmed. 2003. *Fish to 2020: Supply and Demand in Changing Global Markets*, Washington, D.C: International Food Policy Research Institute.

Dey, A. K., M. M. Bose and M. Alam. 2008. *Country Case Study: Development and Status of Freshwater Aquaculture in Bangladesh*, World Fish Center, Bangladesh.

Dey, A. K. 2000. *Providing Architectural Support for Building Context-aware Applications* Doctoral Dissertation, Georgia Institute of Technology.

Dey, M.M., M.F. Alam and M. L. Bose. 2010. "Demand for Aquaculture Development: Perspectives from Bangladesh for Improved Planning," *Reviews in Aquaculture*, 2: 16-32.

Dey, M., D. Spielman, A. Haque, M. Rahman and R. Valmonte-Santos. 2012. "Change and Diversity in Smallholder Rice–Fish Systems Recent Evidence from Bangladesh," IFPRI Discussion Paper 01220, October.

DOF. 1990. *Fish Catch Statistics of Bangladesh, 1987-1988,* Dhaka: Directorate of Fisheries, 1990.

DOF. 2012. *Fisheries Statistical Yearbook of Bangladesh 2010-2011*, Department of Fisheries, Ministry of Fisheries and Livestock, Dhaka.

DOF. 2013. *Fisheries Statistical Year Book of Bangladesh 2011–2012*, Volume 29, Dhaka: Fisheries Resource Survey System, Department of Fisheries, Ministry of Fisheries and Livestock.

Edwards, P. 1999. "Towards Increased Impact of Rural Aquaculture," A Discussion Paper prepared for the First Meeting of the APFIC Ad Hoc Working Group of Experts on Rural

Aquaculture, FAO Regional Office for Asia and the Pacific (RAP) Bangkok, Thailand, 20–22 October.

Edwards, P. and M. S. Hossain. 2010. Global Aquaculture Advocate, 2010 - pdf.gaalliance.org

FAO. 2012. *The State of World Fisheries and Aquaculture 2012*, FAO Fisheries and Aquaculture Department, Food and Agriculture Organization of the United Nations, Rome.

FAO. 2013. *Fish Stat J*, a Tool for Fishery Statistics Analysis. (Accessed 10/07/2013). http://www.fao.org/fishery/statistics/software/fishstatj/en.

Grinspun, A. 2009. Pro-poor Growth: Finding the Holy Grail. IPC-IG Collection of One Pagers. International Policy Centre for Inclusive Growth, United Nations Development Programme, p.6.

Hallman, K., D. Lewis and S. Bugum 2003. "An Integrated Economic and Social Analysis to Assess the Impact of Vegetable and Fishpond Technologies on Poverty in Rural Bangladesh," EPTD Discussion Paper No. 112, Washington D.C.: International Food Policy Research Institute.

Halls, A.S., A. I. Payne, S. S. Alam and S. K. Barman. 2008. *"Impacts of Flood Control Schemes on Inland Fisheries in Bangladesh: Guidelines for Mitigation," Hydrobiologia*, 609:45–58.

Hasan, M., A. Ahammad and M. Khan. 2010. "A Preliminary Investigation into the Production of Thai Koi (Anabas testudineus) Reared in Nylon Hapas in Bangladesh," *Bangladesh Research Publications Journal*, 4 (1):15-23.

HKI. 2011. *State of Food Security and Nutrition in Bangladesh: 2010*, Dhaka: Helen Keller International and James P Grant School of Public Health.

Holmes, Rebecca, John Farrington, Taifur Rahman and Rachel Slater 2008. "Extreme Poverty in Bangladesh: Protecting and Promoting Rural Livelihoods," ODI Project Briefing, No. 15, September.

Hossain, M., M. Rahman, S.C. Nath and A. Chowdhury. 2013. "Nature and Impact of Agricultural Mechanization in Bangladesh: Insights from Farm Level Surveys," presentation given at the Asian Regional Workshop on Rural Mechanization, Organized by Planning Commission, GOB and BRAC, Dhaka 7-8 March.

Hossain M.A.R., B. Belton and S. Thilsted. 2013. *Preliminary Rapid Appraisal of Dried Fish value Chains in Bangladesh*, Dhaka: World Fish Bangladesh.

Howlader, S.R., S. Kavita, B. Ferdousi, P. Dipika, E.A. Sommerfelt and K.Tara. 2012. Investing in Nutrition Now: A Smart Start for Our Children, Our Future. Estimates of Benefits and Costs of a Comprehensive Program for Nutrition in Bangladesh, 2011– 2021, PROFILES and Nutrition Costing Technical Report. Washington, DC: Food and Nutrition Technical Assistance III Project (FANTA), FHI 360.

Hussain, M.G. 2009. "A Future for the Tilapia in Bangladesh," *Aqua Culture Asia Pacific*, 5(4):38-40.

Irz, X., J.R. Stevenson, A. Tanoy, P. Villarante and P. Morissens. 2007. "The Equity and Poverty Impacts of Aquaculture: Insights from the Philippines," *Development Policy Review*, 25(4): 495-516.

Islam, M.M. and R. Chuenpagdee. 2013. "Negotiating Risk and Poverty in Mangrove Fishing Communities of the Bangladesh Sundarbans," *Maritime Studies*, 21(7):1-20.

Jahan, K. M., M., Ahmed and B. Belton. 2010. "The Impacts of Aquaculture Development on Food Security: Lessons from Bangladesh," *Aquaculture Research*, 41(4):481-95.

Kakwani, K., S. Khandker and H.H. Son. 2004. "Pro-Poor Growth: Concepts and Measurement with Country Case Studies," International Poverty Center Working Paper No. 1. Brasilia: United Nations Development Programme International Poverty Centre

Karim, M.A. 1998. A Review of Foreign Assisted Fishery Projects in Bangladesh, AFS/FAO Regional Workshop, Bangkok, Thailand. 16-18 November.

Kassam, L. 2013.*Assessing the Contribution of Aquaculture to Poverty Reduction in Ghana*, PhD thesis, London: School of Oriental and African Studies, 404pp.

Kawarazuka and Béné. 2010. "Linking Small-scale Fisheries and Aquaculture to Household Nutritional Security: An Overview," *Food Security*, 2:343–357.

Kawarazuka and Béné. 2011. "The Potential Role of Small Fish Species in Improving Micronutrient Deficiencies in Developing Countries: Building Evidence," *Public Health Nutrition*, 14(11):1927-38.

Kent, G. 1987. *Fish, Food and Hunger: The Potential of Fisheries for Alleviating Malnutrition*, Colorado, USA: West View Press.

Kibria, G. 1983. 1983. *Shrimp Resources and Shrimp Culture (*in Bangla), Satkhira, Khulna, Bangladesh: Jahan Printing Press.

Lewis, D. 1997. "Rethinking Aquaculture for Resource-poor Farmers: Perspectives from Bangladesh," *Food Policy*, 22(6):533-546.

Minkin, S., F. Stephen, M. Mokhlesur Rahman and Sachindra Halder 1997. In Tsai Chu-Fa and Youssouf Ali (eds.), *Inland Capture Fisheries of Bangladesh*. Dhaka: University Press Limited.

Minten, B., A.Z.M.S. Alam, U.K. Deb, K.K. Akhtaruzzaman, D. Laborde, M. Hassanullah and K.A.S. Murshid. 2010. "Agricultural Marketing, Price Stabilization, Value Chains, and Global/Regional Trade," Dhaka: Bangladesh Food Security Investment Forum.

MoF. 2012. *Bangladesh Economic Review 2012*, Finance Division, Ministry of Finance. Dhaka, Bangladesh.

Mome, M.A. 2007. "The Potential of the Artisanal Hilsha Fishery in Bangladesh : An Economically Efficient Fisheries Policy," The United Nations University Fisheries Training Programme.

Murphy, S. P. and L. H. Allen. 2003. "Nutritional Importance of Animal Source Foods," *The Journal of Nutrition*, 33:3932S–3935S.

Neumann, C., D. M. Harris and L.M. Rogers. 2001. "Contribution of Animal Source Foods in Improving Diet Quality and Function in Children in the Developing World," *Nutrition Research*, 22(1):193-220.

Osmani, S. 2009. "Defining Pro-poor Growth," *IPC-IG Collection of One Pagers*, International Policy Centre for Inclusive Growth and United Nations Development Programme, p.9.

Planning Commission. 1978. *The Two-Year Plan: 1978-80*, Dhaka: Government of the People's Republic of Bangladesh.

Rahman, A. 1989. *Fresh Water Fishes of Bangladesh*, Dhaka: Zoological Society of Bangladesh, University of Dhaka.

Rahman, A. A., A. H. G. Quddus, B. Pokrant and M. L. Ali. 2006. *Shrimp Farming and Industry: Sustainability, Trade and Livelihoods*, Dhaka: Bangladesh Centre for Advanced Studies and The University Press Limited.

Rand, J. and F. Tarp. 2010. "Impact of an Aquaculture Extension Project in Bangladesh," *Journal of Development Effectiveness*, 1(2): 130–146.

Ravallion, M. 2004. *Pro-poor Growth: A Primer*, Development Research Group, Washington, D.C.: The World Bank.

Roos, N, M. A.Wahab, C. Chamnan and S. H. Thilsted. 2007. "The Role of Fish in Food-based Strategies to Combat Vitamin A and Mineral Deficiencies in Developing Countries," *Journal of Nutrition*, 137:1106-1109.

Roos, Nanna, M.A. Wahab, Mostafa A. Hossain, S. H. Thilsted and H. Shakuntala. 2007. "Linking Human Nutrition and Fisheries: Incorporating Micronutrient-dense, Small Indigenous Fish Species in Carp Polyculture Production in Bangladesh," *Food and Nutrition Bulletin*, 28(2 Suppl): 280-93.

Sen, B. 2003. "Drivers of Escape and Descent: Changing Household Fortunes in Rural Bangladesh," *World Development*, 31(3):513-534.

Shankar, B., A. Halls and J. Barr. 2004. "Rice Versus Fish Revisited: On the Integrated Management of Floodplain Resources in Bangladesh," *Natural Resources Forum*, 28(2):91–101.

Stanley, D. L. 2003. "The Economic Impact of Mariculture on a Small Regional Economy," *World Development*, 31(1): 191–210.

Stevenson, J. R. and X. Irz. 2009. "Is Aquaculture Development an Effective Tool for Poverty Alleviation? A Review of Theory and Evidence," *Cahiers Agricultures*, 18(2-3):292-9.

Sultana, P. 2012. "Implications of Floodplain Aquaculture Enclosure," *Journal of Environmental Planning and Management*, 55(9):1159-1174.

Tacon, A.G.J. and M. Metian. 2013. "Fish Matters: Importance of Aquatic Foods in Human Nutrition and Global Food Supply," *Reviews in Fisheries Science*, 21(1):22–38.

Thompson, M. Paul, A.K.M. Firoz Khan and P. Sultana. 2006. "Comparison of Aquaculture Extension Impacts in Bangladesh," *Aquaculture Economics and Management*, 10:15-31.

Thompson, P., N. Roos, P. Sultana and S.H. Thilsted. 2002. "Changing Significance of Inland Fisheries for Livelihoods and Nutrition in Bangladesh," *Journal of Crop Production*, 6:249–31.

Toufique, K. A. 1997. "Some Observations on Power and Property Rights in the Inland Fisheries of Bangladesh," *World Development*, 25(3): 457-467.

Toufique, K. and R. Gregory. 2008. "Common Waters and Private Lands: Distributional Impacts of Foodplain Aquaculture in Bangladesh," *Food Policy*, 33: 587–594.

Tveterås, S., F. Asche, M.F. Bellemare, M.D. Smith, A.G. Guttormsen, A. Lem, K. Lien and S. Vanuccini. 2012. "Fish Is Food: The FAO's Fish Price Index," *PLoS ONE*, 7(5):E36731.

Welcomme, L. Robin, G. Ian Cowx, David Coates, Christophe Béné, Simon Funge-Smith, Ashley Halls and Kai Lorenzen. 2010. "Inland Capture Fisharies," *Phil. Trans. R. Soc. B*, 365: 2881–2896.

World Bank. 2013. “Bangladesh Poverty Assessment: Assessing a Decade of Progress in Reducing Poverty, 2000-2010,” *Bangladesh Development Series Paper No. 31*, Dhaka: The World Bank Office.

Zhang, X., S. Rashid, K. Ahmad, V. Mueller, H.L. Lee, S. Lemma, S. Belal and A. Ahmed. 2013. “Rising Wages in Bangladesh,” IFPRI Discussion Paper 01249, Washington D.C.: International Food Policy Research Institute.

The Author

Dr. Kazi Ali Toufique did his B.S.S. and M.S.S. in Economics in 1982 and 1983 respectively from Dhaka University. He obtained an M.A. from Fordham University in 1987, M.Phil. in 1990 and Ph.D. in 1996, both from the University of Cambridge. He joined BIDS in 1989 as a Research Associate. His main areas of research interest are institutional economics, livelihoods analysis, natural resource management, environment and agricultural economics. He has contributed to many seminars and conferences both at home and abroad and has also published in reputed international journals. At present, he is working as a Research Director of BIDS.