Hilsa's non-consumptive value in Bangladesh

Estimating the non-consumptive value of the hilsa fishery in Bangladesh using the contingent valuation method

Essam Yassin Mohammed, Liaquat Ali, Shahjat Ali, Belayet Hussein, Md Abdul Wahab, Nathan Sage

Working Paper
November 2016

Fish

Keywords:
hilsa fishery; economic valuation; contingent valuation

iied
BCAS
WorldFish

About the author

Essam Yassin Mohammed is a Senior Researcher in the Shaping Sustainable Markets Group at the International Institute for Environment and Development, UK.
Email: eymohammed@iied.org

Liaquat Ali, Shahjat Ali and Belayet Hussein, of the Bangladesh Centre for Advanced Studies, Bangladesh

Md Abdul Wahab of WorldFish Centre, Bangladesh

Nathan Sage of USAID, Bangladesh

Acknowledgements

The authors acknowledge the financial support of USAID. Special thanks are given to the EcoFishBD project team of the WorldFish for their active support in the implementation of the research and to Syed Arif Azad, Director General, Department of Fisheries, Bangladesh for his continuous inspiration, sincere interest and support towards the implementation of the research activities. Finally, the enthusiasm and sincere support from the officials of the Department of Fisheries at the field level, as well as at headquarters, are gratefully recognised.

Produced by IIED's Shaping Sustainable Markets Group

The Shaping Sustainable Markets group works to make sure that local and global markets are fair and can help poor people and nature to thrive. Our research focuses on the mechanisms, structures and policies that lead to sustainable and inclusive economies. Our strength is in finding locally appropriate solutions to complex global and national problems.

Partner Organisation

The Bangladesh Centre for Advanced Studies (BCAS) is an independent, non-profit, non-government, policy, research and implementation institute working on Sustainable Development (SD) at local, national, regional and global levels. It was established in 1986 and has grown to become a leading research institute in the non-government sector in Bangladesh and South Asia.

WorldFish is an international, nonprofit research organization that harnesses the potential of fisheries and aquaculture to reduce hunger and poverty. WorldFish is a member of CGIAR, a global agriculture research partnership for a food secure future.

Published by IIED, November 2016

Mohammed, E.Y., Ali, L., Ali, S., Hussein, B., Wahab, M.A., Sage, N. 2016. *Hilsa's non-consumptive value in Bangladesh: Estimating the non-consumptive value of the hilsa fishery in Bangladesh using the contingent valuation method.* IIED Working Paper. IIED, London.

http://pubs.iied.org/16626IIED

ISBN 978-1-78431-425-5

Printed on recycled paper with vegetable-based inks.

International Institute for Environment and Development
80-86 Gray's Inn Road, London WC1X 8NH, UK
Tel: +44 (0)20 3463 7399
Fax: +44 (0)20 3514 9055
email: info@iied.org
www.iied.org

@iied
www.facebook.com/theIIED

Download more publications at www.iied.org/pubs

Hilsa is Bangladesh's most important single-species fishery: for cultural identity, earnings and employment. However, overfishing, habitat destruction, siltation, pollution and climate change have driven catches down, and management policies have not adequately intervened – probably because the fishery's total economic value is under-appreciated. This study is the first to estimate the non-consumptive (non-use) value of a well-managed hilsa fishery. It used the contingent valuation method and asked 1006 fishing and non-fishing households how much they would be 'Willing To Pay' (WTP) for an effectively-managed fishery. In Barisal Division, an improved fishery could be worth BDT 651.8M – 1,384.2M a year (approximately US$8.3M – 17.7M). Nationally, a better-managed fishery could be worth BDT 13,128.6M – 27,882.1M per year (US$167.5M – US$355.7M). Poorer people are willing to pay the highest proportion of their income, suggesting fishery restoration would be pro-poor. However, any interventions must share benefits equitably and address the systemic constraints facing low income groups.

Contents

Summary

Hilsa is the most important single-species fishery in Bangladesh. Almost all the catch is *Tenualosa ilisha*, and the fishery contributes significantly to cultural identity, the national economy and employment. However, overfishing, habitat destruction, siltation, pollution and climate change mean catches have declined in recent decades.

Management policies have not intervened adequately to reverse this trend – probably because the total economic value of the fishery is not well understood. While citizens and policymakers recognise the cultural significance of the fishery, until now no monetary value has been put on this aspect. Yet valuing the fishery only on landed catches underestimates its true importance and the benefits of better management.

This study is the first attempt to value the non-consumptive (non-use) aspects of a well-managed hilsa fishery. It surveyed 1006 households in Barisal Division, asking how much they would be Willing To Pay (WTP) for a hypothetical fisheries restoration programme run over ten years. We used the contingent valuation method to convert WTP statements to estimates of the fishery's economic value, using the median and the mean amounts people were willing to contribute to calculate lower and upper estimates.

In Barisal Division, an improved fishery is estimated to be worth between BDT 651.8M (approximately US$8.3M) and BDT 1,384.2M (approximately US$17.7M) per annum. Extrapolating the analysis to the national level suggests a better-managed hilsa fishery would be worth between BDT 13,128.6M (approximately US$167.5M) and BDT 27,882.1M (US$355.7M) per annum to Bangladesh. It must be noted that these estimates do not include the fishery's use or consumptive values.

When calculating value, we used a Kaplan Meier survival estimate to establish that respondents had considered their budget constraints and were acting rationally. We also asked a follow up 'how certain are you that you would be willing to pay?' question, which was presented in a 10 point Likert scale. A cut off point of 8 and above was used to calibrate WTP statements. However, the estimates were not statistically distinguishable from the uncalibrated values. This further suggests that the survey protocol was well executed and respondents were behaving as they would in a real world market scenario.

We then explored the distributional implications of benefits from an improved hilsa fishery by estimating income elasticity of WTP. This was found to be less than one, suggesting lower income groups are willing to pay proportionately more for hilsa fish restoration than higher income groups will pay. This implies that low income segments of society are most reliant on the hilsa fishery, and therefore investment in hilsa fish restoration is pro-poor.

We believe that investments equivalent to only a fraction (5-10 per cent) of the fishery's estimated non-consumptive value would bring about the desired change. Such investments could: restore crucial fish habitats; effectively enforce the fishing regulation (as stipulated in the Fish Protection and Conservation Act-1950), and provide incentives to local fishers to stop destructive fishing practices.

1

Introduction

Coastal and marine resources provide a range of ecological functions that directly and indirectly support human lives and economies, often categorised as supporting, regulating, provisioning and cultural services (MEA, 2005).

For many of the world's countries, fisheries play an important role in meeting food demands, in addition to providing employment and income. Fisheries alone support close to 250 million livelihoods around the world and produce food worth nearly US$190 billion per year (WAVES, 2012). In 2010, fish accounted for 16.7 per cent of the global population's animal protein intake (FAO 2014). In 2012, around 58.3 million people were engaged in capture fisheries and aquaculture, with 84 per cent located in Asia (FAO 2014). Over the past 50 years, global landings of fish have increased at an average rate of 3.2 per cent per year (FAO 2014). Despite this upwards trend in landings, coastal fisheries are declining due to overfishing, compromising the sustainability of this important resource (Pauly 2006).

Bangladesh is one of the world's leading fish-producing nations. According to the latest available data, in 2011–2012, fish production contributed 4.4 per cent to the country's national GDP, 2.5 per cent to foreign exchange earnings, and 60 per cent of all consumed animal protein (FRSS 2013). In addition to its economic importance, the fisheries sector is a significant source of employment, with 11 per cent of the country's population directly or indirectly involved in this sector (FRSS 2013).

The hilsa fishery is the biggest single-species fishery in Bangladesh[1] with landings contributing approximately 10 per cent to annual fish production (FRSS 2014), and 1 per cent to the country's annual GDP (DoF 2014). Hilsa spend much of their life in coastal waters but they migrate upstream to spawn in coastal rivers (Rahman and Naevdal 2000).While hilsa is broadly distributed from Vietnam to the Persian Gulf (Freyhof 2014), Bangladesh takes 50–60 per cent of the catch with relatively smaller proportions taken by Myanmar (20–25 per cent), India (15–20 per cent) and other countries (5–10 per cent) (Rahman *et al.* 2012). In Bangladesh alone, an estimated half a million people directly depend on the fishery and a further 2.5 million are indirectly involved in supply-chain activities such as processing, transportation and marketing (Rahman *et al.* 2012).

Hilsa has cultural and religious significance in the South Asian region. The people of Bangladesh and West Bengal in India, as well as Bengali-speaking people throughout the world, love fish. They like to define themselves with the phrase '*mache bhate Bengali*', or 'fish and rice make the Bengali'. Hilsa holds the highest position among the rich biodiversity of the Ganges river system, and its importance is further emphasised through different dishes and their use in ceremonial festivals (see Box 1). Thus, hilsa is important socially, culturally, and religiously to the Bengali people and people in many Indian states including Odisha, Bihar and Assam (Mohammed and Wahab 2013).

[1] While there are three separate species of Hilsa (*Hilsa kelee*, *H. toli* and *Tenualosa ilisha*), where we use the term 'hilsa' throughout this paper we are referring to *T. ilisha* as it the most numerous species making up to 99 per cent of the annual fish catch in Bangladesh.

However, numerous studies have concluded that a burgeoning human population and a corresponding demand for fish protein has driven mass overfishing of both adults and *jatka* (juvenile hilsa) in the gill net[2] fishery (Amin *et al.* 2008 and 2002; Rahman *et al.* 2013). Hilsa, which was abundantly available in the 100 rivers of Bangladesh until the 1960s and 1970s, declined gradually over 30 years to reach a low point in 2002 when catches were 0.19 million tonnes. This decline was due to a combination of factors: the closure of migratory routes, river siltation, overfishing, indiscriminate harvesting of brood stocks and juveniles, use of fishing nets with very small mesh sizes, mechanisation of fishing, increasing numbers of fishers, pollution, and climatic variability.

We argue that such threats from overfishing are exacerbated by policymakers' insufficient investments in restoring the fishery, despite its economic and cultural importance. This probably occurs because the fishery's true value is poorly understood. An explicit, rather than implicit, understanding of the multiple values that artisanal hilsa fishing communities provide to, and receive from, coastal and marine ecosystems is vital for well-informed policy.

Typically, markets do not capture non-use values, or as we call them in this study, non-consumptive[3] values of artisanal and small-scale fisheries. For example, fisheries' socio-cultural values are usually not fully understood, or are poorly accounted for in national accounts (Lafolley *et al.* 2009). Such values are rarely factored into decision making processes, which instead typically focus on short-term, produce-based commodities.

Therefore, this study aimed to estimate the non-consumptive values of the hilsa fishery in monetary terms that encompassed cultural, religious and sentimental values. We used the Contingent Valuation Method (CVM) to estimate the 'willingness to pay' of residents in Barisal Division for non-consumptive (socio-cultural, religious and sentimental) benefits of a hypothetically-restored fishery.

Unlike the majority of CV studies, which are conducted in relatively high income countries, this study aims to estimate the non-consumptive values of hilsa fishery in Bangladesh, a least developed country (LDC). We will also identify the determinants of willingness to pay statements. Subsequently, Section 2 reviews the contingent valuation method and Section 3 describes the survey design. Section 4 reports and discusses empirical results, and Section 5 finally presents concluding remarks.

[2] A fishing net that is hung vertically in the water column and typically made of monofilament or multifilament nylon. The mesh sizes are designed to allow fishes to get only their head through the netting. The gills of the fish then become caught in the net when they try to escape.

[3] While non-use value is commonly used in existing literature, the use of 'non-use' was creating unwanted confusion during consultation meetings and survey design phase of the study. This is primarily because all the stakeholders consulted were interpreting the phrase literally and did not feel with the term. Moreover, we were not able to find a close equivalence of the phrase in Bengali language. Therefore, non-consumptive was used instead.

2

The contingent valuation method (CVM)

The contingent valuation method (CVM) puts a monetary value on something for which there is no market and therefore no price (or compensation payment). Non-use or non-consumptive values of small-scale fisheries fall into this category. The contingent valuation is a survey-based method where people are asked how much they are willing to pay for an improvement and/or how much compensation they would accept for the deterioration of a given ecosystem quality (Mohammed 2009). The improvement or deterioration is the contingency; i.e., the hypothetical state, which the survey respondents are asked to imagine (Blore, 1996).

The method was first mathematically articulated by Maler (1974), who sought to extend standard welfare theory of price changes to changes in the supply of a public good (Willis and Corkindale, 1995, pp. 84–85). A consumer has preferences over *n* conventional market commodities, such as groceries, subscription to internet service, a mobile telephone, and so on, denoted here as X:

$$X : X = \{x_1, x_2, \ldots, x_n\} \quad (1)$$

Since the basic premise of neoclassical economic theory is that people have preference over both marketable and non-marketable goods, it is vital to incorporate the consumer's preference over a set of *k* other items (such as public goods), here called Q:

$$Q : Q = \{q_1, q_2, \ldots, q_k\} \quad (2)$$

For example, a person may want to buy some fruit and vegetables, school uniforms for their children, and also restore a fish stock that they rely on.

If that person faces some budget constraint, s/he will be forced to forgo something in order to afford something else. Let us assume that the consumer has an exogenous disposable income *y*, which is to be spent on some or all *n* commodities. These can be bought for an overall price *P* in non-negative quantities at given, fixed, strictly positive component prices:

$$P : P = \{p_1, p_2, \ldots, p_k\} \quad (3)$$

The best choice lies on, rather than below, any budget constraint (Johansson 1991). Hence, one can write the utility function of the consumer as:

$$U(X,Q) \quad (4)$$

Put simply, utility (or happiness) can be attained by consuming a certain marketable good (*x*) and ecosystem service (*q*). As consumers intend to maximise their utility with respect to *x* marketable goods (subject to the usual budget constraints), the problem of utility maximisation, can be written as:

$$\max_x U(X,Q); \text{ such that } p{*}x \leq y \text{ and } Q = Q_0 \quad (5)$$

Champ *et al.* (2003) explain that there are two constraints that people face in maximising utility. First, the total expenditure on market goods cannot exceed income. Second, the levels of the non-market goods are fixed. This is because the consumer cannot control the level of ecosystem service provided. The (x) that solves this problem then depends on the level of income (y), the prices of all the market goods (P), and the level of the rationed, non-market goods (Q). For each market good, we have an optimal demand function that depends on these three elements, $x_i^* = x_i(P,Q,Y)$; the vector of optimal demands can be written similarly, $x^* = x(P,Q,Y)$ where the vector now lists the demand function for each market good.

If we are inserting the set of optimal demands into the utility function, we obtain the indirect utility function, $U(X^*, Q) = v(P, Q, y)$. Because the demands depend on prices of the goods that a consumer wants to buy, the levels of the non-market goods such as restored fish stock, and the consumer's income, the highest obtainable level of utility or satisfaction also depends on these elements. Now, suppose that Q (the level of environmental quality, the level of river water quality for instance) increases from Q_0 (initial quality or quantity) to Q_1 (improved quality or quantity) while prices and income remain constant at (P, Y). As long as prices and income are kept constant, then we expect the person to be happier when the level of the environmental quality is improved.

Accordingly, the individual's utility increases from:

$$U_0 \equiv v(P, Q_0, y) \text{ to } U_1 \equiv v(P, Q_1, y) \quad (6)$$

Where U_0 is the person's initial utility before improvement, and U_1 is utility or happiness after improvement. Based on the welfare theory of price changes, Maler (1974) defined compensating and equivalent variation measures for this utility change (see also Willis and Corkindale, 1995). The compensating variation, which is denoted as ω, corresponds to the individual's willingness to pay (WTP) for the improvement, and satisfies the following equation:

$$v(P, Q_0, y) = v(P, Q_1, y - \omega) \quad (7)$$

The basic idea behind ω is that if a person gives up ω for the improvement (e.g. a restored fish stock), then he/she is back to the original utility. Champ *et al.* (2003) further argue that ω could be positive or negative depending upon how much benefit is gained or lost.

3 Methodology

Hypothetical market design

Initial focus group discussions with 146 households and 31 fisheries managers and experts were conducted to define the use and non-use (or non-consumptive) values of the hilsa fishery.

Our participatory approach developed a brief description of hilsa's non-consumptive value. This identified the most important cultural values and the most significant threats the fishery currently faces. We explored the investments needed to reverse the trend and restore the fishery, and developed a hypothetical scenario for achieving this, summarised in Box 1.

BOX 1. HYPOTHETICAL MARKET SCENARIO

Hilsa is the most preferred fish of the people of Bangladesh and West Bengal in India, and is of religious and cultural importance, forming part of Bengali festivals. Hilsa has been recognised as the 'national fish' of Bangladesh. In some Hindu Bengali families, large hilsa fish are bought for engagements and pre-wedding ceremonies. One such important occasion is the *Jamai Sashti*, when the son-in-law visits his prospective parents-in-law. A *Jamai Sashti* meal is never complete without at least one dish of hilsa, and it is often expected that the bridegroom will bring a pair of hilsa for the occasion.

Pohela Boishakh, the first day of the Bengali New Year, is ceremonially observed in both Bangladesh and the Indian state of West Bengal as a national day. Bengali communities celebrate *Pohela Boishakh* with a special menu of *Panta-Ilish* (fermented rice and fried hilsa).

Recent and significant declines in catches have pushed up prices, meaning most low income groups can no longer afford to buy hilsa. Decline in hilsa fish stock also poses a major threat to the socio-cultural benefits of the fishery. Significant investment is required to reverse the trend to the pre-1970s situation where hilsa was available in all major rivers, the average weight of caught fish was back up to 800g (from around 300g now), and most people could afford to buy hilsa. We asked fisheries managers and experts what would be needed for a national hilsa fish restoration programme. They suggested a ten year programme to:

1. Dredge river beds;
2. Control pollution;
3. Compensate fishers for the adhering to a fishing ban during spawning season; and
4. Boost capabilities to enforce the closed season and ban on harmful fishing gear (such as the *jal*).

Such a national programme requires a large amount of money. Each household needs to pay a monthly contribution towards the programme over the 10 years. The payment would be an additional fee on *Union Parishad* taxes (on buildings and land holding tax) and would be directed to a National Hilsa Conservation Foundation – which would administer the fund and work closely with the government and fisher communities to implement restoration activities.

There are many ways to ask people their willingness to pay, and these are called 'elicitation methods'. Widely used elicitation methods include: open-ended, single or double bound dichotomous choices, discrete choices, or offering a 'payment card' from which respondents can pick a value. Every method has its own advantages and disadvantages and none is immune to criticism. For example, open-ended questions such as 'how much would you pay to restore the fishery?' may provide a straightforward valuation on the ecosystem service in question (Ahmed and Gotoh, 2007), but the method is susceptible to 'hypothetical bias' in that when the idea is hypothetical people say they are willing to pay, but may be less willing when the payment becomes a reality (Mohammed, 2012). Similarly, bidding games suffer from starting point bias.

Therefore, selecting the right elicitation method is crucial to gathering valid and reliable data. Our focus groups discussed and pre-tested a number of elicitation techniques. A payment card method was found to be the most easily-understood and straightforward. Therefore, following Carson and Michell (1993), the study developed a payment card designed to cover the likely range of responses, as identified in the pre-test surveys (see Box 2).

Our full survey covered 1006 households (see section on sample design). Before asking people about their willingness to pay, they were asked whether they supported the hypothetical National Hilsa Fish Restoration Programme. We used a Likert scale between 0 (strongly disagree) to 10 (strongly agree) and asked respondents to choose their point on the scale. This was done to check for 'protest bidders', who would understate their willingness to pay simply because they do not agree with the proposed programme, and not necessarily because they do not value the ecosystem service. However, since there was no statistically-observable relationship between people's support for a programme and their willingness to pay statements, no interviews were discarded at the data analysis stage.

We also addressed 'hypothetical bias' – divergence between actual and hypothetical willingness to pay (Neil *et al.* 1994; List and Gallet 2001; Murphy *et al.* 2005; Blumenschein *et al.* 2008), which leads to over-valuation of the ecosystem service in question. There are several approaches for mitigating (and where possible eliminating), hypothetical bias. These range from the 'cheap talk method', which reminds respondents to consider their budget constraints and not to 'overstate' their willingness to pay, to using a follow up 'certainty question' that asks respondents to state how certain they are about their choice.

The effectiveness of 'cheap talk' in mitigating hypothetical bias is still debated, but studies conclude that a follow up certainty question can be used to effectively calibrate willingness to pay statements (Murphy *et al.* 2004). In this study, following Champ *et al.* (2004) and Mohammed (2012), a 10 point Likert scale was used, where 0 was 'very uncertain' and 10 was 'very certain'. Those respondents who are 'sufficiently' certain are considered as giving a 'true' WTP statement (Blomquist *et al.* 2008). Following Champ *et al.* (2004), a cut-off point of 8 and above was used to calibrate WTP statements. What this means is that, those respondents who stated certainty level 8 and above were considered to be 'sufficiently' certain.

The questionnaire survey also included a question on the respondent's socioeconomic characteristics, and a set of attitudinal and behavioural questions.

BOX 2. WILLINGNESS TO PAY ELICITATION QUESTION

What is the highest amount of money in Bangladeshi Taka, if anything, that your household would pay **each month for the next 10 years** to make a **National Hilsa Fish Restoration Programme** possible? (Circle the highest amount at which your household would still vote for the programme).'

0	20	40	60	80	100	130
150	180	210	240	300	350	400
500	600	700	800	900	1000	1500
2000	3000	4000	>5000			

If more than BDT 5000, then how much? ____________________

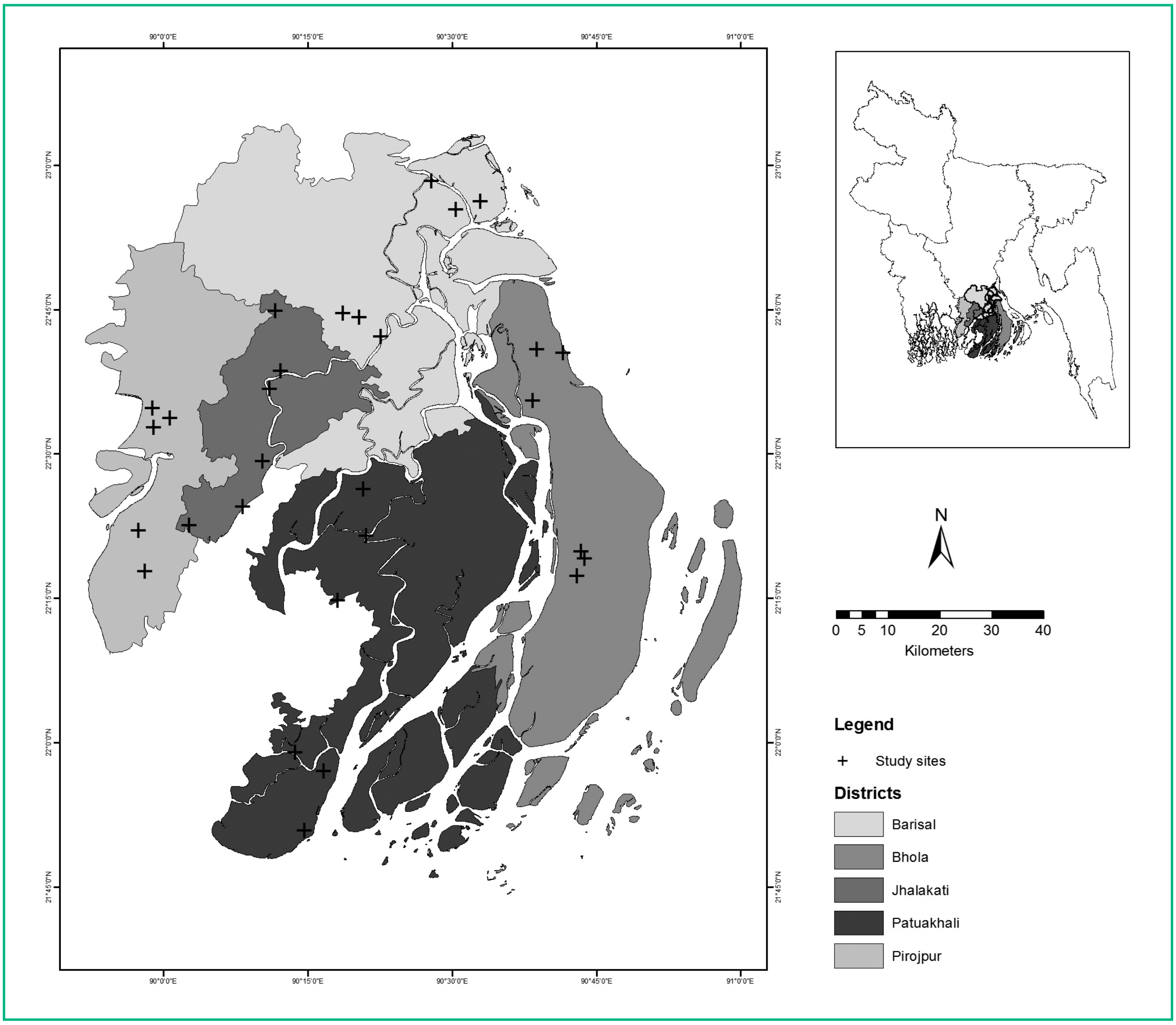
Sampling design

The study surveyed 1006 households in five districts (*Barisal, Bhola, Patuakhali, Pirojpur* and *Jhalokathi*) of Barisal Division. See Figure 1. Within each of the districts, two sub-districts (*upazila*) were identified through consultations with local fisheries officers. Since it is believed that hilsa is important to both fishers and non-fishers alike, sub-districts with sufficient variation in households' main source of livelihood and in income levels were selected.

The site selection process also ensured sufficient variety in distance to major rivers and fish markets. This was done to investigate 'distance decay' in willingness to pay statements.

Household respondents were selected from each sub district through stratified random sampling. Each sub district sample was allocated proportionately to the selected villages, according to population size of the village. To achieve this, all households in the selected village were serially numbered and every n^{th} household was selected for interview, where n is the total number of residents in the village divided by the total sub district level sample size. Household respondents were questioned in person by interviewers using a structured interview (available on request).

Figure 1. Map showing location of the study site and villages surveyed



4

Results and discussion

Descriptive statistics

Since interviews were conducted 'in person', all the 1006 households provided answers to all questions.

As mentioned in the previous section, the issue of 'distance decay' has been discussed in a number of CVM studies. This is the phenomenon in which respondents' willingness to pay falls with distance from the main area of interest (e.g. a major river or market). According to Hanley *et al.* (2003), such relationships are common where people are being asked to bid for the use-value (as opposed to non-use value) of an ecosystem service or good. However, when estimating non-consumptive values (as is the case in this study), such an inverse relationship is not necessarily expected to be observed.

Male and female representation was balanced (51 per cent and 49 per cent respectively). The average age of the respondents was about 41. The sample also had a good mix of household representatives ranging from *aratdars* (middlemen), labourers and fishers to merchants, farmers and professionals (including teachers, government officers, etc.).

The questionnaire included questions on household income. Since most respondents do not have a steady income level, and if they do, they may not feel comfortable to state the exact figure, a range of values was presented (e.g. below BDT 1000; BDT 15000 – BDT 20,000; BDT 1000 – BDT 2000; BDT 20,000 – BDT 30,000 and so on). A midway value of the intervals was used to estimate average income. The average household income was estimated at BDT 12,190.85 per month.

Questions on whether respondents are concerned with the current state of hilsa stock; whether or not they had participated in environmental awareness programmes; and whether or not their jobs involve environmental conservation were used as proxies for attitudinal and behavioural influences. Forty four per cent of the respondents stated that they are very concerned about the current state of hilsa fishery. Sixteen per cent of the respondents had participated in programmes to raise awareness about fisheries management at least once. A staggeringly high 98 per cent of respondents stated that overfishing is the major threat to hilsa fishery.

Table 1. Descriptive statistics

VARIABLE	DEFINITION	MEAN/ PER CENT	STD. DEV.
Gender	1 = male; 0 = otherwise	51%	0.500
Age	In years	40.821	14.03
Education	Years of schooling	6.130	4.151
EconActiveHH	Total number of persons who are economically active or earn income.	1.352	0.753
Aratdar	1 = respondent is aratdar; 0 = otherwise	0.002	0.045
Fisherman	1 = if respondent is fisherman; 0 = otherwise	0.083	0.275
Labourer	1 = respondent is labourer; 0 = otherwise	0.219	0.414
Merchant	1 = respondent is merchant; 0 = otherwise	0.266	0.442
Professional	1 = employed in government and/or non-government sectors	0.182	0.386
Farmer	1 = respondent is farmer (including animal husbandry)	0.240	0.427
DistanceWholesale	Distance from major wholesale fish market in Km.	4.457	5.100
AverageIncome	Family's average income (midpoint of interval).	12190.85	8278.27
VeryConcerned	1 = respondent is very concerned about the state of hilsa fish; 0 = otherwise	0.439	0.497
PartAwarness	1 = respondent has participated in awarness raising programmes; 0 = otherwise	0.158	0.365
WorkEnvNGOs	1 = respondent works for environmental NGO; 0 = otherwise	0.116	0.321
OverFishing	1 = respondent thinks main threat to hilsa fishery is overfishing; 0 = otherwise	0.978	0.146
WTP	Payment card bid value in BDT (monthly)	63.713	170.04
CertaintyQ	Likert scale between 1 and 10	7.417	3.944

Estimating non-consumptive value of hilsa fishery

Once the respondents' WTP statements had been elicited, estimating the aggregate non-consumptive value of a hypothetically improved hilsa fishery is straightforward. However, the value estimates vary depending on whether mean or median values are used.

Using the mean value may reflect the Kaldor–Hicks potential compensation criterion, which says that there will be a net gain in social welfare if those who have welfare gains can both compensate losers and still have a net gain for themselves (as argued by Cameron and Huppert 1989 and echoed by Mohammed 2009).

However, the median value may be a more realistic measure of the central tendency of WTP in a world where decisions are based on voting and where people have concerns about the distribution of a programme's benefits and costs.

It must be also noted that mean values are higher than median values. Therefore, in some studies they have been used as upper estimates of WTP, and median values are used as an indication of the lower limit. We adopt this approach here. Tables 2 and 3 estimate value of the fishery based on the mean and median respectively. Total estimated value is computed by multiplying mean or media WTP statements by the number of households at division and national levels. Average monthly WTP statements were multiplied by 12 to obtain annual estimates.

Table 2. Value estimates using mean WTP

GEOGRAPHICAL SCOPE	MEAN WTP STATEMENT (BDT)	NUMBER OF HOUSEHOLDS*	TOTAL ANNUAL ESTIMATED VALUE (BDT)
Barisal Division	63.71	1,810,444.44	1,384,186,162.67
Bangladesh (national)	63.71	36,468,330.11	27,882,080,597.39

* Population statistics were obtained from National Census 2011 (latest available data) and is available at: http://203.112.218.69/binbgd/RpWebEngine.exe/Portal?BASE=HPC2011_short&lang=ENG

Table 3. Value estimates using median WTP

GEOGRAPHICAL SCOPE	MEDIAN WTP STATEMENT (BDT)	NUMBER OF HOUSEHOLDS	TOTAL ANNUAL ESTIMATED VALUE (BDT)
Barisal Division	30	1,810,444.44	651,760,000.00
Bangladesh (national)	30	36,468,330.11	13,128,598,840.45

At Barisal division level, the non-consumptive value of the hilsa fishery was estimated between BDT 651,760,000.00 (approximately US$8.3M) and BDT 1,384,186,162.67 (US$17.7M) per annum.

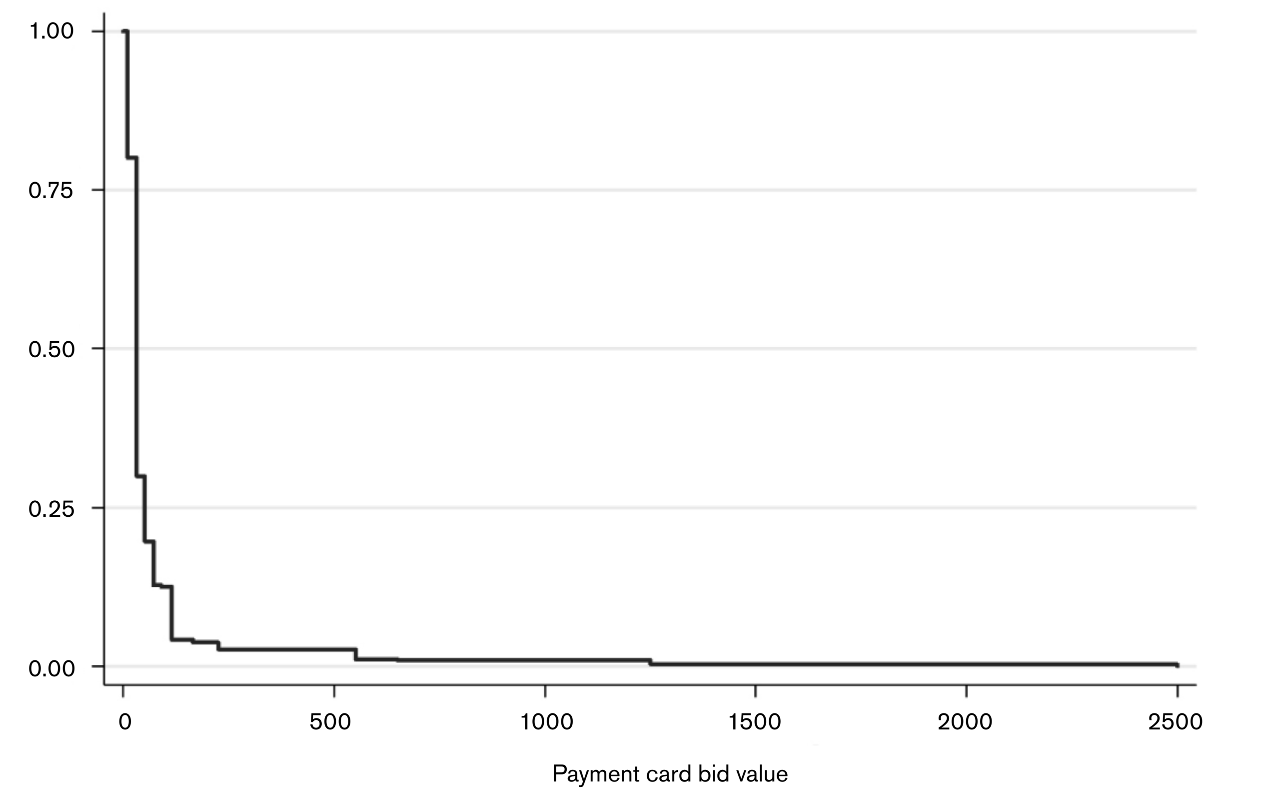
While extrapolating value estimates by multiplying average or median WTP statements is a common practice when estimating values at sub-national level, the validity of employing the same principle to estimate national level estimate is often disputed.

One of the main criticisms of such a general approach is that some determining factors can be significantly different across regions. For example, and as previously alluded to, distance from an environmental good or service may make WTP vary significantly. But in this study WTP did not diminish with distance from rivers. On the contrary, the further the distance the higher the WTP (even though only slightly higher). Therefore, assuming all other factors are constant, we believe that it is reasonable to extrapolate to a national value, particularly since hilsa is revered as part of national identity across the country. Therefore (and as presented in Table 2 and 3, we estimate lower and upper national values for the fishery at BDT 13,128,598,840 (approximately US$167.5M) and BDT 27,882,080,597 (US$355.7M) respectively.

To examine whether respondents have seriously considered their budget constraints in answering the WTP question we ran a Kaplan-Meier survival estimate. This shows the probability that a given payment card bid value is selected. In the real world we would expect a decreasing curve showing that higher bids are less likely to be selected – and this is what we found. Figure 2 demonstrates that respondents have indeed considered their budget constraint and were behaving rationally. This can be used to demonstrate the reliability of the data collected.

We tested for statistical variability between calibrated (using certainty question cut-off point of 8) and uncalibrated WTP values, and it was found that they were not statistically distinguishable. We conclude, with a word of caution, that there was no evidence found to suggest that the survey suffered from hypothetical bias.

Figure 2. Kaplan-Meier survival estimate of WTP statements



Factors explaining willingness to pay

Beyond value estimates, we are also interested in examining the factors that affect WTP statements. To do so, we regressed the natural logarithm of WTP against socioeconomic, attitudinal and behavioural variables. The value function can be mathematically denoted as:

$$LnWTP(\omega) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_n X_n \quad (8)$$

The regression analysis is presented in Table 4. While the coefficients of respondents' age and gender are not statistically significant, educational level, average monthly income, number of economically active household members, whether the respondent is an aratdar (middleman), and distance from wholesale fish market were found to be statistically significant. A one per cent increase in income yielded a 0.13 per cent increase in WTP.

It was also found that if a household has one more economically active member, then its WTP is likely to increase by 5.1 per cent. This is mainly because there is a positive correlation between the number of earning household members and its income level. Interestingly, but not unexpectedly, *aratdars* (middlemen in the hilsa supply chain) are willing to pay nearly double than non-aratdars. This is chiefly because their livelihood relies heavily on the status of hilsa fish stock. As mentioned earlier, distance from major fish market was also positively related to WTP (even though by a less remarkable magnitude). This is presumably because hilsa fish are regarded as a national treasure and are highly valued by Bangladeshis regardless of their geographic location. According to Hanley *et al.* (2003) and Mohammed (2009), this is not uncommon in studies that estimate non-use or non-consumptive values of ecosystem services.

The study also started with a hypothesis that attitudinal and behavioural characteristics affect respondents' WTP. While attitudes are primarily about beliefs and opinions, behaviour involves actions. If a respondent believes that overfishing poses the main threat to the hilsa stock, our analysis suggests WTP will be 31.1 per cent higher.

Those who have participated in sustainable fisheries management awareness programmes, and those who work for environmental groups and non-governmental organisations had higher WTP by 22.5 per cent and 14.4 per cent respectively.

Finally, we found that if a respondent is more certain about his/her WTP statement by one unit on the one to ten scale, then s/he is very likely to state 13.2 per cent higher WTP than those who are not. This further demonstrates that the respondents were considering a real-world scenario where they considered making a payment only when they thought they were certain.

Table 4. Regression result

VARIABLES	β	STD. ERR.
Age	0.001	0.002
Gender	0.024	0.043
Education	0.023***	0.005
LnIncome	0.133***	0.047
EconActiveHH	0.051***	0.028
Aratdar	0.947*	0.447
Distance from major fish market	0.007***	0.004
Affordable	0.259***	0.048
VeryConcerned	−0.041	0.043
OverFishing	0.311**	0.136
PartAwareness	0.225***	0.059
WorkEnvNGO	0.144**	0.066
CertaintyQ	0.132***	0.005
(Constant)	0.515	0.417
R^2	*0.5118*	
Prob > F	*0.000*	

Dependent variable = LnWTP, n = 1006. Single (*), double (**), and triple (***) asterisks indicate significance at 90%, 95%, and 99%, respectively.

Income elasticity of willingness to pay

It has been long debated whether sustainable management of ecosystem services is a luxury or a necessity. Kristrom and Riera (1995) note there is a widely held notion that the environment is a luxury good and therefore receives little attention from policymakers.

Perhaps one way of assessing whether communities see investment in fish stock restoration as a luxury or as essential is to look at how demand varies with income. But since there is no market where environmental goods and services are traded, estimating income elasticity of demand for environmental goods is difficult. Hokby and Soderqvist (2003) argue that "independent of the issue whether environmental services are luxuries or not, there are distributional reasons to be concerned about what income groups in society are relatively more willing to pay for an increased provision of environmental services", i.e., a measure of willingness to pay (WTP) is affected by changes in income.

Ebert (2003) emphasised that income elasticity of demand for environmental improvement does not enable us to assess distributional impacts; therefore, an assessment of the income elasticity of WTP for environmental good is decisive.

Recall equation (7) from the CVM section. We established that a consumer would have the same utility by giving up some of his income to attain a desired improvement in ecosystem service (from q_0 to q_1) so long as the price of other marketable goods and services remains constant.

Therefore, solving for WTP (ω) from equation 7 we obtain:

$$wtp = \int_{q^0}^{q^1} \frac{\partial v/\partial q}{\partial v/\partial q}\,\partial q = \int_{q^0}^{q^1} Mwtp\,\partial q \qquad (8)$$

Since this study included income as an explanatory variable, it is possible to use the value function to compute income elasticity of willingness to pay (ε_{wtp}) as;

$$\varepsilon_{wtp} = \frac{y}{wtp}\frac{\partial W}{\partial y} = \frac{\partial(\ln W)}{\partial(\ln y)} \qquad (9)$$

If ε_{wtp} is less than one the benefits of environmental improvement are distributed regressively. If ε_{wtp} equals one the distribution is proportional. If ε_{wtp} is greater than one, the benefits are distributed progressively.

This study found that the income elasticity of WTP to restore hilsa fish in Bangladesh is 0.133, which is less than 1 (see coefficient for *LnIncome* in table 4). We interpret this to mean lower income groups are willing to pay a higher proportion of their income for hilsa fish restoration than are better-off groups. This clearly suggests that the low income segments of the society are more reliant on hilsa fishery, and therefore investment in hilsa fish restoration is pro-poor. However, one must note that such investments should be carefully designed so that they address some of the systemic constraints faced by low income groups and so that benefits are shared equitably.

5

Conclusion

The hilsa fish is the most important single-species fishery in Bangladesh. Its contribution to national economy (export earnings) and employment opportunities is widely recognised. However, overfishing, habitat destruction, siltation, pollution and climate change pose significant threats to the fishery. These threats are compounded by insufficient investment to restore the fishery, making the future of the fishery and the people who rely on the resource uncertain. We argue that this underinvestment is chiefly due to the fact that the total economic value of the fishery is not well understood.

This study is the first attempt to estimate the non-consumptive value of the hilsa fishery. While citizens generally recognise the cultural significance of the fishery, no monetary value has been put on this. We surveyed people's 'Willingness To Pay' (WTP) for a hypothetical fisheries restoration to estimate the fishery's value. The study estimated the lower and upper non-consumptive values of an improved hilsa fishery in Barisal Division to be BDT 651,760,000.00 (approximately US$8.3M) and BDT 1,384,186,162.67 (approximately US$17.7M) per annum respectively. Extrapolating the estimate to national level gives lower and upper estimates of BDT 13,128,598,840.45 (approximately US$167.5M) and BDT 27,882,080,597.39 (approximately US$355.7M) per annum respectively for a better-managed fishery. It must be noted that these estimates do not include the fishery's use or consumptive values.

Using a Kaplan Meier survival estimate, we established that respondents have considered their budget constraints and were acting rationally. To further test the reliability of the data, we also used a follow up 'certainty' question which was presented in a 10 point Likert scale. A cut off point of 8 and above was used to calibrate WTP statements. However, the estimates were not statistically distinguishable from the uncalibrated values. This further suggests that the survey protocol was well executed and respondents were behaving as they would in a real world market scenario.

We also explored the distributional implications of benefits from an improved hilsa fishery by estimating income elasticity of WTP. This was found to be less than one, suggesting lower income groups are willing to pay proportionately higher for hilsa fish restoration than higher income groups will pay. This suggests that low income segments of the society are more reliant on hilsa fishery, and therefore investment in hilsa fish restoration is pro-poor. However, such investments should be carefully designed to ensure that benefits are shared equitably and that interventions address some of the systemic constraints faced by low income groups.

We believe that investments equivalent to only a fraction of the estimated value of non-consumptive benefits of hilsa fishery would bring about a desired change including: restoring critical habitats of the fishery, effective enforcement of the fishing regulation (as stipulated in the Fish Protection and Conservation Act-1950), and providing incentives to local fishers to stop destructive fishing practices.

References

Ahmed SU and Gotoh K (2007) The choice of elicitation methods in CVM and their impact on willingness to pay in environmental assessment *Reports of the Faculty of Engineering, Nagasaki University* 37(68): 47–52

Amin SMN, Rahman MA, Haldar GC, Mazid MA and Milton D (2002) Population dynamics and stock assessment of hilsa shad, *Tenualosa ilisha* in Bangladesh. *Asian Fishery Science* 15: 123–128

Amin SMN, Rahman MA, Haldar GC, Mazid, MA and Milton, DA (2008) Catch per unit effort, exploitation level and production of hilsa shad in Bangladesh. *Asian Fishery Science* 21: 175–187

Blore, I (1996).How useful to decision-makers is contingent valuation of the environment? *Journal of Public Administration and Development* 16: 215–232

Blomquist, Glenn C.C., Blumenschein, Karenand Johannesson, Magnus (2008). Eliciting Willingness to Pay without Bias Using Follow-Up Certainty Statements: Comparisons between Probably/Definitely and a 10-point Certainty Scale, iHEA 20076th World Congress: Explorations in Health Economics Paper. Available at SSRN: htpp://ssrn.com/abstract=993509.

Blumenschein K, Glenn C, Blomquist M, Johannesson N, Horn, and Freeman P (2008) Eliciting willingness to pay without bias: evidence from a field experiment *The Economic Journal* 118(525): 114–137

Cameron, TA and DD Huppert (1989). OLS versus ML estimation of non-market resource values with payment card interval data. *Journal of Environmental Economics and Management*, 17, 230–246.

Carson RT, and Michell RC (1993) The value of clean water: the public's willingness to pay for boatable, fishable, and swimmable quality water *Water Resource Research* 29: 2445–2454

Champ PA, Boyle KJ and Brown TC eds. (2003). *A Primer on Nonmarket Valuation* Dordrecht: Kluwer Academic Publishers

Champ PA, and Bishop RC (2004) *Hypothetical bias: the mitigating effects of certainty questions and cheap talk* Selected paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Denver, Colorado

DoF (2014) *Fishery Statistical Yearbook of Bangladesh* Department of Fisheries, Dhaka, Bangladesh

Ebert, U (2003) Environmental goods and the distribution of income *Environmental and Resource Economics* 25: 435–459

FAO (2014) *The State of World Fisheries and Aquaculture* Food and Agriculture Organization of the United Nations, Rome

Freyhof J (2014) *Tenualosa ilisha* IUCN Red List of Threatened Species 2014. See: http://dx.doi.org/10.2305/IUCN.UK.2014-1.RLTS.T166442A1132697.en

FRSS (2013) Fisheries Statistical Yearbook of Bangladesh 2011–2012 *Fisheries Resources Survey System* 29: 44 Department of Fisheries, Bangladesh

FRSS (2014) Fisheries Statistical Yearbook of Bangladesh 2012–2013 *Fisheries Resources Survey System* 30: 52 Department of Fisheries, Bangladesh

Hanley N, Schlapfer F and Spurgeon J (2003). Aggregating the benefits of environmental improvements: distance-decay functions for use and non-use values. *Journal of Environmental Management* 68: 297–304

Hokby S and Soderqvist T (2003) Elasticities of demand and willingness to pay for environmental services in Sweden *Environmental and Resource Economics* 26: 361–383

Johansson PO (1991) An introduction to modern welfare economics. In Champ PA, Boyle KJ and Brown TC eds., *A Primer on Nonmarket Valuation* Dordrecht: Kluwer Academic Publishers

Kristrom B and Riera P (1996) Is the income elasticity of willigness to pay less than one? *Environmental Resource Economics* 7: 45–55

Lafolley, Dd'A and Grimsditch G. (eds) (2009) *The Management of Natural Coastal Carbon Sinks* IUCN, Gland, Switzerland. 53 pp

List JA and Gallet C (2001) What experimental protocol influence disparities between actual and hypothetical stated values? *Environmental and Resource Economics* 20: 241–254

Maler KG (1974) Environmental economics. In Champ PA, Boyle KJ and Brown TC, eds., *A Primer on Nonmarket Valuation*. Dordrecht: Kluwer Academic Publishers

MEA (2005) Ecosystems and human well-being: biodiversity synthesis Millennium Ecosystem Assessment, World Resources Institute, Washington, DC

Mohammed EY (2009) Measuring benefits of river quality improvement using contingent valuation method: the case of Ping River, Chiang Mai, Thailand. *Journal of Environmental Assessment Policy and Management* 11(3): 349–367

Mohammed EY 2012. Contingent valuation responses and hypothetical bias: mitigation effects of certainty question, cheap talk, and pledging *Environmental Economics* 3(3): 62–71

Mohammed EY and Wahab MA (2013) Direct economic incentives for sustainable fisheries management: the case of hilsa conservation in Bangladesh. International Institute for Environment and Development, London. http://pubs.iied.org/16527IIED.html.

Murphy JJ, Allen PG, Stevens TH, Weatherhead D (2005). A meta-analysis of hypothetical bias in stated preference valuation *Environmental and Resource Economics* 30: 313–325

Murphy JJ and Stevens TH (2004) Contingent valuation, hypothetical bias, and experimental economics *Agricultural and Resource Economics Review* 33(2) Northeastern Agricultural and Resource Economics Association

Neil HR, Cummings RG, Ganderton P, Harrison GW and McGuckin T (1994). Hypothetical surveys and real economic commitments *Land Economics* 70: 145–154

Pauly D (2006) Major trends in small-scale fisheries, with emphasis on developing countries, and some implications for the social sciences. *MAST* 4: 7–22

Rahman M and Naevdal G (2000) Population genetic studies of hilsa shad, *Tenualosa ilisha* (Hamilton), in Bangladesh waters: evidence for the existence of separate gene pools *Fisheries Management and Ecology* 7: 401–411

Rahman M, Rahman B, Hasan S, Flura A,T and Haidar M (2013) Impact of eleven days fishing ban in the major spawning grounds of hilsa (*Tenualosa ilisha*) on its breeding success *Bangladesh Research Publications Journal* 9: 116–122.

Rahman MJ, Rahman MA and Bhaumik U (2012) Biology and ecology of hilsa shad, *Tenualosa ilisha* (Ham.) In: Hilsa: Status of Fishery and Potential for Aquaculture. Proceedings of the regional workshop held in Dhaka 16–17 September 2012. The WorldFish Centre, Bangladesh and South Asia Office, Dhaka

WAVES (2012) *Moving beyond GDP: how to factor natural capital into economic decision making* The World Bank, Washington DC, USA.

Willis KG and Corkindale JT eds. (1995) *Environmental Valuation: New Perspectives.* Wallingford, United Kingdom: CAB International.

Abbreviations

BDT	Bangladeshi Taka
US$	United States dollar
WTP	willingness to pay
GDP	Gross Domestic Product

Hilsa is Bangladesh's most important single-species fishery: for cultural identity, earnings and employment. However, overfishing, habitat destruction, siltation, pollution and climate change have driven catches down, and management policies have not adequately intervened – probably because the fishery's total economic value is under-appreciated. This study is the first to estimate the non-consumptive (non-use) value of a well-managed hilsa fishery. It used the contingent valuation method and asked 1006 fishing and non-fishing households how much they would be 'Willing To Pay' (WTP) for an effectively-managed fishery. In Barisal Division, an improved fishery could be worth BDT 651.8M – 1,384.2M a year (approximately US$8.3M – 17.7M). Nationally, a better-managed fishery could be worth BDT 13,128.6M – 27,882.1M per year (US$167.5M – US$355.7M). Poorer people are willing to pay the highest proportion of their income, suggesting fishery restoration would be pro-poor. However, any interventions must share benefits equitably and address the systemic constraints facing low income groups.

International Institute for Environment and Development
80-86 Gray's Inn Road, London WC1X 8NH, UK
Tel: +44 (0)20 3463 7399
Fax: +44 (0)20 3514 9055
email: info@iied.org
www.iied.org

Funded by:
USAID
আমেরিকার জনগণের পক্ষ থেকে

Knowledge Products