

Power, profits and payments for ecosystem services in *Hilsa* fisheries in Bangladesh: A value chain analysis



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A B S T R A C T

Commitments for sustainable growth often look good on paper but are messy in the practice. The Government of Bangladesh shows huge initiative towards SDG 14 (conservation and sustainable use of marine resources) by establishing measures to improve the stock of *hilsa* fish in the country, thus ensuring the supply of a valuable and charismatic fish species. Initial reports of the measures are optimistic, suggesting larger sizes of fish caught across the seasons. Bigger *hilsa* fetches better prices – as high as US\$25 per kilo in niche markets. It is conservation business with profits. Yet the costs of these regulations are falling squarely on the shoulders of small fishermen who are poor, uneducated and in permanent debt. The government offers a small in-kind payment for ecosystem service (PES) in the form of rice, which is good but does not compensate for the loss of revenues and household protein during bans. These small fishers have no bargaining power and no voice in the design of policies that affect them. A common problem in policy design is the lack of clarity of the markets they affect, especially if they are informal. This study uses value chain models to unpick the *hilsa* value chain. It study provides hard data and evidence on processes, power, and profit creation. This consultation can help policy makers design better strategies to re-govern markets in more inclusive ways and help to achieve Sustainable Development Goals commitments.

1. Introduction

Fishery policies are particularly vulnerable to failure. For example, their open access characteristics make compliance difficult. Trade is often informal and non-regulated, with multiple pressure points across the supply chain. Attention to the social component of the policies is particularly important for artisanal fisheries, as the main actors affected by regulation tend to be poor, vulnerable and with no power to influence policy decisions.

This article explores how improvements in marine ecosystems affect value chains associated with fish capture and trade. It focuses in Bangladesh, where a temporary fishing ban and a payment for ecosystem services (PES) compensation are used to improve the stock of *hilsa* fish.

Hilsa fish (*Tenulosa ilisha*) is an important source of income and cultural identity in Bangladesh. It represents 11 per cent of the total catch in the country, and provides jobs to over 2.5 million people [1]. Declining stocks over 30 years led to the government's decision to introduce drastic measures to improve the health of the stock. Some of the measures include restrictions on fishing gear, regulation on the type of

vessels, and seasonal fishing bans. This ban is designed to allow mature fish to reproduce and juvenile *hilsa* (*jatka*) to grow, thus achieving better sizes (and prices). It also allows juvenile fish to mature and reproduce to replenish the overall stock.

While the primary goal of this programme is environmental, it is funded through a national Vulnerable Group Feeding (VGF) programme aimed at reducing food insecurity [2,3]. Because of this the programme targets the artisanal fishers living inside and around the sanctuary areas that affected by the ban, and tries to improve their socioeconomic condition [4,5].

As a compensatory measure the government distributes rice (40 kg per month per family) as a form of Payment for Ecosystem Services (PES), and provides capacity building for alternative income generating activities, to partially compensate for the temporarily loss of their fishing income, and balance out household diets.

This set of measures seems to be working, and the reported *hilsa* stock shows signs of recovering. Although there are no counterfactuals or before/after impact evaluations, recent studies suggest that the ban has a positive impact on the stock: 1) higher number of mature *hilsa* fish at maturity stages (V and VI) than in the other adjacent areas [6], as

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well as a higher number of spent fish –e.g. fish which have recently completed spawning; 2) increased production of hatchlings and juveniles: Rahman et al. [6] recorded about eight times as many eggs and juveniles in 2011 than in the base year 2007–2008, attributed to the 11-day fishing ban in the spawning grounds of *Hilsa* during peak spawning period; and 3) positive impact of the HCP on the finfish and shellfish biodiversity: evaluations by Islam et al. [1] in several fish sanctuaries (Shariatpur, Chandpur, Paatuakhai and Bhola) suggest that the temporal fishing ban is impacting positively on the fish and shellfish biodiversity within all the four sanctuary areas.

Bigger and better fish sizes sell at much better prices and bring higher profits across the value chains. The flavour and characteristics of Bangladesh *hilsa* make it a valuable commodity –fetching as much as US \$25 per kilo in niche Dhaka and foreign markets. This is good news for the fishing industry and exports in Bangladesh, which already represents 4.3% of GDP [4].

Focusing on the fishing families as the entry point of analysis, the study uses value chain analysis and business model canvas as methodologies [7] to: 1) understand the main value chains affected by a change in the quality of the ecosystem; 2) to provide a snapshot of the state of the *hilsa* fish value chain in Bangladesh, identifying and measuring the economic relationships along the value chain; 3) to identify existing opportunities and conflicts in the chain, and 4) to suggest how can a compensation scheme be designed to help re-balance the chain. The ultimate aim of the study is to help inform the design of economic instruments, such as PES that are better aligned to market failures.

2. Policy relevance: PES for environmental and poverty objectives

Ecosystem management and poverty reduction have traditionally been pursued in isolation: from each other, using separate instruments, and managed by unconnected and often opposing government departments. The emergence of global agendas like the Sustainable Development Goals, the Addis Ababa Action agenda and the Paris Climate Change Agreement bring back to the table the urgent need to link agendas, deal with trade-offs, maximise overlaps, and achieve larger pools of financing by joining resources.

Action for ecosystem conservation needs to be coordinated [8,9]. This includes looking at the mix of regulation and incentives needed to manage resources, for example rules and rights for resource access, elimination of harmful subsidies and conditional incentives, such as PES, to promote good behaviour to manage ecosystems. PES is a positive incentive that rewards good ecosystem management agreements (such as improving soil conservation, or refraining from doing damaging activities like overfishing) expected to result in ecosystem benefits, like cleaner water, reduced carbon emissions [10,11]. Recent meta-analysis of PES schemes [11,12] brings forward practical suggestions for better environmental effectiveness linked to spatial targeting, payment differentiation, and strong conditionality. The social reach of PES remains more dubious. Pascual et al. [13] suggest that many PES examples lack a focus on equity issues and poverty reduction, and experience from ongoing PES suggests that they may moderately help reduce poverty [14] and in many cases the payments go to large or relatively wealthier participants [15,16]. According to Rodríguez et al. [36], attempting to incorporate a few measures to make PES look proper and legitimate has meant less efficiency in achieving environmental outcomes – or risking not to achieve either [17].

Instrument design also needs to respond to the specific economic activity, taking into account the impacts within the economic unit [18] and the rest of the economy. Recent attention turns to how PES affects associated value chains such as forestry or fisheries and tries to understand motivations, obstacles and opportunities [19–21]. Many of these obstacles are similar to traditional smallholder agriculture and artisanal fisheries activities and much can be learned from their strategies [22–24].

3. Methodology

This study combines desk-based research, focus group discussions, interviews with key informants and household surveys to map out value chains and business model canvas (BMC) of the *hilsa* fish industry.

3.1. Value chain and business model canvas

The value chain approach is used to identify and characterise the key actors of the *hilsa* trade, with a strong focus on the artisanal fishing family enterprise. The value chain is useful to identify partner networks that supports, intervenes, or assists different links of the business. It helps to define relationships and interconnections, understand the flow of products, services, information and payments; and identify entry points or key leverage points to improve the value chain. The business model canvas [7,25] shows how individual economic units create, capture and deliver value. It is used in combination with value chains to understand and compare players along the chain. BMC uses a common language along the stages to: a) what is the value proposition; b) who are the buyers of the products and what are the channels to reach them; c) how is value created (e.g. the key partners, resources, inputs, and activities necessary to capture and create value); and d) what are the costs and benefits attached to the operation. The BMC helps to identify opportunities and gaps, distributional impacts and develop reasonable monitoring strategies. Interviews with key stakeholders are used to understand the formal and informal rules determining how costs and benefits are distributed for the different actors.

3.2. Data collection

Data collection followed a three-step approach. First, a field trip at the start of the study helped to identify research gaps, firm up methodology and determine field sites. It included a focus group in Dhaka (fishers, intermediaries, Department of Fisheries, universities and NGOs), as well as visits to local fish markets. Second, field surveys (conducted between March and October 2016) which generated 249 valid observations for fishers, suppliers and intermediaries located mostly in Barisal, Bhola and Dhaka. Third, structured focus groups and in-depth interviews were conducted with five wholesaler intermediaries (*araddars*) from Kawran Bazar (the biggest wholesale fish market in Bangladesh, with more than 300 wholesalers) and six from Suwarighat fish market (one of the oldest wholesale fish market near Chawkbazar in Dhaka, with over 40 wholesale traders), as well as a personal interview with a fish exporter in Dhaka South City Corporation.

4. Results: the *hilsa* fish value chain

Fig. 1 presents a simplified value chain for the *hilsa* fish in Bangladesh. It focuses on three stages: 1) the fishing families and their input suppliers, 2) landing centers and first level wholesalers, and 3) retailers reaching final consumers (including the export sector). The figure also identifies their position in relation to primary, secondary and retail markets, as well as some of the main inputs needed for their value proposition. It is important to highlight that the focus of this study is on the fishing families. See Porras et al. [26] for detailed business canvas for fishers, wholesalers (*araddars*) and exporters as high-end retailers.

4.1. Who? Description of key players along the chain

Fishers are at the first rung of the *hilsa* value chain. For the most part they are poor, uneducated and have large households with many dependents. Roles are gender divided [1]: males will own or rent boats, or join as crew. Women participate in other activities such as processing, trading and gear mending.

Fishing is a job for life. The average age across the group was

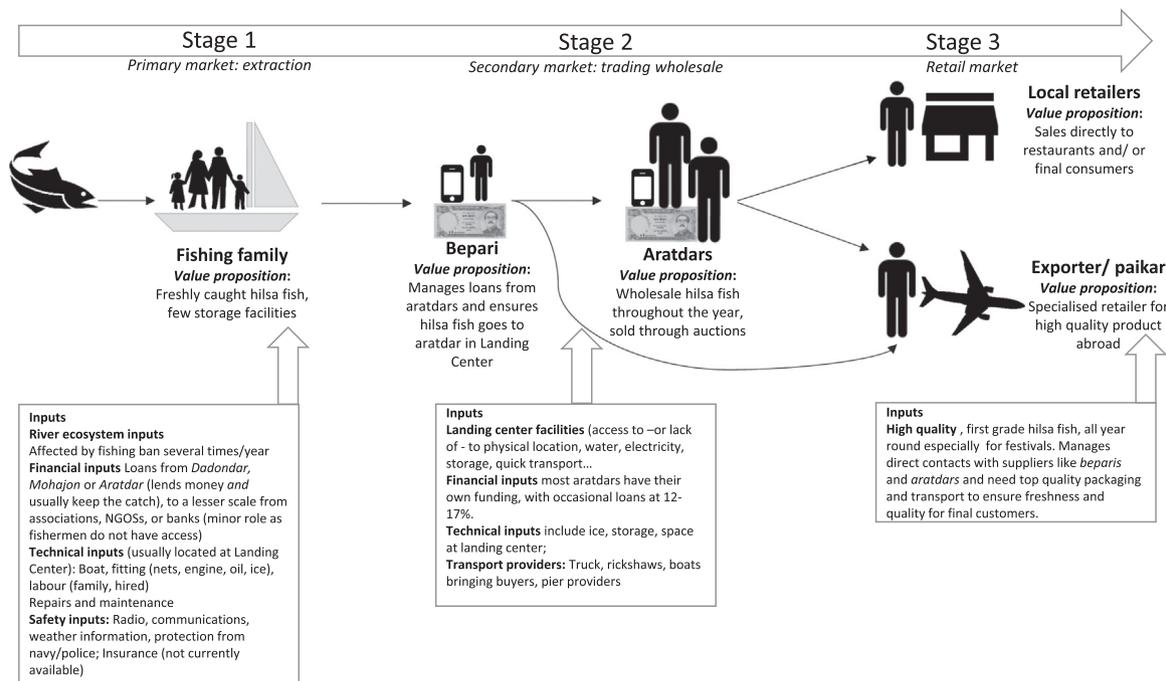


Fig. 1. A stylised value chain. Note: Terminology: *Dadondar/mohajon*: money lender; *aratdar*: wholesaler; *bepari* (facilitator/intermediary between fishers and aratdar); *paikar*: exporter. Source: prepared following consultations and fieldwork.

approximately 37 years old, with a median of 35 ranging between 15 and 70 years old. Young fishers begin early, either as hired crew labourers or family members. Fishers (labourers and boat captains) had the larger proportion of experience to age in the sample compared to other jobs, spending well over half their life (irrespective of their age) in their activity. One of the reasons for staying in the industry is the lack of education to access alternatives. The majority of fishers in the sample only reached an average of 1.6 years of schooling. Wholesalers (*aratdars*) and specialist input suppliers like freezing and transport had the highest schooling in the group (7–9 years).

Families are large. There are on average 6 members per household, with high variations across the sample. The smallest household sizes are linked to specialist jobs: transport, storage, preservation. Fisher labourers have on average 5 members. While the families are large, fisher labourers reported in their majority only one person in the household bringing in wages or cash earnings. People involved in the more technical parts of the value chain have more wage-earning family members 2.5–4 wage earning members, in small family groups). Previous studies of the sector also show that fishers live in very poor socio-economic conditions, with little physical infrastructure and moderate access to public education and health [1,27,28]. When the *hilsa* fishing ban takes place and these fishers are not allowed to fish, there is no other source of income in these households.

There is wide variety of intermediaries and facilitators along the *hilsa* trade [29,30]. *Aratdars* are one type of intermediary reported by many. Its direct translation is “a man who has a place to keep fish, subjected to sell through auction”. Fishers give *aratdars* their catch to sell through auction. Many *aratdars* loan money to fishers in exchange for the right to the fish. *Aratdars* have their own stall in Fish Landing Centers and sell to wholesalers and large retailers. *Bepari* (translated as “businessman”) are intermediaries who buy large quantity of *Hilsa* from fishers or *aratdar* to sell to other traders. *Farias* are fish brokers, similar to *bepari*, but only operate during short-terms when fish is abundant. They also lend money to fishers with high interest rate, and purchase small quantity of fish from fishers located away from market and sell to *aratdars* or retailers. *Paikars* are licensed trader or exporters who purchase *hilsa* from fishers through intermediaries and export the entire product to overseas markets. International trade is however heavily

regulated and most of the *hilsa* fish is for domestic markets. **Local retailers** are the last intermediaries in the distribution channel. Some have fixed places in markets, or sell fish from door to door.

Other important actors along the chain include *dadondars*, *mohajon* and *nikaris*. *Dadondars* are money lenders, they give loans for investments in a productive activity. *Mohajon* –with literal translation as “big man” or “man with higher status”, also loan money and collect interest. The loans can be used for productive/non-productive uses as long as it is paid back in cash (i.e. not in exchange for fish, like the *aratdars*). *Nikaris* are informers, or middlemen who provide information to the buyers in exchange for commissions.

The *aratdars* interviewed in this study were middle aged (29–45 years, with a maximum of 75), professional traders specializing (but not limited) to fish trade. Half of respondents reported other businesses as well as fishing, trading in transport, groceries and vegetables especially during the low fishing season. Their households tend to be smaller, but they hold strong ties and responsibilities with their extended families at the local villages. They have higher annual incomes, ranging from Taka 0.5million (US\$6400) to Taka 1.5 million (US\$19,000) in both groups. According to the interviews, these values are fairly representative for other *aratdars* in both landing centers. They are also fairly confident on the market prospects, reporting increases in household income during past 5–10 years. All of them own land either as homestead or agricultural land. Fish exporters are at the top of the value chain, selling *hilsa* to other countries. Education level is high, as is experience in fish export business (25 years). Fish exports represent more than 50% of the income, but this is also diversified to include exports of vegetables, and fresh and frozen fruits. The annual income is more than Taka 2 million (USD 34,250). All respondents in these traders groups pay taxes such as Union (Pourashova) tax and as trade license fees.

4.2. What? Value proposition along the chain

4.2.1. Fish as a commodity

Fish is highly valuable but perishable commodity. On average, the level of freshness using basic preservation methods can be kept for about 10–14 h. This requires fast and organized control of storage and transportation to ensure the quality of the fish. Fishers sell their catch

immediately upon landing to avoid spoilage, as good quality ice and cold storage are often unavailable. Quality of the catch is linked to their freshness and its size, with larger fish (over 800gms) obtaining better prices. The high demand however pushes the market towards smaller juvenile fish (*jatka*) mostly caught in freshwaters.

Because it is very valuable, fishers are careful to consume or lose relatively little *hilsa* fish. On average fishers reported catching 2.88 kg (kg 0.8–6 min and max) of *hilsa* fish per day during the peak season, and 0.95 kg (0.8–3) during the lean season. The difference between caught and sold is 4% during peak season, and 7% during lean season. Although the individual quantities are relatively small, a 5% loss in the quantity of fish can have an impact on income at the end of the season.

The marketing channel of *hilsa* is complex. There are many actors who play a vital role in collecting, trading, transporting the fish before it reach to the consumers – each adding value each time it goes another rung up the ladder.

The amount of fish traded by the *aratdar* depends on the fish caught in the fishing ground by the *hilsa* fishers and also demand in Dhaka and other district (local) markets. *Bepari* purchase the *hilsa* from the local landing and pack the fish preserved with ice in suitable containers such as basket, drum, wooden box, plastic box, Styrofoam box and sent to Dhaka or other districts by road or waterways. All fish caught on the southern fishing grounds and marine catch go to Dhaka market, where they fetch higher prices.

4.2.2. Seasonality

There are three main fishing seasons for *hilsa*: the peak season, the lean season, and the ban period. Apart from the ban period, which is fixed, the concepts of “lean” and “peak” are subjective. On average, the peak season lasts approximately 75 days and the lean season 137, as reported by all respondents in the sample. Because they bear the burden of loans and credit, boat captains (*mahjee*) tend to perceive the shortest peak season, and the longest lean season. With better access to alternative incomes, intermediaries perceive the shortest lean season. Final demand of *hilsa* as a popular fish is always high, and trading continues throughout the year with no closure of fish market. The average amount of fish sold /day during peak and lean season is 700 kg and 200 kg respectively by a single *aratdar*. During ban period *hilsa* is sold irregularly and the supply comes (officially) from the cold storage and outside of ban area.

4.2.3. Diversification strategies

Hilsa constitutes all of the catch during the peak season for the vast majority of the fishers (93%) and tradesmen (90%). Only 6% of fishers and 8% of tradesmen report less than full *hilsa* catch or trade. A few fishers (23 responses) reported catching other type of fish, such as pangas. Traders also sell tilapia, catla and rohu.

The lean *hilsa* season presents a more varied picture. *Hilsa* constitutes the full catch for only 10% of fishers and 5% of trade. For the majority *hilsa* represents less than half of their catch (65% for fishers and 85% of traders). During the lean and ban seasons fishers tend to catch only pangas or “other” types of fish in small quantities from outside of sanctuary/ban area, and during the ban period 40% of fishers report that they do not fish at all – with a direct drop both on cash income from sales and protein intake at the household level. Only 15% of the tradesman report that they do not trade at all during the ban period. While they do not consume *hilsa* fish within their households, bycatch fish is an important source of nutrition for the fishers households. This source of protein is usually forfeited during the ban period, when *hilsa* fishers stop fishing.

4.3. How? Inputs, technologies and trade strategies

Fishers rely heavily on healthy freshwater ecosystems to catch sufficient *hilsa* and of good quality and size. Over-fishing and catching juveniles has been reducing the size of the *hilsa* stock and the fishers

daily and annual catch size. The main inputs for fishing are:

- a) *Technical inputs*: Artisanal fishers use a mechanised boat or trawler to catch *hilsa*. Each boat has a crew of approximately 15 members, either family or hired. Each boat (hired, or owned) has a head fishers or captain of the boat (*mahjee*), and is responsible overall for the activity. Technical inputs also include fitting (nets, engine, oil, ice); repairs and maintenance and food for the fishing crew while at sea. This requires significant upfront cash investments before each trip. Results from the sample suggest values of about Taka 112,000 (US\$1500) for a boat, and running annual costs of about 250 thousand taka (about US\$3200). Artisanal fishers, however, with virtually no savings or financial resources of their own, find it very difficult to finance the outfit of fishing trips.
- b) *Financing*: Fishers do not have a regular access to banking systems. Financing of the operations is through their own resources or from money lenders. According to the sample, fishers rely primarily on their own resources to finance their operations (peak season 60%, lean season 44% and ban season 46%). They also take loans from dadondars (15% peak, 13% lean and 9% ban) or enter into loan/fish exchange agreement with *aratdars* (14% peak, 18% lean and 5% ban). There are other sources of finance, like associations, banks, and NGOs which play an important role during the lean and ban season, financing about a quarter of fishers. The interest reported varied depending on the source: loans or credit from *dadondar* was on average 10%, as was the equivalent of catch for loan with *aratdars*. According to the survey, associations charged the highest interest rate (14%).
- c) *Safety and risk*: They is little to no back-up if the fishing trip goes wrong, and fishers are constantly at risk of losing their few household assets to repay loans. These risks are absorbed primarily by the fishing household: they forfeit the next fishing trip, or lose their family assets to repay loans. When fishers are not able to pay (death, or they are forced to leave) the lost debt is taken by the lender. Fishers in the study report the urgent need for safety inputs –of which there is a large gap at present. This includes radio communications, weather information, protection by navy/police against piracy; and insurance. As reported, these risks and dangers include:
 - *Inadequate/ old boat*: while there are many advances in technologies for small vessels, most artisanal fishing boats in Bangladesh have inadequate safety standard control, are old and may not have accessible shelter and sanitation facilities on board.
 - *Loss of power due to engine breakdown or insufficient fuel*, and most artisanal boats do not have spare outboard motor engine or sailing rig. The risk of fire is high when carrying large amounts of fuel for long trips.
 - *Bad weather*: small boats are at higher risk to sudden gales, and heavy rainfall and fog which reduces visibility and can cause capsizing, grounding, collisions and getting lost. The risks are higher when fishers have little access to weather warning systems and radio communication.
 - *Lack of access to communication* is a problem also in case of piracy, and to report when other fishers are breaking regulations;
 - *Fishing operations risks to crew*: fishing is notorious for being a high risk operation. Vessels of any size can capsize due to various reasons, from bad weather to weight unbalances during the net hauling of a large catch. There can be injuries to the crew while operating equipment and people can be swept overboard.

Wholesale intermediaries operate at different levels. Wholesalers obtain fish and sell through open auction, charging a 5–8% commission from the suppliers. The amount of fish received depends on the money invested as a loan among the fishing communities. The average investment is about Taka 0.2–1.2 million/year, through *beparis* and *paikars*, with the fishing communities with mutual understanding that

they will supply fish only to the *aratdar*.

Respondents in the sample report that they use their savings to finance operations. Lack of capital in the business is an acute problem. There is a small level of funding through commercial banks, *aratdar* association and relatives as short term loan. Loans from banks are charge interest rates between 12% and 17%. Some operational costs reported include:

- Labour: staff to handle the fish in the arat on daily basis and paid them Taka 250–300/day; specialized labour like auctioneer, account keeper and manager are paid monthly basis at Taka 14,000–15,000 to run the arat. The amounts invested per year vary depending on the size of the operation, but respondents in the sample reported an average of over Taka 230,000/year (US\$3000) in total for labour.
- Suppliers use launch /steamer or covered van to transport the fish. Average annual reported costs are about Taka 23,500 (about US \$300).
- Taxes: trading license to Dhaka North City Corporation: Taka 5000–6000/year (US\$65–80) reported in Kawran, and Taka 2500–3500 (US\$35–US\$45) in Suwarighat.
- Market stall fee: About US\$2.5 per day (Taka 200–300) which covers electricity, water, cleaning, etc in Kawran bazar; and an annual fee of about US\$260 (Taka 20,000) in Suwarighat bazar.

Delays in transport, for example due to traffic jams, deteriorate the quality and affect price of the fish. Wholesalers rely heavily on the conditions offered by the landing center, which affect their capacity to operate at different scales, engage with customers, and offer other services. The Suwarighat fish market for example is extremely basic, with no cover from weather or access to electricity or running water. The availability and access to cold storage, for example, can help traders manage the fluctuations in peak/low/ban seasons and maximise profits.

The fish exporter's inputs and supplies include beparis who collect the good quality exportable bigger size (at least 1 kg) *hilsa* fish directly from the fishers as soon as they landed the fish in landing center and preserve the fish in ice to keep the fish fresh, and send to Fish Processing Plant. Before export the quality of the fish is tested in the Department of Fisheries (DoF) Fish Quality Control laboratory and should fulfil the import criteria of the intending country's quality control criteria and regulations. Paper cartons are used to pack the fish (at about Taka 30–40/unit) to prevent contamination during transportation. Transportation requires refrigerated or covered vans from landing center to airport or port of shipment. International transport is mostly by ship.

4.4. To whom? *Hilsa* at the sale points

The type and number of buyer –and with it the power to determine price – varies strongly between the initial stage of marketing (fisher to bepari or *aratdar*) and all subsequent stages.

Fishers tend to sell their fish as soon as they land, mostly to pre-agreed contracts with intermediaries like *aratdars*, beparis or mohajans (money lenders) who act as commissioning agents and deal with the fish marketing. Each of these commissioning agents has a chain of suppliers who bring in regular catches of *hilsa*. They provide advance money to boat owners on condition of exclusive right to buy their catch. They charge a commission (3–8%) and take 2–4 fish for every 80 fish sold [1].

4.4.1. Monopolies for fishers, open markets for intermediaries

Ninety percent (224 observations) of respondents in the sample reported that they sell to only one buyer, 26% (64 observations) reported 2 buyers, and only 8% of respondents (20 persons) reported three types of buyers. This indicates a high degree of monopoly

especially at the beginning of the chain, with in turn affects the opportunities for fishers to make a decent profit. All of the fishers report only one buyer (only two respondents reported two buyers). Intermediaries, and to a lesser extend service providers, are more likely to have different buyers for their product. Nearly three quarters of the fishers in the sample sell all their catch to the *aratdar* (73%), and 25% to a *dadondar*. As discussed in the previous section, *dadondars* and *aratdars* who provide money upfront are the only point of call for the fishers to sell their catch (similar to outgrower models often used in agriculture [20])

4.4.2. Prices along the chain and across seasons

The amounts sold (in kg), the range of prices obtained and the price mark up all vary depending on the seasons –especially for intermediaries. Respondents in the survey shifted 2025 t of *hilsa* fish during the peak season, 1085 t during the lean season and 28 t during the ban season.

Prices vary across seasons. The prices reported by fishers did not vary much between peak and lean season (753 and 727 tk/kg respectively- see “Fishers, sales point”), although the variation in prices was larger during the lean season. Traders purchased fish at an average of 706 tk/kg across the year, but the price varied depending on the season (peak, lean and ban), and it also presented important variations, with the highest prices paid during the lean season (see “Traders: entry point”).

There is also a significant price mark-up along the value chain. The average price (see Traders: sales point). The average price at which traders sold through the year (to other traders, and to final customers) was 838 tk/kg. There is also significantly more variation at sales point, with prices reaching over 2500 tk/kg during the peak season and 3000 tk/kg during the lean season.

There is some information about *hilsa* trading during the ban season, mostly from actors involved in providing services like ice. The average prices during the ban season were 650 tk/kg at entry point and 800 tk/kg at sales point.

4.4.3. Determinants of price: regression analysis for fishers prices

Regression models do not show strong statistical relations in price determinants, suggesting that prices are determined by other rules. As the previous section shows, wholesale buyers have a strict control on prices they offer the fishers. The main results from several regression models are:

1. Quantity of fish does not appear to be a significant variable in determining price of *hilsa* fish throughout the year. The variable is statistically significant, and it does not vary for any of the model specifications. The main determinants of price are linked to demand, for example festivals when *hilsa* fish is traditionally consumed.
2. Being a fisherman reduces the prices received at sales point, irrespective of demand. The variable is statistically significant.
3. Age is negatively related to the prices obtained. This is linked to the characteristics of the actors. According to the sample, fishers remain in the trade for longer than other tradesmen or service providers, who are located higher in the value chain.

4.4.4. Household incomes along the value chain

Fishing is a highly specialised activity representing well over 50% of the household head's income along the majority of the value chain. The key input providers –transport, storage- cater nearly in their totality for fishing. Retailers have a more varied source of income.

People's perceptions as to how their incomes have changed during the past 5–10 years is varied. At first glance the proportion of people across the fisheries value chain is similar for those whose incomes decreased (33%), remained the same (34%) or increased (33%) over the past 5–10 years, suggesting a fairly stable economic activity. Fishers (crew and captains) feel worse off: 68% of fishers felt income either

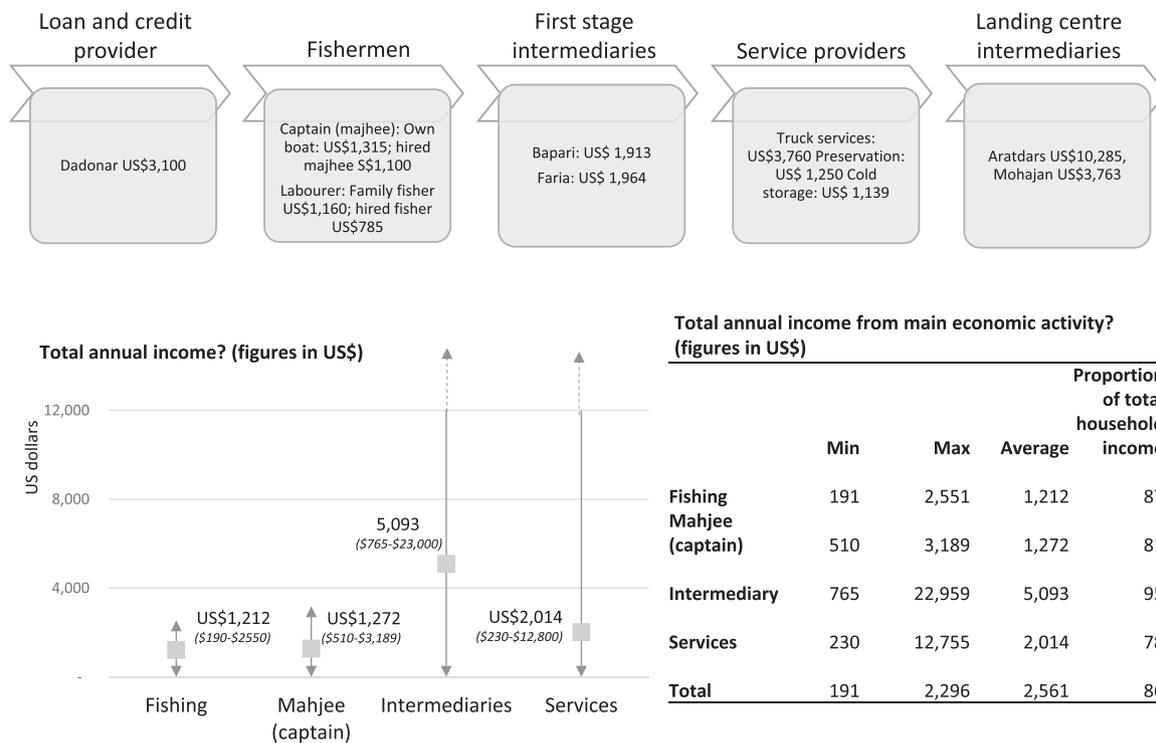


Fig. 2. Annual income in fisheries along value chain. Source: observations from fieldwork.

decreased (41%) or stayed the same (27%) in the past 10 years – this while inflation in Bangladesh has oscillated widely, reaching as high as 16% around 2011 [31].

The average income of people associated with fisheries (fishing, trading and providing services) is about US\$2560 per year (about 200,000 taka). The income varies widely depending on the stage of the value chain (see Fig. 2). Fishers have the lowest annual income of the sample, along with the simplest services like preservation and cold storage. Hired fishers are at the lowest of the income rank. Importantly, the annual income is not enough to cover the annual costs of outfitting the fishing boat: the results from this analysis suggest that fishers constantly operate at a financial loss.

The fish exporter in this study reports the highest income, approximately Taka 2 million (over US\$25,000), which has remained roughly the same over the past 5–10 years. Between 50–75% of annual income comes from fish export.

5. Discussion: opportunities for sustainable and inclusive *hilsa*

This study shows the level of the vulnerability of fishers to weather patterns and market access, as well as the potential benefits that could be derived from more equitable distribution of benefits, risks and costs along the chain. Table 1 presents a summary of the main challenges and associated opportunities linked to three stages of the *Hilsa* value chain: fishers, wholesalers (*aratdar*) and fish exporter. This section discusses five issues linked to demand, PES, opportunities to invest, inclusive financing and risk management.

5.1. High value market with guaranteed demand

Hilsa fish is highly valued – in terms of its flavour but also as a traditional fish during Bengali festivities across all levels of society, at home and abroad. The prices fetched for *hilsa* are significantly higher than other types of fish, and there is a guaranteed market for its supply. In theory, this high demand should benefit the fishers, who are the key suppliers of fish. However, the *hilsa* fish market is divided into two very

different trading systems. Fishers are affected by a monopoly, where they have obligations to sell all their catch to a pre-agreed buyer. In many cases these buyers have provided upfront loans in exchange for the catch, effectively bringing the fishers bargaining power to zero. Wholesalers (known as *aratdars*) on the other hand trade through instant auctions, where information about supply of fish in other markets in the city is made immediately available through tight networks of informants. This means that there are many possibilities of making good profits from the high consumer demand. Better governance of markets can help break this monopoly and help pass profits down the value chain to fishers, making the activity more profitable and bringing costs in line with revenues.

5.2. Fair compensation: investments can help quantity and size of *hilsa* – but the cost relies heavily on the fishers

Overfishing, especially of juvenile and mother fish, has a direct impact on the size and quality of the *hilsa* stock. Recent reports suggest that the introduction of the temporary ban in Bangladesh is helping *hilsa* juvenile fish achieve bigger and better sizes. Other instruments used elsewhere to promote ecosystem enhancement in fisheries can also improve the health of the fish stock, for example the reduction of land-based pollution, use of improved technologies, and fishing quotas.

This study shows that intermediaries and retailers are more likely to be directly benefited, as better graded *hilsa* gets significantly higher prices in the markets. With better access to cold storage, some intermediaries are able to freeze *hilsa* during the high season and sell it during the low and ban seasons, using supply and demand to their advantage to maximise profits. They are also able to switch to other fish trade not affected by the ban.

But the cost of this fishing prohibition falls almost completely on the fishers. Already poor, uneducated and in-debt, fishers are not bearing this easily. Lacking access to fish protein, the rice compensation they receive is good and welcomed but not enough to provide nutrition to their large families (40 kg per family, of which a proportion of 5–10 kg are lost as informal transaction fees). Their very low levels of education

Table 1
Challenges and opportunities for key *hilsa* players.

	Value proposition	Input side	Sales point
Fishing Family	Freshly caught <i>hilsa</i> fish. Have few storage facilities	<ul style="list-style-type: none"> Some technologies, like production of current jal (monofilament net) in factories is a problem for juvenile <i>hilsa</i> Fishing ban: helps juvenile fish reach better sizes, which also improves quality of the catch. But it reduces the number of fishing days; fishermen have little capacity for other jobs. Most fishermen households depend fully on their wage. The loss of main (often only) income during ban period strongly affects household cash flow, despite rice compensation. Safety inputs ideal but not commonly available –piracy a common problem. Makes ban enforcement difficult for authorities and fishermen. Over 60% of fishermen need loans on a permanent basis to operate. Because they do not have access to formal banks, most of the cash is provided by dadondars and aratdars, who advance resources in exchange for the fish, and share the risk of the operation. There are opportunities for the government and banking sector to offer soft loans to fishermen. 	<ul style="list-style-type: none"> While there are many players along the <i>hilsa</i> chain most of them only have one buyer. Prices obtained for <i>hilsa</i> range between Taka 200–1000 depending on the season. There is no bargaining power at all: fishermen hand over 100% of their catch to pre-agreed buyer (who usually provides upfront credit) Average reported incomes for fishermen are very low, and as much as 40% lower than the country's per capita income (US\$1316) Average reported incomes are barely able to cover the running costs for fishing operation. Fishermen are constantly in debt. It is very hard for them to abide to ban rules to stop fishing.
Wholesaler (intermediary)	Wholesale <i>hilsa</i> fish throughout the year, sold through auctions	<p>Aratdars worry about the ecosystem degradation (e.g. siltation) that affects migration of <i>hilsa</i> to rivers. They perceive a positive impact from the fishing ban, helping juvenile fish reach better sizes, which also improves quality of the catch. They would like improvements in services along chain (transport, storage) that affect quality of fish will reduce costs and increase profits. For example:</p> <ul style="list-style-type: none"> Modern facilities needed: larger size of landing center, to facilitate provision of other services on site and access to consumers (e.g. electricity, roof, water) Cold storage systems that could be rented to supply fish during ban and during festivals Develop affordable technologies for preservation, like steel or wooden boxes Good location close to city, but traffic jams around markets increase transport time and affect freshness of fish 	<ul style="list-style-type: none"> No demand restrictions means that efforts to improve supply will improve profits. Efforts to increase the quantity and size of fish caught will deliver higher prices and better profit margins Investment risk: Government does not invest in catching or marketing. Most investment comes from aratdars. They can lose the money invested as loans if the local intermediaries (bepari) fails to collect it or if the fishermen are not able to deliver (illness, illegal fishing, loss of nets and boats, etc). Existing fees/taxes very low - can be increased and earmarked to re-invest in landing facilities if services are improved.
Exporter (high-end retailer)	Specialised retailer for high quality product abroad	<ul style="list-style-type: none"> Good quality exportable fish sometimes difficult to obtain – need investments in time and effort to collect from multiple sources. Longer transport time affects quality of fish, which can be rejected by final buyer at the exporter cost. Perceive positive impact of fishing ban: helps juvenile fish reach better sizes, which also improves quality of the catch. But the existing export ban restricts high value market development. Rewarding quality: reported prices paid for fish are about 10% above market price to get best quality fish directly at landing center. 	<ul style="list-style-type: none"> Potential high value market with quality control but highly restricted by government bans on export. The good results from fishing ban in making stock more available should lead to lifting export ban. Product differentiation and branding: Bangladesh <i>hilsa</i> is preferred because of quality but it carries no differentiation in international markets. A local standard (eco-standard) can help increase consumer awareness and support the export market. High gross price – more than 5 times higher than fishermen receive on average.

Note: Most *hilsa* fish traded after the aratdar stage is sold locally. This analysis highlights the potential for *hilsa* export as high end-value market. Source: observations from fieldwork.

stops them from finding alternative incomes. Importantly, incentives should be extended to all fishers affected by the ban: at the moment only *hilsa* fishers are entitled to compensation, although non-*hilsa* fishers cannot operate during the ban [1]. The lack of suitable compensation to other people affected across the chain puts further pressure on fishers to attempt illegal fishing. Although there are alternative income generating activities the subscription is very low (7785 fishers in 2013 and 1743 in 2014, out of 186,000 households receiving rice compensation). This urgently points at the need to review the type of training on offer in a way that responds to the needs and skills of the fishing families.

5.3. Opportunities to invest with improved infrastructure

Artisanal fisheries operate with relatively low running costs (about US\$3000/year variable costs). This means that relatively small amounts of investments at the beginning of the chain can have a significant impact on the fishers's ability to operate. For example, respondents to

the survey mentioned the need to invest in better technologies, like production of current *jal* (monofilament net) as it can be a problem for juvenile *hilsa*.

In terms to trading, it is evident that investment is highly required in terms of good landing center facilities. Investing in these markets or bazars makes a lot of economic sense, as they are already important well known trading locations near Dhaka with a guaranteed demand. Traders from Dhaka and adjacent districts have easy access through road, train, waterways to this market from around the city and easily collect the fish and move to their own market. Cold storages are available in some of the trading centers, with ice factories nearby available to meet the demand of ice to preserve the fish.

Specific strategies for investment include improving services along chain (transport, storage) that affect quality of fish will reduce costs and increase profits. For example:

1. Modern facilities needed: larger size of landing center to accommodate a larger number of intermediaries and facilitate provision of

other services on site, as well as safe access to consumers (e.g. electricity, roof, water).

2. Cold storage systems that could be rented to supply fish during ban and during festivals
3. Develop affordable technologies for preservation, like steel or wooden boxes;
4. Good location close to city, but traffic jams around markets increase transport time and affect freshness of fish. This was highlighted several times during the survey and focus groups.
5. Potential to increase stall fees and reinvest in better facilities. At the moment the existing fees/taxes very low (and in line with the basic provision of services). *Hilsa* is a very profitable activity, and traders would be open to increased fees if they are ear-marketed to be reinvested in better landing facilities.

5.4. Inclusive financing

Most respondents in this study perceive that the government invests little in artisanal fisheries in improving marketing facilities. Fishers have no access to finance for fitting out their boats. Intermediaries are affected by lack of suitable trading facilities with services, some basic –like a roof or water, others more technical like cold storage and better and quicker transport to ensure freshness of this valuable yet perishable commodity.

Rather than a limitation, this represents a good opportunity for the Government of Bangladesh to develop an impact investment strategy to promote the sustainable provision of *hilsa*. These investments would complement the existing government's fishing ban that helps prevent overfishing in juvenile *hilsa*. This could include, for example, financing through a mix of sources like the government's central budget, philanthropy sources and private sector investments in a collective fund –see for example Bladon et al. [32] for examples of trust funds in marine conservation. This would make resources available for small-enterprise loans for fishers and processors, for example making loans and equity investments in relatively inexpensive processing improvements (nets, boat fitting, icing and packaging for boats), as well as cold storage and distribution investment like trucks and local storage depots for intermediaries. There is also potential for larger amounts for public-private fisheries infrastructure, like modern, well connected landing centers and better road systems.

There are clear possibilities for repayment along the chain. For example, the Government could repay investors under long-term investment contracts, such as long-term purchasing contracts from wholesalers and retailers, especially high value retailers like exporters. This will mean also lifting the ban on *hilsa* exports, while ensuring that high profits can be shared along the rest of the value chain. For exporters, the lifting of the ban can be accompanied by a system that would allow them to differentiate their product in international markets: according to the survey, Bangladeshi *hilsa* is renowned and priced by its taste, yet there is no official label to differentiate and capitalise on this niche product. A form of eco/fairtrade labelling for example could improve traceability across value chain and permit the targeting of high-end buyers of *hilsa* (see for example Rapidel et al. [33] for discussion on PES and eco-labelling in Costa Rica).

5.5. Risk reduction and insurance

Risk is a major problem in artisanal fisheries. At the moment there is major gap in insurance against losses. Most investment currently comes from wholesalers or *aratdars*. They can lose the money invested as loans if their local facilitator (*bepari*) fails to collect it or if the fishers are not able to deliver (e.g. due to illness, illegal fishing, loss of nets and boats). There is a palpable use/abuse feeling across the respondents of the survey: fishers feeling oppressed by the lack of alternatives and the conditions of the loans, and *aratdars* feeling that they pay a high price in sharing the risk of failed fishing when things go wrong. According to

FAO [34], fishing insurance can provide many benefits and support connectivity across the value chain:

1. *At the individual/fishers level*: protects against accidents and natural hazards beyond their control; as compensation (full or partial) for the loss of or damage to fishing vessels, gear and catch (or harvest), thus contributing to stabilization of incomes within the fisheries sector; and to reduce the individual's risk when adopting new technologies and buying improved equipment;
2. *Throughout the chain*: it reduces the risk to investors or financial institutions –e.g. a fund targeting artisanal fisheries - which provide credit to fishers and fish farmers, in relation to fisheries credit; and fosters mutual assistance and cooperation among fishers, fish farmers and their organizations, and reduces frictions from existing loans/repayment tensions;
3. *At the macro level*: it reduces the Government's role and burden in terms of emergency relief in natural disasters; it promotes the stability in fishery enterprises and the wellbeing of fishing communities, contributing to government's commitments to poverty alleviation, food security, “zero hunger” objectives, and sustainable development; and it helps to stabilise the contribution of the fisheries sector to national economy, supporting multiple jobs and livelihoods across the rest of the value chain.

Renaud et al. [35] discuss PES in relation to disaster-risk mitigation, as a complement to other instruments used in coastal areas, such as a) *compensation* (predominantly used in developed countries), as b) *subsidised property insurance* –basically subsidising private insurance premiums, making it more affordable but potentially encouraging development of higher-risk areas; and c) *ecosystem service insurance*, where payouts from ecosystem services contribute to the restoration of the ecosystem if it is damaged due to an external event.

6. Conclusions

International and national commitments to promote sustainable growth are big on paper but not easy in practice. The Government of Bangladesh and its fisheries department are showing huge initiative in establishing measures to improve the stock of *hilsa* fish in the country, thus ensuring the supply of a valuable and charismatic fish species. Initial reports of the measures are optimistic, suggesting larger sizes of fish caught across the seasons. Bigger *hilsa* fetches better prices – as high as US\$25 per kilo. It is a business with profits.

Yet the costs of these regulations are falling squarely on the shoulders of small fishers who are poor, uneducated and already in constant debt. The government offers a small payment for ecosystem service in the form of rice, which is good but does not compensate for the loss of revenues and household food from by catch that takes place during bans. These small fishers have no bargaining power and no voice in the design of policies that affect them.

The situation of fishers in Bangladesh is not dissimilar to many smallholder farmers affected by policies like payments for ecosystem services. Unless systematic efforts are taken to enable them to participate and obtain fair deals, environmental programmes may result in further exclusion of some of the poorest and most vulnerable members of society.

This study provides hard data to help policy makers design sustainable development policies that are more inclusive, and do not leave behind those with less power. The study used the Link Methodology and business model canvas to unpick the business propositions of key players across the value chain, as well as a combination of focus groups, field surveys and interviews with key informants to untangle the value chains. The study reveals the level of the vulnerability of fishers to weather patterns and market access, as well as the potential benefits that could be derived from more equitable distribution of benefits, risks and costs along the chain.

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