DIRECT ECONOMIC INCENTIVES FOR SUSTAINABLE FISHERIES MANAGEMENT

The case of Hilsa conservation in Bangladesh

ESSAM YASSIN MOHAMMED AND MD. ABDUL WAHAB – 2013

SHAPING SUSTAINABLE MARKETS

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Acronyms and abbreviations

ACIAR	Australian Centre for International Agricultural Research
AIGA	Alternative income-generating activities
BDT	Bangladeshi Taka
BFRI	Bangladesh Fisheries Research Institute
CPUE	Catch per unit of effort
DFID	Department for International Development (UK)
DoF	Department of Fisheries (Bangladesh)
FAO	Food and Agricultural Organization
FFP	Fourth Fisheries Project
FY	Financial year
GDP	Gross domestic product
HFMAP	Hilsa Fisheries Management Action Plan
IUCN	International Union for Conservation of Nature
KCWA	Kuruwitu Conservation and Welfare Association
MBREMP	Mnazi Bay Ruvuma Estuary Marine Park
MPA	Marine protected area
PES	Payments for ecosystem services
REDD	Reducing emissions from deforestation and forest degradation
TAC	Total allowable catch
tCO_2e	Tonnes of carbon dioxide equivalent
UNO	*Upazila Nirbahi* Officer
USD	United States Dollar

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FOREWORD

World fish stocks are running dangerously low. Only 20 per cent of global fishery resources are moderately exploited according to the FAO. The remaining stocks are either fully exploited (52 per cent) with no further increases anticipated, overexploited (19 per cent) or depleted (8 per cent). Only 1 per cent are on track to recovering from previous depletion. If current trends continue, we are very likely to see 'fishless oceans' by 2050.

This would be a tragedy not just for the oceans' ecosystems, but for the people that rely on them to survive. Globally, some 43.5 million people work directly in the fisheries sector, with the great majority in developing countries. Adding those who work in associated processing, marketing, distribution and supply industries, the sector supports nearly 200 million livelihoods. Unless current trends are reversed, millions of livelihoods could be lost. But there are some signs of hope – like the case of Hilsa fish in Bangladesh where direct economic incentives are being used for conservation.

It was not long ago I was sitting in the 100th Anniversary of Indian Science Congress and chairing a session on fisheries. A sharp Indian scientist was presenting the data on Hilsa productivity over the years in the Ganges and Hoogly rivers. It was a source of great pride to me when he described how Hilsa in the past five to seven years had increased in productivity in the Ganges basin, i.e. Bangladesh. In contrast, the productivity of Hilsa was declining over the past 20 years in the Hoogly river in West Bengal because of a lack of any conservation effort. He further described in detail how the Department of Fisheries, coupled with law enforcement agencies, had a ban on the capture of Hilsa for 10–12 days in October/November and a months-long ban on the capture of small Hilsa (called Jatka). When these conservation methods – described in detail in this book – were enforced, everyone won. Fishers were trained on the benefits of this conservation, despite hindering their income in the short term. They were also provided with monetary incentives to respect this conservation effort. In 2013, Bangladesh had a bumper harvest of Hilsa, proving to all that conservation is a win-win proposition.

This book in particular details the success of the payments for ecosystems services, implemented throughout the world, that served as an incentive-based approach for the conservation of fish and in particular Hilsa in Bangladesh. I hope all who read this book will find it a remarkable success story, one which can be replicated in many parts of the world. Happy reading!

Dr. Craig A Meisner, Country Director,
South Asia, WorldFish.

EXECUTIVE SUMMARY

Fisheries provide millions of people with a source of livelihood. Yet across the world, these resources are fast diminishing because of pollution, habitat destruction, overfishing, natural disasters and climate change. Traditional approaches to halt this decline focus on regulating against destructive practices, but to little effect. A more successful strategy could be to establish a direct economic incentive mechanism such as payments for ecosystem services (PES), or to incorporate an element of PES in existing regulatory mechanisms.

There are five ways direct economic incentive mechanisms can be used to complement regulatory approaches. These are:

1. compensating for lost earnings from the imposition of marine protected areas (MPAs)
2. compensating for lost earnings from the imposition of closed (no-take) season
3. incentivising coastal habitat restoration activities
4. rewarding for the conservation of threatened marine and coastal species
5. rewarding sustainable fishing practices.

Examples from terrestrial environments, and a few from aquatic environments, suggest that economic incentive-based mechanisms can work to protect both livelihoods and environments. But to succeed, these schemes must be underpinned by robust research, clear property rights, effective monitoring and compliance, equitable benefit sharing, and sustainable finance.

One of the rare examples of using a direct economic incentive mechanism for sustainable fisheries management is the payment for Hilsa conservation in Bangladesh. The Hilsa fish is anadromous in nature (an uncommon phenomenon in tropical waters), living in the sea for most of its life, but migrating up to 1200 kilometres inland along major rivers in the Indian sub-continent for spawning. It is also one of the most important single-species fisheries in the Bay of Bengal, which Bangladesh shares with Myanmar and India. 250 million Bengali people are dependent on Hilsa for nutrition and more than half a million people for their livelihoods. Hilsa also has significant cultural value.

Hilsa was once abundant in the 100 rivers of Bangladesh. Fishers used to catch plenty of fish, which were sold fresh to local and urban markets. It was cheap and affordable for the poor. From the 1970s, the Hilsa fishery began to gradually decline, with output reaching a low point of 0.19 million tonnes in 1991–1992. This situation was attributed to a combination of closure of migratory routes, river siltation, over-fishing, indiscriminate harvesting of brood stocks and juveniles (locally known as *jatka*), use of fishing nets with very small mesh sizes, the mechanisation of fishing gear, increased numbers of fishers, pollution, and hydrological and climatic changes.

Such a significant decline in Hilsa catches prompted the government of Bangladesh to declare five sites in the country's coastal rivers as Hilsa sanctuaries, restricting fishing during the breeding season. To compensate for loss of earnings due to fishing restrictions, the government started providing affected fisher communities (187,000 households) with 30 kilograms of rice per household per month and supporting alternative income-generating activities (AIGAs). While no study has been carried out to rigorously evaluate the ecological and social impact of the intervention, it is widely believed by both scientists from the department of fisheries, and the fishers themselves, that it has had significant positive ecological impacts.

The significance of this scheme is twofold. First, it is locally financed without external support; and second, it is operating in a developing country context – often regarded as too challenging a context for such schemes. This case study offers replicable lessons for the implementation of direct economic incentive mechanisms for sustainable fisheries management in developing countries and more widely.

Despite its apparent success, the design and implementation of the scheme could be improved. We recommend:

1. Improving the understanding of the complex socio-economic and ecological systems underpinning the Hilsa fishery.
2. Identifying the beneficiaries of the scheme (the 'buyers' of the ecosystem service) to enable it to be put on a sustainable financial footing.
3. Identifying how fisher communities would prefer to receive their compensation packages and redesigning them accordingly.
4. Empowering local fishermen to monitor and enforce compliance.
5. Improved regional co-operation between the three countries which make up the Bay of Bengal: Bangladesh, India and Myanmar.

One of the critical conditions for success is ensuring the financial sustainability of the economic incentive mechanism. There are several examples of terrestrial PES schemes that have collapsed after donors withdraw or external funding ends. Having a sustainable funding source is even more critical in low-income countries such as Bangladesh where the government is often financially constrained. It is important to have an innovative approach in place to ensure the financial sustainability of the scheme. One such approach could be the establishment of a conservation trust fund which generates financial resources by earmarking export taxes or charging beneficiaries for the sustainable management of the fishery resources. This can only be done after clearly mapping and identifying those affected (ecosystem service providers) and those who are beneficiaries of the scheme (ecosystem service consumers).

ONE
INTRODUCTION

Marine and coastal resources provide millions of impoverished people across the global South with livelihoods. They provide the world with a range of critical 'ecosystem services', from biodiversity and culture to carbon storage and flood protection (Mohammed 2012) to recreation and amenity opportunities (Whitmash 2011). Fisheries provide multiple benefits to poor and impoverished coastal communities in developing countries. Fish is a major source of food for many poor and vulnerable communities. Some 43.5 million people are employed directly by fisheries, with a great majority in developing countries (FAO 2008). Once those who work in associated processing, marketing, distribution and supply industries are included, fishing supports nearly 200 million livelihoods (Barrange and Perry 2009).

However, the importance of fisheries is often understated or ignored. According to Murray *et al.* (2011) this is mainly because markets do not easily capture the values of coastal and marine ecosystem services in general and the value of artisanal fisheries in particular. Consequently, those who control coastal resources often do not consider this value when choosing how to use these resources. This has led to over-exploitation and degradation of the resource, reducing the quality and effectiveness of the services they provide (Millennium Ecosystem Assessment 2005).

Traditional fishery conservation and management approaches mainly focus on maintaining high levels of productivity, sustainable harvests, economic stability, and so on (Salomon *et al.* 2011). Trying to maintain or restore these resources often conflicts with the objective of increasing food supplies from the sea. The level of resource extraction, such as fishing, required to achieve increased food supplies typically compromises the ability to maintain marine resources (Brander 2010). Balancing marine and coastal ecosystem conservation and sustainable social and economic benefits from fisheries or other marine and coastal resource extraction activities is crucial but very challenging.

Many long-pursued regulatory approaches to fisheries management and development have tried to encourage fisher and coastal communities to change their unsustainable practices but have failed. According to Arnason (2000), regulatory approaches such as mesh size regulations for fishing nets, total allowable catch (TAC) limits, and fishing ground closure may enhance fish stocks but they often fail to improve the economic situation of the fishery because they fail to compensate fishers for lost earnings as result of the restrictions. As a result, the fishers will respond to such approaches simply by increasing their fishing efforts, thus eliminating any temporary gains generated by the management measures.

Where regulatory mechanisms have failed, economic incentive mechanisms such as payments for ecosystem services (PES) have been considered as the most viable and effective tool. These reward resource users for improved practices or compensate them for the benefits forgone by complying with regimes limiting their use of natural resources. While incentive-based approaches such as PES have gained popularity in terrestrial environments such as forest and watershed ecosystems, they are only at an embryonic stage in sustainable fisheries management. This can be attributed to three factors. First, PESs were developed initially as an instrument suitable for forestry and watershed management and may not have reached fisheries management due to lack of communication between fisheries and forestry scientists. Second, unlike some resources in terrestrial ecosystems,

fish are highly mobile and difficult to monitor (Begossi *et al.* 2011) which makes PES harder to implement. Third, ownership or property rights of aquatic environments are often (if not always) either ill-defined or only traditionally recognised, which makes implementation, monitoring, and enforcement very challenging. Nonetheless, if well designed, economic incentive mechanisms can play a significant role in incentivising fisher communities to conserve, restore, and co-manage their resources.

This paper shows how economic instruments can be used to incentivise local fisher communities to sustainably manage their fisheries resources, despite some of the challenges discussed above. It shows that establishing schemes that provide economic incentives (in the form of reward or compensation), or incorporate an element of financial incentives into existing regulatory mechanisms could be the most successful strategy. Examples, both terrestrial and marine, from across the world suggest that such economic incentives can in fact work to protect both livelihoods and environments. In the subsequent sections, we demonstrate how direct economic incentive mechanisms can complement regulatory approaches. Finally, we present a case study from Bangladesh, which offers a rare example of how direct economic incentive mechanisms can work to promote sustainable management of fisheries resources.

The case study was completed using desk-based research, through which both published and unpublished documents were reviewed, and interviews with key informants including officials from the Bangladeshi Department of Fisheries, fisheries' scientists, and fisher communities. Additional information was also collected through a multi-stakeholder workshop on incentive-based Hilsa conservation and management (conducted in March 2013 in Bangladesh); inception workshop on 'payments for Hilsa (*T. Ilisha*) conservation' (conducted in May 2013 in Bangladesh); and an informal meeting with fishers in Chandpur, Bangladesh (conducted in August 2013).

This paper is organised as follows: Section 2 introduces sustainable fisheries management. Section 3 explains how direct economic incentive mechanisms may complement existing regulatory approaches for sustainable fisheries management. Section 4 describes factors that may limit or determine the effectiveness of direct economic incentive mechanisms. Section 5 presents and discusses the case study from Bangladesh. Section 6 presents our conclusions and recommendations.

TWO
UNDERSTANDING SUSTAINABLE FISHERIES MANAGEMENT

There is no any commonly agreed definition of fisheries management. The Food and Agricultural Organization (FAO) has adopted a working definition of fisheries management as:

the integrated process of information gathering, analysis, planning, consultation, decision-making, allocation of resources and formulation and implementation, with enforcement as necessary, of regulations or rules which govern fisheries activities in order to ensure the continued productivity of the resources and the accomplishment of other fisheries objectives. (Cochrane 2002: 7)

According to Cochrane (2002), fisheries management involves a complex set of activities with the underlying goal of achieving sustained optimal benefits from the resources. The definition does not consider the provision of direct economic incentives, however, and mainly emphasises the use of regulatory approaches and effective enforcement of management regimes.

In this report we use the following working definition of sustainable fisheries management: the process of making informed decisions to ensure sustainable, equitable and near-maximum economic, social and ecological benefits attained through regulatory, direct economic instruments, and/or community-based management approaches via the practical engagement of resource users.

Traditionally, fisheries management mechanisms are categorised as either 'input' or 'output' control. Input control mechanisms emphasise putting restrictions on fishing efforts through restrictions on the type of vessel or fishing gear used, while output control focuses on the amount of resources fishermen can extract, which includes limiting allowable catches. Other mechanisms also exist, such as 'access' control, which restricts access to fishing grounds which are believed to be sanctuaries or spawning grounds for some target species. This can also be done by restricting fishing during the breeding seasons, known as 'closed' or 'off' seasons. There are also relatively new mechanisms and approaches being developed including ecosystem-based management, community-based management, rights-based management, and adaptive management approaches – all with varying degrees of effectiveness and efficiency.

Command-and-control or regulatory approaches have commonly been used to ensure that these mechanisms are enforced and that they do achieve sustainable management of the resource. This usually involves policing and monitoring the activities of fishers and sanctioning those who violate the rules. More recently, economic incentive-based approaches have also been used to complement regulatory approaches. Castello *et al.* (2010) argue that society can achieve the same level of abatement using incentive-

based mechanisms as command-and-control approaches, but at a lower economic cost. The relative effectiveness of incentive-based approaches has been extensively examined by a number of researchers (e.g. MRAG 2010). It is, however, very important to make a clear distinction between 'economic incentive-based' and 'direct economic incentive' approaches. Economic incentive-based approaches mainly include individual transferrable quotas[1], while direct economic incentives aim to reward fishers for giving up their destructive fishing practices or to compensate them for the lost earnings due to regulatory approaches such as a closed season. This paper focuses on direct economic incentive mechanisms.

1. Individual transferable quota allocates a divisible, leasable and transferable right to harvest a limited amount of fish in a defined period of time (usually per year) in perpetuity.

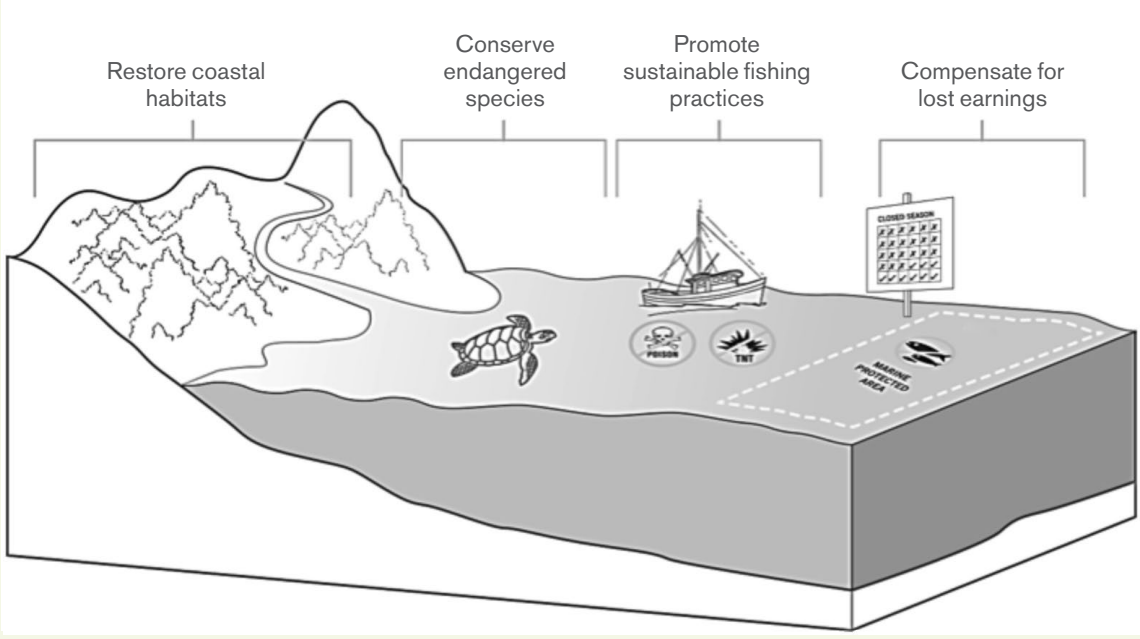
THREE
COMPLEMENTING EXISTING REGULATORY SCHEMES WITH DIRECT ECONOMIC INCENTIVES

Providing direct economic incentives in the form of a reward or compensation can enhance the effectiveness of regulatory schemes. In this section we discuss how direct economic incentive mechanisms (from now on referred to as incentive mechanisms) can be added to some of the most widely used regulatory approaches: (1) imposing temporal and special fishing restrictions i.e. off/closed seasons or protected areas; (2) restoring coastal habitats; (3) conserving endangered species; and (4) regulating fishing practices (Figure 1).

3.1 COMPENSATING FOR LOST EARNINGS FROM THE IMPOSITION OF MARINE PROTECTED AREAS

Marine protected areas (MPAs) are areas of coastal land and water that are specifically designated to protect natural resources and ecosystems (Coral 2005). MPAs have become increasingly popular as policy instruments. Typically, their central goal is to protect livelihoods by increasing the productivity of fish resources

FIGURE 1. WAYS THAT ECONOMIC INCENTIVES CAN BE ADDED TO EXISTING REGULATORY SCHEMES



Source: Mohammed 2012.

by creating sanctuaries that allow fish to spawn. They also protect biodiversity and offer sites for recreation (Albers *et al.* 2012). Despite their goal of protecting livelihoods, MPA restrictions on fish harvesting can be particularly costly for artisanal fishers, especially in the short term, because they have limited alternative livelihood options. The combination of degraded fish stocks and new harvest restrictions such as MPAs create difficulties for communities and households who live near MPAs (Albers *et al.* 2012). Implementing an incentive mechanism can compensate fisher communities for lost revenues and offer local communities an incentive to actively participate in protecting coastal and marine parks. This has been practised in a number of places, as discussed below.

For example, the Kuruwitu Conservation and Welfare Association (KCWA) in Kenya established a 2 square kilometre no-take zone after the local fishermen noticed a significant decline in fish catches. During a six month trial period the International Union for Conservation of Nature (IUCN) provided funds to compensate the fishermen for not fishing in the area. This resulted in positive outcomes – coral cover increased by 30 per cent, seagrass species increased by 12 per cent, and fish stocks rose by 200 per cent (Lee 2011). The scheme faced a major setback, however, as the funding generated from ecotourism was not enough to compensate fishers as initially anticipated. Having a sustainable source of financing is essential to ensure the effectiveness and sustainability of the economic incentive mechanism.

In another case, in southern Tanzania, the Mnazi Bay Ruvuma Estuary Marine Park (MBREMP) was gazetted in 2000 to improve the health of the bay's fishery by changing local people's behaviour (Albers *et al.* 2012). This estuarine marine park includes both coastal and intertidal zones and puts restrictions on fishing gear, such as defining minimum net mesh size to avoid capturing juvenile fish and banning dynamite fishing, as well as banning cutting mangrove trees for commercial purposes. The fisher communities, who are primarily dependent on marine resources, are provided with fishing gear with large mesh nets in exchange for 'illegal' small mesh nets. They were also helped to develop alternative income-generating activities such as beekeeping and sustainable aquaculture. No rigorous studies have been carried out to assess the social and ecological impacts of the scheme, but proponents of the establishment of this marine park claim that that the park contributes significantly to the region's poverty reduction initiatives and promotes investment in eco-tourism. Albers *et al.* (2012) found problems associated with the scheme such as inequitable cost and benefit sharing, however. For instance, those villages most dependent on marine resources, typically those located on the bay and distant from agricultural land, face the highest costs associated with complying with the MBREMP regulations.

3.2 COMPENSATING FOR LOST EARNINGS FROM THE IMPOSITION OF CLOSED (NO-TAKE) SEASON

Closed seasons prevent fishers from fishing at certain times of the year to protect species at vulnerable times in their life cycle, such as during spawning seasons. This is a traditional method that many countries use within their marine or aquatic jurisdiction. In most cases, no compensation to fisher communities for lost opportunities is considered, but some compensation schemes have been implemented. The *defeso* scheme in Brazil is one example. This scheme, which literally means 'closed', compensates communities for loss of income during the closed season, and allows some fishermen to move temporarily to other fisheries or to other sectors such as tourism (Azevedo and Fidelman 2011). According to Begossi *et al.* (2011) one of the problems of the scheme is free riding: not all the beneficiaries of the scheme depend on fisheries for their livelihoods. This could dilute the incentive provided and endanger the efficacy of the scheme. It is key to identify those who are directly affected by the closure, and estimate their costs in complying in the short term.

In another example, the government of Bangladesh has imposed an 11 day ban on fishing Hilsa (*Tenualosa ilisha*) in November every year during its breeding season to allow the species to spawn successfully. The Hilsa fishery is by far the largest single-species fishery in Bangladesh, providing full-time employment for about 450,000 'professional' fishers and 2.5 million part-time ones. Hilsa is the region's most affordable fish, and preferred among the poor; thus contributing to poverty alleviation. It is feared that stocks could collapse in the near future as the fishery is over-exploited. The exploitation rate (the proportion of the population harvested each year) of Hilsa

increased sharply from under-exploited (0.33)[2] in 1990 to over-exploited (0.66) in 2002, the latest year for which data are available. This prompted the government to declare five sites in the coastal areas of the country as Hilsa sanctuaries preventing fishing during the reproductive season. To compensate for lost earnings, the government has started providing 'affected' fisher communities (187,000 households) with 30 kilogrammes of rice per household and alternative income-generating activities. Section 4 of this paper explores this scheme in more detail.

3.3 INCENTIVES FOR COASTAL HABITAT RESTORATION

Coastal habitats in general, and mangrove forests in particular, are being lost at an alarming rate from pollution, land clearance, coastal development, natural disasters, and climate change (FAO 2007). Globally, approximately 35 per cent of mangrove areas have been lost or converted to alternative land uses (e.g. aquaculture farms or tourism facilities), and approximately 20 per cent of coral reefs have been destroyed in the last few decades (Rashid *et al.* 2005). Emerton (2013) argues that such alarming coastal degradation is happening mainly due to undervaluation of the ecosystem. Neither the economic benefits associated with ecosystem services nor the economic costs and losses associated with their degradation and loss are being fully or accurately considered. Emerton (2013) further argues that incentive mechanisms can be seen as a response to the problem of undervaluation – providing a means of recognising, capturing, and internalising the ecosystem values that have traditionally been excluded from the prices, markets, and policies that drive land and resource-use decisions in coastal areas.

In Eritrea, the Manzanar project has been planting mangrove trees in areas where mangroves do not naturally grow (75 per cent of Eritrea's coastal area) by injecting fertilisers (diammonium phosphate and iron) to supplement the nutrients that are usually provided by freshwater runoff. In return for their labour, coastal communities receive small financial and in-kind benefits. The participants are primarily poor women. They receive a total of 20 Nakfa (GBP 1.31) per day and breakfast, usually cooked and mashed fava beans and bread. In addition the most impoverished households receive livestock (sheep and goats)[3]. Even though no study has been done to assess the ecological and social benefits of the intervention, it is claimed that the coastal communities have successfully afforested up to 250 acres of coastal land. In addition to fodder for livestock provided by the mangrove trees, the communities reported that they have witnessed an increase in fish and shellfish stock, thus contributing to local food security. The project which has been funded by the government of Eritrea and some philanthropic support, is now facing some financial constraints (Negassi, 2013).

It has been suggested to make the case for tradable reduced carbon emissions due to the carbon sequestered in the mangroves to ensure the financial sustainability of the project (Murray *et al.* 2011). This has been trialled elsewhere, for example in Vietnam and South

2. On a scale of 0–1, where 0.5 is the maximum limit for the optimal rate of exploitation. A rate above 0.5 is deemed to be overexploitation.

3. Based on one of the author's own observations working in fisheries in Eritrea.

Africa. Intact coastal habitats store hundreds or thousands of tonnes of carbon per hectare. For example, seagrasses store 500 tonnes of carbon dioxide equivalent (tCO_2e) per hectare; salt marshes store 917tCO_2e per ha; and oceanic mangroves store 1800tCO_2e per ha. Incentives to retain rather than emit such 'blue' carbon, similar to payments for reducing emissions from deforestation and forest degradation (REDD), could help conserve biodiversity as well as a variety of other ecosystem services at local and regional scales (Murray *et al.* 2011).

3.4 CONSERVATION OF THREATENED MARINE AND COASTAL SPECIES

Conservation of threatened species is often done either by directly protecting the species or protecting their habitat. One example is a payment scheme to protect sea turtle nests in Tanzania. The scheme pays communities for finding and reporting a nest to an appropriate project monitor, along with a variable payment based on the hatching success of the nest. According to Ferraro and Gjertsen (2009) the scheme has led to a significant reduction in poaching rates (from as high as 48.5 per cent in 2001 to as low as 0.6 per cent in 2004) while hatching rates increased by up to 71 per cent in 2004 compared with 2001 levels.

In another example documented by Niesten and Gjertsen (2010) the Luis Echeverria community in Mexico agreed to protect about 48,500 hectares of grey whale habitat in exchange for annual payments of USD 25,000 to support small-scale development projects. Payments have been used to provide training in business skills and launch new income-generating activities. This scheme has been praised for considering the preferences of the participant community members about the type of income-generating activities they would want to get involved in, and for securing a dedicated trust fund that covers payments to communities, monitoring, and legal expenses.

3.5 SUSTAINABLE FISHING PRACTICES

Destructive fishing gear use and practices can have either reversible or irreversible impacts on marine ecosystems. Reversible impacts can be corrected using input or output controls. Destructive fishing techniques include the use of poison, explosives, bottom trawls, and *muro-ami. Muro-ami* is a fishing technique used on coral reefs in Southeast Asia which uses an encircling net together with pounding devices and has a devastating impact on coral reef ecosystems. Bottom trawls are often used by commercial or industrial fisheries. Poison (for example to catch ornamental fish in Indonesia) and explosives are widely used by small-scale fishers across the tropics because the materials needed are usually inexpensive and readily available, requiring limited capital investment from artisanal fishers.

To tackle the problems associated with destructive fishing practices, traditional fisheries management regimes often use restrictions on fishing effort and maximum catch limits. As discussed earlier, this approach is often ineffective because fishers lack the incentive to change their behaviour or comply with the restrictions – leading to phenomena such as 'effort creep' and 'race to fish' (Grafton *et al*. 2006), endangering the environmental sustainability and economic performance of marine ecosystems. Effort creep occurs as fishers in an input-controlled fishery switch from regulated inputs to unregulated ones in order to offset the targeted reduction in fishing effort. Race to fish is a negative by-product of total allowable catch quota where fishers race to get a maximum possible share of the total catch. This has in many cases led to over-exploitation of the fishery resources.

Economic mechanisms could offer artisanal fishermen an incentive to change their behaviour but the incentives to continue employing destructive fishing practices are very high, so the incentives provided need to be high too. If they cannot offset the benefits forgone by giving up the destructive behaviours then they are very likely to be ineffective.

FOUR
CONDITIONS FOR SUCCESS

Section 3 discussed a number of ways in which incentive mechanisms can either replace or complement existing regulatory measures for marine and coastal ecosystem conservation. In order for them to be successful, however, there are some challenges or limiting factors that need to be considered while designing direct economic incentive schemes.

4.1 CLEARLY DEFINED PROPERTY RIGHTS

It has long been recognised that a lack of clearly defined property rights in coastal ecosystems has led to unsustainable natural resource use such as overfishing and consequent threats to biodiversity. To overcome these problems, recognition of the customary rights of the communities to access coastal resource is crucial. Such recognition can empower local fisher communities to co-manage their coastal and marine resources and reduce overfishing. However, the issue of property rights in coastal areas is far more complex than in terrestrial environments. Fishing rights are often (if not always) nested under coastal and marine-resource use rights.

A growing number of groups are seeking greater access to coastal resources leading to overcrowding, ecosystem-service degradation, and community dissatisfaction. The uses of marine and coastal areas involve diverse rights such as harvesting rights (fish extraction), use rights (tourist permits and passive recreation), conservation rights (the right to conserve threatened species), and management rights, each with different degrees of exclusivity. This makes fishing and property rights very complex.

Marine or coastal resources, whether mobile ones such as fish or immobile ones such as mangroves, share a series of characteristics: (1) they are often governed by regimes based on community or public property rights; (2) they often also share high subtractability of use, meaning that appropriation by some users diminishes the availability of the resource and its services for others; and (3) it can be difficult to exclude users, either because they are mobile (ships, etc.) or because of difficulties controlling access (Muradian 2013). This is further complicated by a government lack of capacity to enforce property rights (Viswanathan 1999) especially when it comes to small-scale or artisanal fisheries.

The most viable option would be to move towards community rights rather than individual property rights in small-scale fisheries, both in high-income and low-income countries. The community approach requires the recognition of the customary rights of the communities to use their resources. It also needs to go beyond simple 'dos and don'ts' of fisheries management, and actively engage communities in the management of the resources. Involving communities in coastal and fisheries management is more likely to overcome problems associated with monitoring and enforcement than not involving local communities. Better monitoring and enforcement through community engagement is crucial to ensure the effectiveness of the direct incentive mechanism which requires clear identification of the buyers and sellers of ecosystem services.

4.2 EQUITABLE BENEFIT DISTRIBUTION

The issue of distribution is key to ensuring that the poor or the most vulnerable parts of society benefit from economic incentive mechanisms (Mohammed 2011). This is critical to building wider local legitimacy and support for the mechanism, ensuring that low-income groups do not lose out, and ultimately enhancing

the effectiveness of the scheme. In principle, compensation levels have to be equal to or greater than the cost of conservation borne by communities. It is often the case that small-scale fishers are disproportionately and negatively affected in the short term by limits on their harvests, due to a heavy reliance on fishing and limited alternative livelihood options (Sunde and Isaacs 2008). Therefore, schemes need to make a careful assessment of 'who loses and who wins' and estimate as accurately as possible any loss of earnings arising from measures restricting access to resources.

Such assessments enable the implementing body to determine who (household or community) should receive how much – a process called targeting. While blanket compensation or payment, which compensates every community and household regardless of their contribution of impact, may sound fair, as Grieg-Gran *et al.* (2005) argue, there is a wider equity issue. Non-participants who may also bear opportunity costs may be excluded (exclusion error) or they may benefit without any effort or cost on their part (inclusion error).

Neither of these types of errors is desirable. Exclusion and inclusion errors can diminish the effectiveness of the scheme. In circumstances where there are limited financial resources (e.g. low income countries) both inclusion and exclusion errors mean inefficient use of financial resources. Therefore, careful targeting of the most affected segments of society is crucial if direct economic incentive mechanisms are to deliver the intended ecological and social benefits.

4.3 SUSTAINABLE FINANCING MECHANISMS

It is extremely important that the incentive mechanism is financially sustainable to ensure its continuity so that resource owners do not abandon the scheme and return to their unsustainable practices. The supply chain of ecosystem services provision needs to be mapped to identify 'buyers' and 'sellers'. Ecosystem service buyers, or beneficiaries, may include stakeholders such as the tourism sector, industrial fisheries, offshore extractive industries (e.g. oil and gas companies), coastal and marine tourism and recreation centres, and government agencies. At an international level, certified emission reductions may provide a beneficiary.

Effective fund management is also key to ensuring the financial sustainability of direct economic incentive mechanisms. One innovative approach has been to set up a conservation trust fund to manage financial resources and channel them to the affected communities or households. Setting up a conservation trust fund requires assessment of the cost (in other words the amount of financial resources required to administer the scheme) and securing revenue or having a clear business plan to identify potential financing sources. As Spergel and Moye (2004) documented, the Network of Southeast Asian Marine Protected Areas – a network of MPAs in Indonesia, Malaysia and the Philippines – has developed an innovative portfolio of financing mechanisms. A business plan was developed through a bottom-up analysis of the full economic costs of MPAs and an analysis of funding sources including local sources (e.g. ecotourism, extractive industries, and user fees), traditional donors (e.g. bilateral and multilateral agencies, foundations, and NGOs), and new biodiversity investors. Several other similar conservation funds have been established in Latin America and sub-Saharan Africa.

In the next section we present a case study from Bangladesh, a government-sponsored scheme that compensates fisher communities for abiding by fishing restrictions including no-take zones and periods. It offers a rare example of an incentive-based mechanism introduced to sustainably manage fisheries resources. The significance of this case study is twofold: (1) it is locally financed without external support; and (2) it is a developing country example – despite it often being deemed by many to be very challenging (if not impossible) to implement such schemes in the developing world. Therefore, this case study offers replicable lessons on the implementation of direct economic incentive mechanisms for sustainable fisheries management.

FIVE
CASE STUDY: PAYMENTS FOR HILSA CONSERVATION IN BANGLADESH

Hilsa is an anadromous fish, meaning that it migrates from the sea into freshwater to spawn. It inhabits the coastal regions from the Mekong estuary of Vietnam to the Persian Gulf (Pillay and Rosa 1963). There are three species of Hilsa, the largest being *Tenualosa ilisha*, which makes up 99 per cent of total Hilsa catches in the Bay of Bengal region (Rahman, M.A. *et al.* 2012). The Bay of Bengal is the major producing region for this species, from where it migrates to the rivers Padma and Meghna and their tributaries for breeding and spawning (Rahman, M.J. 2006). It was the dominant species in the Ganges river system in the pre-Farakka period until the mid-1970s.

Hilsa is now mostly available in the Meghna estuary, the Padma River and some coastal areas of Bangladesh. It is commercially exploited in India and Myanmar as well as Bangladesh (Milton 2010). Bangladesh accounts for about 60 per cent of the total Hilsa catch within the Bay Bengal region, with the remainder caught by Myanmar and India. Hilsa constitutes 11 per cent of the total 2.9 million tonnes of fish produced in Bangladesh (Rahman, M.A. *et al.* 2012). Hilsa alone makes up 1 per cent of Bangladesh's gross domestic product (GDP) and contributes a considerable amount to foreign exchange earnings. About 287,000 fishers are directly dependent on the Hilsa fishery for their livelihood and about 2–2.5 million people are involved in activities throughout the supply chain – transportation, marketing, processing, and other post-harvest activities (Rahman, M.A. *et al.* 2012). It is the preferred fish of the people of Bangladesh and West Bengal in India, and is of religious and cultural importance, forming part of Bengali festivals (Box 1). Hilsa has been recognised as the 'national fish' of Bangladesh.

The unique taste of Hilsa has been attributed mainly to the presence of significant quantities of fatty acids like stearic acid, oleic acid and many polyunsaturated fatty acids (Nath and Banerjee 2012). The amount of fat ranges from 22 per cent to 36 per cent of the weight of fish muscle. In addition to its highly desired flavour, Hilsa is also rich in omega-3 polyunsaturated fatty acids, proteins and minerals, and thus quite a nutritious fish (Mohanty 2011). A 100 gram Hilsa contains 22g of protein, 19.5g of fat, 180 mg of calcium and 250 mg of phosphorus along with other nutrients. Besides fatty acids, Hilsa is also rich in amino acids. Micronutrients present in Hilsa play a major role in the metabolic activity of the human body, by serving as co-factors of enzymes. The minerals of Hilsa muscle are highly 'bioavailable', meaning that they are easily absorbed in the human body. The high nutritional value, taste and culinary properties of Hilsa amply justify the popular Bengali saying '*macher raja ilish*', meaning 'Hilsa is the king of fish'. It explains its historical significance and its importance for Bangladesh's food and nutrition security.

Hilsa was once abundantly available in the 100 rivers of Bangladesh. Fishers used to catch plenty of Hilsa which were sold fresh to the local and urban markets. It was a cheap fish and was affordable even for the poor. The Hilsa fishery declined gradually over 30 years to reach a low

BOX 1. THE CULTURAL VALUE OF HILSA

Hilsa has cultural and religious significance in the South Asian region. Traditional knowledge is the key to the Hilsa fisheries – knowledge of fishing grounds, seasonality, tidal influx, and lunar periodicity are transferred from one generation to the next.

The people of Bangladesh and West Bengal in India, as well Bengali-speaking people throughout the world, love fish. They like to define themselves with the phrase '*mache bhate Bengali*", or 'rice and fish make the Bengali'. Hilsa holds the highest position among the rich biodiversity of the Ganges river system, and its importance has been further accelerated through the development of different dishes and their use in occasions related to ceremonial festivals, especially among the Hindu communities. Thus, Hilsa is important socially, culturally, and religiously to the Bengali people and people in many other Indian states like Orrissa, Bihar and Assam.

In some Hindu Bengali families, large Hilsa fish are bought for engagements and pre-marriage ceremonies. Hilsa may also be included in the wedding ceremony menu. An important occasion is the *Jamai Sashti*, when the son-in-law visits the house of his prospective parents-in-law. A *Jamai Sashti* meal is never complete without at least one dish of Hilsa, and a pair of Hilsa is considered very auspicious on certain occasions. The parents-in-law often expect that the bridegroom will bring a pair of Hilsa fish for the *Jamai Shashti* occasion (Barman 2012).

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). This event is observed through mass participation in all parts of Bangladesh; the largest gathering takes place under the historic large Banyan tree of Ramna Park in Dhaka (Khatun 2012). Hilsa is thus considered as the 'cultural icon of Bengal'.

There is an old custom that Bengalis should purchase a pair of Hilsa on the day of *Vijay Dashami* in October and after that they will not eat it again until *Basant Panchami* (February). There is a scientific basis for this tradition, as the major Hilsa breeding season falls within this period. Thus, the culture reflects conservation measures as practised traditionally over the centuries (Sharma *et al.* 2012).

point of only 0.19 million tonnes in 1991–1992.[4] This decline appears to be due to a combination of the closure of migratory routes, river siltation, overfishing, indiscriminate harvesting of brood stocks and juveniles (locally known as *jatka*), use of fishing nets with very small mesh sizes, mechanisation of fishing, increased number of fishermen, pollution, and hydrological and climatic changes (Haldar and Islam 2003).

Such a significant decline in Hilsa catches prompted the government of Bangladesh to declare five sites in the country's coastal rivers as Hilsa sanctuaries, restricting fishing during the breeding season. To compensate for loss of earnings, the government also started providing 'affected' fishing communities with rice and alternative income-generating activities.

In the following sections, we discuss how incentive-based conservation – through payments to the affected fishers' households – works, and explore ways to make it more equitable, effective and efficient, as well as sustainable.

4. Comparisons with pre-1990 were not made mainly because the pre-1990 data is commonly regarded as 'unreliable' by local fisheries scientists and senior government officials.

5.1 THE STATUS OF THE HILSA FISHERY

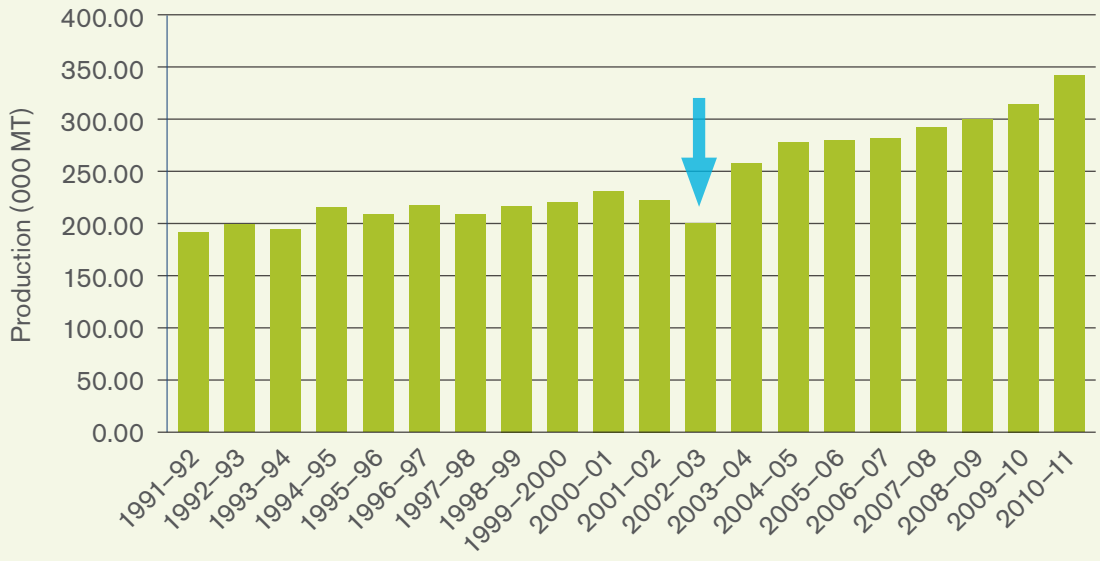
The Hilsa catch has gradually but significantly declined since the 1970s, resulting in increased market prices, often putting it beyond the reach of the majority of rural and urban poor people. This caused policy makers and the government of Bangladesh to initiate scientific research on Hilsa and its fishery through the Riverine Station of the Bangladesh Fisheries Research Institute (BFRI) in 1991. The policy directives emphasised close monitoring of the Hilsa catch and understanding the reasons for its decline, as well as the measures that should be taken to sustainably manage and conserve this important natural fishery resource. The research was holistic, including the study of the Hilsa's biology, ecology, life cycle, migration patterns, and population dynamics, as well as identifying its spawning and nursery grounds, and assessing stocks and management potential. The Department of Fisheries (DoF) started the implementation of the recommended measures (e.g. zoning Hilsa sanctuaries and defining the no-take season) to address the declining trend and increase production.

In another research initiative, the Fourth Fisheries Project (FFP) funded by the World Bank and the United Kingdom's Department for International Development (DFID), has made a demonstrable contribution to improved management and sustainability of Hilsa production. Its action plans were built upon the improved biological understanding gained during collaborative studies made by the BFRI and the Australian Centre for International Agricultural Research (ACIAR) during 1996–2001 (Milton 2010). The DoF also carried out a fresh census of fishing households dependent on Hilsa fishing and those involved in post-harvest processing and marketing and other parts of the value chain.

Figure 2 shows that the Hilsa catch remained at similarly low levels from the base year of 1991–1992 to 2001–2002. Catch levels further declined during 2002–2003, which marked the implementation of economic incentive-based mechanisms to halt further decline, and to focus on efforts to increase Hilsa production. Regulations on the catching of small Hilsa, a ban on fishing of *jatka* (juvenile Hilsa less than 23 cm in size) and restrictions on the catching of brood (mature and about to spawn) Hilsa during the breeding season were adopted in 2003–2004. The government mobilised its resources to build awareness, and introduced monitoring and enforcement involving the coast guards, navy, and fishery officers, including the seizure and destruction of monofilament nets. To compensate for the loss of earnings, the government started providing 'affected' fisher communities (187,000 households) with 30 kilograms of rice per household per month and providing training and cash for to develop alternative income-generating activities (AIGAs) for fishermen and women.

While encouraging catch levels were recorded after the introduction of the economic incentive mechanisms, it is difficult to attribute these gains to the intervention. Moreover, catch levels are not necessarily good indicators of a healthy ecosystem. Increased catch can be achieved by increasing the input or effort. Catch per unit effort (CPUE) is often used as an indicator to assess the recovery (or lack thereof) of fish stocks. Unfortunately such data are not available in Bangladesh. Nonetheless, the improvement in catch level is often presented as an indication that the intervention has succeeded in reversing the decline in Hilsa stock.

FIGURE 2. TOTAL HILSA CATCH LEVEL IN BANGLADESH (1991–2011)



Source: Data obtained from DoF; analysed by authors.

5.2 MANAGEMENT APPROACHES FOR THE CONSERVATION OF HILSA

The DoF has adopted several management measures for Hilsa conservation. As well as the declaration of five Hilsa sanctuaries to conserve juveniles in the major nursery and spawning grounds of river systems, brood Hilsa are protected for 11 days during the peak breeding season in October, before and after the full moon (Rahman, M.A. *et al.* 2012). The following sub-sections offer a brief description of the management plans.

5.2.1 Hilsa Fisheries Management Action Plan

The DoF implemented the Hilsa Fisheries Management Action Plan (HFMAP) in 2003 with the aim of protecting *jatka*. This action plan included a number of implementation strategies, assigned responsibilities to relevant agencies and target communities, and fixed a specific time frame for implementation (Alam 2012). Its activities included:

- involving district administrations/public representatives in management interventions

- boat rallies in important Hilsa fishery rivers for the implementation of conservation measures
- raising awareness among fishers and the general public through the use of mass media
- distributing leaflets and posters explaining the benefits of protecting *jatka* with the slogan 'today's *jatka* is tomorrow's Hilsa'
- enforcing the Fish Protection and Conservation Act of 1950
- establishing Hilsa sanctuaries in the major fishing and spawning grounds in rivers and estuaries
- banning fishing for 11 days (5 days before and 5 days after the full moon in October) in the major spawning grounds of the river Meghna and Meghna estuary to allow the Hilsa to breed
- offering support for alternate livelihoods for *jatka* fishers during the ban periods, such as supplying food, rickshaws or vans, sewing machines, livestock, or grants for small businesses.

5.2.2 Special operations for jatka protection

The DoF introduced special measures for the protection of *jatka,* formulating a specific act for these measures in 2003. The act states that 'all activities related to juvenile Hilsa (*jatka*) catching, transportation, marketing, selling and possession is banned between 1 November and 31 May every year in Bangladesh' (Alam 2012). Under the Protection and Conservation of Fish Act, 1950, the following activities have also been implemented:

- identification of operation areas for proper functioning and co-ordination among the implementing agencies
- formation of a special task force involving different law enforcing agencies
- an awareness-building programme using both print and electronic media
- the introduction of economic incentives (in cash and in-kind) as well as support for alternative income generating activities for *jatka* fishers.

5.2.3 Declaration of Hilsa sanctuaries

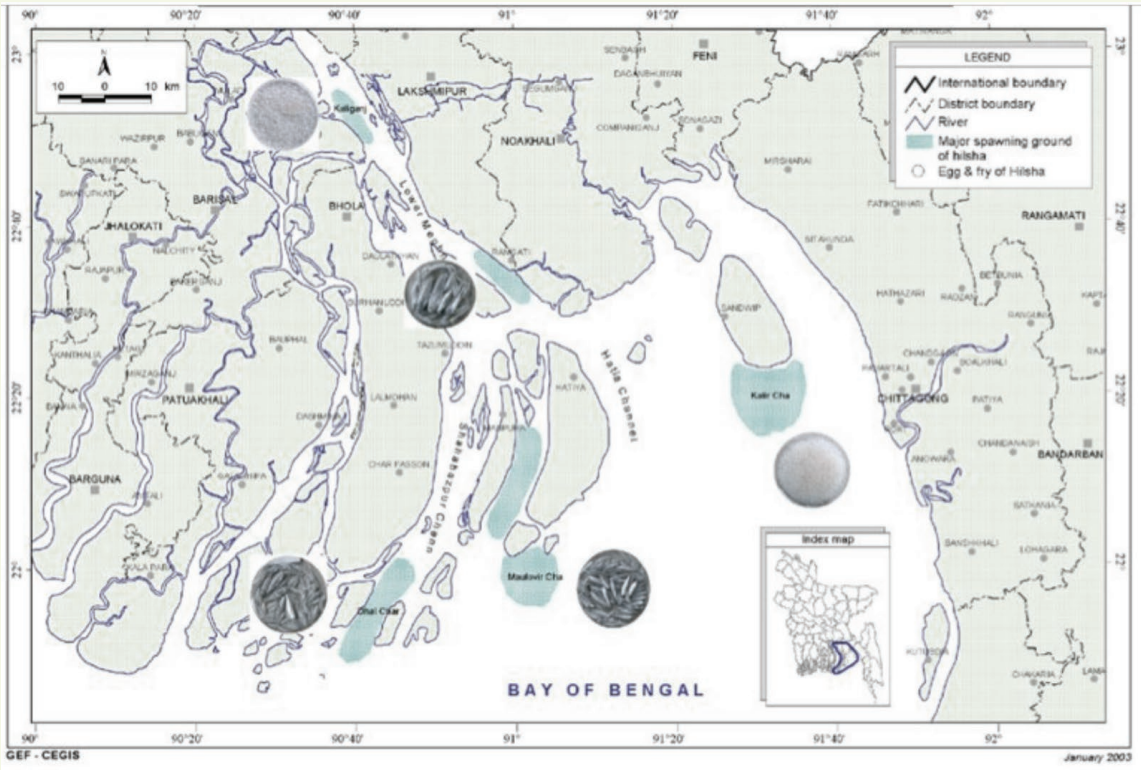
As mentioned above, five sites in the Meghna and Padma rivers, and some inshore marine areas, have been declared Hilsa sanctuaries under the Protection and Conservation of Fish Act, 1950, intended for the conservation of *jatka* in the major nursery areas, and maintenance of fish biodiversity. Figure 3 shows the two main nursery grounds in Bangladesh waters (Mazid and Islam 1991; Mazid 1998; Haldar and Rahman 1998).

The largest river nursery ground is situated in the Meghna River, in and around Chandpur, from Mawa (Munshiganj) down to Hazimara. The juveniles (2–12 cm) appear in large numbers in this nursery ground in November and remain there up to June, but the peak period for their use of the nursery grounds is approximately 15 February to 15 May. Another large nursery ground is situated in the coastal belt from Kuakata (Patuakhali) to Dubla Island (Khulna). Within this area, comparatively large (11–15 cm) *jatka* are caught during December and January. Table 1 shows the defined Hilsa sanctuary areas, ban periods and the locations of the sanctuary sites.

5.2.4 Conservation of gravid Hilsa for uninterrupted spawning

Close observation and field surveys found that every year the highest number of ripe and running brood Hilsa (mature fish that are about to spawn) were caught during five days before and five days

FIGURE 3. MAJOR SPAWNING GROUNDS AND SANCTUARIES OF HILSA IN THE MEGHNA ESTUARY



Note: light grey circles represent *jakta* sanctuaries and dark grey circles represent Hilsa in brood.

Source: Halder 2004.

TABLE 1. SANCTUARY AREAS AND BAN PERIODS IMPLEMENTED EACH YEAR

HILSA SANCTUARY AREAS	BAN PERIOD
From Shatnol of Chandpur district to Char Alexander of Laxmipur (100 km of lower Meghna estuary)	March–April
Madanpur/Char Ilisha to Char Pial in Bhola district (90 km area of Shahbajpur river, a tributary of the Meghna)	March–April
Bheduria of Bhola district to Char Rustam of Patuakhali district (nearly 100 km area of Tetulia river)	March–April
Whole 40 km stretch of Andharmanik river in Kalapara Upazila of Patuakhali district	November–January
Lower Padma river at Shariotpur district, 20 km stretch of the Padma river	March–April

Source: Rahman, M.A. *et al.* (2011).

after the full moon in October (*Ashvin*; the sixth month of the solar Bengali calendar) (Haldar and Islam 2003). Catching Hilsa has therefore been banned each year in the major spawning grounds during this peak breeding season. The ban covers four major spawning grounds with an estimated area of about 7000 square kilometres (Table 2).

5.3 ECONOMIC INCENTIVES FOR HILSA CONSERVATION

These management plans involved some level of fishing restriction either through the imposition of the no-take zones or the off season. Such fishing bans deprive fishers of their fishing activities, and this will certainly have some short-term negative implications for their livelihoods. As a result, fishers have found it difficult to comply with the regulations regarding bans on fishing.

It is widely recognised that the fisher communities in Bangladesh are among the most impoverished people in society. Consequently any conservation efforts that limited their fishing catches would have a disproportionately negative impact on their income and livelihoods, even if fishers would ultimately benefit from these measures. Therefore, it was recognised that economic incentives (or compensation) should be provided to fishers households and communities to compensate for their loss in earnings and give them an incentive to abide by the imposed regulations. This is a good example of how direct economic incentive mechanisms can complement regulatory or command-and-control approaches.

According to a previous study funded by the Global Environmental Facility, an estimated 45 per cent increase of the Hilsa catch in four major landing centres could be achieved through restriction on *jatka* fishing (Ali, 2013). This research suggested that effective enforcement measures in critical sites and during the critical breeding period could contribute significantly to increasing Hilsa production and maintenance of biodiversity (Haldar 2004). These findings encouraged the government of Bangladesh to further strengthen its ongoing Hilsa management campaign through the provision of economic incentives. The incentive-based Hilsa conservation programme has three main activities: providing food to fisher households,

TABLE 2. LOCATION OF HILSA SPAWNING GROUND SANCTUARIES

LOCATION	AREA	BAN PERIOD
North-East	Mayani point, Mirersharai	Five days before and five days after the full moon (including the day of the full moon).The moon is first sighted in the Bengali month of *Ashvin* each year (it is fixed between 15 and 24 October each year)
North-West	West Syed Awlia point, Tajumuddin	
South-East	Gandamara point, Kutubdia	
South-West	Lata Chapili point, Kalapara	

Source: Alam (2012).

TABLE 3. DETAILS OF FOOD GRAIN DISTRIBUTION AND AIGA PROGRAMME 2007–12

FINANCIAL YEAR (FY)	NO. OF *UPAZILA* (NO OF DISTRICTS)	FOOD GRAIN DISTRIBUTION		AIGS PROGRAMME	
		ALLOCATED AMOUNT (TONNES)	NO. OF HOUSE-HOLDS	ALLOCATED MONEY (BDT) PER FISHER HOUSEHOLD	NO. OF HOUSE-HOLDS
2007–08	59 (10)	4360	145,335	20.00	16,990
2008–09	59 (10)	5730	143,252	20.00	18,350
2009–10	59 (10)	19,770	164,740	50.00	14,750
2010–11	85 (15)	14,470	186,264	51.70	6870
2011–12	85 (15)	22,352	186,264	58.80	7500

awareness raising, and support for alternative income generating activities.

5.3.1 Providing food (rice) to fisher households

In order to meet the dietary needs of Hilsa fisher households during the ban period, about 30 kilograms of rice is provided per household per month. Such compensation packages are reported to be highly effective for the enforcement of regulatory measures (Bhola 2012).

The government identified a total of approximately 287,000 fisher households from 20 coastal districts, covering 91 sub-districts (locally known as *Upazila*), who were directly affected by the declaration of sanctuaries, based on 2004 census data. Out of these, 187,000 vulnerable households were selected – those households headed by older fishermen or women and with no alternative livelihood to fishing. The local government, including the chairman of the Union Council (the lowest tier of the administrative hierarchy), the relevant fishery officer and the *Upazila* Chief Executive (*Upazila Nirbahi Officer* or UNO) prepared the preliminary list of the fishing households identified as being most in need. This list was further validated through visits to individual households by the relevant fishery officer or their representatives. Table 3 shows that about 146,000 households were selected for the year 2007–2008, when Bangladeshi Taka (BDT)[5] 20 million (USD 244,000) was allocated to provide incentives in cash and in-kind. The number of fisher households covered under this scheme has now reached 187,000, with BDT 59 million (USD 719,500) allocated in the financial

5. USD 1 is equivalent to about BDT 80 at 2012 exchange rates.

year 2010–2011. Individual households were paid about BDT 6000 ($77) to 10,000 ($128), based on the number of household members and their degree of vulnerability (Habib, 2013).

The compensation scheme is fully funded by the government of Bangladesh without any external support. It should be noted that the management and conservation of Hilsa fisheries – for example, incentives, awareness building, and implementation of regulations by the different law enforcing agencies – have taken about 5.5 per cent of the total DoF development budget. The DoF aims to expand the coverage of the incentive scheme to up to 287,000 Hilsa fisher households. This will have significant financial implications. An innovative approach is being explored to finance the scheme through the establishment of a National Hilsa Conservation Fund and earmarking a percentage of government earnings from Hilsa exports.

5.3.2 Awareness-raising programmes

Awareness-raising activities are an important component of the programme. These are regularly held in the communities as well as at the *Upazila* level. They are intended to raise general awareness about the ban period among all concerned, but particularly among fishers and other stakeholders who benefit one way or another from the conservation of *jatka* and brood Hilsa. The government, through the DoF, supports the observation of Jatka Conservation Week, and organises talk shows on TV, TV adverts, poster/ leaflet distribution, road rallies, boat rallies, meetings, workshops, and seminars. The programme provides financial and technical support to hold short courses on *jatka* conservation activities on a regular basis for the *Upazila*- and district-level officers, as well as fisher leaders. About BDT 4.0 million (USD 480,000) was allocated to awareness-building activities in the financial year 2010–2011 (Roy undated).

5.3.3 Alternative income-generation activities

The support for alternative income-generation activities (AIGAs) programme is aimed at improving the livelihoods of the affected households or communities. The programme provides need-based training/refresher courses and microcredit to enable the Hilsa fishers to undertake effective AIGAs. A total of 20,000 fishermen and women from areas declared as Hilsa sanctuaries have been identified as beneficiaries and received benefits from the scheme, an average of 1000 fishers per *Upazila*. Some households have been provided with rickshaws, goats, cows (for fattening) or sewing machines, as well as cash for small businesses, net making, poultry, plant nurseries, kitchen gardening and cage culture[6] (Alam 2012). The trainees are provided with a daily meal and about BDT 500 to attend the training. Table 3 shows the number of households receiving support through this programme.

5.4 ECOLOGICAL IMPACT

There are a number of ecological and economic benefits that can potentially be attributed to the combination of the incentive mechanisms and the regulatory approaches. However, it should be noted that there has not been any counterfactual or before-and-after impact evaluation of the intervention. Any potential ecological benefits should therefore be treated with caution.

The Hilsa catch had declined in the pre-intervention period. This decline was both in the volume of the catch and the size of individual fish.

6. Cage culture is when fish are reared from fry to fingerling to marketable size while captive in an enclosed space that maintains the free exchange of water with the surrounding water body

Most fish were 1 or 2 year old prematurely gravid females, which produce lower quantities of eggs and offspring. After the intervention, large Hilsa of 2–3 years of age dominated the catch (Habib, 2013). In addition, there is anecdotal evidence that the setting up of sanctuaries increased the presence and diversity of other river fishes, especially river catfish *Pangasius pangasius* and *Rita rita* (Anon undated). The incentive mechanism can therefore potentially deliver additional ecological and biodiversity co-benefits by protecting fish species with similar breeding and migratory patterns as Hilsa. Other ecological benefits are described in the next three sections.

5.4.1 Changes in size, sex ratios and composition of large Hilsa

Rahman, M.A. *et al.* (2012) reported that during the monitoring activities carried out in 2011–2012, they observed relatively larger (2 year+) Hilsa among the catches at all landing centres located from downstream of Chandpur to upstream of Bhola District. In the upstream areas, most Hilsa were less than 30–35 centimetres in length, whereas in the downstream areas more than 90 per cent of Hilsa caught were larger than 35cm. This may indicate that first runners in the breeding season migrate upstream to graze on the abundant algal feeds, and as they gradually reach an advanced stage of growth they swim down to the desired breeding place. In the downstream spawning ground areas of Monpura and Hatia, over 95 per cent of fish were over 35cm and almost all were large gravid Hilsa. Among the captured Hilsa, males made up 31 per cent of the catch and females 69 per cent, suggesting a male to female ratio in the breeding grounds of about 1:2. These findings are widely believed to further confirmed that these areas are the Hilsa's spawning grounds.

It was assumed that the management interventions have increased the availability of large Hilsa and a large number of brood stock, both of which have positive impacts on population regeneration. Hilsa may have changed their migratory routes and spawning/breeding grounds, however, as an adaptive mechanism in response to physical and chemical changes of the habitat mainly due to pollution, siltation, and climate change impacts. If they have done so, then the most important Hilsa sanctuaries will have to change accordingly. Otherwise the scheme could be ineffective. Therefore, careful assessment and regular monitoring of the Hilsa's migratory routes and breeding grounds is crucial.

5.4.2 Changes in abundance of breeding and spent Hilsa

There were more Hilsa at maturity stages V and VI found in the spawning grounds than in the other adjacent areas (stage V means before breeding and stage VI means oozing fish, from which eggs run out at catch). The increased availability of mature Hilsa in the spawning grounds may be due to the fishing ban. A large number of oozing Hilsa were also observed by a government inspection mission (Rahman, M.A. *et al.* 2012). The number of spent fish – fish which have recently completed spawning – was also found to be higher. This is also seen as an indicator that the bans on catching brood fish ensured increased successful breeding of Hilsa in the spawning grounds. A lower presence of spent Hilsa means a higher catch on their way to the breeding grounds (Rahman, M.A. 2013).

5.4.3 Increased egg/fry production

The positive impact of the management interventions have been observed not only on the survival of brood Hilsa, but also in the increased production of hatchlings and juveniles. In one of the few before-and-after studies conducted,

TABLE 4. IMPACT OF BAN ON SURVIVAL OF GRAVID HILSA AND HATCHLING PRODUCTION

YEAR	BROOD HILSA (x10 MILLION) SURVIVED	RECORDED EGG PRODUCTION (KG)	HATCHLINGS (APPROX. 50% HATCHING)	*JATKA* (APPROX. 10% SURVIVAL) x10 MILLION
2007–2008	1.44	46,800	29,300	2930
2008–2009	1.56	392,620	245,385	24,538
2009–2010	1.49	170,420	85,210	8521
2010–2011	1.51	336,199	168,099	21,012
2011–2012	1.61	385,500	240,937	24,094

Source: Rahman, M.A. *et al.* (2012).

Rahman, M.A. *et al.* (2012) recorded about eight times as many eggs and *jatka* in 2011 than in the base year 2007–2008. These are also attributed to the 11-day fishing ban in the spawning grounds of Hilsa during peak spawning period (Table 4).

In an experimental sampling of eggs and juvenile Hilsa, Rahman, M.A. *et al.* (2012) recorded juvenile Hilsa (fingerlings and fries of around 20-30 days old) in all the surveyed areas in and around the spawning grounds in the Meghna River. They also observed plenty of juveniles of other fish species in and around the spawning grounds. This is believed to be a result of the positive impact of the fishing ban on reproduction and the maintenance of biodiversity of other fishes in the sanctuaries and adjacent areas of the rivers.

It is important that these results are interpreted with caution, however. The attribution of the observed ecological gains to the intervention are subjective and based on the perceptions of the authors.

5.5 CRITICAL EVALUATION OF IMPACTS OF PAYMENTS FOR HILSA CONSERVATION

The direct economic incentives to fishermen in cash and in-kind were mostly concentrated within 10 districts covering 59 *Upazilas* over 3 financial years up to 2009–2010. It has now increased to 85 *Upazilas* covering 15 coastal districts. The DoF has preliminarily selected 20 districts that will be gradually covered under its support programme for Hilsa fishers. The emphasis in future will be on increased involvement of the fishermen in AIGAs during the prohibited *jatka* fishing period (Alam, 2012).

This intervention has arguably helped halt the decline of Hilsa production and reversed it, with

an increase in the catch of about 42,000 tonnes over the last two years (FRSS 2012). Fishers and consumers have claimed to have caught large Hilsa, which were last caught two decades ago. With a conservative estimate of USD 6.5 per kilogram, the value of the increased quantity of Hilsa is USD 27.3 million per year. The increased catch and larger size of Hilsa available have also increased the export potential. There is increased demand for large Padma Hilsa in the ethnic market of the Middle East, Europe and the United States. India has also become a major market for Bangladeshi Hilsa. As a result, earnings from Hilsa exports increased to a record high of USD 43 million, about 10 per cent of Bangladesh's total fish and fishery export in the financial year 2011–2012. This represents the highest share from a single fish export (Habib, 2013).

Besides the increase in catch and income of the fishers' households, there has been some impact on the socio-economic status of fishermen in the south and south-eastern regions of the country where the ban is imposed. Fishermen have used the ban period and the compensation scheme as an opportunity to diversify their income-generating activities, spend more time with their families, take care of children's education and welfare, enjoy a better social life, and improve their overall well-being (Jaher 2012). No independent studies have been conducted to assess the extent to which such interventions have influenced fisher behaviour or livelihoods, however.

Some Hilsa fisher households have been able to become self-reliant and been able to break the vicious cycle of resorting to rural moneylenders. This system had kept them poor from generation to generation. Because of the increased size of individual Hilsa, their catch per unit of effort has increased and so has their income. Moreover, large Hilsa over 1 kilogram occasionally sell for up to USD 12 per kg, which has helped fishers increase their income (Mohammed 2013).

In spite of the perceived socio-economic and ecological benefits of the economic incentive mechanism for Hilsa conservation, there are a number of weaknesses with the ongoing management strategies. For instance, there has been no proposal to observe the ban period during the Hilsa breeding season in the marine environment. Only about 50 per cent of the Hilsa fishers have been included in the programme and due to the difficulty of distinguishing the genuine Hilsa fishermen from those who claim to be so, it is believed that there have been significant exclusion and inclusion errors. Some fishers from Chandpur District have suggested issuing identity cards to genuine fishermen in order for them to be part of the compensation package.

Due to the limited amount of compensation that is provided to each fisher household, some fishers have expressed their preference for a more holistic approach to fishers' village development through infrastructure development of roads, community centres, schools and village protection embankments, and the provision of low-interest credit facilities for all fishermen and women.

The type of compensation packages may also have some distributional implications. In a previous study conducted to assess the distributional impacts of food-for-work programmes in Bangladesh it was shown that providing rice to households can potentially lead to nutritional inequalities within households. According to Ahmed *et al*. (2009), food interventions that provide rice have a greater effect on men's caloric intake relative to women, whereas the opposite is true for an intervention that provides *atta* flour, the main ingredient of most varieties of bread in the Indian subcontinent. The use of a less-preferred food type such as *atta* increases the share of food that goes to women relative to men. This indicates that the type of in-kind benefit is likely to affect benefit transfers between household members. Therefore a careful assessment of the compensation packages on inter- and intra-household distribution of benefits is crucial.

A thorough assessment of the preferences of the fisher communities has not been carried out. However, based on a one-off informal meeting held with fishermen from Chandpur by authors in August 2013, there appears to be a preference for the compensation package to include assisting fishers to open savings accounts with minimal fees and requirements, so that they can better withstand the shock of natural disasters or unprecedented declining catch levels from savings. Moreover, the fisher communities usually find it difficult to repay their debts during the ban period as they cannot fish and earn money. Some fishers have urged the DoF to introduce a mechanism which freezes repayments (mainly to formal microfinance institutions) during the ban period.

SIX
CONCLUSIONS AND RECOMMENDATIONS

Fisheries provide millions of people with a livelihood source. Yet across the world, these resources are fast diminishing because of pollution, habitat destruction, overfishing, natural disasters, and climate changes. Traditional approaches to halt this decline have focused on regulating against destructive practices, but to little effect. Establishing a direct economic incentive mechanism such as payments for ecosystem services, or incorporating elements of it into existing regulatory mechanisms could be a more successful strategy. Land-based examples, along with a few aquatic ones, suggest that economic incentive-based mechanisms can work to protect both livelihoods and environments. But to succeed, these schemes must be underpinned by robust research, clear property rights, effective monitoring and compliance, equitable benefit sharing, and sustainable finance.

Bangladesh's Hilsa conservation scheme is a rare example of the use of a direct economic incentive mechanism for sustainable fisheries management. The DoF's efforts to encourage fishers to conserve Hilsa has already started to bear fruit in terms of improving the catch and compensating some affected households for lost earnings from the ban. However, the scheme's design needs to be improved to make it more effective and sustainable.

6.1 TOWARDS AN EFFECTIVE PAYMENT MECHANISM FOR SUSTAINABLE HILSA CONSERVATION

Direct economic incentive mechanisms such as payments for ecosystem services (PES) involve contracts between the consumers of ecosystem services and the suppliers of these services (Greiber 2009). However, the context of the Hilsa fishery is different from other areas where PES has been implemented – typically terrestrial environments. Hilsa is a naturally available fish seasonally abundant in rivers, estuaries, and inshore marine areas. It is mainly caught by fishers who own neither the surrounding land nor the water bodies. They are among the poorest members of society. The nature of fisheries in general and migratory fish species such as Hilsa in particular makes the situation even more complex. Hilsa stocks are shared by fisher communities in Bangladesh, West Bengal (India), Myanmar, and beyond.

The effectiveness of the scheme could be enhanced by an improved understanding of the complex socio-economic and ecological systems around the Hilsa fishery, and an adaptation of the scheme accordingly. The scheme could also identify the beneficiaries of the management plan (that is, the ecosystem service buyers), assess the preference of fisher communities for compensation packages, empower local fishermen to monitor and enforce compliance, and promote regional co-operation.

6.1.1 Understanding the complex socio-economic and ecological systems

Successful implementation of direct economic incentive mechanisms such as PES requires a thorough understanding of the complex socio-economic and ecological systems involved. Although no rigorous study has been done to evaluate the social and ecological impact of the scheme, it is widely believed that it has had some encouraging outcomes. Nonetheless, there are numerous knowledge gaps that need to be filled to better understand how to enhance the effectiveness of the scheme.

The knowledge of the socio-economics and ecology of the Hilsa fishery in Bangladesh has improved, yet is still limited. Except for some

biological information collected from some parts of the migratory routes or at certain stages of the life cycle, there is incomplete information on breeding biology, environmental requirements, foods and feeding ecology and hydrological dynamics, and other key biological information related to Hilsa. Therefore, the study of the Hilsa's entire life cycle from spawning to adulthood should be a research priority. The effective management of the Hilsa fishery requires an understanding of its breeding biology, spawning seasonality, triggering factors that influence breeding, and the fate of eggs and spawn and spent fish after breeding. Survival rates of fry and fingerlings, recruitment and abundance of *jatka*, nursery grounds and how long the fish spend in freshwater rivers, as well as the time of their descending migration should be ascertained.

It is also believed that Hilsa are likely to change their migratory routes and breeding behaviour in response to changes in their environment. The quality of Bangladeshi waters has deteriorated over the past few decades mainly due to pollution from industrial effluents, siltation, and damming, which changes the hydrology of the water. In order to enhance the effectiveness of the scheme, continuous monitoring and assessment of the Hilsa's physical environment and how the fish stock cope with these changes needs to done.

There is a need to collect information to identify the fisher households and communities, how many of the population are engaged in the Hilsa fishery, and their wealth ranking, availability of and access to finance, fishing gear type and size, catch by season, and fishing grounds, as well as, most importantly, a stock assessment of the Hilsa fishery. The benefits of collecting such information are twofold. It would provide a baseline scenario against which changes in fish stocks, catch levels, and the livelihoods of the affected communities can be monitored. It would also enable the scheme to effectively target the poorest of the poor (or the most vulnerable households) and maximise the well-being of communities depending on Hilsa for their livelihoods.

6.1.2 Identifying ecosystem service beneficiaries and buyers

One of the critical steps in setting up a direct economic incentive mechanism is to clearly define the ecosystem service providers and buyers (or beneficiaries). Currently the government of Bangladesh is subsidising the incentive-based mechanism. As financial resources are limited and government priorities could change, this puts the continuity of the mechanism at risk. Identifying alternative financial resources to ensure the financial sustainability of the scheme is crucial.

In this case, the ecosystem providers are the Hilsa fishers who have been banned from (or agreed to stop) fishing for a defined period of time each year. The beneficiaries from the ban period may include downstream or marine fishers (since Hilsa is anadromous), who are mainly commercial fishers with relatively big motorised fishing vessels. The ban also delivers benefits to other fish species with similar migratory routes and spawning or breeding seasons, allowing them to be conserved too. Therefore, commercial fishers who specialise in catching those fish species are another beneficiary. Similarly, those fishers who depend on fish other than Hilsa and who may also be affected by the ban should be included in the compensation scheme as well. This can minimise its unintended consequences and reduce the negative impacts on non-target fisher communities. It will be important to undertake a stakeholder mapping and identification of the ecosystem service providers and beneficiaries along the supply chain.

Once the government has identified the ecosystem service consumers or beneficiaries, it could impose a charge in the form of tax or fishing license fees. This would in turn contribute towards ensuring the financial sustainability of the scheme.

6.1.3 Assessment of the preference of fishers for compensation packages

In order to ensure the success of the incentive mechanism, it is crucial that the benefit provided is sufficient at least to compensate the ecosystem service providers for lost opportunities and in a form that they prefer (Mohammed 2011). Assessing the preferences of participating households with regard to payment/compensation levels and formats is crucial to ensure the effectiveness of any economic incentive mechanism. Johnson *et al.* (2001) argue that many similar schemes (mainly in watershed management) around the world have performed poorly because they failed to take into account the needs, constraints, and practices of local people.

According to meetings we held with about 30 fishers from Chandpur in August 2013, the fishers suggested that since the monetary compensation provided is 'very low' the money should rather be invested in community infrastructure such as roads and schools. They also suggested that the government regulate microfinance institutions and freeze debt repayment during the ban period. This is mainly because Hilsa fishers cannot earn money during the ban period and therefore cannot repay their debt. Even though a one-off consultation such as this with fisher communities is not conclusive, it indicates that there may be a discrepancy between the preferences of local communities and the actual form in which the compensation received.

A careful assessment of the preferences of the fisher communities would enhance the effectiveness of the scheme.

6.1.4 Empowering local fishers to monitor and enforce compliance

One of the critical conditions for success of any direct economic incentive mechanism is monitoring and enforcement. Even though coast guards and the navy are involved in policing, financially constrained governments such as Bangladesh's have very limited financial and technical capacity to effectively monitor and enforce compliance. As a result, it has been reported that some fishermen breach the regulations especially at night.[7] The regulation is also breached by fishermen from other regions who have not been offered the economic incentive.

The effectiveness of monitoring and enforcement could be enhanced by engaging the fisher communities in monitoring and policing activities as part of the compensation scheme. In addition to strengthening compliance, engaging local fishers in monitoring and policing would create local jobs and empower them to become stewards of their resources.

Another problem that is repeatedly reported by the fishers is piracy. During the period where the fishers enjoy good catches they are increasingly being attacked by pirates who confiscate their catch and fishing gear. If the fishers are actively engaged in monitoring and enforcing compliance, the coast guard and navy can play a more active role in deterring, prosecuting, and sanctioning pirates.

7. Based on observations from fishermen in August 2013 held in Chandpur, as mentioned above.

6.1.5 Promoting regional co-operation

The world catch statistics show that a total of 90–95 per cent of the global Hilsa catch comes from three countries: Bangladesh (50–60 per cent), India (20–25 per cent) and Myanmar (15–20 per cent) (Rahman, M.A. *et al.* 2011). The remaining 5–10 per cent comes from countries including Iraq, Kuwait, Malaysia, Pakistan and Thailand. The Hilsa lives in the sea for most of its life, but migrates up to 1200 kilometres inland along major rivers in the Indian sub-continent for spawning. Its migration pattern was obstructed by the construction of the Farakka barrage on the river Ganges in 1975. Now, Hilsa migrates through the Hoogly estuary to different Indian rivers (Bhaumik and Sharma 2011). It migrates through the Meghna estuary into the Padma, Jamuna and Meghna rivers and their tributaries. They also migrate into the waters of Myanmar through the Naf and Irrawady rivers (ISDR, 2012). All these countries harvest Hilsa for their own consumption as well as for export. Indian demand for Hilsa is very high so exports are rare, but Bangladesh and Myanmar export a good proportion of their catch. India is also the largest importer of Hilsa from Bangladesh and Myanmar.

As the biology of the Hilsa is the same throughout the region and the population is from the same stock, its management and conservation requires regional co-operation and collaboration (Anon 2012). Despite this need, there is still no regional initiative among these three countries to collaborate over its management and conservation. Bangladesh has single-handedly been trying to improve the management and conservation of Hilsa through its own interventions, including fishing bans, while no such measures have been taken in either Myanmar or India. There is an immediate need to have a regional conservation strategy. This should include a ban on fishing brood stocks and *jatka* during the off-season. In order to enable such regional collaboration and co-ordination, a platform needs to be created. This would allow decision makers from the three countries to share knowledge and information and conduct research to understand the complex ecological and socio-economic systems of the Hilsa fishery in the region and come up with a regional conservation action plan. Other efforts should include setting up a common area, or a network of marine protected areas, with no (or limited) fishing allowed, and monitoring and abatement of pollution in the rivers used by the Hilsa for breeding, feeding, and migration. These would significantly contribute to Hilsa conservation.

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DIRECT ECONOMIC INCENTIVES FOR SUSTAINABLE FISHERIES MANAGEMENT

THE CASE OF HILSA CONSERVATION IN BANGLADESH

Fisheries provide millions of people with a source of livelihood. Yet across the world, these resources are fast diminishing because of pollution, habitat destruction, overfishing, natural disasters, and climate changes. Traditional approaches to halt this decline focus on regulating against destructive practices, but to little effect. A more effective strategy could be to establish a direct economic incentive mechanism such as payments for ecosystem services, or to incorporate such payments into existing regulatory mechanisms. Examples from terrestrial environments, and a few from aquatic environments, suggest that economic incentive-based mechanisms can work to protect both livelihoods and environments. But to succeed, these schemes must be underpinned by robust research, clear property rights, effective monitoring and compliance, equitable benefit sharing, and sustainable finance.

A scheme offering payment for Hilsa conservation in Bangladesh offers a rare example of a direct economic incentive mechanism being used for sustainable fisheries management. Hilsa is one of the most important single-species fisheries in the Bay of Bengal. More than half a million people depend on it for their livelihood and 250 million Bengali people depend on it for nutrition. This study examines how a direct economic incentive mechanism can complement regulatory fisheries management approaches. We explore the merits of the Bangladesh scheme, but argue that its effectiveness could be enhanced by an improved understanding of the complex socio-economic and ecological systems underpinning the fishery. Such schemes need to accurately identify the beneficiaries of the scheme, design the right compensation packages, and empower local fishing communities to monitor and enforce compliance. Better regional co-operation between the three countries which make up the Bay of Bengal (Bangladesh, India, and Myanmar), will also be vital to the conservation of the Hilsa fishery.

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