Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy

Research results from the Incentive-based Hilsa Conservation Programme, Bangladesh

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Contents

Summary

Ecosystem-based adaptation (EbA) is the use of biodiversity and ecosystem services as part of an overall strategy to help people to adapt to the adverse effects of climate change. Under the 'Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy' project, IIED, IUCN and the UN Environment World Conservation Monitoring Centre (UNEP-WCMC) are working at 13 sites in 12 countries to gather practical evidence and develop policy guidance for governments on how EbA can best be implemented. The project has developed a definition of effective EbA and a framework for assessing EbA effectiveness which has been applied at all 13 sites and the results will be collated and compared to draw conclusions that are based on more than single case studies. This report presents the findings from a literature review, and interviews and focus groups discussions with a wide variety of stakeholders conducted by the Bangladesh Centre for Advanced Studies (BCAS) at the project site in Bangladesh, where economic incentives have been used to conserve hilsa fish.

It concludes that, although the incentive-based hilsa conservation programme was not designed as an EbA project, it is likely to have increased ecosystem resilience as well as hilsa fish catch levels, and has had a large number of social co-benefits. The increased catches have strengthened local adaptive capacity, particularly among fishers, one of the poorest and most vulnerable groups in Bangladesh. Fishers have also been affected most by the programme's fishing restrictions, however, and it is unclear whether the programme is of overall financial benefit to this group. Barriers to implementing the programme have included insufficient capacity, technical skills, logistical support and financial resources at the local level, and inadequate policies and knowledge gaps at the national level. The sustainability of the programme, while dependent on continued government support and funding, seems likely, suggesting that the improvements in adaptive capacity could be long-term.

Acronyms and local terms

Aratdar	People who receive fish from fishers to sell by auction to wholesalers and sometimes large retailers. They sometimes act as informal money lenders.
BMUB	German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
CBA	Community-based adaptation
CBD	Convention on Biological Diversity
DoF	Department of Fisheries, located under the Ministry of Livestock and Fisheries
EbA	Ecosystem-based adaptation
Haor	Wetland ecosystem in Bangladesh, typically a bowl- or saucer-shaped shallow depression. Also known as a backswamp.
IIED	International Institute for Environment and Development
IKI	International Climate Initiative
IUCN	International Union for Conservation of Nature
Jatka	Young/juvenile hilsa (up to 25 centimetres long)
Khas land	Government-owned fallow land
Mohajan	Credit providers
PES	Payments for ecosystem services
SDGs	Sustainable Development Goals
Union parishads	Smallest rural administrative and local government unit in Bangladesh
UNCCD	United Nations Convention to Combat Desertification
UNEP-WCMC	United Nations Environment World Conservation Monitoring Centre
UNFCCC	United Nations Framework Convention on Climate Change
Upazila	Administrative level above union parishads. Sub-units of districts.

Introduction

The global climate is changing rapidly, and as nations and the international and bilateral organisations and processes that support them plan how best to adapt to climate change, they need evidence on where to focus adaptation efforts and direct financial resources accordingly. The main approach to climate change adaptation to date has tended to involve investment in engineered interventions, such as sea walls or irrigation infrastructure (Jones et al. 2012). There is growing realisation, however, that ecosystem-based adaptation (EbA) may sometimes provide the optimal adaptation solution, particularly for poorer countries where people are more dependent on natural resources for their lives and livelihoods. A growing number of organisations and countries are implementing EbA and integrating it into emerging climate change policy responses (Seddon et al. 2016a; 2016b).

EbA is defined by the United Nations Convention on Biological Diversity (CBD) as the "use of biodiversity and ecosystem services to help people adapt to the adverse effects of climate change as part of an overall adaptation strategy" (CBD 2009). This definition was later elaborated by the CBD to include "sustainable management, conservation and restoration of ecosystems, as part of an overall adaptation strategy that takes into account the multiple social, economic and cultural co-benefits for local communities" (CBD 2010). Examples of EbA include: restoring coastal ecosystems to lower the energy of tropical storms and protect local communities against erosion and wave damage; wetland and floodplain management to prevent floods and to maintain water flow and water quality in the face of changing rainfall patterns; conservation and restoration of forests and natural vegetation to stabilise slopes and prevent landslides, and to regulate water flows preventing flash flooding; and the establishment of diverse agroforestry systems to help maintain crop yields under changing climates. Box 1 describes some of the key attributes of effective EbA, derived from a review of relevant literature (taken from Seddon et al. 2016b).

Box 1: Key attributes of effective ecosystem-based approaches to adaptation (EbA)

1. **Human-centric.** EbA emphasises human adaptive capacity or resilience in the face of climate change.
2. **Harnesses the capacity of nature to support long-term human adaptation.** It involves maintaining ecosystem services by conserving, restoring or managing ecosystem structure and function, and reducing non-climate stressors. This requires an understanding of ecological complexity and how climate change will impact ecosystems and key ecosystem services.
3. **Draws on and validates traditional and local knowledge**. Humans have been using nature to buffer the effects of adverse climatic conditions for millennia. Traditional knowledge about how best to do this should thus be drawn upon when implementing EbA.
4. **Based on best available science**. An EbA project must explicitly address an observed or projected change in climate parameters, and as such should be based on climatic projections and relevant ecological data at suitable spatial and temporal scales.
5. **Can benefit the world's poorest**, many of whom rely heavily on local natural resources for their livelihoods.
6. **Community-based and incorporates human rights-based principles.** Like community-based adaptation (CBA), EbA should use participatory processes for project design and implementation. People should have the right to influence adaptation plans, policies and practices at all levels, and should be involved with both framing the problem and identifying solutions. EbA initiatives should be accountable to those they are meant to assist and not simply those providing support (ie donors or governments). EbA should consistently incorporate non-discrimination, equity, the special needs of the poor, vulnerable and marginalised groups, diversity, empowerment, accountability, transparency and active, free and meaningful participation.

7. **Involves cross-sectoral and intergovernmental collaboration.** Ecosystem boundaries rarely coincide with those of local or national governance. Moreover, ecosystems deliver services to diverse sectors. As such, EbA requires collaboration and coordination between multiple sectors (eg agriculture, water, energy, transport) and stakeholders. EbA can complement engineered approaches, for example combining dam construction with floodplain restoration to lessen floods.
8. **Operates at multiple geographical, social, planning and ecological scales**. EbA can be mainstreamed into government processes (eg national adaptation planning) or management (eg at the watershed level), provided that communities remain central to planning and action.
9. **Integrates decentralised flexible management structures** that enable adaptive management.
10. **Minimises trade-offs and maximises benefits with development and conservation goals** to avoid unintended negative social and environmental impacts. This includes avoiding maladaptation, whereby adaptation 'solutions' unintentionally reduce adaptive capacity.
11. **Provides opportunities for scaling up and mainstreaming** to ensure the benefits of adaptation actions are felt more widely and for the longer term.
12. **Involves longer-term 'transformational' change** to address new and unfamiliar climate change-related risks and the root causes of vulnerability, rather than simply coping with existing climate variability and 'climate-proofing' business-as-usual development.

Sources: Travers et al. (2012); Jeans et al. (2014); Faulkner et al. (2015); Reid (2014a); Reid (2014b); Girot et al. (2012); Ayers et al. (2012); Anderson (2014); Andrade et al. (2011); GEF (2012); ARCAB (2012); Bertram et al. (2017); Reid et al. (2009).

If properly implemented, EbA can meet objectives under all three Rio Conventions (Seddon et al. 2016b). For example, its emphasis on restoring natural ecosystems and increasing habitat connectivity helps countries meet their commitments under the Convention on Biological Diversity (CBD). EbA often involves maintaining the ability of natural ecosystems to control water cycles or supports effective management regimes for dry areas, and thus aligns with the goals of the United Nations Convention to Combat Desertification (UNCCD). Many EbA activities sequester carbon and some prevent the greenhouse gas emissions that would be emitted from hard infrastructure-based approaches to adaptation, thus helping meet mitigation targets under the United Nations Framework Convention on Climate Change (UNFCCC). EbA promotes sustainability across a range of sectors, including agriculture, forestry, energy and water, and as such could help countries meet their Sustainable Development Goals (SDGs) (Seddon et al. 2016b). Lastly, by increasing the resilience of vulnerable communities to extreme events such as flooding and landslides, EbA helps countries to meet the goals of the Sendai Framework for Disaster Risk Reduction (Renaud et al. 2013).

Despite its strong theoretical appeal, many positive anecdotes from around the world and the acknowledged multiplicity of co-benefits, EbA is not being widely or consistently implemented, or sufficiently mainstreamed into national and international policy processes. Relative to hard infrastructural options, EbA currently receives a small proportion of adaptation finance (Chong 2014) There are four major explanations for this (Biesbroek et al. 2013; Ojea 2015; Vignola et al. 2009; Vignola et al. 2013; Seddon et al. 2016b).

1. First, there is uncertainty around how best to finance EbA. International climate finance, through mechanisms such as the Green Climate Fund or the Adaptation Fund, is one possibility, but this will not provide enough to address adaptation challenges at the scale required to meet the needs of the world's poorest. Payments for ecosystem services (PES) is another possibility, and may provide an alternative source of funding, or large-scale government social protection, employment generation or environmental management programmes. However, in the context of providing finance for adaptation, both are in their infancy.
2. Second, many climate change impacts will be long-term, but this does not sit well with what are usually short-term political decision-making processes often based on standard electoral cycles. Photogenic engineered adaptation solutions with immediate but inflexible benefits are thus often

favoured over the long-term flexible solutions offered by EbA, under which benefits may only be apparent in the future.

3. Third, the evidence base for the effectiveness of EbA (especially its economic viability) is currently weak. Much evidence is anecdotal and comes from single case studies, and often the costs, challenges and negative outcomes of EbA activities are under-reported. More robust quantitative evidence, or at least consistently collated qualitative evidence, on the ecological, social and economic effectiveness of EbA projects relative to alternative approaches is needed (Doswald et al. 2014; Travers et al. 2012; Reid 2011; Reid 2014a; UNEP 2012).
4. The final major challenge to EbA relates to issues around governance. EbA necessitates cooperation and communication across multiple sectors and varying administrative or geographical scales. This is challenging for most models of governance, where decision making is often strongly based on sectors and administrative boundaries, and opportunities for supporting participation and locally driven approaches are limited.

Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy

The 'Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy' project was conceived to address the third (and fourth) challenge in the above list. The project aims to show climate change policymakers when and why EbA is effective: the conditions under which it works, and the benefits, costs and limitations of natural systems compared to options such as hard infrastructural approaches. It also aims to promote and provide tools to support the better integration of EbA principles into policy and planning. The project is supported by the International Climate Initiative (IKI). The German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) supports IKI on the basis of a decision adopted by the German Bundestag. The project is being implemented by the International Institute for Environment and Development (IIED), the International Union for Conservation of Nature (IUCN) and the United Nations Environment World Conservation Monitoring Centre (UNEP-WCMC) in collaboration with 13 in-country partner organisations in 12 countries across Asia, Africa and the Americas (see Table 1). The project runs from July 2015 to September 2019.

Table 1: 'Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy' project countries, partners and case studies

Project partner country	In-country partner institution	Project case studies
China	Centre for Chinese Agricultural Policy, Chinese Academy of Science	Participatory plant breeding and community-supported agriculture in Southwest China
Nepal	IUCN	Ecosystem-based adaptation in mountain ecosystems programme (Nepal)
Bangladesh	Bangladesh Centre for Advanced Studies	Economic incentives to conserve hilsa fish in Bangladesh – a supportive research project to the Incentive-based hilsa fishery management programme of the Department of Fisheries
Kenya	Adaptation Consortium; Kenya Drought Management Authority	Adaptation Consortium – supporting counties in Kenya to mainstream climate change in development and access climate finance
South Africa	Conservation South Africa	Climate-resilient livestock production on communal lands: rehabilitation and improved management of dryland rangelands in the Succulent Karoo

Uganda	IUCN	Ecosystem-based adaptation in mountain ecosystems programme (Uganda)
Burkina Faso	IUCN	Helping local communities to prepare for and cope with climate change in Northern Burkina Faso
Senegal	IUCN	Ecosystems protecting infrastructure and communities (EPIC)
Peru	IUCN	Ecosystem-based adaptation in mountain ecosystems programme (Peru)
	ANDES	Indigenous people biocultural climate change assessment, Potato Park
Chile	IUCN	Ecosystems protecting infrastructure and communities, South America geographical component (EPIC Chile)
Costa Rica	IUCN	Livelihoods and adaptation to climate change of the Bri Bri indigenous communities in the transboundary basin of Sixaola, Costa Rica/Panama
El Salvador	IUCN	Mangrove ecosystem restoration and responsible fishing

In order to address the weak evidence base for EbA, the project has developed a definition of effective EbA and a framework for assessing EbA effectiveness. It defines effective EbA as “an intervention that has restored, maintained or enhanced the capacity of ecosystems to produce services. These services in turn enhance the wellbeing, adaptive capacity or resilience of humans, and reduce their vulnerability. The intervention also helps the ecosystem to withstand climate change impacts and other pressures” (Reid et al. 2017, based on Seddon et al. 2016b). This definition generates two overarching questions that need to be addressed in order to determine whether a particular EbA initiative is effective:

1. Did the initiative allow human communities to maintain or improve their adaptive capacity or resilience, and reduce their vulnerability, in the face of climate change, while enhancing co-benefits that promote wellbeing?
2. Did the initiative restore, maintain or enhance the capacity of ecosystems to continue to produce services for local communities, and allow ecosystems to withstand climate change impacts and other stressors?

By definition, EbA should also be financially and/or economically viable, and for benefits to materialise it needs support from local, regional and national governments and to be embedded in an enabling policy, institutional and legislative environment (Seddon et al. 2016b; Reid et al. 2017). This leads to two further overarching questions:

1. Is EbA cost-effective and economically viable?
2. What social, institutional and political issues influence the implementation of effective EbA initiatives and how might challenges best be overcome?

These questions encompass much important detail regarding how to assess and compare effectiveness in ecological, social and economic terms. They lead to a further set of nine more specific questions (Table 2) that reflect the growing consensus around the key characteristics of effective EbA (Box 1).

This framework is being applied in 13 project sites in 12 countries, and results from all sites will be collated and compared to draw conclusions that are based on more than single case studies and help answer the question of whether EbA is effective or not. Reid et al. (2017) provide detailed guidance on the way that researchers and project managers can use the framework to draw conclusions about the effectiveness of an EbA project, or to shape project design or assess the progress of an ongoing EbA project or a project that has ended.

Research conducted under the project will then be used to help climate change policymakers recognise when EbA is effective, and where appropriate integrate EbA principles into national and international climate adaptation policy and planning processes. An inventory of EbA tools and a 'tool navigator' are also being developed to support this process.

Table 2: Framework for assessing EbA effectiveness

1) Effectiveness for human societies *Did the initiative allow human communities to maintain or improve their adaptive capacity or resilience, and reduce their vulnerability, in the face of climate change, while enhancing co-benefits that promote long-term wellbeing?*
1. Did the EbA initiative improve the resilience and adaptive capacity of local communities, and help the most vulnerable (eg women, children and indigenous groups)? If so, over what time frames were these benefits felt, and were there trade-offs (or synergies) between different social groups? 2. Did any social co-benefits arise from the EbA initiative, and if so, how are they distributed and what are the trade-offs between different sectors of society? 3. What role in the EbA initiative did stakeholder engagement through participatory processes and indigenous knowledge play? Did/does the use of participatory processes support the implementation of EbA and build adaptive capacity?
2) Effectiveness for the ecosystem *Did the initiative restore, maintain or enhance the capacity of ecosystems to continue to produce adaptation services for local communities, and allow ecosystems to withstand climate change impacts and other stressors?*
1. What were/are the factors threatening the local ecosystem(s)? How did/do these pressures affect the resilience of the ecosystem(s) to climate change and other stressors and their capacity to deliver ecosystem services over the long-term? 2. After the EbA initiative, which ecosystem services were restored, maintained or enhanced, and did the resilience of the ecosystem change? Over what geographic scale(s) and time frame(s) were these effects felt, and were there trade-offs (or synergies) between the delivery of different ecosystem services at these different scales?
3) Financial and economic effectiveness *Is EbA cost-effective and economically viable over the long-term?*
1. What are the general economic costs and benefits of the EbA initiative? How cost-effective is it, ideally in comparison to other types of interventions, and are any financial or economic benefits sustainable over the long term?
4) Policy and institutional issues *What social, institutional and political issues influence the implementation of effective EbA initiatives and how might challenges best be overcome?*
1. What are the key policy, institutional and capacity barriers to, or opportunities for, implementing EbA at the local, regional and national levels over the long term? 2. What, if any, opportunities emerged for replication, scaling up or mainstreaming the EbA initiative or for influence over policy, and how? 3. What changes in local, regional and/or national government or in donor policies are required to implement more effective EbA initiatives?

The incentive-based hilsa conservation programme

Hilsa (*Tenualosa ilisha*) is an anadromous migratory fish species that completes its life cycle in both the ocean and the Padma (Ganges) and Meghna freshwater river systems in Bangladesh. Every year, hilsa fish undergo large-scale migrations from the coastal waters of the Bay of Bengal to spawn in the Bangladesh river systems in October. The hilsa fishery is by far the largest single-species fishery in Bangladesh, providing employment for half a million professional fishers and an additional 2.5 million people engaged in part-time fishing activities or in the fishing supply chain, for example as net/boat makers or in fish processing and export (Islam et al. 2016b; Bladon et al. 2016a; Dewhurst-Richman et al. 2016). The hilsa fishery contributes 1% to the country's GDP and 11% of total fish production in Bangladesh (Dewhurst-Richman et al. 2016). Hilsa is also the most affordable and preferred fish amongst the poor. Around 250 million Bengali people depend on hilsa for nutrition (Islam 2016). It is the national fish of Bangladesh and has huge significance in Bengali culture (Mohammed and Wahab 2013).

Hilsa production has gradually declined in Bangladesh since the 1970s, mainly due to overfishing and habitat degradation. This fuelled fear about the collapse of the hilsa fishery, thus prompting the Department of Fisheries (DoF) to establish the Hilsa Fisheries Management Action Plan in 2003. This involved (Dewhurst-Richman et al. 2016; Haldar and Ali 2014):

- Declaring five sanctuary sites in what were thought to be important hilsa nursery areas in the coastal areas of Bangladesh to reduce pressure on the jatka (juvenile hilsa). Together, these constitute about 230 kilometres of four different rivers. All forms of fishing are banned in the sanctuaries at certain times of the year for a period of two to three months to coincide with peak jatka abundance.
- Establishing four nationally important spawning grounds covering an area of 6,900 square kilometres in the Meghna River estuary.
- Implementing a fishing ban for a period of 11 days (recently extended to 15 days) in October in these spawning grounds to preserve brood fish and allow for uninterrupted spawning.
- Enforcing the Protection and Conservation of Fish Act (1950). For example, banning nets with mesh sizes of less than 4.5 centimetres due to concerns about high levels of juvenile fish being caught.
- Offering compensation for lost earnings to fishers affected by the ban. The government started providing 'affected' fisher communities (186,000 households, increasing to 224,000 households by 2016) with 30kg (later increased to 40kg) of rice per household per month through the government's Vulnerable Group Feeding Programme. Support for alternative income-generating activities, such as sewing, livestock and poultry rearing, agriculture, net making and running small businesses, was also provided to reduce fisher vulnerability and diversify their sources of income. Access to microcredit was improved.
- Efforts to generate awareness and support for the fishing bans were conducted using boat rallies in the major hilsa fishery rivers, mass media, leaflet distribution, posters and the involvement of public representatives in management interventions.

The DoF also 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 jatka catching, transportation, marketing, selling and possession is banned between 1 November and 31 May every year in Bangladesh (Mohammed and Wahab 2013). Subsequently, the ban on catching jatka was extended to the end of June. These activities are collectively referred to as the incentive-based hilsa conservation programme in this paper.

Between 2013 and 2016, IIED received support from the Darwin Initiative for a project called 'Economic incentives to conserve hilsa fish in Bangladesh'. Box 2 describes the aims of this work.

Box 2: Aims of the 'Economic incentives to conserve hilsa fish in Bangladesh' project

- Carry out ecological assessments to better understand the biological and ecological requirements of hilsa fish and provide baseline data for monitoring water quality.
- Conduct social baseline assessments with fisher communities and others affected by fishing bans to characterise fisher dependence on the hilsa fishery, and preferences regarding compensation types and mechanisms.
- Evaluate the legal and institutional capacity of relevant government authorities and communities to ensure there are the necessary institutional structures to support hilsa management.
- Evaluate the equitability of the benefit distribution mechanism, with a focus on the beneficiary selection process, how costs of the scheme are distributed, beneficiary preferences and the unintended impacts of the compensation scheme.
- Examine a conservation trust fund as a potential tool for ensuring the long-term financial sustainability of the hilsa management project.

Source: Dewhurst-Richman et al. (2016).

Genuine ecosystem-based adaptation initiatives must meet the following four criteria (Martin 2016; CBD 2009; CBD 2010): they must use biodiversity and ecosystem services; they must help people; they must support human adaptation to the adverse effects of climate change; and they must form part of an overall strategy. The incentive-based hilsa conservation programme did not consider climate change in its inception and planning, and thus was not intended to be EbA. But as with many natural resource management initiatives, significant adaptation benefits can emerge from improved management of natural resources (Reid and Alam 2017; Reid and Faulkner 2015). If assessed through an EbA lens, the programme provides opportunities to collect information that fills key EbA knowledge gaps, which is why it has been included under the broader 'Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy' project. For example, it has strong economic data (which most EbA studies lack), support from government at the highest level means it operates at scale (whereas most EbA projects are small stand-alone initiatives), and it looks at a migratory fish species (most EbA projects target land-based ecosystems).

To address the lack of consideration given to climate change in hilsa management work to date, a workshop entitled 'Scenario planning of adaptation of freshwater fisheries to climate change with emphasis on ecosystem-based adaptation and biodiversity conservation' was held in May 2017, with support from the 'Ecosystem-based approaches to adaptation: strengthening the evidence and informing policy' project. This initiated thinking and support for planning on how climate change affects hilsa fish populations and what types of adaptation options could help address emerging challenges.

Methodology for assessing effectiveness

The methodology applied for assessing EbA effectiveness is detailed in Reid et al. (2017). This guidance describes a process – based around asking a detailed set of questions – that can be used to draw conclusions about the effectiveness of an EbA project that is ongoing or has ended. This paper collates information from interviews and focus group discussions with a wide variety of incentive-based hilsa conservation programme stakeholders (see Table 3), along with relevant literature, to assess effectiveness according to the four criteria above.

Results from interview questions regarding the key local and district-level policy, institutional and capacity barriers and opportunities for implementing EbA have been combined. This is because governance in Bangladesh is so centralised there is little distinction between the local and district levels.

Table 3: Programme stakeholders interviewed

Level 1	National government officials: Additional Secretary, Ministry of Fisheries and Livestock; Director General, Department of Fisheries; Director, Hilsa Fisheries Management, Department of Fisheries; Chief (Fisheries Sector), Planning Commission; Director (Planning), Department of Environment; Director General, Bangladesh Fisheries Research Institute; Principal Scientific Officer, Bangladesh Fisheries Research Institute; Project Director, Jatka Conservation Project (Department of Fisheries).
Level 2	Local authority stakeholders: District Fisheries Officer (Chandpur, Laxmipur, Barisal, Bhola, Patuakhali Districts), Deputy Commissioner (Administration – Chandpur, Laxmipur, Barisal, Bhola, Patuakhali Districts), Deputy Director of Fisheries (Barisal Division and Chittagong Division), Chief Scientific Officer (Bangladesh Fisheries Research Institute), and Principal Scientific Officer (Bangladesh Fisheries Research Institute).
Level 3	Implementing partners in the incentive-based hilsa conservation programme. This includes the Upazila Nirhabi Officer, who heads the upazila (in each of the five districts), the Upazila Fisheries Officer (one from each of the five districts) and the upazila chairman and/or upazila members. It also includes non-government organisations (such as the Bangladesh Centre for Advanced Studies, Centre for Natural Resource Studies, Community Development Centre, or CODEC) and local leaders.
Level 4	Community level stakeholders: fishers association chairman/secretary, fishers community leader, fish traders, aratdar (who receive fish from fishers to sell by auction to wholesalers and sometimes large retailers; they also act as informal money lenders), ice factory owners, hilsa fishers, fisher groups (focus group discussion), fish trader groups (focus group discussion), and women fishers community groups at Barisal and Chandpur.

Much has been written and published on the incentive-based hilsa conservation programme, so this was used along with the interviews conducted to assess the characteristics of incentive-based hilsa conservation programme activities that contribute to EbA effectiveness. The results of this assessment are described in the following results section.

Research results

Effectiveness for human societies: did the initiative allow human communities to maintain or improve their adaptive capacity or resilience, and reduce their vulnerability in the face of climate change, while enhancing co-benefits that promote long-term wellbeing?

Did the initiative improve the resilience and adaptive capacity of local communities, and help reduce vulnerability?

Implementing partners and community-level interviewees agreed that the incentive-based hilsa conservation programme improved community resilience and adaptive capacity, and reduced community vulnerability to climate change. The main reason given for this was the fact that fish production has increased since the programme began (roughly doubling between 2006-07 and 2016-17). This has increased the availability of food, but has also provided more cash to buy medicine and clothes, pay for education, pay back loans, repair houses and improve livelihood opportunities. The programme has also provided incentives to fishers – in the form of rice – to compensate for new fishing controls, and it has provided alternative income-generating activities to help diversify livelihoods. These

observed increases in human, social, physical, natural and financial capital by definition contribute to improved adaptive capacity.[1]

Both groups of interviewees cautioned, however, that more time was needed to see if the observed increases in fish catches would be sustained. Hilsa fish abundance is dependent on many factors such as rainfall, water flow, water depth, migratory routes, gonadal development, spawning, natural food abundance, pollution, fishing pressure and use of illegal nets. As such, hilsa production levels are hard to predict each year, and it is unclear whether the increases observed can be categorically attributed to the management interventions (although fishers interviewed for another study were sure they were; see Islam et al. 2016a). Programme implementing partners agreed that a few more years were needed before conclusions on the impacts of the programme could be drawn.

Which particular social groups experienced changes in resilience, adaptive capacity or vulnerability as a result of the initiative?

Programme implementing partners and community-level interviewees felt that hilsa fishers in particular have experienced improvements in resilience and adaptive capacity due to the government incentives provided under the programme, and the increases in fish production. Most fishing in Bangladesh is artisanal, and many of the 1.4 million registered fishers are from traditional groups. Fishers are particularly vulnerable to climate change because they are amongst the poorest and most marginalised sections of society in Bangladesh. With more income-earning opportunities from fishing, fishers have more financial capital and feel less need to consider changing their occupation, for example migrating to Dhaka to find employment in the garment industry. Other people involved in hilsa-related fishing and trading activities have also secured more financial capital (thus contributing to adaptive capacity), such as aratdar (who sell fish by auction and act as informal money lenders), mohajan (credit providers), fish wholesalers, fish labourers, traders and retailers, ice suppliers, net and boat makers, and those operating transport. Hilsa is the most affordable and preferred fish among the poor in Bangladesh, and interviewees agreed that improvements in adaptive capacity and resilience generally reached the poorest and most vulnerable, women, children and the elderly. Some 11% of the population of Bangladesh depend to some extent on fisheries for their livelihoods, so improvements in adaptive capacity are widespread.

Trade-offs in terms of who *experiences changes in resilience, adaptive capacity or vulnerability,* where *changes occur and* when

Who experiences changes?

Whilst improvements in adaptive capacity and resilience were experienced across those involved in the fishing industry, programme implementing partners and community-level interviewees felt that some programme stakeholders benefitted more from these improvements than others. First, fishing restrictions under the incentive-based hilsa conservation programme have hit poorer fishers affected by fishing bans the hardest, especially those with no alternative livelihoods they can revert to. Some 175,700 hilsa fisher families lost income when the fishing bans and fishing restrictions in the sanctuaries were established (Haldar and Ali 2014; Majumder et al. 2016). Islam et al. (2016a) report that observed increases in hilsa catches have not benefitted all fishers, and that poor fishers in particular struggle if they are forced to fish illegally and are then caught and penalised (by imprisonment or fishing gear confiscation). Porras et al. (2016) argue that “the cost of this fishing prohibition falls almost completely on the fishers”.

1 Adaptive capacity is defined here as the ability to shape, create or respond to longer-term change in addition to ‘bouncing back’ from shocks. It strengthens resilience and reduces vulnerability to a wide range of hazards. It requires information plus the capacity and opportunity to learn, experiment, innovate and make decisions. The amount, diversity and distribution of assets and resources of the five capitals facilitates alternative strategies: 1) human capital represents the skills, knowledge, ability to labour and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives; 2) social capital means the social resources that support people in pursuit of their livelihood objectives; 3) physical capital comprises the basic infrastructure and goods needed to support livelihoods; 4) natural capital means stocks from which ecosystem services flow; and 5) financial capital denotes the financial resources that people use to achieve their livelihood objectives.

Government officials and DoF policymakers have also expressed concern that during the fishing ban "fishermen in India and Myanmar can continue fishing. Therefore they are reaping the benefits of the Bangladeshi fishermen's sacrifice but not making any sacrifice themselves" (Mohammed 2013a).

Porras et al. (2016) argue that incentives should be extended to all fishers affected by the ban. At the moment, only hilsa fishers are entitled to compensation, even though non-hilsa fishers cannot operate during the ban.

Community-level interviewees explained that aratdar, mohajan and those transporting the fish experienced greater improvements in adaptive capacity and resilience than others. Programme implementing partners agreed that stakeholders in different parts of the supply chain (fishers, fish traders, service providers, etc) benefitted to different extents, with aratdar, mohajan and boat owners benefitting more than other stakeholders. Law enforcement officials and coast guards also benefit more due to the bribes (often fish) they extract from fishers working illegally during the ban periods. Porras et al. (2016) note that "[f]ishers are under a monopoly, which obliges them 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 lowering the fishers' bargaining power to zero." Wholesalers, on the other hand, have many opportunities to benefit from any improvements in the production and sale of hilsa. Access to cold storage means they can freeze hilsa during the high season, selling it later to maximise profits. They can also switch to other fish not affected by the fishing bans. Some intermediaries make about five times more income than fishers (Porras et al. 2016). Mohammed and Wahab (2013) also note that marine fishers and commercial marine fishing operations benefit from improvements in catches of hilsa and other fish as a result of the fishing restrictions.

Where are changes experienced?

Implementing partners and community-level interviewees felt that there were trade-offs in terms of *where* improvements in adaptive capacity and resilience accrued. They explained that people in downstream programme areas experienced improvements more than upstream areas where catch/production increases were lower. Community interviewees also explained that fishers close to sanctuary areas experienced higher catches, but that those who used to fish in areas where sanctuaries had been established and fishing bans consequently imposed had been deprived of their traditional fishing areas at certain times of the year.

When are changes experienced?

In terms of *when* changes occurred, implementing partners and community interviewees felt that fishing restrictions had been detrimental to the local fishing community (in terms of its resilience, adaptive capacity or vulnerability) during the short-term ban period and also shortly afterwards, as fish prices became depressed when fish flooded the market. These short-term detrimental impacts were partly offset by the provision of rice and alternative income-generating strategies, and medium-term improvements in resilience, adaptive capacity or vulnerability also emerged as fish populations grew. Interviewees felt these improvements could prove to be long-term if hilsa production keeps increasing. Implementing partners mentioned that benefits could be long-term if the community took on management of the hilsa fishery and the government incentives also continued. But community interviewees were not sure if the government incentive scheme would continue.

Social co-benefits from the initiative

Programme implementing partners and community interviewees reported a number of social co-benefits accruing to communities from the incentive-based hilsa conservation programme. These are listed below. Many also contribute to improving climate change resilience and adaptive capacity or to reducing vulnerability. This reflects the challenge of distinguishing between climate change-related and development-related social benefits, especially in the context of the incentive-based hilsa conservation programme, which was not designed with climate change in mind.

- Disaster risk reduction. Fewer economic crises and easier recovery from loans; improvements in social security.
- Livelihood diversification. Mohammed (2013a) also notes the social co-benefits of income source diversification as a result of the alternative income-generating scheme.

- Improvements in income meant greater ability to repair houses and better education, as children who had previously dropped out of school could return. Islam et al. (2016b) point out, however, that the food compensation provided during fishing ban periods does not help cover the costs of education during this period, and that fishers would like support in areas such as this as well.
- Improvements in market access.
- Improvements in governance.
- Greater knowledge and awareness about conservation and management practices.
- Better food security and health benefits from dietary improvements. Protein intake increased. Hilsa is a very nutritious food item, but rice distribution and alternative income-generating activities such as poultry rearing also contributed (see Tables 5 and 6). Interviewees noted lower incidences of blindness and higher energy levels. Islam et al. (2016b) and Porras et al. (2016) note, however, a reduction in protein intake during the fishing ban, which rice cannot compensate for.
- Better social cohesiveness – reduced conflict over fish resources, lower crime levels (income levels are higher, so there is less need to steal) and prevailing social peace within families and society. Mohammed and Wahab (2013) also note increased social time with friends and family as a programme co-benefit.
- Strengthened cultural heritage. Hilsa has a rich cultural heritage and strong aesthetic value in Bangladesh. It is a symbol of national heritage, and is always in demand because it is a favourite food for local people. For example, people celebrate the Bengali new year with 'pathna-Ilish' (watered rice with hilsa) (Islam 2016) and hilsa is an integral part of engagement and pre-marriage ceremonies (Mohammed and Wahab 2013). Occasional fishing also provides a hobby for many.

Distribution and trade-offs relating to social co-benefits

As with adaptation benefits, programme implementing partners and community-level interviewees felt that aratdar, mohajan and those trading and transporting the fish accrued more social co-benefits than others (such as those in the fishing community), particularly relating to increases in income. These groups largely control the fishing industry. Because fishing industry market chains reach far beyond the hilsa habitat, programme implementing partners also felt that benefits from higher protein intake have accrued throughout Bangladesh.

Efforts were made to reach the most vulnerable. At the start of the programme, the government used census data to identify around 287,000 fisher households who were directly affected by the fishing ban and could benefit under the incentive scheme. Of these, 187,000 vulnerable households were selected (defined as those headed by women or older fishers, and having no alternative livelihood to fishing; see Majumder et al. 2016). National-level interviewees described how children, women and poor people benefitted in particular from improvements in quality protein intake from fish. Local authority interviewees also mentioned people whose homes had been lost due to river erosion particularly benefited, because they are without assets and are totally reliant on the hilsa fishery for their livelihoods.

Despite these efforts to target poor and vulnerable people, there were weaknesses in terms of how beneficiaries (for rice and alternative income-generation activities) were selected and how rice incentives were distributed. In 2013-14, only 226,852 of the 450,000 households affected by hilsa regulations received rice, with a further 905 households offered support for generating alternative incomes. This meant that many affected households received no compensation. Dewhurst-Richman et al. (2016) describe how some households did not receive their full allocation of rice, as those in the distribution chain withheld rice to cover their own costs. Partisanship in beneficiary selection occurs, and the Bangladesh government has worked to address this by introducing fisher identify cards and involving non-government officials in the beneficiary selection process (Dewhurst-Richman et al. 2016). However, interviewees explained that some 20-30% of fishers still receive no rice (for example, those that are not full-time registered fishers with identity cards, or those who come from outside the local area). By targeting jatka fishers for compensation, those relying on other fish species who were also affected by the ban lost out when food compensation was dispersed; non-hilsa fishers feel discriminated against (Islam et al. 2016b; Dewhurst-Richman et al. 2016). Dewhurst-Richman et al.

(2016) argue that targeting the poorest and most vulnerable fishers for benefit distribution would be more equitable. Lastly, food incentives to compensate for the fishing ban are not given during the shorter spawning season ban in October, and the same amount of rice is given to each household regardless of family size, which can also lead to inequity in terms of how much rice an individual will receive (Islam et al. 2016a).

Some key players in the fishing industry (boat owners, aratdars and big seine net operators) have argued that they should also benefit from the incentives scheme in addition to fishers (Islam et al. 2016b).

Fishers also suffered numerous other social costs. Interviewees mentioned how it remains difficult for really poor communities to comply with the regulations, and how the fishing ban and compensation scheme can distort local fish and rice prices, force fishers to take out high-interest loans and distort labour markets, all of which can have negative social consequences. Conflict can arise as fishers take on other work during the fishing ban (Mohammed 2014; Dewhurst-Richman 2016).

Women may have also benefitted less. Although the rice is given to provide for the fisher's family and not him alone, most fishers are male. Providing households with rice has also been shown to improve men's caloric intake more than that of women, whereas providing a less-preferred food type such as flour increases the share of food that goes to women (Ahmed et al. 2009).

The role of participatory processes and local/indigenous knowledge

Local authority interviewees and programme implementing partners felt that the initiative incorporated local knowledge and practices. They explained that local knowledge was used to design conservation measures for pregnant hilsa/brood fish and for jatka. Local knowledge was sought on hilsa habitat, migration routes, and spawning areas and periods. Local stakeholders and the fishing community also provided advice on programme design issues, such as the appropriateness of the period proposed for banning hilsa fishing and the programme awareness campaign. Mohammed (2013b) argues, however, that the government of Bangladesh's Hilsa Fisheries Management Action Plan was set up with little community input.

Benefit-sharing mechanisms – which address how programme incentives should be distributed, and what alternative income-generating activities would be appropriate for local fishers – at first did not reflect the preferences of fisher communities. Islam et al. (2016b) argue that the alternative income-generating activities on offer were not helpful because of a lack of stakeholder engagement in the needs assessment process. Steps are being taken to address this, however, particularly through the Darwin-funded hilsa project, which emphasised the need to assess recipient community preferences before compensation packages are determined and made specific efforts to fully engage women in project consultations (Dewhurst-Richman et al. 2016).

A range of participatory processes[2] were used in the programme design and implementation, most importantly the provision of material incentives whereby rice was distributed to fishers in return for their abidance by programme fish conservation regulations. Information giving also occurred when local stakeholders provided inputs to research questions around fish biology and behaviour, and socioeconomic issues. Consultation occurred when fishing associations and local stakeholders were involved in meetings and workshops, and their knowledge was used to inform intervention planning. A very strong awareness-raising programme was also implemented (through media and meetings). Overall, however, the planning process was still quite top-down.

2 Participatory approaches can be characterised according to the following typology: (1) passive, where people are told what is going to happen or has already happened; (2) information giving, where people answer questions posed by extractive researchers (they cannot influence proceedings and research findings may not be shared with them); (3) consultation by external professionals who define both problems and solutions (decision making is not shared, and professionals are under no obligation to take on board people's views); (4) for material incentives, where people provide resources, for example labour, in return for food, cash or other material incentives; (5) functional, where people form groups to meet predetermined objectives related to the project (such involvement tends to be during later project cycle stages after major decisions have been made); (6) interactive, where people participate in joint analysis, which leads to action plans and the formation of new local institutions or the strengthening of existing ones (groups take control over local decisions so people have a stake in maintaining emerging structures or practices); and (7) self-mobilisation, where people take initiatives independent of external institutions, develop contacts with external institutions for the resources and technical advice they need, but retain control over how resources are used. Adapted from Adnan et al. (1992) and Dazé et al. (2009).

Local authority, implementing partner and community member interviewees all felt that the participatory processes adopted under the programme supported programme implementation and helped build community adaptive capacity. The material incentives (rice) provided a clear, visible (but conditional) benefit from abiding by the new fishing regulations imposed under the programme. The fishers accepted this 'payment for environmental services' at the start of the programme, and as hilsa production increased they saw the further benefits from their involvement in programme planning. They now support the incentive-based hilsa conservation programme and many willingly cooperate with the enforcement of regulations relating to hilsa conservation and management. Their involvement in awareness-raising and motivational campaigns relating to the programme has also improved adaptive capacity. Community interviewees felt, however, that greater fisher involvement in programme management could secure even higher production levels. Islam et al. (2016a) concur, arguing that "[f]ishers have a wealth of indigenous knowledge and experience that can be integrated into the decision-making process to help improve the performance of sanctuaries".

Effectiveness for the ecosystem: did the initiative restore, maintain or enhance the capacity of ecosystems to continue to produce ecosystem services for local communities, and allow ecosystems to withstand climate change impacts and other stressors?

Factors threatening local ecosystem resilience and service provision

Local authority, implementing partner and community interviewees listed a number of factors threatening the local ecosystems depended on by hilsa. These factors degraded the ecosystem and affected its ability to adapt to climate change and other stressors. They also limited the ability of the ecosystem to continue to provide key ecosystem services – namely, hilsa fish production – in various ways:

- **Climate change impacts**, including sea level rise and tidal surges, saline water intrusion in previously freshwater habitats, shifts in seasons, erratic rainfall, increased temperatures, river bank erosion, and an increase in extreme events (storms, cyclones, tidal surges, floods and drought). Excessive and erratic rainfall has a negative impact on fish biodiversity and local ecosystems, because it causes erosion and thus siltation, which inhibits migration, affects the spawning success and growth of hilsa populations and degrades fishing grounds. Darby et al. (2015) predict greater sediment loads in the Ganges–Brahmaputra–Meghna Delta as a result of climate change. Because hilsa generally prefer deeper water (anything less than seven metres and they won't migrate) and stronger currents, drought could negatively affect them. Higher temperatures and salinity levels could also affect fish physiology and spawning, and a shift in the timing of rainfall could affect hilsa breeding and feeding. Fernandes et al. (2016) predict that the impacts of climate change on hilsa populations in the Bangladesh exclusive economic zone (ie marine areas) are likely to lead to a minor decline in catches by 2030 and a 25% decline by 2060 under sustainable management practices, but they project a 95% fall in catches by 2060 if overexploitation is allowed. Conversely, excessive rain in India and upstream could also lead to river regeneration, provide downstream hilsa populations with more food and support hilsa migration (they prefer to swim against a strong current). Generally speaking, more floods means better fish production. Sea level rise and cyclones could have a positive effect on fish breeding (there is a positive correlation between sea level rise and hilsa catches, although a causal link has not been proven). Generally speaking, however, interviewees felt that the effects of climate change on hilsa populations are largely unknown.
- **Changes to river morphology**, such as increases in river bank erosion, reductions in water flow and depth (eg in the Chandpur area of the Meghna River), formation of submerged sand islands (chars), river segmentation and alteration of the river course. These occur due to climate change and other factors. Changes in fish migration routes and reductions to water depth and flow negatively affect fish populations, for example by inhibiting migration and altering hilsa food availability (Dewhurst-Richman et al. 2016).
- **Water pollution** and industrial waste from the leather processing industry and textile/garment factories, sewerage and municipal waste (for example from Dhaka, a mega city with significant quantities of effluent and waste), and oil spillage by ships/vessels navigating the rivers. This leads to

deteriorating water quality as the amount of carbon dioxide, ammonia and nitrates in the water increases. This affects biodiversity, including hilsa growth and habitats, most notably their spawning grounds (Dewhurst-Richman et al. 2016; Hasan et al. 2015). Heavy metals also accumulate in aquatic organisms and habitats.

- **Overexploitation of fish resources**, for example from excessive fishing pressure, the use of destructive fishing gear and nets, and fishing brood hilsa or jatka. This alters food webs by causing an imbalance in the normal levels of species and leads to reductions in biodiversity. The result is reduced ecosystem service delivery and lower aquatic production levels.
- **Poorly planned infrastructure**, such as the construction of barrages/embankments, or flood control, drainage and irrigation structures (such as sluice gates), which block fish migration pathways and reduce the flow of water through the river system. These reductions in water flow increase siltation, which degrades fish habitats and limits hilsa migration in the rivers and between the sea and the rivers, ultimately affecting production levels of hilsa and other fish. Port and electric power plant infrastructure also alters the river ecosystem. Dams and water extraction upstream (for example, in India) reduce water flow and thus current, which is not good for hilsa, which like to swim against a strong current (this is why the Ganges has less hilsa). They can also increase upstream salinity levels, which affects hilsa.
- Increases in river navigation (boats) disturbs riverine biodiversity.

Boundaries influencing ecosystem resilience

Local authority and implementing partner interviewees both felt that the entire oceanic and riverine ecosystem used by hilsa needed to be considered for the natural resource management initiative to be more effective. This includes the lower Meghna and the Padma (Ganges) Rivers and their distributaries, tributaries, canals and branches. It also includes upstream and downstream areas, including both shallow and deeper water areas. Bladon et al. (2016a) note that the fluid, transboundary and often open access nature of fish resources present challenges for the design and implementation of payments for ecosystem services schemes in developing world fisheries such as hilsa.

Roughly 40-50% of global hilsa production is from outside Bangladesh (20-25% from Myanmar, 15-20% from India and 5-10% from other countries such as Iraq, Kuwait, Malaysia, Thailand and Pakistan). Hilsa production levels in Myanmar and India will benefit from hilsa conservation activities in Bangladesh, and fish management in these countries will affect stocks in Bangladesh (Hasan et al. 2015). Interviewees explained how cooperation between India, Myanmar and Bangladesh is needed to ensure effective transboundary river management. This includes management of water flow, embankment and barrage construction. Dewhurst-Richman et al. (2016) add that transboundary cooperation is needed because water management projects, climate change impacts, overfishing, siltation and pollution are common to all countries in which hilsa occur. Interviewees explained that hilsa habitat also includes areas in the Bay of Bengal that fall under Indian jurisdiction. Transboundary marine protected areas are needed here for hilsa conservation and restoration.

Thresholds influencing ecosystem service provision

Local authority and implementing partners interviewees felt that a number of thresholds existed beyond which hilsa fish production would no longer be viable. Already, production levels are far lower and the size of hilsa caught far smaller than they were 20 to 30 years ago. Mome (2007) adds that hilsa is overexploited. Both groups felt climate change impacts (namely, increases in temperature and extremely erratic rainfall or salinity) could be key thresholds, and programme implementing partners felt that extreme levels of pollution, siltation, reductions in water flow, poorly planned infrastructure construction and exploitation (especially fishing jatka and brood hilsa) could also lead to tipping points in hilsa production.

Initiative impacts on ecosystem resilience and services provision

Local authority and implementing partner interviewees felt that riverine and coastal ecosystem resilience had improved as a result of the incentive-based hilsa conservation programme. General improvements in biodiversity in the Padma and Meghna River ecosystems and coastal areas were

observed, including increases in fish diversity and in populations of fish that were previously depleted. Mohammed and Wahab (2013) comment on the increased diversity of other aquatic species within the sanctuaries, and many fishers interviewed by Islam et al. (2016a) noted an increase in the abundance of other species due to the sanctuaries. Bladon et al. (2016a) describe how limiting the use of certain fishing gear and establishing sanctuaries has contributed to the climate change resilience of fisheries. Interviewees said that maintenance of biogeochemical cycles had improved. Local authority interviewees explained that the policy changes resulting from programme implementation would benefit many more species than just hilsa alone.

These interviewees and additional community-level interviewees felt that the delivery of ecosystem services also improved as a result of the programme. Higher hilsa production levels in the rivers and the sea had been observed, with a doubling of catch weight from 199,032 metric tonnes in 2002/3 to 387,211 metric tonnes in 2014/15. Rahman et al. (2012) note increases in hilsa brood stock and catches dominated by larger hilsa, and Bladon et al. (2016a) describe how limiting the use of certain fishing gear and establishing sanctuaries has provided a range of regulating and supporting ecosystem services. One interviewee and much published literature, however, caution that whilst programme activities correlate with catch increases, a causal effect cannot be assumed (eg Mohammed and Wahab 2013) and it may have also been due to greater fishing intensity. Bladon et al. (2016b) show that evidence that programme management actions have increased hilsa abundance is equivocal and spatially variable, and argue that changing environmental conditions could be responsible for the observed increases. They also argue that whilst the provision of compensation (rice and alternative income-generating activities) appears to have improved livelihoods, it may not have incentivised compliance with regulations.

Some interviewees also said that cultural services have improved, with recreational benefits coming from the festive mood in fishing areas.

Geographic scale of ecosystem services provision and trade-offs or synergies between geographical scales

Local authority, programme implementing partner and community interviewees agreed that although the implementation of programme activities was limited to certain areas, improvements in hilsa production levels were observed throughout the Padma and Meghna riverine ecosystems, including in distributaries, tributaries and canals, estuarine areas in the Bay of Bengal, the coastal areas inhabited by hilsa for part of the year, and even areas upstream from programme implementation sites and in adjacent watersheds and neighbouring countries. Benefits were not limited to hilsa alone; other species occupying similar niches also showed population increases beyond the project implementation sites.

No trade-offs were observed in ecosystem service delivery at different geographic scales as a result of the programme.

Time frame over which ecosystem services are provided, and trade-offs or synergies between timescales

Local authority, programme implementing partner and community interviewees agreed that improvements in ecosystem services from the programme could be long-term (ie continuing for more than 10 years, or for as long as the programme continues). Indeed, the programme started in 2003 and gradual improvements in fish catches continue to be observed as ecosystem restoration continues. Local authority interviewees said that motivational campaigns and fisher awareness-raising activities coordinated by the Department of Fisheries helped sustain benefits. Programme implementing partners and community interviewees added that success depended on the continuing distribution of incentives (rice), and community-level interviewees suggested improvements in ecosystem service provision might be disrupted without them.

Local authority and implementing partner interviewees mentioned no trade-offs in ecosystem services delivery at different timescales resulting from the incentive-based hilsa conservation programme. However, they did describe many synergies. The programme raised awareness amongst fishers, elite people in the fishing industry and government officials about hilsa survival and production in the Padma and Meghna River basins. Those fishing jatka were particularly targeted, which is important because if

hilsa cannot reach maturity the population will fall. This raised awareness will improve understanding of sustainable management, and along with the programme incentives will likely lead to synergistic effects for ecosystem service delivery in the future. The significant investments made in strengthening DoF capacity for implementing and managing the programme will also have synergistic effects for sustainable management and ecosystem service delivery (not limited to hilsa fish production) in the future. Lastly, programme investments in supporting alternative income-generating activities for fishers under the programme will reduce the pressure on hilsa populations, and thus benefit production levels in the future.

Financial effectiveness: is the initiative cost-effective and economically viable over the long term?

How cost-effective is the initiative?

No formal cost-benefit analysis has been conducted, but national-level interviewees and project implementing partners felt that the programme had been cost-effective. Their observations were based on increases in hilsa production volumes recorded by DoF and observed in the field, and results from studies conducted under the Darwin-funded hilsa project. One Darwin-funded project implementing partner pointed out, however, that costs and benefits are different for different people. For example, middlemen (eg fish traders) generally accrue more economic benefits. Financial and broader economic costs and benefits are looked at in more detail below for two stakeholder groups: the fishers and the government of Bangladesh.

Is the scheme cost-effective for fishers?

Evidence on whether or not the incentive-based hilsa conservation programme is of overall benefit to fishers is mixed. A government white paper proposing a hilsa conservation trust fund shows that the average annual costs to fishers are outweighed by the average annual benefits from the compensation programme (see Table 4).

Table 4: A 'back-of-the-envelop cost-benefit analysis' of the incentive-based hilsa conservation programme for fishers

Value of annual costs and compensation benefits from the programme	Bangladeshi taka (BDT)
Loss per fisher during the two-month jatka fishing ban	20,252
Loss per fisher during the shorter brood hilsa ban period	10,231
Average minimum compensation per fisher household	89,167

Source: Majumder et al. (2016).

Evidence from interviewees and other sources suggests, however, that the compensation is not sufficient to cover losses (Dewhurst-Richman et al. 2016). Mohammed (2013a) reports dissatisfaction amongst fishers who "have to sacrifice more than they benefit from participating in the ban and the compensation scheme". Fishers initially received 30kg of rice per household for the four months of the jatka fishing ban, and although this then increased to 40kg, most stated that it was not sufficient. One reasons for this is that despite there being a budget to cover the costs of rice transportation and distribution, bureaucracy meant that it was easier for local officials to deduct some of the rice to cover their costs instead. Islam et al. (2016b) report that the fishers they interviewed said they received 25-32kg out of their 40kg allocation, which was inadequate for a household for a month, and that 50kg per month would be enough. Food compensation has increased most years (see Table 5), and under the Darwin-funded hilsa project, the DoF has written a proposal to central government arguing that fishers be provided with up to 80kg of rice per household per month.

Table 5: Rice compensation under the incentive-based hilsa conservation programme

Financial year	Number of households receiving food	Amount per household per month (kg)	Duration (months)	Total amount of food allocated (tonnes)
2004-2005	33,300	10	3	1,000
2006-2007	103,000	15	1	1,546
2007-2008	145,335	10	3	4,360
2008-2009	143,252	10	3	5,731
2009-2010	164,740	30	4	19,769
2010-2011	186,264	20	4	14,471
2011-2012	186,264	30	4	22,352
2012-2013	206,229	30	4	24,748
2013-2014	226,852	40	4	36,296

Source: Haldar and Ali (2014).

The alternative income-generating scheme has supported 21,690 fisher households to date, with an average household benefit value of 7,541 Bangladeshi taka (BDT). Dewhurst-Richman et al. (2016) report that one of the reasons fishers sometimes prefer compensation under the alternative income-generating scheme is that they don't receive their full rice allocations. Alternative income-generating activities are decreasing, however (see Table 6), in part because fishers feel support provided under the scheme is not based on an effective assessment of their needs (Dewhurst-Richman et al. 2016; Haldar and Ali 2014).

Table 6: Alternative income-generating activity support under the incentive-based hilsa conservation programme

Financial year	Number of households supported	Districts covered	Upazilas covered	Number of households supported per upazila
2009-2010	4,388	Chandpur, Bhola, Laxmipur, Patuakhali	20	219
2010-2011	6,869	As above	21	327
2011-2012	7,785	As above	21	371
2012-2013	1,743	As above	16	109
2013-2014	905	As above	22	41
Total number of households	21,690			

Source: Haldar and Ali (2014).

Islam et al. (2016a) report that "fishery closure led to substantial economic hardship due to lost income" and fishers felt "frustrated that the added harvest is much less than their lost income". Fishers did, however, benefit from improvements in their catches. Interviewees explained that improvements in hilsa production and catch value had enhanced local income levels. This particularly benefited poor people who are reliant on fishing and those in the fishing industry such as fish traders, labourers and ice suppliers. Mohammed and Wahab (2013) also comment on the observed increased income from hilsa catch sales. One interviewee felt that the net overall benefits for fishers outweighed the costs, as evidenced by increasing levels of compliance with the new rules. Dewhurst-Richman et al. (2016) also report that fishers "were willing to forego compensation if the duration of the ban was reduced", but state that a full cost-benefit analysis is needed to see how benefits from hilsa catch increases and rice or alternative income-generating schemes compare to loss of income due to the ban under an optimally operating scheme. Bladon et al. (2016b) and Porras et al. (2016) recommend redesigning the rice and

alternative income-generating schemes to better fit hilsa fishers' needs in order to lower the opportunity costs associated with the fishing bans that they experience and to incentivise compliance.

Is the scheme cost-effective for its government funders?

The two compensation schemes both have relatively low management costs. Table 7 shows the government costs of running the food compensation scheme. The total administration and distribution costs equate to about 3% of the total costs of the scheme, which compares well to similar schemes in other countries, but this could still be improved by making the lengthy and complex process of deciding who should receive food allocations each year shorter and simpler (Halar and Ali 2014).

Table 7: Cost of running the food compensation scheme 2013-2014

Item	Cost (BDT per tonne)	Total cost (BDT million)	Percentage of total cost
Food allocation	70.00	2.54	0.22
Food transport	422.00	15.32	1.37
Food distribution	126.00	4.57	0.47
Administration	300.31	10.90	0.97
Sub-total	**918.31**	**33.33**	**3.00**
Cost of 36,926 tonnes of food	30,000.00	1,088.90	97.00
Total	**30,918.00**	**1,122.23**	**100.00**

Source: Haldar and Ali (2014).

The average annual costs of running the alternative income generating scheme are BDT 163.56 million. The administrative, beneficiary allocation and distribution costs of this scheme amount to only 0.7% of the total operational costs, with materials accounting for 99.3% of the total. This makes it more efficient than the food compensation scheme (Dewhurst-Richman et al. 2016; Haldar and Ali 2014). These measures of efficiency are just one component of effectiveness, however, and cannot be considered on their own as a proxy for cost-effectiveness.

The costs of running these schemes is more than offset by the income to government from increases in tax revenue from hilsa, although the figures obtained for this income vary dramatically across the literature studied (see Table 8). Darwin-funded project implementing partners felt that the incentive-based hilsa conservation programme costs (see Table 7) were offset by benefits. Dewhurst-Richman et al. (2016) concur with this view, and Majumder et al. (2016) states that "[f]rom the economic analysis, it showed that hilsa has a creditable contribution to the economy of Bangladesh, and that the incentive-based PES scheme is attractive as well as effective in increasing the conservation and production of hilsa".

Table 8: Costs and benefits of the incentive-based hilsa conservation programme for the government[3]

	Amount (BDT and sometimes US$)	Data source
Annual programme costs[4]		
Incentives (in cash and in-kind) for roughly 146,000 households in 2007–08	20 million (US$ 244,000)	Mohammed and Wahab (2013)
Incentives (in cash and in-kind) for fisher households in 2010–11	59 million	Mohammed and Wahab (2013)
Awareness raising activities in 2010–11	4 million	Mohammed and Wahab (2013)
Cost of running the food compensation scheme 2013–14	1,122.23 million	Haldar and Ali (2014)
Average annual costs of running the alternative income generating scheme	163.56 million	Dewhurst-Richman et al. (2016); Haldar and Ali (2014)
Cost of compensating fishers for hilsa fishery bans	1,238.73 million	Dewhurst-Richman et al. (2016)
Incentives for 226,000 fishers during the four-month ban period (36,296 metric tonnes of rice)	1,450.00 million	Majumder et al. (2016)
Annual programme benefits		
Annual government tax earnings from hilsa exports	US$630 million (BDT 43,470 million according to 2007 exchange rates)	Mome (2007); Majumder et al. (2016)
Annual government tax earnings from hilsa exports[5]	US$43 million (BDT 3,426 million according to 2013 exchange rates)	Mohammed and Wahab (2013); Majumder et al. (2016)
Earnings from chilled hilsa exports and frozen hilsa exports	240.39 million	Majumder et al. (2016)
Annual revenue from the hilsa fishery	49,483.22 million	Dewhurst-Richman et al. (2016)

How did the approach compare to other types of intervention?

National-level interviewees and project implementing partners said the incentive-based hilsa conservation programme had not been compared to other approaches that might increase production levels in the fisheries sector. They felt, however, that it would prove more effective than other approaches if such a comparison were to be made.

Broader economic costs and benefits from the initiative

Although no formal assessment has taken place, interviewees described three key broader economic benefits resulting from the programme:

[3] Figures listed are from different sources and also vary according to different years. Where exchange rates are given, they are from the original source or calculated according to the official exchange rate in January during the year of the source publication.
[4] Costs increase over the years as more fisher families are provided with more rice for longer periods.
[5] The reduction from the row above is likely to be because hilsa exports were banned in 2012, leading to a large drop in revenue between 2007 and 2013.

- Losses from disaster events have decreased.
- The increased income from hilsa catch sales has allowed some fisher households to become self-reliant and to break the vicious cycle of resorting to money lenders that had kept them poor from generation to generation (Mohammed and Wahab 2013).
- The alternative income-generating programme has also diminished reliance on money lenders (Mohammed 2013a).

There were, however, a number of unintended negative socioeconomic consequences resulting from the incentive-based hilsa conservation programme. These are listed below and are described in more detail in Dewhurst-Richman et al. (2016) and Mohammed (2014), who explain how such consequences are seldom identified by standard impact evaluation studies and consequently remain largely unaccounted for in policymaking.

- Rice compensation does not provide money for other important costs such as buying or repairing nets and boats in preparation for the next fishing season. This forces many fishers to seek loans during the fishing ban, largely from informal money lenders who provide high-interest loans. Demand for loans can increase by up to 30% during the ban periods, forcing interest rates up by 20-30%.
- When rice is distributed during the fishing ban, rice retailers and wholesalers report a drop in sales of up to 20%, and rice prices fall by up to 10%. Compensating fishers can thus economically disadvantage other sections of the community.
- During the ban, many fishers and supply-chain workers seek work as casual labourers and flood the local labour market. This drives down local labour wages by up to 40%.
- One Darwin-funded project implementing partner explained that whilst broadly beneficial, increases in hilsa production have also depressed fish value.

Financial and economic trade-offs at different geographical scales

National-level interviewees and project implementing partners described no trade-offs in financial or economic benefit accrual at different geographical scales. They did, however, describe synergies – namely, the economic benefits arising from improvements in hilsa production levels in the areas of the fish sanctuaries, but also downstream from the sanctuaries in the rivers and also the coastal and marine areas inhabited by hilsa for part of the year. Hilsa makes an important contribution to the Bangladesh economy, so as fishing industry market chains reach far from the riverine and coastal hilsa habitat (some 2.5 to 3 million people rely directly and indirectly on the fishing sector in Bangladesh), it is likely that the economic multiplier effects of increased hilsa production could be felt throughout Bangladesh.

Changing financial and economic benefits and costs over time

All interviewees felt that the programme's financial and broader economic benefits had changed over time. Provision of incentives (rice) and alternative income-generating activities under the programme ensured short-term local benefits accrued, but with hilsa production levels continuing to increase, benefits for the many stakeholders in the hilsa supply chain could be sustained for as long as the programme continues.

Policy and institutional issues: what social, institutional and political issues influence the implementation of this initiative, and of effective EbA initiatives in general, and how might challenges best be overcome?

Local and district-level barriers to implementing the initiative and EbA in general

Insufficient local government resources and weak governance

Many interviewees listed insufficient capacity, technical skills, manpower, logistical support and financial resources at the local government level for implementing the incentive-based hilsa conservation programme as key concerns. Weak governance was also listed as a key concern. Weak

local government institutions and leadership made implementation difficult. Local DoF officials lacked the legal power to implement fishing rules and regulations.

Interviewees felt that more intensive and continuous local government support was needed for effective implementation. However, no recruitment policy exists to ensure skilled staff are hired for the programme, and there is no systematic way to strengthen local DoF programme staff skills. Shortages in local DoF staff capacity and resources have affected the department's ability to manage the programme effectively (Dewhurst-Richman et al. 2016). Interviewees described, for example, how it is not easy for programme officials to identify fishers given that many move around or only fish at certain times of the year. The scale of the programme and the size of the hilsa fishing community also make management challenging, given the resources available.

Islam et al. (2016b) report that "[i]n hilsa conservation areas the [upazila] fisheries officers become too occupied with the conservation project to properly carry out their other duties" and the main government posts are often left vacant for long periods. Likewise, the 'mobile court', which enforces fishery regulations, struggles with insufficient staff availability (eg of police and magistrates), and financial and physical resources (Islam et al. 2016b). Most policing activities happen during day time, but most hilsa fishing is done at night (Mohammed et al. 2014) and the chances of punishment if caught fishing illegally are slim (Bladon 2014).

Community interviewees also reported an absence of rehabilitation programmes for the fishing community who have lost their homes due to river erosion.

Corruption and a lack of transparency

Corruption and a lack of transparency were also key concerns. Community interviewees explained how weak organisational capacity fuels poor governance and corruption, and makes it hard to stop illegal fishing and limit industrial effluent entering into riverine ecosystems. Illegal fishing is increasing and compliance with conservation measures in the hilsa fishery is low, which is in part facilitated by the bribery of local enforcement officers (Dewhurst-Richman et al. 2016; Islam et al. 2016b; Bladon et al. 2016a; 2016b). Bladon (2014) describes how fishers set their nets regardless of the rules, and how the few who are caught may pay a bribe, lose their nets or at worst face jail time or get a hefty fine, none of which will stop them doing it again.

Community interviewees also reported a lack of transparency in rice distribution. Programme implementing partners said there were gaps in the list of fishers and the revised hilsa conservation plan. Dewhurst-Richman et al. (2016) describe how those in the distribution chain withholding rice from households to cover their own costs fuels resentment and non-compliance with fishing regulations. Some upazila members and chairmen may have included or excluded certain people from the lists of those due to benefit for political reasons, and fishers with kinship ties to local government are able to secure fisher identity cards more easily (Dewhurst-Richman et al. 2016). In a study conducted by Bladon (2016), some 70% of informants felt that compensation was biased towards the elite, while Mohammed (2013a) reports that fishermen feel that "there are lots of loopholes in the system. There is a worrying amount of partisanship in the distribution system."

Inadequate cooperation

Inadequate cooperation between institutions and departments was deemed problematic in the context of management, implementation and policy support. For example, local authority officials said coordination between local departments – such as law enforcement agencies, the Bangladesh Fisheries Research Institute, DoF and other relevant organisations – was lacking. Programme implementing partners said that links between local non-government institutions and government bodies need strengthening for improved planning and implementation. Party politics made programme implementation more challenging. Community interviewees described how administrative cooperation for imposing the fishing ban, seizing illegal nets and distributing incentives (rice) in a transparent manner was lacking.

Limited community capacity and awareness, and extreme poverty

National and local authority interviewees also mentioned challenges associated with community organisations and local power structures, as well as the lack of institutional capacity within the hilsa fishing community. Interviewees said there is little community-based natural resource management.

Fishers need to be empowered in relation to those who own boats and nets and other middlemen; this could boost compliance with the ban (Dewhurst-Richman et al. 2016; Mohammed 2014). Their low levels of education prevent them from finding alternative incomes (Porras et al. 2016). Dewhurst-Richman et al. (2016) argue that greater involvement of local representatives could improve the effectiveness of alternative income-generating activities and ensure they are more needs-based, for example providing khas land (government-owned fallow land) to landless fishers and support for aquaculture. Participatory monitoring could help address knowledge gaps (Dewhurst-Richman et al. 2016; Islam et al. 2016b).

Local authority interviewees explained that levels of awareness of the programme were low, in part because knowledge dissemination was not as effective as it could be. For example, the government media campaign to raise awareness of the programme amongst local stakeholders was weak.

Extreme poverty and heavy levels of indebtedness affected compliance with the fishing bans (Islam et al. 2016b). Limited financial services prevent most fishers from obtaining loans from formal microfinance institutions, so many fishers fish illegally to repay high-interest loans from informal lenders (which are not put on hold during the fishing ban). Fishers need access to suitable financial products and services instead that can accommodate their very varied and seasonal incomes, for example including grace periods when fishing restrictions make it impossible for fishers to service their debts. Access to well thought-out microcredit could liberate hilsa fishers from cyclical debt traps (Dewhurst-Richman et al. 2016; Mohammed 2014).

National-level barriers to implementing the initiative and EbA in general

Inadequate government policies

Interviewees described the lack of government policies and policy implementation as a key national level challenges to programme implementation, particularly policies relating to fisheries, climate change and EbA. Government did not prioritise these issues and mandates were unclear. There is no policy or strategy in place for addressing climate change impacts in the fisheries sector, and fisheries policies in Bangladesh lack long-term planning, especially in the context of dealing with climate change. Coastal land and ocean resources are largely open access, so the collection of aquatic resources is unregulated. There are climate change policies and fisheries policies but the two are not well linked, and there is also no explicit national-level policy or strategy that recognises and facilitates EbA implementation in Bangladesh (Rahman 2014). For example, Bangladesh's second national communication only suggests raising dykes and introducing new climate change-resilient species as possible adaptation actions in the fisheries sector (Ministry of Environment and Forests 2012). Programme implementing partners felt that EbA needs a better legal framework with associated monitoring and evaluation guidance for different ecosystems. EbA should be included or better addressed in the National Adaptation Plan, the Intended Nationally Determined Contribution and the Bangladesh Climate Change Strategy and Action Plan. They also felt a hilsa fishing licensing system would improve governance, and that fishers who had lost their land due to river erosion needed a programme to support their rehabilitation.

Knowledge and awareness gaps

Knowledge gaps relating to hilsa biology and behaviour were a key challenge. There is little baseline ecological data available for the hilsa fishery, and stock assessments are highly uncertain (Dewhurst-Richman et al. 2016). Data on catch per unit of effort are lacking to assess the exact extent of the recovery of hilsa stocks (Islam et al. 2016a). The contribution of sanctuaries and fishing bans to increasing catches still needs to be evaluated (Bladon et al. 2016a; Dewhurst-Richman et al. 2016), along with the impacts of non-fishing related stressors on hilsa populations (Dewhurst-Richman et al. 2016). There are significant gaps in knowledge on hilsa breeding biology, environmental requirements, diet and feeding ecology at different stages of life (Islam et al. 2016b). Local authority interviewees said that riverine ecosystems and local ecosystem hotspots were inadequately understood. Some hilsa sanctuary boundaries are in the wrong place, suggesting the need for better habitat modelling (Islam et al. 2016b; Bladon et al. 2016b). Recent research has addressed some of these knowledge gaps. Darwin-funded project research suggests, for example, that an additional sixth sanctuary is needed, and the length of what is defined as jatka and the duration of the fishing bans have been altered as new information has become available. Many knowledge gaps still remain, however. For example, in 2014

the ban period was 5–15 October, but an upazila fisheries officer noted that spawning began on 20 September in Bhola district (Islam et al. 2016b). The peak hilsa spawning season could thus be much longer – as long as 25–30 days – than the original 11-day ban period. In addition, uncertainly remains about the level of inter-annual variability in the timing and duration of spawning (Dewhurst-Richman et al. 2016).

Local authority interviewees explained that there was a lack of ecosystem-oriented research institutes specialising in hilsa, which meant facilities for short-term training, funded research time, and research/laboratory facilities, with all the necessary supplies and logistical support, were lacking. The Bangladesh Fisheries Research Institute is responsible for conducting research to support the programme, but it lacks sufficient scientists, research assistants, quality technical equipment (Islam et al. 2016b) and suitable skills-enhancement programmes. Inadequate DoF staff capacity and resources have also affected the department's ability to carry out the biological research needed and to coordinate between research bodies (Dewhurst-Richman et al. 2016). Local authority interviewees explained that knowledge of ecological statistics was poor and that modern digital tools and techniques are needed, for example to support programme monitoring and evaluation. Much of the research on hilsa conducted has not been published in accessible formats (Islam et al. 2016b) and local authority interviewees said that documentation of the incentive-based hilsa conservation programme has been limited.

Knowledge gaps relating to social components of hilsa management also need to be addressed. Local authority interviewees called for a better understanding of the whole hilsa supply chain (covering the middlemen, fishers, service providers, retailers, exporters and consumers) to identify key constraints and bottlenecks. They said that a conceptual understanding of programme implementation, sustainability, management and community benefits was lacking. Dewhurst-Richman et al. (2016) add that there are little baseline social or economic data available for the fishery and that a better understanding of what drives illegal behaviour (eg fishing during ban periods) is needed.

A better understanding of the impact of climate change on fisheries in Bangladesh is needed. The government has identified the data needed to support its 7th Five Year Plan and the attainment of the Sustainable Development Goals (BBS 2016) in the context of natural resource management challenges and also climate change, but does not connect these two issues.

Community-level interviewees said that political leaders, policymakers, planners and those involved in programme implementation lacked the knowledge they need for effective incentive-based hilsa conservation programme implementation. Local authority interviewees added that awareness amongst political leaders about the benefits of EbA needs to improve, as government tends to prioritise economic growth (with associated industrial effluent and waste dumping in riverine ecosystems) over good environmental management. Local authority interviewees said that integration of ecosystem-based research into higher education, which would facilitate programme replication elsewhere, was weak.

A lack of decentralisation

A lack of decentralisation, and little support for bottom-up processes, made implementation difficult. Local authority and programme implementing partner interviewees described how this results in district levels and below having little power. Programme implementing partners felt fisher community associations with support and supervision from government, provision of a legal basis and with links to the DoF were needed. Little devolution occurs in Bangladesh, however, and it is currently very hard for local voices to reach higher levels of policy and planning. Dewhurst-Richman et al. (2016) and Islam et al. (2016a; 2016b) argue that more decentralised governance structures could help address many of the challenges faced by the programme, such as compliance with fishery regulations, illegal fishing and bribery of local enforcement officers. They could also reduce transaction and administration costs, increase awareness of regulations and improve institutional frameworks. Islam et al. (2016a) add that the top-down management approach applied to sanctuary establishment has limited community engagement, and that this needs to change because "fishers' involvement is key to the success of sanctuaries". The fishers interviewed by Islam et al. (2016a) supported a co-management approach to sanctuary management, an approach also supported by Bladon et al. (2016b).

Insufficient capacity and resources

Interviewees felt weak national-level institutions and insufficient manpower, resources (including financial resources), technical and project management skills, and capacity at different levels were major barriers to programme implementation. Islam et al. (2016b) argue that "while the 1998 National Fisheries Policy gave the responsibility for conserving and managing resources to the DoF, it has not yet provided the necessary capacity or mechanisms to carry out this mandate". Interviewees said key stakeholders lacked the authority to take the actions needed or planned. Covering the cost of the incentive payments is also challenging for the Bangladesh government, which is why other sources of finance – such as a Hilsa Conservation Trust Fund – are being explored.

Limited cross-sectoral and transboundary collaboration

Interviewees felt that insufficient cross-sectoral institutional and inter-ministerial collaboration, as well as weak collaborative cross-sectoral legal frameworks, were barriers to programme implementation. Bladon et al. (2016a) argue that links between the various agencies involved in hilsa management are weak and Dewhurst-Richman et al. (2016) call for more cross-sectoral coordination and cooperation.

There is a memorandum of understanding on hilsa management with India, but transboundary river management between India, Myanmar and Bangladesh needs to be improved. The lack of a regional transboundary institutional framework for management, and the lack of financial capacity to administer such a large-scale initiative should it exist, is a major challenge to managing hilsa across its habitat (Dewhurst-Richman et al. 2016).

Poor donor support

Interviewees felt donor support for EbA could be improved. Interviewees at all levels reported that more donor support for EbA research, policy improvements and implementation was needed. National-level interviewees emphasised the need to implement a multi-country EbA pilot project, and for knowledge enhancement and updated policies relevant for EbA initiatives. Local authority-level interviewees emphasised the need for research on fish (such as hilsa) that migrate across national boundaries, and for the implementation of an EbA programme involving government and NGOs to deliver sustainable benefits using payments for ecosystem services. Programme implementing partner interviewees emphasised the need for donor support with awareness-raising on hilsa conservation and transboundary population management, and for programme implementing partner institutional capacity building. Community-level interviewees said donors should support community institutional development, and emphasised the need for a programme for the socioeconomic development of the fishing community, especially sustainable livelihood provision for women.

Inadequate marketing

Local authority interviewees explained how improvements in hilsa marketing are needed. They suggested a 'hilsa e-bazaar' could help ensure better pricing at the local level. Currently, aratdars and mohajans dominate and control the supply chain and reap the most financial rewards (Islam et al. 2016b). Porras et al. (2016) describe the absence of government investment to improve artisanal fisheries and associated marketing facilities. They argue for government investment along the entire value chain – in finance for fishers to outfit their boats, good landing centres, transport, storage, and markets or bazaars. Rahman et al. (2014) also argue that more efforts to penetrate high-value consumer markets, combined with a robust hilsa conservation programme, could realise greater profits.

Local and district-level opportunities for implementing the initiative and EbA in general

All interviewees noted how government had prioritised the incentive-based hilsa conservation programme. This provides a major impetus for programme implementation at the local level and also implementation of EbA more generally, should the programme be incorporated into adaptation planning responses. Local authority interviewees stated that government support for the programme was apparent within union parishads (the smallest rural administrative and local government unit), and above this level within the upazilas (sub-units of districts) too. Interviewees felt local government was really committed to the programme, and that some officials were 'championing' and had capacity to support programme implementation.

All interviewees mentioned the importance of providing appropriate incentives to motivate community involvement and action. Programme incentives (rice), along with alternative income-generating activities and increases in hilsa production levels, meant many communities supported the programme

and the fishing restrictions that accompany it, as they saw clear benefits from its implementation. Grass-roots non-government organisations were also supportive and a national media campaign – both print and electronic – helped raise awareness about programme benefits. Dewhurst-Richman et al. (2016) argue that the incentives complement punitive measures under existing marine and fisheries conservation and management structures, reduce the negative impacts of the programme on those who are particularly vulnerable, and promote behavioural change.

Despite the challenges of weak governance mentioned earlier, national-level and programme implementing partner interviewees mentioned how local institutions, and also local governance structures and bylaws, supported programme implementation. Central government prioritisation of the programme has helped ensure district- and local-level officials (in the DoF, coastal police, etc) work together. Established upazila fisheries committees, headed by upazila fisheries officers, are involved in programme implementation. Local-level administration units are already functioning, and the government conducts annual needs-based capacity building programmes for them. Local institutions such as community fisher associations are operational, have some capacity and support the programme aims. Community interviewees said that fisheries policies, laws and regulations exist and can be reviewed and amended to facilitate programme implementation.

National-level opportunities for implementing the initiative and EbA in general

As at the local level, interviewees noted how national government had prioritised the incentive-based hilsa conservation programme, providing a major support to implementation. National institutions were very active and officials had championed this 'flagship' initiative. National-level interviewees felt that policies and legislation were in place to support sustainable fisheries management. For example, the Protection and Conservation of Fish Act (Act No. XVIII of 1950), the Marine Fisheries Ordinance (Ordinance No. XXXV of 1983) and the Protection and Conservation of Fish Rules (1985) have been amended (in part due to work under the Darwin-funded hilsa project) to accommodate the fishing bans and sanctuary establishment in riverine and marine areas (Islam et al. 2016b). Government support emerged in part from the opportunity for policymakers to secure political benefits as well as social and environmental gains. This prioritisation provides an opportunity for EbA implementation, should the programme be incorporated into national adaptation planning.

A number of policies and strategies address climate change and EbA at the national scale.

- The ***National Adaptation Programme of Action*** (NAPA) was submitted to the UNFCCC in 2005. It contains 15 priority adaptation interventions, the first of which involves community-based coastal afforestation which can be classified as EbA, while others have a strong ecosystem basis. The NAPA was revised in 2009.
- The ***Bangladesh Climate Change Strategy and Action Plan*** was first developed in 2008 and then updated in 2009. This document lacks an explicit focus on EbA but refers to some strategies and projects, such as coastal reforestation and developing climate-resilient cropping systems or fish varieties, that relate to EbA. To implement the Bangladesh Climate Change Strategy and Action Plan, the government established two funds: the Bangladesh Climate Change Trust Fund (BCCTF) with government resources, and the Bangladesh Climate Change Resilient Fund (BCCRF) with donor support.
- The ***Intended Nationally Determined Contribution*** includes EbA.
- The ***National Environment Policy*** (revised in 2013) addresses the importance of ecosystem services in terms of contributions to the national economy, and ecosystem-based management of environment and climate change impacts in hilly, coastal and marine ecosystems.
- The ***National Biodiversity Strategy and Action Plan***, 2004, has been adopted to conserve and restore national biodiversity for the wellbeing of the people and also to maintain and improve the stability of ecosystems.

Bangladesh is also a world leader in practical experience with community-based adaptation, and has a number of EbA projects (Rahman 2014). The Bangladesh Climate Change Trust Fund has developed considerable high-level sectoral expertise on climate change issues which, as the Fund closes, will be mainstreamed into Ministry of Finance planning and budgetary processes.

National and local authority-level interviewees also said that relevant national institutions were in place, and that collaboration/cooperation between them was occurring. Because of the centralised nature of governance in Bangladesh, lower levels of government fall into line, making coordination easier.

Is the initiative sustainable?

Most interviewees agreed that the policy, institutional and capacity support available at the national and local levels was enough to ensure programme sustainability over the long term. Central to this was government support and the fact that the programme has been mainstreamed into, and depends on, permanent government structures and local-level planning and management processes. There is national-level institutional, policy and legal support for programme implementation and for capacity building and institutional development.

Secure long-term finance is needed, however, and programme implementing partners mentioned that embedding the programme in government institutional strategies, plans and budgets would enhance the prospects for long-term sustainability. The costs of the incentives (rice) provided under the incentive-based hilsa conservation programme are currently covered by a government social safety net programme, and there are concerns about the susceptibility of this programme to cancellation in the event of political instability or major government changes. These are being partially addressed by plans to develop a National Hilsa Conservation Fund, which would ensure funding for the financial compensation scheme in the years to come (Islam 2016; Dewhurst-Richman et al. 2016; Bladon et al. 2014; Bladon et al. 2016a).

Interviewees emphasised that increases in hilsa production levels had secured national-level and community-level support for the programme, which would in turn support sustainable implementation. One interviewee and various publications emphasise, however, that it was still uncertain whether the programme had caused the observed increases in hilsa catches (Bladon et al. 2016a). Islam et al. (2016b) and Islam et al. (2014) also express concerns about fishers' socioeconomic conditions and the long-term sustainability of Bangladesh's hilsa fishery. Whilst implementing partners mentioned that fisher involvement in the programme has encouraged sustainability, several interviewees added that the lack of local programme ownership could pose a challenge to its sustainability and that fishers were keen to either manage the programme themselves or to get more involved in management with support from the DoF (if rice incentives remain in place). Some early alternative income-generating ideas were also unsuccessful – for example, women sold the sewing machines they were given for non-productive consumable goods as they did not know how to sew – but the Darwin-funded hilsa project helped ensure benefits from alterative income-generating activities were more sustainable (Haldar and Ali 2014; Dewhurst-Richman et al. 2016).

Some national-level interviewees and programme implementing partners felt that local knowledge of and capacity levels in hilsa fish conservation were now sufficient to ensure programme sustainability.

Programme message dissemination to the wider community helped with this. Mome (2007) argues, however, that the hilsa fishery is over-exploited and that the fishing effort required to ensure the hilsa fishery attains maximum sustainable economic benefits was about a third of the effort observed in 2007. And uncertainty about the impacts of climate change on hilsa populations remains.

Opportunities for replication, scaling up or mainstreaming the initiative or for influencing policy

The incentive-based hilsa conservation programme is already large-scale and mainstreamed into government planning processes, but national-level, local authority-level and implementing partner interviewees all felt there were opportunities for further replication, scaling up or mainstreaming of programme activities. Those mentioned included the following:

- Changing attitudes amongst government policymakers and planners, as a result of programme success, could lead to the programme being scaled up and further opportunities for embedding in institutional priorities and implementation. The DoF is looking at implementing similar programmes elsewhere. Replication in other ecosystems, such as the Sundarbans, haor (backswamp) basins, and the Chittagong hill tracts, is possible. Implementing partner interviewees cautioned, however,

that planner and policymaker understanding of the EbA concept needs to improve for potential to be achieved.

- In addition to adjustments to the two fisheries policies listed above, further national policy change would be beneficial. For example, programme work could be incorporated into the National Adaptation Plan, Intended Nationally Determined Contribution, and Convention on Biodiversity policy responses. Fisheries management policies and plans could also better address climate change issues more generally.
- Changes in donor policy, and hence in-country funding, are needed. For example, USAID has a major US$15 million Enhanced Coastal Fisheries (EcoFish) project building on the Darwin-funded hilsa project work. This aims, amongst other things, to strengthen fisheries' adaptive co-management, although it does not address climate change directly.
- New tools and techniques for incentive-based fisheries management have been developed – including, for example, a programme monitoring and evaluation system – which can support replication.
- Stronger links have been forged between the relevant government bodies, which can support future cross-sectoral planning.
- Meetings with the Indian and Myanmar government have been initiated, in recognition of the fact that much of the hilsa fish stock falls outside Bangladesh's borders and also in shared areas such as the Bay of Bengal. In May 2016, delegates from Myanmar and India (West Bengal State) attended a workshop in Dhaka where they agreed on the need for enhanced collaboration between countries and the development of a common hilsa management system.
- Various stakeholder groups, especially the fishing community, are now more organised than they were previously.

Summary and conclusions

The incentive-based hilsa conservation programme was not designed as an EbA project. It did not consider climate change in its planning and implementation, and it was not part of an overall adaptation strategy. Those interviewed under this research agreed, however, that it led to improvements in adaptive capacity and resilience, and reductions in vulnerability. It thus meets three of the four basic criteria for an EbA project (CBD 2009; CBD 2010) and has therefore been assessed along with other EbA projects as part of this broader study on EbA effectiveness. This report shows that given the adaptation benefits provided by the programme, it could be considered for inclusion in future climate change policy and planning responses in Bangladesh.

Although the programme has not been conclusively shown to lead to hilsa catch increases, this seems a strong possibility. And these catch increases, along with programme incentives (provision of rice and alternative income-generation strategies), have strengthened local adaptive capacity by increasing available human, social, physical, natural and financial capital, particularly amongst fishers (who are one of the poorest and most vulnerable groups in Bangladesh), but also more widely given the national importance of hilsa. Fishers have also been affected most by the programme's fishing restrictions, however, and other stakeholders in the fishing industry may have experienced relatively greater improvements in adaptive capacity (mostly through income increases). Improvements in adaptive capacity were widespread with few trade-offs in terms of where they accrued. Improvements could also be long-term but are dependent on whether the programme can be continued.

A large number of social co-benefits also emerged from the programme, including disaster risk reduction, livelihood diversification, and increased food security, all of which can also be considered to contribute indirectly to adaptive capacity. Programme incentives provide clear immediate short-term benefits to complement the longer-term benefits from fish catch increases. They demonstrate how 'payments for ecosystem services' can provide a model for securing finance for EbA where regulation alone might be ineffective (Mohammed 2012). But as with the changes to adaptive capacity mentioned above and despite efforts made to reach the most vulnerable, social co-benefits relating to increases in income may have benefited others in the fishing industry more than the fishers themselves.

Whilst some efforts were made to incorporate local knowledge into the programme and to adopt participatory processes in design and implementation, the programme planning process was largely top-down. Better community involvement could have improved planning and implementation and secured greater improvements in adaptive capacity.

A number of factors threatened local ecosystem resilience and hilsa catch levels, most notably climate change, although the impacts of this are unclear. Climate change and changes to water flow and river morphology, overfishing and pollution could all lead to tipping points in hilsa production, but little is known about this. The large area over which hilsa migrate, including across national borders, provides a management challenge. However, it is likely that the programme has increased ecosystem resilience and service provision (ie hilsa catch levels). These ecosystem benefits extend far beyond programme implementation sites due to the large area over which hilsa migrate, and are potentially long-term if the programme continues, with no discernible trade-offs in terms of ecosystem impacts.

The financial costs and benefits of the incentive-based hilsa conservation programme vary for different stakeholder groups, and it is unclear whether or not the programme is of overall financial benefit to fishers. Compensation from the incentive scheme may not have been sufficient to cover losses from fishing restrictions, and there were a number of (mostly localised) unintended negative economic impacts from the programme. These losses may have been partly offset by catch improvements, the broader economic benefits of which were felt throughout Bangladesh. For government, however, the costs of running the incentive schemes were more than offset by the income from increases in tax revenue, even though costs and benefits were accrued in different departments.

At the local/upazila level, insufficient capacity, technical skills, manpower, logistical support and financial resources were key barriers to implementing the incentive-based hilsa conservation programme and EbA in general. Corruption, weak governance and a lack of transparency were also key concerns, along with weak local institutions and leadership at times. Inadequate cooperation between institutions and departments was problematic in the context of management, implementation and policy support, as were high levels of poverty and indebtedness. At the national level, inadequate government policies, particularly relating to fisheries, climate change and EbA, made programme implementation and implementing EbA problematic, along with knowledge gaps relating to hilsa biology and behaviour, social issues relating to hilsa management, and the impact of climate change on fisheries in Bangladesh. A lack of decentralisation, insufficient capacity and resources and limited cross-sectoral and transboundary collaboration also proved challenging, along with few opportunities to market hilsa.

Opportunities for implementing the incentive-based hilsa conservation programme and EbA in general included government prioritisation of the programme, the presence of appropriate incentives, established local institutions and bylaws, and a number of national level institutions, policies and legislation to support sustainable fisheries management, climate change and EbA (although these issues were rarely addressed together).

Programme sustainability seems likely, in part because it was developed without donor assistance and is already mainstreamed into government structures, policies and processes. But this mainstreaming also means it is dependent on continued government support and funding, which may not be forthcoming in the event of major government changes. Great fisher involvement in the programme could improve sustainability. Although the programme is already mainstreamed into government planning, many further opportunities for replication and scaling up exist.

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Ecosystem-based adaptation (EbA) is the use of biodiversity and ecosystem services as part of an overall strategy to help people to adapt to the adverse effects of climate change and promote sustainable development. This report presents the results of using our Framework for Assessing EbA Effectiveness at the Incentive-based Hilsa Conservation Programme, Bangladesh. The findings will be combined with those from 12 other sites in 11 other countries to help show climate change policymakers when and why EbA is effective.

Project Report

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