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Enhanced Coastal Fisheries in Bangladesh II

Annual Report

January 1, 2021 –December 31, 2021

Submission Date: January 31, 2022

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WorldFish

ENHANCED COASTAL FISHERIES IN BANGLADESH II (ECOFISH II)

ANNUAL REPORT

YEAR 2

January 2021–December 2021

Submission Date: January 31, 2022

Contract Number: PIO Grant BFS-G-11-00002
Activity Start Date and End Date: December 1, 2019 to November 30, 2024
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List of abbreviations

AIGA	Alternative Income Generating Activity
BFRI	Bangladesh Fisheries Research Institute
BFDC	Bangladesh Fisheries Development Corporation
BORI	Bangladesh Oceanographic Research Institute
BSMRAU	Bangabandhu Sheikh Mujibur Rahman Agricultural University
CVASU	Chattogram Veterinary and Animal Sciences University
CFG	Community Fish Guard
CS	Citizen Scientist
CSG	Community Savings Group
DOF	Department of Fisheries
EAFM	Ecosystem Approach to Fisheries Management
ECOFISH-BD	Enhanced Coastal Fisheries in Bangladesh
ECOFISH II	Enhanced Coastal Fisheries in Bangladesh II
FCG	Fisheries Conservation Group
FMC	Fisheries Management Committee
EMMP	Environmental Mitigation and Monitoring Plan
GIS	Geographic Information System
GOB	Government of Bangladesh
GSI	Gonadosomatic Index
HCDF	Hilsa Conservation and Development Fund
HFMAP	Hilsa Fisheries Management Action Plan
HCG	Hilsa conversation group
HGG	Hilsa Ghat Group
IUU	Illegal, Unreported and Unregulated
IRs	Intermediate Results
IUCN	International Union for the Conservation of Nature
LCF	Landing Center Facilitator
MEL	Monitoring, Evaluation and Learning
MPA	Marine Protected Area
MRE	Meghna River Ecosystem
MSP	Marine Spatial Plan
MoFL	Ministry of Fisheries and Livestock
MoFECC	Ministry of Forest, Environment and Climate Change
NGO	Nongovernmental organization
NSTU	Noakhali Science and Technology University
PES	Payment for Ecosystem Services
SUST	Shahjalal University of Science and Technology
USAID	United States Agency for International Development
USG	United States Government
ZOR	Zone of Resilience (Cox's Bazar)

Contents

1 Program overview/summary

Program name:	Enhanced Coastal Fisheries in Bangladesh II (ECOFISH II)
Activity start and end date:	December 1, 2019 to November 30, 2024
Name of prime implementing partner:	WorldFish
[Contract/Agreement] number:	PIO Grant BFS-G-11-00002
Name of subcontractors/sub-awardees:	BSMRAU, CVASU, NSTU, SUST, IUCN and Shushilan
Major counterpart organization:	Department of Fisheries (DOF), Ministry of Fisheries and Livestock, Government of Bangladesh (GOB)
Geographic coverage:	*Barishal Division*: Barishal, Patuakhali, Barguna and Bhola districts *Dhaka Division*: Shariatpur District *Chattogram Division*: Chandpur, Lakshmipur, Noakhali and Cox's Bazar districts
Reporting period:	January 1, 2021 – December 31, 2021

1.1 Program description/introduction

1.1.1. Introduction

Enhanced Coastal Fisheries in Bangladesh II (ECOFISH II) is a five-year transformative project of Enhanced Coastal Fisheries in Bangladesh (ECOFISH-BD). It is funded by the United States Agency for International Development (USAID) and implemented jointly by WorldFish and the Department of Fisheries (DOF) in Bangladesh. Along with the DOF, the project has developed partnerships with various public universities, conservation organizations and nongovernmental organizations (NGOs). ECOFISH II supports the DOF and local fishing communities in establishing collaborative management ("co-management") following the Ecosystem Approach to Fisheries Management (EAFM) framework, focusing on hilsa shad and other coastal fisheries resources. The project also supports host fishing communities in USAID's Zone of Resilience (ZOR) around Cox's Bazar and the Teknaf Peninsula as well as fishing communities in the Meghna River Ecosystem (MRE) and the Nijhum Dwip Marine Protected Area (MPA). The aim of the project is to enhance ecosystem resilience by establishing effective co-management of coastal fisheries resources in these areas. It focuses on hilsa shad, catfish and other important coastal and marine fish species, and the communities that rely on them. Following the pathway of ECOFISH-BD, ECOFISH II has been enhancing community resilience by improving the savings, livelihoods and coping strategies of host fishing communities in the ZOR, Cox's Bazar as well as marginalized and extremely poor fishers in the MRE and MPA. The project emphasizes the sustainability of the original ECOFISH-BD interventions and adopts its best practices in these regions.

1.1.2. Objective and theory of change

ECOFISH II will contribute directly toward IR2.1 and IR3.2 of the results framework for USAID Bangladesh's Country Development Cooperation Strategy (CDCS). By addressing the results framework, ECOFISH II's theory of change will achieve the project's goal of "improved social and ecological resilience of coastal fisheries in securing equitable food, nutrition and income benefits for fisheries communities by achieving the following two intermediate results (IR) (Figure 1):

IR1: Improved management and governance of natural resources that form the foundation of fisheries

Sub-IR1.1: Improved science outputs for decision-making

- ecosystem health assessed
- biodiversity assessed and conserved
- fisheries dynamics monitored.

Sub IR1.2: Improved adaptive co-management and fisheries governance

- co-management institutions strengthened
- EAFM mainstreamed and strengthened
- fisheries governance improved.

Sub IR1.3: Improved policy support

- Hilsa Fisheries Management Action Plan (HFMAP) implemented
- MPA legal framework formulated
- Hilsa Conservation Fund (HCF) and Payment for Ecosystem Services (PES) introduced
- transboundary legal framework formulated.

IR2: Improve equity and resilience of food, nutrition and livelihood benefits

Sub-IR 2.1 Improved livelihood resilience of coastal fishing communities

- livelihood capacity and options diversified
- women's access to finance improved
- access to improved technologies and market links strengthened.

The project will maintain and increase the productivity of fisheries, conserve biological diversity, enhance ecosystem productivity and improve the economic well-being of fishers in the ZOR and MRE. ECOFISH II aims to enhance ecosystem resilience by establishing effective co-management in hilsa shad (*Tenualosa ilisha*) sanctuaries and the coastal ZOR. The project's objectives focus on (1) improved management of natural resources, targeting biodiversity conservation and leading to indirect adaptation benefits, and (2) enhanced adaptation capacity and resilience to shocks of the reliant fisher communities (Figure 2). Moreover, the activity will improve gender equity, create opportunities for youths and improve environmental compliance at every stage of implementation for all stakeholders, communities and habitats involved. ECOFISH II implemented the planned activities following its Year 2 Annual Work Plan 2021.

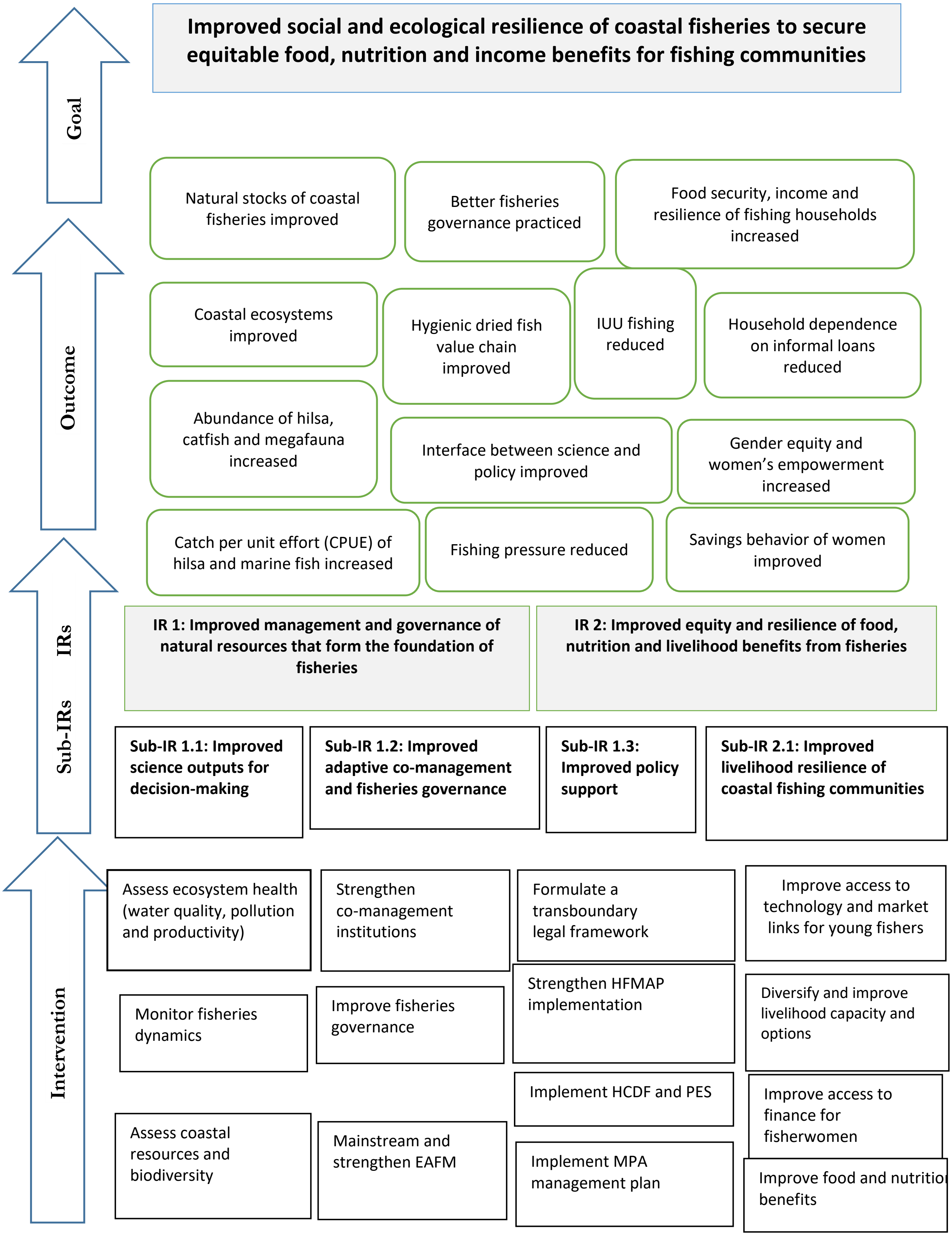

Figure 1 ECOFISH II's TOC (version 1).

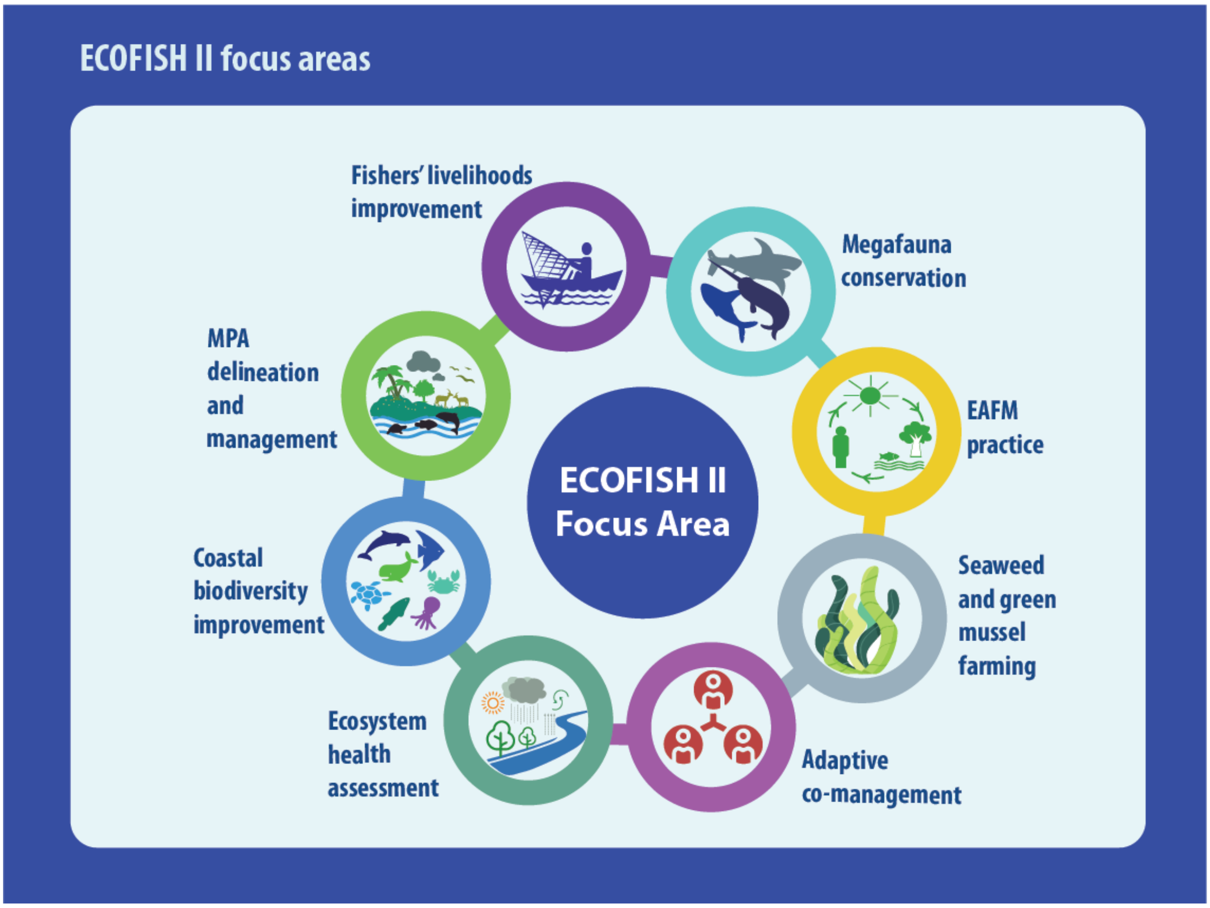

Figure 2 ECOFISH II's focus areas.

1.1.3 Theater of operation

ECOFISH II's theater of operation has mainly covered the areas of the ZOR, Cox's Bazar, the MRE and the Nijum Dwip MPA (Figure 3). The ZOR includes the area of Cox's Bazar and the coasts of the Teknaf Peninsula as well as the Naf River/Estuary ecosystems, including the Upazilas of Teknaf, Ukhiya, Ramu, Cox's Bazar Sadar and Moheskhali. The MRE includes the hilsa sanctuary areas located in the Meghna, Tetulia, Gajaria, Andharmanik and Padma rivers in the districts of Chandpur, Laxmipur, Barishal, Bhola, Patuakhali and Shariatpur. The Nijhum Dwip MPA area specifically includes the declared 3,188 km^2 at the mouth of the Meghna and Tetulia rivers toward the Bay of Bengal around the Nijhum Dwip island areas (Figure 3). The Nijhum Dwip MR/MPA directly impacts the lives and livelihoods of the people living in 28 unions under five Upazilas (Hatiya, Manpura, Charfassion, Galachipa and Rangabali) within the districts of Noakhali, Bhola and Patuakhali. Because of this, ECOFISH II included the direct impact area of Nijhum Dwip MPA in its ToO.

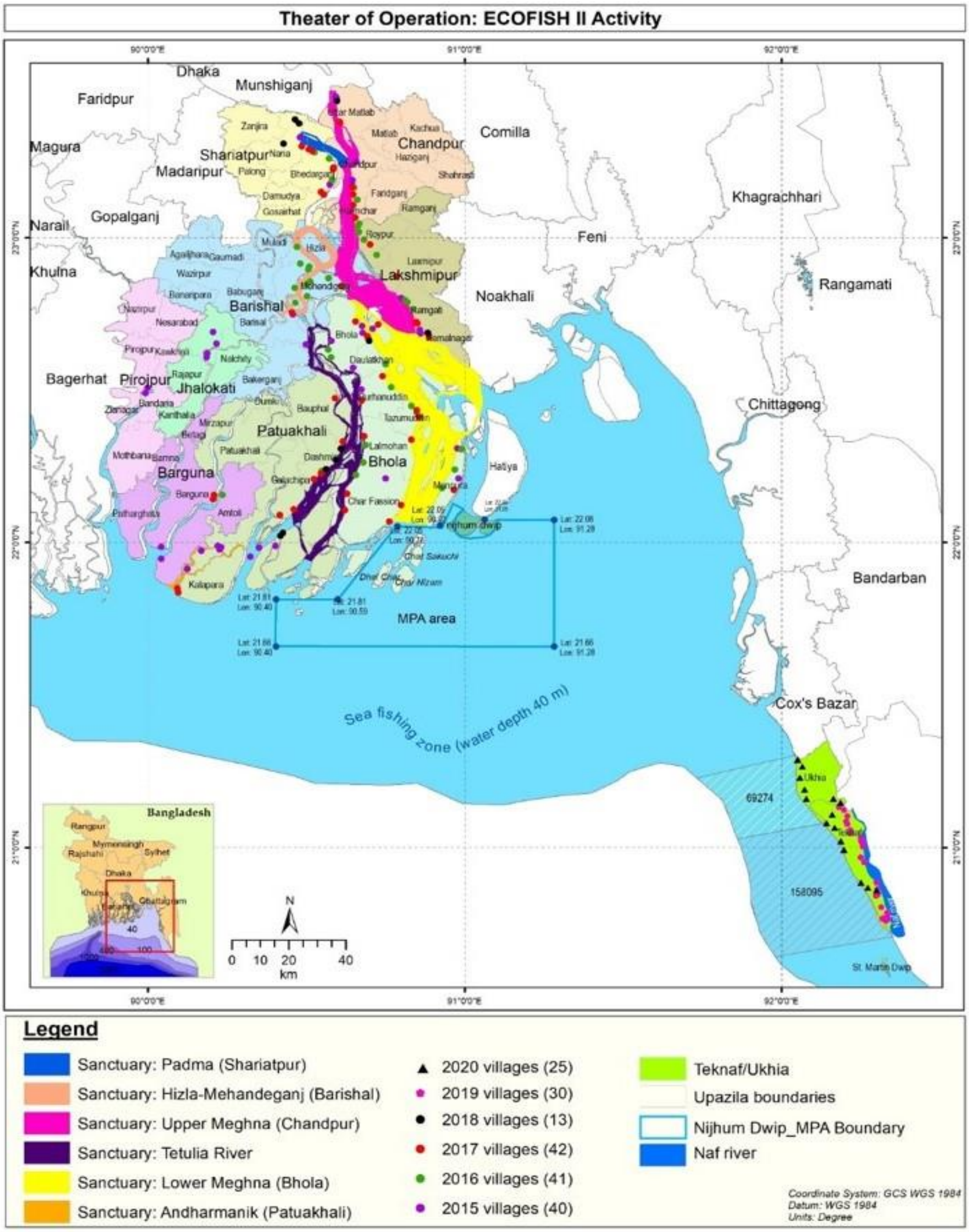

Figure 3 ECOFISH II's theater of operation in the MRE, MPA and ZOR.

2 Activity implementation progress

2.1 Progress narrative

This annual report describes the accomplishments and achievements of ECOFISH II for the period of January-December 2021. Activities were implemented using key partnerships with the NGO Shushilan, Chattogram Veterinary and Animal Sciences University (CVASU) and the Shahjalal University of Science and Technology (SUST), Noakhali Science and Technology University (NSTU) and Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), International Union for the Conservation of Nature (IUCN) and Sher-E-Bangla Agricultural (SAU) and a private partner Falcon International Ltd.

Target activities on ecosystem health management, coastal biodiversity conservation and monitoring coastal fisheries dynamics were achieved under the first Sub-IR1. Five universities (BSMRAU, CVASU, NSTU, SAU and SUST) played important roles in achieving the science outputs. The BSMRAU measured nutrient concentrations, focusing on dissolved inorganic phosphate and dissolved inorganic nitrogen, and assessed seasonal variations in plankton composition in different locations of the Lower Meghna River and the Nijhum Dwip MPA.

To improve the coastal ecosystem health, the ECOFISH II field teams collected 12.4 tons of plastic, net and other garbage materials from the sea beaches and other coastal shore areas engaging 100 local youths known as Blue Guard. In partnership with the CVASU, ECOFISH II assessed fish biodiversity and the spawning season by identifying fish larvae microscopically and using DNA barcoding technology. Through DNA barcoding, identification of 16 species were confirmed, of which three species were newly reported.

The new MPA delineation activities in the area of the Naf River and St. Martin's Island were conducted in partnership with the SUST. Based on socio-ecological assessment and stakeholder consultations, the project identified 2,992 km^2 potential area of the Naf–Saint Martin Peninsula for MPA declaration with four restriction options (no-entry, no-take; entry, no-take; partial reserve and general reserve zones).

Fish landing in quantity, species composition and wholesale price were regularly monitored in the major landing centers in ZOR and MRE focusing on the Bangladesh Fisheries Development Corporation's (BFDC) centers, Cox's Bazar. In ZOR, fish landing records of six LCFs indicated 40 predominant species in the commercial marine fishery, of which hilsa dominated the landings. Landing of the smaller adult hilsa (<1kg size) was the highest (>266 t), followed by premium size hilsa (>1 kg size) and 20 other important marine fish species. On-board real-time fish catch was monitored engaging 40 Citizen Scientists (CSs) of which 30 CSs have worked in ZOR covering CoxB Sadar, Ukhiya, Moheshkhali and Teknaf and the remaining 10 CSs collected data from the Nijhum Dwip MPA. Based on the CS's data, catch per unit efforts (CPUEs) of 40 species/groups in major intervened areas were estimated, and the highest CPUE for all species was found in CXB Sadar, (1,837 kg/boat/day) and the lowest was found in Teknaf (163 kg/boat/day), and the average overall CPUE was 715 kg/boat/day.

ECOFISH II and project partner Shushilan worked concurrently both in ZOR and MPA to establish adaptive co-management model. In the second year, 100 FCGs were formed in the ZOR and MPA areas while 96 came from the first year. In total, the team conducted 600 training sessions for 15,663 participants, 23% of whom were women, for 100 FCGs (12,798 in the ZOR and 2,865 in the MPA). About 414 FCG quarterly training meetings were conducted for Y1 beneficiaries that comprise a total of 10,389 participants, including 1,018 women (25%). Simultaneously, 77 PGs (producer groups) meetings were conducted in the ZOR area with 1,688 participants of which all the participants were women. ECOFISH II, however, this year moves farther towards landing center-based artisanal fisheries resource management in the ZOR area within the scope of co-management. In October 21, 2021, a large-scale consultation meeting with 40 artisanal fishers was held in Cox's Bazar.

ECOFISH II is grounded on the EAFM approach. To follow the EAFM framework more explicitly, activities in Year-2 focused on facilitating multi-stakeholder processes for MPA management with a focus on updating the MSP. A preliminary list of 76 biophysical variables was developed. Then, 17 landing stations and 27 boats were surveyed. Among its activities, IUCN conducted a megafauna survey during the last quarter of 2021. Total 14 transects covering 330.88 km were surveyed where 69 individuals were sighted. Two locations (21.835082, 91.083193, and 21.852466, 91.078239) that had the highest number of sightings of Irrawaddy Dolphin were identified as hotspots or habitats for this species. Several MPA zoning consultation meetings were held at Char Montaz, Char Kukrimukri, Nijhum Dwip, and Monpura unions.

To improve fisheries governance, ECOFISH II assessed the level of IUU fishing in the artisanal fisheries of the Bay of Bengal. Results suggest that every year, industrial trawlers catch 37,532 t of fish illegally in the waters below 40 meters' depth and within marine protected areas. The unreported take-home catch of small-scale fishers is 376 kg per person per year, resulting in conservative estimates of 3,210 tons for all six coastal districts evaluated. Fisheries officers report 76% of the landed artisanal fish catches are legal, while 24% are illegally caught. Every year, about 29% of illegal fishing nets are seized. This illegal practice can be cut down with extensive capacity building and awareness programs such as boat skipper training. To do so, total 485 boat skippers were trained in ZOR, MPA, and MRE areas. Besides, CFG continues its work towards biodiversity conservation and fisheries resource protection.

ECOFISH II team provided livelihood support to 3,000 HHs in 2021. The fishing households used these supports as startup capital to run their household-level enterprises. The support in turn will give benefits to the 18,000 household members (50% women). Around 48% of households received goats followed by the chickens & ducks (42%) where only 7% of households received support for doing small business. ECOFISH II supplied 5-6 varieties of winter vegetable seeds (Bottle Gourd, Beans, Red Spinach, Tomato, Chili, and Brinjal) to 2,472 targeted fishing households. Around 595 household members (40% women) in 22 batches received the capacity-building training organized at the fishing villages. ECOFISH-II formed 28 Community Savings Groups (CSGs) with 735 fisherwomen in ZOR and MPA in 2021. Fifty-two (52) CSGs saved US$ 25,754, including their own savings and matching funds. Around 15 CSG members received US$ 890 to begin cattle and poultry rearing, grocery, and dried fish businesses.

With the assistance of CVASU and Falcon International Limited, ECOFISH II introduced community-led seaweed farming practice in the coastal waters in Cox's Bazar, Bangladesh engaging coastal fishermen and women. In 2021, five farming sites were selected for seaweed farming in Cox's Bazar. *Gracilaria* (red seaweed) was considered for seaweed farming with four farming systems. The project selected 200 men and women and provided training in seaweed cultivation techniques, harvesting, processing, and marketing. A total of 9350 kg (wet weight) of seaweed was collected till the end of December.

Currently, 102 fisher's households are actively engaged in green mussel farming and monitoring the culture systems. CVASU and Falcon International Limited organized training programs in three farming sites prior to establishing the three culture systems. Green mussel harvesting has not yet been completed from any site because the green mussels have not yet reached harvesting size.

ECOFISH II introduced safe and hygienic dried small pelagic fish production technology to the underprivileged fishers' women to ensure women empowerment, income, food and nutrition security. So far, 1,014 fishers' women trained and supported hygienic dried fish production using marine pelagic small fishes in Cox's Bazar. In two cycles, the project delivered 23,546 kg raw fish to 975 women producers. The women artisans produced 7,147 kg of dried fish, of which 5,168 kg was sold in local markets. After the production season concludes, the economic analysis will be completed. In addition, ECOFISH II provided 2,750 kg dried fish and 250 kg fish powder among 3,000 fishing households as supplementary nutritional food aid to the fishing communities to complement the government's rice support during the 65-day marine fishing ban.

The project's Monitoring, Evaluation and Learning (MEL) team generated community-level information covering all the villages where the project is working in and integrated the information into the GIS map and Google Earth maps. The MEL team conducted periodic assessments to assess project performance against six standard USAID indicators and seven custom indicators. In February 2021, ECOFISH II assisted USAID in conducting a Data Quality Assessment (DQA). A three-person USAID team visited Cox's Bazar to assess the data quality and performance of the ECOFISH activities in the field level.

As communication outcomes, the project produced 68,000 leaflets and 274,000 posters on Jatka conservation, a 65-day marine fishing ban, a 22-day brood hilsa fishing ban, biodiversity conservation and MPA management, catfish conservation, and a one-pager on dried fish, sea weed, and green mussel. The project organized a media visit, received 98 media coverages, published 13 op-eds in leading Bangladeshi media, organized live TV talk show on: "Hilsa and Marine Fisheries & Development: Potentials & Challenges" & "Impacts of 65 days fishing ban on marine biodiversity and fisheries conservation," organized virtual round table discussion program titled "Role of Hilsa in Blue Economy & Fishers' Livelihoods," and organized a webinar. In addition, 41 pieces of social media contents were created and published on various aspects of key interventions and thematic issues.

2.2 Implementation status

2.2.1 IR1: Improved management and governance of natural resources that form the foundation of fisheries

To achieve the IR1 component, science outputs for decision-making (Sub IR1.1), steps were taken for the coastal ecosystem health assessment, marine biodiversity assessment and conservation, and marine fisheries dynamics assessment activities in-line with fisheries blue economy improvement. For improved adaptive co-management and fisheries governance (Sub IR1.2) in the ZOR and MRE regions focusing on the hilsa, catfish and other important coastal fisheries, co-management building blocks formation and skill development activities were implemented. The achievements of different IR1 activities from January to December 2022 (Year 2) are summarized in Table 1.

Table 1 Summary of progress under IR1. (completed in progress yet to start)

Activities	Progress	Status
Sub-IR1.1: Improved science outputs for decision-making		
Ecosystem health assessment	• ECOFISH II team in partnership with BSMRAU and SAU conducted spatiotemporal analysis of water quality focusing on nutrient inflow and phytoplankton concentration in the South-western Rivers and MPA, and identified Char Kukrimukri as a nutrient hub and biodiversity hotspot that needs management attention. • To improve coastal ecosystem health, collection and safe disposal of plastic, net and other garbage materials were continued, and 12,432 kg of the waste materials from the Cox's Bazar and Kuakata sea beaches were removed engaging 100 local youths as Blue Guards.	

Activities	Progress	Status
Biodiversity assessment and conservation	• In partnership with CVASU, fish biodiversity assessment through fish larvae sampling were continued, and 37 larval fish families were identified. • Both the highest diversity index (1.864) and Evenness (1.168) were observed at the Rezu khal estuary. • Through DNA barcoding, identification of 16 species were confirmed, of which three species were newly reported. • Important catfish spawning and nursery grounds, focusing on native Pangas in the lower Meghna region were identified and a GIS map was produced indicating those management focus areas. • The project identified 2,992 km^2 potential area of the Naf–Saint Martin Peninsula for MPA declaration with four restriction options (no-entry, no-take; entry, no-take; partial reserve and general reserve zones).	
Fisheries dynamics assessment	• On-board real-time fish catch was monitored engaging 40 Citizen Scientists (CSs) of which 30 CSs have worked in ZOR covering CXB Sadar, Ukhiya, Moheshkhali and Teknaf and the remaining 10 CSs collected data from the Nijhum Dwip MPA. • Based on the CS's data, catch per unit efforts (CPUEs) of 40 species/groups in major intervened areas were estimated, and the highest CPUE for all species was found in CXB Sadar, (1,837 kg/boat/day) and the lowest was found in Teknaf (163 kg/boat/day) and the average overall CPUE was 715 kg/boat/day. • In ZOR, fish landing records of six LCFs indicated 40 predominant species in the commercial marine fishery, of which hilsa dominated the landings. Landing of the smaller adult hilsa (<1kg size) was the highest (>266 t), followed by premium size hilsa (>1 kg size) and 20 other important marine fish species.	
Sub-IR1.2: Improved adaptive co-management and fisheries governance		
Form and strengthen co-management institutions	• Total 100 FCGs were formed as co-management building blocks in the ZOR and MPA. • Team conducted 600 monthly training sessions for 15,663 participants, 23% of whom were women, for 100 FCGs those were formed in 2021. • Total 414 FCG quarterly training sessions were conducted for Y1 beneficiaries that comprised 10,389 participants, including 1,018 women (25%). • Total 77 producer group meetings were conducted in the ZOR area with 1,688 participants all of whom were women. • Following detailed Ghat profiling, 7 Ghat consultation meetings were held in ZOR. • A regional consultation meeting with 40 artisanal fishers from ZOR was held in Cox's Bazar aiming to understand current practices, identify future opportunities, and develop a platform for fishers.	
Strengthen EAFM	• To facilitate MPA management with MSP planning, 28 KIIs and 6 FGDs were conducted. • Preliminary list of 76 biophysical variables was developed under five categories for MSPs. Total 17 landing stations and 27 boats were surveyed. • About 69 wild animals, including three dolphin species, were recorded along the 14 transects (survey) covering 330.88 km and hotspots of Irrawaddy Dolphin were identified. • In MPA areas, 11,894 boats were surveyed (boat census) to support MSP planning in Nijhum Dwip MPA.	

Activities	Progress	Status
Improve fisheries governance	• ECOFISH II assessed the level of IUU fishing in the Bay of Bengal and found that industrial trawlers annually catch 37,532 t of fish illegally in waters below 40m. • The unreported take-home catch of small-scale fishers was estimated to be 376 kg/person/year, which equals 3,210 t in all six coastal districts. • About 76% of the landed artisanal fish catches were found legal, while 29% of illegal fishing nets were seized in a year. • Total 485 boat skippers were trained in ZOR, MPA, and MRE areas. • CFG continues to work towards biodiversity conservation and fisheries resource management. With DoF approval, 20 more Community Fish Guards (CFG) have been deployed in MPA areas.	
Sub-IR1.3: Improved policy support		
Support HFMAP implementation	• ECOFISH II submitted the revised Hilsa Fisheries Management Action Plan (HFMAP) for 2020 -2030 and advocated for its approval. • For the hilsa fishery to be sustainable, approximately 24 management measures have been recommended.	
MPA assessment and management	• Delineated about 2,992 km^2 potential area of the Naf–Saint Martin Peninsula for MPA declaration with four restriction options • The Nijhum Dwip MPA management plan was submitted to the MOFL via the DOF. The Nijhum Dwip Management Plan has been approved by the Ministry of Fisheries and Livestock (MoFL).	
HCDF and PES introduction	• The HCDF was rolled out to support fishers. The DOF has made lump sum incentives available to CFGs, now and in the future.	
Transboundary legal framework formulation	• Taken steps to strengthen efforts for a transboundary hilsa cooperation in the form of a joint ecological, biological and socioeconomic assessment, while trying to establish a viable transboundary policy platform.	

2.2.1.1 Sub-IR1.1: Improved science outputs for decision-making

To generate high quality scientific information to support decision making for sustainable fisheries management and biodiversity conservations supporting fisheries blue economy as well as mitigation and adaptation of the climate change impacts on the resources. The outputs will help in optimizing marine fishing ban, new sanctuary delineations in the Bishkhali river, new MPA delineation in the St. Martin-Naf and its Management Plan formulation and megafauna conservation guidelines preparation.

2.2.1.1.1 Ecosystem health assessment

In partnership with BSMRAU and SAU, coastal ecosystem health was assessed by evaluating the spatial and seasonal variation of water quality parameters, nutrient inflow and the compositions of plankton species in different locations of the lower Meghna river and the Nijhum Dwip MPA. The assessment explored the impacts of hydrological connectivity on plankton diversity indexes and its seasonal succession. A dataset of 10 water quality parameters was monitored at 12 sites and scientifically analyzed. A multivariate statistical analysis showed a seasonal gradient for the water quality parameters, forming two different groups corresponding to the dry and wet seasons. Among them, the level of dissolved inorganic phosphate was significantly higher in the area of Char Kukrimukri, which is a part of the MPA, indicating the most nutrient-rich area for plankton and fish species diversity. As a result, this biodiversity hotspot needs special attention to sustainably manage coastal resources. In addition, 3D models showed that a freshwater plume was extending southwest, and they also showed enhanced primary productivity through increasing planktonic biomass. A simulation of the surface current and salinity in the MPA were made to better understand the health of the ecosystem in the MRE. Thirty-nine plankton species, including 27 phytoplankton and 12 zooplankton species, were recorded. Analysis of the phytoplankton alpha diversity indices and quantified species diversity of the habitat, indicated the MPA as the highly diversified habitat. The Simpson's index of diversity for the phytoplankton was found the highest in April and the lowest was observed in June.

Ecosystem health improvement

For ecosystem health improvement, the project interventions concentrated on the reduction of plastic and net materials from the sea beaches and other important coastal areas within our ToO. To accelerate the activities, 100 volunteer local youths (25% women) were engaged as ECOFISH Blue Guards and facilitated them to perform those activities (Figure 4). Through this activity, 12.4 tons of plastic, polythese, nets and other garbage materials were removed from the sea beaches and coastal areas covering CXB Sadar, Moheshkhali, Ramu, Ukhiya,Teknaf and Kuakata areas (Table 2). Recently, the Nijhum Dwip MPA coast is also included in the activity (Figure 4).

Figure 4 ECOFISH II Blue Guards are disposing collected plastic waste in the ECOFISH bins.

Table 2 Quantities of different types of wastes reduced from various coastal regions

	Type of Waste Materials				
Area	Plastic Bottle	Polythene	Net Materials	Garbage	**Total**
CXB Sadar	294	-	1070	670	**2034**
Moheshkhali	88	108	24	220	**440**
Ramu	269	29	41	431	**770**
Ukhiya	213	138	258	1041	**1650**
Teknaf	194	-	1057	1959	**3210**
Kuakata	255	864	363	2846	**4328**
TOTAL	**1313**	**1139**	**2813**	**7167**	**12432**

2.2.1.1.2 Biodiversity assessment and conservation

Ichthyoplankton (fish larvae) assessment

In partnership with CVASU, larval fish biodiversity was assessed through round the year monthly fish larvae sampling using Bongo Net in the Naf estuary, Bakkhali estuary, Rezu Khal estuary, Moheshkhali Para coasts were continued, and 37 larval fish families consist of 9704 specimens were identified microscopically. Based on the percentage composition of the larvae, five dominant families were identified as Engraulidae (36.40%), Clupeidae (31.12%), Mullidae (8.93%), Pristigasteridae (4.93%), and Photichthyidae (2.47%). Both the highest diversity index (1.864) and Evenness (1.168) were observed at Rezu khal, and the highest Richness (2.415) was found at Moheskhali Para.

The presence of fish larvae is directly related to the spawning season of the fish. Usually, the planktonic stage of fishes lasts from a couple of weeks to a few months. Based on the frequency of occurrence of the 37 identified larvae families, 13 families were predicted as Winter spawners and 12 families were found as Summer spawners and the remaining 9 families were monsoon spawners. This assessment will contribute toward making policy decisions on marine fisheries management in the Bay of Bengal.

Through DNA barcoding, identification of 16 species were confirmed, of which three species were newly reported in the northern Bay of Bengal. The newly recorded species were Fang-toothed blenny, *Omobranchus ferox*, Malabar glassy perchlet, *Ambassis dussumieri* and Snouted gobies, *Pseudogobius fulvicaudus* (Table 3). The new records will enrich the listed fish biodiversity in the Bay of Bengal.

Table 3 Three were newly reported fish species in the northern Bay of Bengal as identified through DNA bar coding

Family	Common name	Scientific name	Larvae stage	Adult stage
Blenniidae	Fang-toothed blenny	*Omobranchus ferox*		
Ambassidae	Malabar glassy perchlet	*Ambassis dussumieri*		
Gobiidae	Snouted gobies	*Pseudogobius fulvicaudus*		

Assessment for the MPA site at St. Martin’s Island and the Teknaf Peninsula

The SUST, a partner university, assessed the suitability of St. Martin’s Island and the Teknaf Peninsula in the southeast coastal zone of Bangladesh to declare an MPA considering bio-physical and socioecological characteristics and stakeholders’ consultations. The study revealed 905 species, from primary producers to top predators, including 230 finfish, 180 mollusks, 102 phytoplankton species, 84 zooplankton species, 48 reef fish, 21 shrimps, 13 crabs and 5 lobsters. Both social and biodiversity data suggest that conservation efforts are required for the area of St. Martin’s Island and the Teknaf Peninsula. Based on rigorous study and analyses of the data, SUST identified 2,992 km^2 of the Naf–St. Martin’s Island seascape as the most suitable site for an MPA. A suitable no entry–no take zone covers an area of 44.4 km^2, entry–no-take zone covers 710.9 km^2, partial reserve extended 1,436 km^2 and general reserve includes 801 km^2.

Catfish juvenile assessment and conservation

ECOFISH II continued assessment of juveniles' hotspots of important riverine catfish, focusing on Pangas covering the regions of Noakhali, Bhola, Barguna and Patuakhali. Using the information collected this year together with the information collected in the previous year, an informative GIS map of the locations of nursery grounds and spawning grounds was produced (Figure 5). The assessment also confirmed the hot spots of the most vulnerable juvenile enriched area which are under major threats of illegal juvenile catch. The large bamboo trap, specially designed to catch Pangas juvenile called 'Chai' was found as the main threat for Pangas. To reduce the harmful effect of the Chai, ECOFISH II Patuakhali Team organized stakeholders meeting with Upazila Administration (UNO) and DoF personnel at Galachipa Upazila to conserve riverine Pangas. Simultaneously, awareness building activities regarding the necessity and ways of conservation of catfish juveniles through posters and leaflets were continued in the lower Meghna region.

The Barguna team identified most potential Pangas spawning ground at the Kalmegha block area of the Bishkhali river in Patharghata, Barguna (Figure 5). About 2 km long stretch of the river (Coordinates, upstream: 22.111755, 90.012519 & downstream: 22.094004, 90.018415), where water depth varied from 18 m to 23 m and has an underwater sluice gate at the middle was identified as the potential Pangas spawning ground. Other potential species found in the area include, Kawoin Magur (*Plotosus canius*), Rita (*Rita rita*) and Ayr (*Sperata aor).* The information was verified through one to one discussion and various FGD (5-12 fishers in one group), Hook and long line users, Game fishers, Paikers, Arotders of the both sides of the river and associated Govt. representatives as well as DoF officials. Senior Upazila Fisheries Officer (SUFO), Patharghata suggested ECOFISH II to extend more efforts on Pangas conservation by establishing a Pangas sanctuary in the area. The information will be useful to prepare a data-driven riverine catfish management plan for the government.

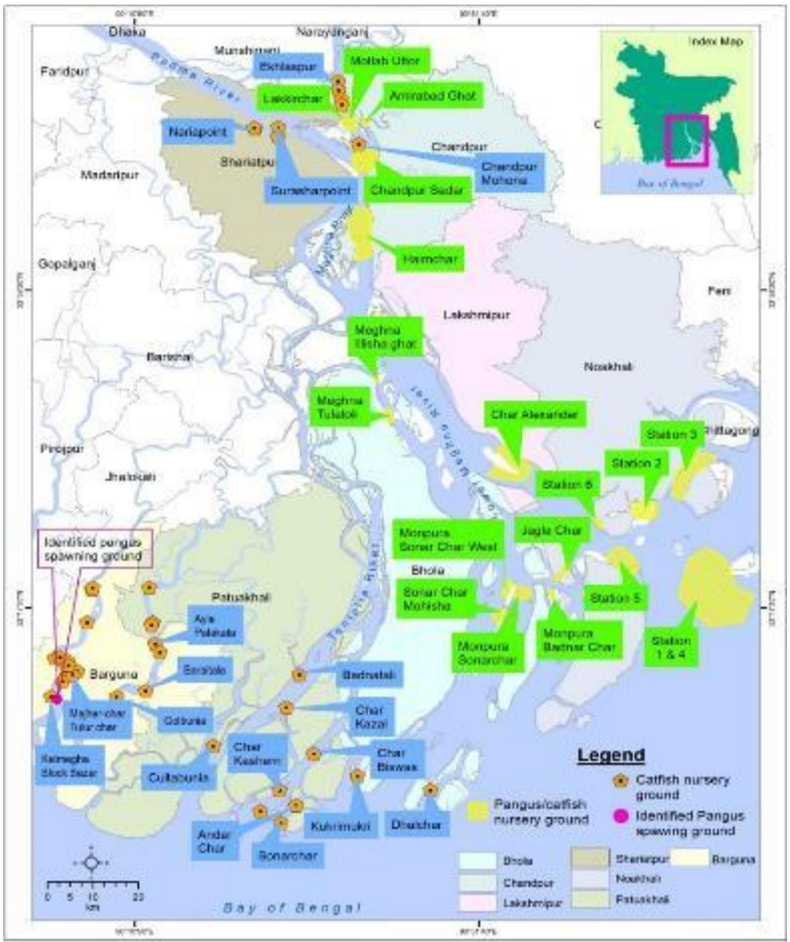

Figure 5 Locations of Pangas and other catfish nursery grounds in the lower Meghna and Tetulia rivers.

2.2.1.1.3 Fisheries dynamics monitoring

Species compositions of harvested fish covering bony fishes, cartilaginous fishes and shellfishes were monitored round the year in the ZOR and Nijhum Dwip MPA (Figure 6). Inventories with pictures of about 100 bony fishes, 60 cartilaginous (sharks, skates & rays) and 20 shellfishes (shrimps, crabs and mollusks) are prepared, which will be enriched in the coming years. The dynamics of the status of the fisheries were monitored basically in two ways, firstly, through fish landing monitoring in the major fish landing stations and secondly, through on-board real-time catch monitoring using Citizen Science approach. Details of those approaches are described in the following two sections:

Figure 6 Some representative species of different groups of fishes commonly harvest in Cox’s Bazar.

Fish landing monitoring

In ZOR, six trained Landing Center Facilitators (LCFs) have been engaged to monitor fish landings in 5 major landing centers using Smartphone with Bangla apps. They record species-wise landing and approximate wholesale price of those species. More than 40 dominant species/groups were significantly landed in 2021, of which hilsa dominated the landings (Figure 4). Landing of the premium size hilsa ($\geq$1 kg size) was the highest (>266 t) followed by smaller hilsa (<1kg size) and 20 other species also contributed remarkably (Figure 7).

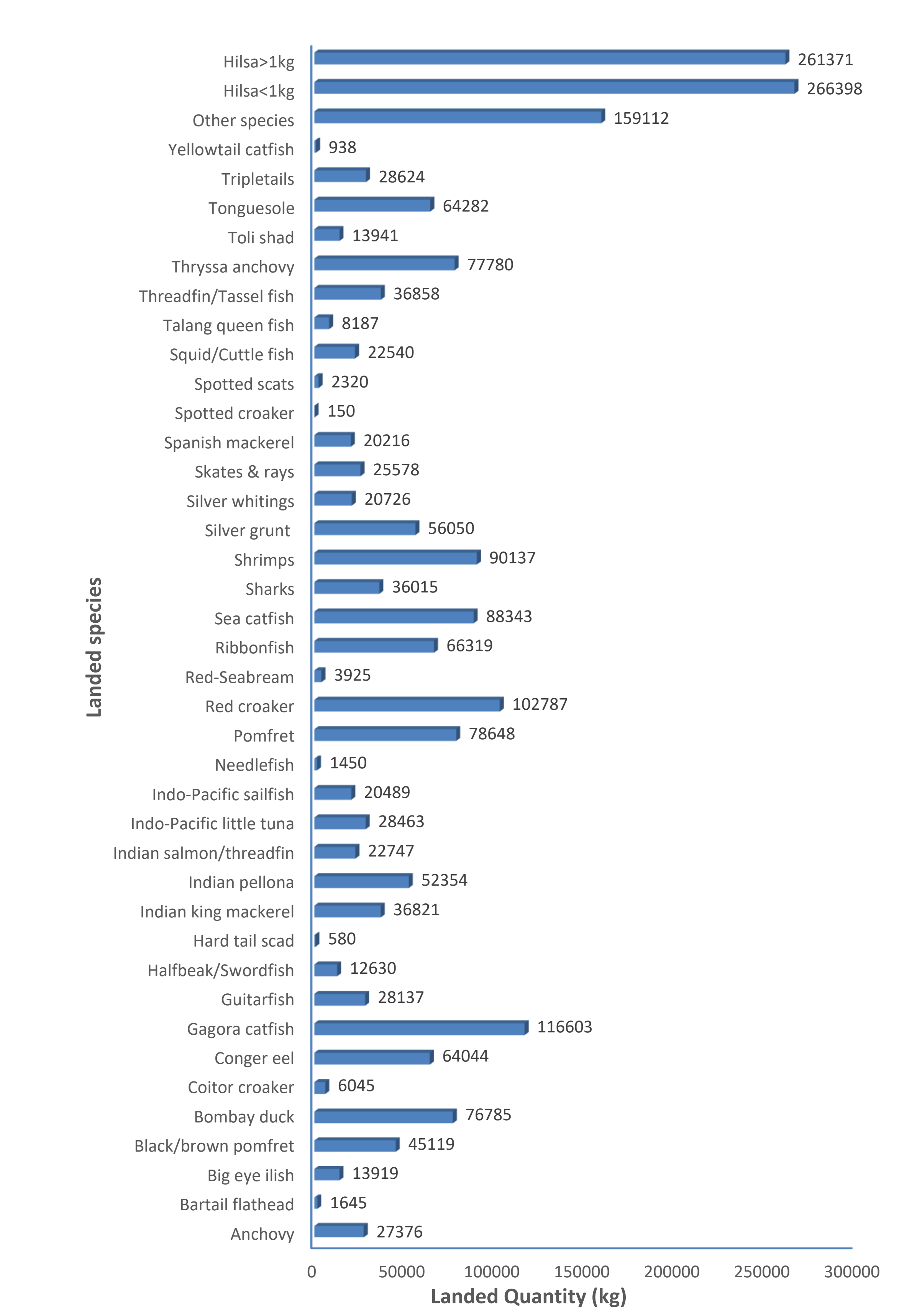

Figure 7 Quantity of different size Hilsa and other marine fish landed in ZOR in 2021.

On-board catch per unit effort (CPUE) monitoring

The real-time on-board fish catch was monitored in the five major intervened areas of ECOFISH II based in CXB Sadar, Moheshkhali, Ukhiya, Teknaf and the Nijhum Dwip MPA through engaging 40 trained Citizen Scientists (experienced boat skippers), who were equipped with smartphones and Kobo Tool Box of ODK Mobile Apps in Bangla. Analysis of the data revealed the catch per unit effort (CPUE) for each of 40 major species/groups harvested and contributed significantly. Aggregated value of all species CPUE was the highest in CXB Sadar, (1,837 kg/boat/day) followed by Moheshkhali (950 kg/boat/day) and the lowest was found in Teknaf (163 kg/boat/day) followed by the 2nd highest catch in Ukhiya (225 kg/boat/day). For Hilsa, the highest CPUE was 189 kg/boat/day in the MPA and the average value was 78 kg/boat/day (Table 4). Detailed species-wise CPUE is presented in Table 4. The variations in the CPUEs are mostly associated with the boat length, type of gear used, area of operation, season and engine power (Table 4). The species-wise CPUE information would be very valuable to compare the abundance of different species in different areas, season and years as a result of different situations, harvesting gears and management interventions.

Table 4 Average CPUE (kg/boat/day) in different intervened areas of ECOFISH II as recorded by CSs in Y2

Species ⬇	Cox's Bazar	Moheshkhali	Ukhiya	Teknaf	N Dwip MPA	**Average**
Hilsa	15.4	101.7	62.4	20.8	188.7	**77.8**
Anchovy	80.7	35.5	10.6	15.2	11.4	**30.7**
Spotted scats	0.0	0.0	0.5	0.3	2.2	**0.6**
Indo-Pacific little tuna	0.4	29.3	1.5	0.0	5.0	**7.2**
Sea catfish	22.0	13.3	12.4	13.6	10.6	**14.4**
Indian mackerel	3.0	1.6	0.4	0.1	1.6	**1.4**
Toli shad	0.0	3.6	4.9	0.1	9.1	**3.5**
Talang queen fish	1.6	2.0	0.6	0.4	2.9	**1.5**
Hard tail scad	5.3	2.4	0.2	0.0	1.1	**1.8**
Indian pellona	13.8	28.5	3.8	3.6	1.0	**10.1**
Big eye ilish	0.1	3.8	5.9	0.0	4.1	**2.8**
Ribbonfish	105.2	71.2	11.4	12.3	5.2	**41.1**
Thryssa anchovy	233.3	66.4	10.3	13.3	2.8	**65.2**
Bartail flathead	9.4	0.6	0.5	0.2	1.2	**2.4**
Skates & rays	42.1	14.5	1.4	0.6	4.4	**12.6**
Silver whitings	18.6	7.7	6.5	2.6	13.7	**9.8**
Needlefish	0.5	0.3	0.5	0.8	0.8	**0.6**
Grunter	0.0	0.7	0.1	0.0	0.7	**0.3**
Black/brown Pomfret	1.0	0.0	2.3	0.2	8.3	**2.4**
Coitor croaker	0.0	2.4	0.5	0.2	2.2	**1.1**
Conger eel	0.0	0.0	0.4	0.0	2.3	**0.5**
Indian salmon/threadfin	0.1	0.6	0.2	0.1	0.7	**0.4**
Red croaker	7.7	21.7	7.2	8.1	3.1	**9.6**
Squid/Cuttle fish	1.1	19.4	1.4	2.2	2.4	**5.3**
Bombay duck	814.5	225.8	27.4	19.4	65.5	**230.5**
Indian king mackerel	6.8	17.0	10.0	1.3	8.6	**8.7**
Indian threadfin	0.0	0.0	0.1	0.0	0.3	**0.1**
Red-seabream	0.0	0.1	0.6	0.9	1.1	**0.5**
Red-snapper	0.6	0.1	0.1	0.0	0.9	**0.3**

Species⬇	Cox's Bazar	Moheshkhali	Ukhiya	Teknaf	N Dwip MPA	**Average**
Spanish mackerel	0.2	3.2	0.5	0.1	2.0	**1.2**
Pomfret	0.1	0.1	0.7	0.8	2.1	**0.8**
Silver grunt	83.6	63.3	6.0	10.2	8.7	**34.4**
Silver jewfish/croaker	5.5	20.4	5.7	9.2	6.3	**9.4**
Tripletails	1.8	2.1	0.4	0.0	2.7	**1.4**
Sharks	8.2	10.5	0.6	0.8	1.2	**4.3**
Shrimps	97.1	74.0	4.3	8.9	1.0	**37.0**
Treadfin/Tasselfish	6.1	15.2	7.4	3.0	2.5	**6.8**
Spotted croaker	6.7	7.8	0.7	0.4	3.0	**3.7**
Tongue sole	41.3	13.9	5.8	4.9	1.4	**13.4**
Other species	203.4	69.9	8.4	8.1	4.5	**58.8**
TOTAL	**1837.1**	**950.8**	**224.6**	**162.7**	**397.4**	**714.5**
Boat length (m)	***16.2***	***16.2***	***10.9***	***9.6***	***19.49***	**14.5**
Boat width (m)	***5.3***	***5.5***	***2.9***	***3.9***	***7.44***	**5.0**
Engine power (hp)	***77***	***78***	***23***	***23***	***156***	**71**

2.2.1.2 Sub-IR1.2: Improved adaptive co-management and fisheries governance

ECOFFISH II has made some notable progress during the last year to establish collaborative management (co-management) following the EAFM framework focusing on hilsa, riverine catfish, and other valuable coastal and marine fisheries in ZOR, MRE, and MPA through supporting the Department of Fisheries (DoF) and local fishing communities. Among the several achievements, the important activities under this Sub-IR1.2 are briefly described below.

2.2.1.2.1 Forming and strengthening co-management institutions

Co-management institutions formed and continued to strengthen by ECOFFISH II with the active participation of Shushilan in ZOR and the Nijhum Dwip MPA. The initiative was intended to establish co-management building blocks in villages such as forming Fisheries Conservation Group (FCGs) and producer groups, as well as ghat groups at landing centers. Simultaneously to the FCGs, producer groups were formed with dry fish producers following a standard protocol that incorporated available best practices and lessons learned from ECOFISH-BD.

In the second year, 100 FCGs were formed in the ZOR and MPA areas while 96 came from the first year. In the MPA, with the help of Shushilan, the project formed 16 FCGs in three important islands (Char Fasson, Hatiya, Rangabali) surrounding the mouth of the Meghna River. Each FCG in 2021 (Y-2) received six monthly training sessions (2.5 hours long) while those from 2020 received 4 quarterly training (Figure 8). In total, the team conducted 600 training sessions for 15,663 participants, 23% of whom were women, for 100 FCGs (12,798 in the ZOR and 2,865 in the MPA). About 414 FCG quarterly training meetings were conducted for Y1 beneficiaries that comprise a total of 10,389 participants, including 1,018 women (25%). Among these 330 training event was conducted for the FCGs in ZOR while the rest of the meetings were conducted in MPA. Simultaneously, 77 (producer group) PG meetings were conducted in the ZOR area with 1,688 participants of which all the participants were women.

Figure 8 Monthly training-meetings of Fishers' Conservation Groups.

ECOFISH II, however, this year moves farther towards landing center-based artisanal fisheries resource management in the ZOR area within the scope of co-management. To facilitate Ghat Group formation, the team conducted stakeholder consultation meetings in different landing centers. Co-management practices for improved fisheries management in the Ghats were discussed at these meetings. Fishers, traders, boat owners, laborers, investors, other value chain actors, and government officials attended the meeting. In October, 2021, a large-scale consultation meeting with artisanal fishers was held at the Hotel Ocean Paradise in Cox's Bazar for this purpose (Figure 9). Total 40 artisanal fishers alongside other participants including ECOFISH II Activity Team Leader, scientist, consultant, and ZOR team were present. This program aimed to identify future opportunities relating to artisanal fisheries resources and develop a platform for fishers. This event was a major step in bringing all fishers together for more effective management and sustainable use of existing resources.

Figure 9 Team leader of ECOFISH II delivering his speech in a consultation meeting arranged with artisanal fishers in Cox's Bazar.

MPA region held union-level co-management meetings as well as an inception meeting on how stakeholders can participate in MPA planning. The team successfully organized a consultation meeting for the Union Co-Management body at the Char Kukrimukri, Bhola. A 5-member Ad-hoc committee was formed with the respective UP chairman serving as convener. An Upazila level co-management meeting, as well as some awareness building programs with the co-management committee were conducted in Patuakhali to conserve brood hilsa during the ban period (4 to 25 October 2021). To conserve brood hilsa in Dashmina, Patuakhali, an awareness program was conducted with the Upazila Task Force and Co-Management Committee. Throughout the ZOR, MPA, MRE areas, awareness programs were carried out on the 65-day marine fishing ban (12), brood hilsa ban (15), and on biodiversity conservation (18), facilitating the fisheries governance efforts of the government. Awareness building programs and bi-monthly training meetings were held, for example, protecting brood hilsa and bycatch in the Andharmanik sanctuary and breeding, nursery, and spawning grounds for catfish on the Payra, Bishkhali and Baleshwar rivers.

2.2.1.2.2 Strengthening the Ecosystem Approach to Fisheries Management

To follow the EAFM framework more explicitly, the project with the help of SUST and IUCN made a significant effort towards developing the MSP as a management tool for the Nijhum Dwip MPA. As an initial step, a number of consultation meetings, focus group discussions, and key informant interviews were conducted to inform fishers about the objectives of the EAFM.

Activities in Year-2 focused on facilitating multi-stakeholder processes for MPA management with a focus on updating the MSP. A preliminary list of 76 biophysical variables was developed under five categories. Total of 17 landing stations and 27 boats were surveyed. Among its activities, IUCN conducted a megafauna survey during the last quarter of 2021. Total 14 transects covering 330.88 km were surveyed and 69 individuals including three dolphin species were sighted (Irrawaddy Dolphin, Indo-Pacific Bottlenose Dolphin, and Indo-Pacific Humpback). Two locations (21.835082, 91.083193, and 21.852466, 91.078239) that had the highest number of sightings of Irrawaddy Dolphin were identified as hotspots or habitats for this species. A roundtable meeting was held in Dhaka on 29 December 2021 on MPA management and further opportunities in Bangladesh. For socio-economic variables, 28 KIIs and 6 FGDs were conducted. MPA zoning consultation meetings were held at the Char Montaz, Char Kukrimukri, Nijhum Dwip, and Monpura unions. The key recommendations from the Upazila level consultations include scientific investigation, ending IUU fishing, reducing pollution near MPAs, and strengthening co-management.

MPA team organized an Upazila Co-Management Meeting chaired by UNO, Charfasson, along with DFO (Bhola) and SUFO (Charfasson) to make an effective plan to conduct a boat census in the Upazila. The team collected data from 11,894 boats, making it one of the largest surveys of its kind (Plate 3). The data provided here will help MSP planning for the Nijhum Dwip MPA.

Figure 10 Census of artisanal fishing boats at the Shamraj landing center (Bhola) conducted by an enumerator.

2.2.1.2.3 Improved fisheries governance

ECOFISH II assessed the level of IUU fishing in the artisanal fisheries of the Bay of Bengal with the assistance of international consultant Dr. Pramod Ganapathiraju (MCS & Fisheries Expert). Research on IUU fishing is of the utmost importance as a way to support Bangladesh's artisanal fisheries management plan. IUU surveys were conducted between April and May 2021 in six coastal districts of southeast Bangladesh (Barguna, Patuakhali, Bhola, Noakhali, Chattogram, and Cox's Bazar). About 250 questionnaires were collected, including interviews with government agencies and small-scale fishers (Figure 11). These data covered demography, licensing, fishing practices, gear, catches, laws, enforcement, and barriers to good governance. Results suggest that illegal fishing nets are widely used and that mobile platforms and surveillance equipment are needed to capture and deter poaching operations. Every year, industrial trawlers catch 37,532 t of fish illegally in the waters below 40 meters' depth and within marine protected areas. The unreported take-home catch of small-scale fishers is 376 kg per person-year, resulting in conservative estimates of 3,210 tons for all six coastal districts evaluated. Fisheries officers report 76% of the landed artisanal fish catches are legal, while 24% are illegally caught. Every year, about 29% of illegal fishing nets are seized. IUU assessments provide detailed recommendations on how management issues can be prioritized in the future.

Figure 11 Data collection by field staff from fishers and stakeholders; D-F: ESBN; Current jal; Discarded Bycatch.

Fishers' training program on sustainable biodiversity conservation and responsible fisheries fosters improved fisheries governance. Training was conducted to improve the monitoring and management of artisanal fishing practices so that fishers could learn to comply with fishing regulations, maintain safety at sea, and follow responsible fishing practices. Total 485 boat skippers were trained in ZOR, MPA, and MRE areas that include landing centers of Teknaf, Ukhiya, Cox's Bazar Sadar, Moheshkhali, Charfasson, Patharghata, Taltoli, and Kalapara. Boat skipper training consultant and ECOFISH II field staff conducted the training. Many boat skippers are unaware of government rules and regulations, which were clarified by invited resource persons, such as DFO, SUFO, the Coast Guard Commander, Bangladesh Navy personnel, and the president and secretary of the press club at various locations

Figure 12 Life jacket distribution among the trained skippers at the end of 3-day long boat skipper training.

together with ECOFISH II field personnel. Every skipper receives a life jacket (Figure 12). Fishers and scientists share ideas and views through training programs. For example, fishers use ecological knowledge can be used to improve our understanding of catch and effort dynamics in the past.

Box 1. Sea turtle & porpoise rescued by fishers in the Bay of Bengal: An example of biodiversity action

Abu Sayed Majhee (47) is a skipper in his own fishing boat from Kutubdiapara, Sadar, Cox's Bazar district. He has 27 years of fishing experience, 17 years of which he has spent as a skipper. He usually goes out to sea for 7 to 14 days. He received training in biodiversity conservation and responsible fishing from ECOFISH II and now works as a Citizen Scientist. Prior to the training, he believed sea turtles and porpoises were harmful to fishers, particularly during fishing, so whenever a sea turtle or porpoise are entangled in his net, he generally ordered his fishers to kill or injure it: "Like me, other fishers believed that sea turtles and porpoises eat debris as well as fish from our catch and also destroy our fishing nets. We learned from ECOFISH II training that all species, particularly megafauna, are important in balancing the marine ecosystem. They should be protected, and skippers can play an important role in doing so." "During my most recent fishing trip (December 2021), I caught a large Olive Ridley sea turtle and a porpoise in my nets while fishing in the Bay of Bengal." When I noticed the sea turtle and porpoise, I directed my crews to protect them at all costs and without causing any harm. "My crews carefully rescued the turtle and porpoise and quickly returned them to the sea," he added. "After rescuing both the turtle and the porpoise, I felt very happy and proud," Majhee said. In November 2021, two more trained skippers, like Mr. Abu Sayed, rescued and safely released two more sea turtles.

CFG continues its work towards biodiversity conservation and fisheries resource protection. CFGs made every effort to support DoF during the 65-day ban periods. This year, a total of 20 Community Fish Guard (CFG) was successfully deployed in Charfassion (10) and Rangabali (10) with DoF's approval. Also, Brood Hilsa ban period awareness activities were carried out at all stations including Ukhiya, Teknaf, and Hatiya. ECOFISH II team conducted bi-monthly meetings and FGD with Pangas group at Barbital, Barguna to conserve and protect catfish in the Bishkhali River and reiterated Kalmegha as a highly important area for catfish breeding and spawning ground. Total 13 awareness programs with the Catfish conservation group were conducted this year throughout the MRE region. Furthermore, the Bangladesh Navy recently called for an initiative to control IUU fishing practices following information provided by the ECOFISH II team. ECOFISH-II has prepared detailed landing center reports for several Ghats in ZOR which may be used in developing proper management guidelines for artisanal fishing. On top of that, motorboat mechanics have been trained in Ukhiya to empower and motivate young fishers for conservation efforts.

ECOFISH II continues to support to CFGs in community and Ghat-level patrolling during the hilsa sanctuary ban period (March–April). The DOF engaged 300 CFGs in six hilsa sanctuaries during the brood hilsa ban period (October–November). It is a significant step to mainstreaming one of the ECOFISH's best practices into regular activities of the Government of Bangladesh (GOB). The DOF decided to provide lump-sum incentives to CFGs to pay for their activities. During the patrolling period, CFGs helped the DOF team with active surveillance and logbook maintenance. The CFGs, along with DOF officials and other law enforcement bodies, played a tremendous role in conserving brood hilsa. On top of regular patrolling along the river, other activities were carried out successfully throughout the riverine and coastal areas. These included awareness-raising meetings, rallies, documentaries, banners and posters with conservation messages, and maintaining relations with stakeholders.

Community-led and evidence-based conservation initiatives are also in progress. Efforts are ongoing to conserve riverine catfish and Pangas and to protect their juveniles from illegal craft and gear. These efforts are carried out throughout the MRE regions by arranging public campaigns and delivering messages. The campaigns largely help promote the production of native Pangas in the Meghna, Hizla-Mehendiganj and Tetulia river sanctuaries. In addition, 10,000 leaflets and 3,000 posters were provided to all CFGs for distribution in their respective areas.

ECOFISH II has taken steps to combat IUU fishing across its intervention areas in small-scale artisanal fisheries. The marine artisanal fisheries sector has become a major area of concern due to a gradual decline in CPUE for many species except hilsa, so it is extremely important to prevent IUU fishing. Because of this, an attempt was made to assess the status of IUU fishing of Bangladesh's artisanal marine fisheries. Current information suggests that most fishing is unreported and/or illegal. Some unregulated fishing was also reported. The major types of IUU fishing activities include fishing without licenses, poaching in protected areas and non-compliance with spatiotemporal fisheries closures. Illegal intrusions from fishers of neighboring countries is another common form of IUU fishing inside Bangladesh's territorial waters, and domestic industrial fishing fleets also violate national fisheries laws. Illegal fishing also occurs in shallow coastal areas by fishers using illegal gear and nets. Preliminary data collected for this study from Teknaf and Ukhiya Upazilas suggest that per capita (per boat) unreported catch in artisanal fisheries dropped significantly between 2020 and 2021 to below 15 m depth contour. A major study is in the works to detail how much and what kind of IUU fishing is taking place in the artisanal fisheries sector.

2.2.1.3 Sub-IR1.3: Improved policy support

2.2.1.3.1 Supporting HFMAP implementation

ECOFISH II submitted the revised Hilsa Fisheries Management Action Plan (HFMAP) for 2020 -2030 and advocated for its approval. For the hilsa fishery to be sustainable, approximately 24 management measures have been recommended. Through its co-management structure and modalities, ECOFISH II assists the DOF in implementing the HFMAP.

2.2.1.3.2 MPA assessment and management

SUST worked on the Saint Martin-Teknaf peninsula with an inclusive and data-driven approach. The validation of the MPA zones (identified in 2020) through stakeholder consultation, assessing local impacts, and identifying compensation options received a lot of attention. This study then assessed the proposed MPA's potential impact on marine biodiversity and developed a marine spatial plan (MSP) for the proposed MPA. The study identified about 2,992 km^2 potential area of the Naf–Saint Martin Peninsula for MPA declaration with four restriction options (no-entry, no-take zone; entry, no-take; partial reserve, and general reserve zones). Researchers predict a 3-6 percent increase in biomass for species in no-fishing areas compared to no-fishing areas; thus, imposing fishing restrictions will improve species standing stocks. Under the current situation of the declaration of MPA at the St. Martin by the MoFECC, ECOFISH II will continue to pursue accommodate its science-based wider areas in the gazette notified MPA for inclusion of the Naf estuary and broader livelihoods resilience program of the dependent fishing communities.

ECOFISH-BD achieved a landmark success in facilitating the declaration of the 3,188 km^2 MPA in and around the Nijhum Dwip seascape, which shows the importance of conserving hilsa and other megafauna. The Nijhum Dwip MPA management plan was developed through a consultative process with technical assistance from the IUCN and Wildlife Conservation Society (WCS), and was then submitted to the MoFL via the DOF. However, the Nijhum Dwip Management Plan has been approved by the Ministry of Fisheries and Livestock (MoFL) and will be published in a government gazette. At the same time, the project began implementing the management plan with its partners and stakeholders following a request from the MoFL. Among other activities, the project started forming the co-management building blocks in the direct impacted area of the MPA and provided livelihood support to the impacted fishing households.

2.2.1.3.3 Hilsa Conservation and Development Fund and Payment for Ecosystem Services

The HCDF is a revolving fund of BDT 35 million (USD 430,000) that was created under ECOFISH-BD. The fund is in a fixed deposit account, and only the interest will be used following the guidelines that the MoFL approved for the benefit of hilsa fishers and fisheries management. ECOFISH II is playing a key role in operationalizing the HCDF from the DoF's management and has continued advocating for policies to increase seed capital through government support. The DoF arranged a meeting of the HCDF (Figure 13) to operate this fund smoothly for the benefit of poor fishers. The DoF decided to increase lump sum incentives to CFGs, now and in the future.

Figure 13 Quazi Shams Afroz, Director General, Department of Fisheries, presided over a meeting in the DoF conference room with MoFL and DoF officials on the Hilsa Conservation and Development Fund (HCDF).

Introducing the PES is still challenging in the context of current fisheries management practices in the coastal areas of Bangladesh. It also requires a legal framework for implementing the PES in the fish landing centers. The project, however, has maintained dialogue with key stakeholders and policymakers involved with the landing center to switch the PES on and install it as a financial instrument to sustain the fisheries co-management system in coastal Bangladesh.

2.2.1.3.4 Transboundary legal framework formulation

Bangladesh, India, and Myanmar combined make up more than 98% of global hilsa production and own a common pool resource in the Bay of Bengal. Following the previous initiatives of ECOFISH-BD, ECOFISH II has taken steps to strengthen efforts for a transboundary hilsa cooperation in the form of a joint ecological, biological and socioeconomic assessment, while trying to establish a viable transboundary policy platform.

2.2.2. IR2: Improved equity and resilience of food, nutrition and livelihood benefits

ECOFISH II has been working to improve equity and resilience for food and nutritional security for greater livelihood benefits. This will be accomplished through the implementation of various livelihood improvement activities among fishermen and fisherwomen. The progress of various IR2 activities is shown in Table 5.

Table 5 Summary of progress under IR2. (completed in progress yet to start)

Activities	Progress	Status
Sub-IR2.1: Improved livelihood resilience of coastal fishing communities		
Diversify and improve livelihood capacity and options	• Livelihood supports were provided to 3,000 households in the ZOR and MPA in various enterprises, and 2,472 fishing households received vegetable seeds. • Total 514 fisherwomen were trained and supported in small pelagic dried fish production in the ZOR. • Around 595 household members (40% women) received the capacity-building training on AIGA organized at the fishing villages.	
Improve access to finance for fisherwomen	• Formed and operated 23 Community Savings Groups (CSGs) with 735 fisherwomen in ZOR and MPA in 2021 • By the end of 2021, the CSGs saved US$ 25,754, including their own savings and matching funds.	
Increase access to improved technology and market links	• Support was provided to beneficiaries for seaweed farming (200), green mussel farming (104) • From November to December 2021, 9,350 kg (wet weight) of seaweed was produced. • Three farming sites were found suitable for green mussel spat attachment. • A portion of a green mussel farm was harvested from the Khurushkhul	
Improve food and nutrition benefits, focusing on women and young children	• Five hundred fisherwomen received training and inputs in support of catching small pelagic fish for safe and hygienic dried fish production. • With the assistance of NSTU, the project developed a composite fish powder for lactating mothers and their children. • In Cox's Bazar, a Randomized Control Trial (RCT) was carried out to assess the nutritional efficacy of fish powder.	

2.2.2.1 Sub-IR2.1: Improved livelihood resilience of coastal fishing communities

ECOFISH II has been working to improve the livelihood resilience of the coastal fishing communities through a collaborative partnership program. Among the partners, Shushilan has primarily focused on AIGA support activities for the host fishing communities, piloting crab fattening, and mobilizing women-led CSG activities in the ZOR. Falcon International Limited is a private sector partner whose role is to provide technical assistance for successful seaweed farming and to develop market links in home and abroad. The CVASU supports seaweed farming and green mussel culture practices in coastal marine waters as a novel AIGA solution for the fishing communities there. In addition to the work of its partners, ECOFISH II co-designed livelihood interventions with both community and nature-based solutions to strengthen the resilience of the coastal fishing communities. A brief description of these accomplishments is provided in the following sections.

2.2.2.1.1 Diversify and improve livelihood capacity and options

ECOFISH II team selected 3,000 HHs in 2021 to provide support for the livelihood improvement of the targeted fishing households. The transfer of technology and productive assets is an integral component of the project. Forward and backward market linkage is also a part of the interventions to make the livelihood interventions sustainable. Initially, the project assessed the capacity and identified the options that households could manage to bring an additional income for the households, especially during the ban period. ECOFISH II baseline study showed that the fishing ban is one of the biggest shocks that the fishing households are facing. The fishing communities become more vulnerable when they face climate-induced events like storms, cyclones, flash floods, and heavy rainfall. So, ECOFISH II employed a holistic approach to increase their income and improve their adaptive capacities to make their livelihood resilient. The project organized 22 trainings on goat rearing and poultry husbandry for the improvement of technological skills. Around 595 household members (40% women) received the capacity-building training organized at the fishing villages. The household members also participated in the monthly training meeting of the Fisheries Conservation Group (FCG) at the village level and got opportunities to discuss their farming success and failure.

The targeted 3,000 households in 21 fishing communities received livelihood support as productive assets. The fishing households used these supports as a startup capital to run their household-level enterprises. The support in turn will give benefits to the 18,000 household members (50% women). Around 48% of households received goats followed by the chickens and ducks (42%) where only 7% of households received support for doing small business (Figure 14). Among the distributed livelihood supports, 2,400 HHs (AIGA) were received at ZOR and 600 HHs at the MPA sites. As follow-up support, the households received vaccines for their livestock through seven vaccination programs in ZOR and MPA with the help of the Department of Livestock Service (DLS). In addition to that, two market linkage workshops organized in Teknaf and Ukhiya to connect with 26 service providers who pay services to the small scale producers. ECOFISH II supplied 5-6 varieties of winter vegetable seeds (Bottle Gourd, Beans, Red Spinach, Tomato, Chili, and Brinjal) to 2,472 targeted fishing households. The ECOFISH II team continues to monitor the targeted fishing households in order to assist them in receiving benefits from the livelihood support. Household level AIGA performance was evaluated for tracking the effects of livelihood supports. Table 6 shows, for example, that the selected livelihood supports will benefit fishing households in the MPA.

Figure 14 An ECOFISH II targeted fisherman received ducks as the livelihood support in Char Kukrimukri, Charfasson, Bhola.

Table 6 AIGA performance of A) Duck and B) She goat in the Nijhum Dwip MPA[¥]

Preferred Livelihood support	No. of HH	No. Duck / she-goat Provided (PCS)	Invest ment (BDT)	No. of Duck/ she-goat -at Present	Price of Duck / Kids (BDT)	Price of Egg/ She goat kids (BDT)	Total price (BDT)	Price Increase from investment (BDT)
Ducks	409	4499	16.36	3725	18.37	2.18	20.55	4.19
She-goat	81	81	3.24	81	3.82	0.41*	4.23	0.99
Total	490	-	19.6		22.19	2.59	24.78	5.18

[¥]*All monetary amounts are given in hundreds of thousands of Bangladeshi Taka (BDT).*

** The price was calculated by adding the prices of newly born 49 she-goats.*

Resilient model fishing village

Following the success of three resilient model villages in ECOFISH-BD (2014-2019), ECOFISH II primarily selected three fishing villages (Rastarpara-Khurushkul of Cox's Bazar Sadar, Nidania of Ukhiya, and Bou Bazar of Char Montaz, Rangabali Upazila) for the transformative change of the fisher's livelihoods. US Ambassador Earl Robert Miller and Marsha Michel of USAID, Bangladesh visited Rastarpara-Khurushkul, an ECOFISH II proposed resilient model fishing village in CXB Sadar on September 18 (Box 2; Figure 15). Following that, ECOFISH II convened a discussion with the fishing households about the requirements for their overall development. Out of the regular livelihood intervention, ECOFISH II provided 97 she-goats and three swing machines to 100 fishing households.

Box 2: US Ambassador Earl Robert Miller visited to a Resilient Model Fishing village

A delegation that included the US Ambassador to the People's Republic of Bangladesh Earl Robert Miller and Marsha Michel visited Rastarpara, Khurushkul, an ECOFISH II intervened resilient model fishing village in Cox's Bazar Sadar on September 18 (Figure 15). During the visit, the USAID officials had an open discussion with the women-led Community Savings Group (CSG) members, and the visitors observed a training session of the Business Literacy School (BLS). They walked through the village and observed the livelihood supports that the poor fishing households received from the activity, like goats, chicken, Turkey and ducks for alternate income generation to cope with their hardships. They visited the homestead backyard to see the efforts of land preparation and sowing seedlings for winter vegetable cultivation. The delegation also met the Citizen Scientists, Boat skippers, Blue Guards and had a meeting with the Fisheries Conservation Group (FCG) members. The visitors were highly impressed seeing the green mussels and seaweed farming at a distance in the coastal waters as a part of the USAID/ECOFISH's efforts to pilot some innovative activities of marine farming to explore the potentials of blue economy.

Figure 15. US ambassador observed an on-going training on the Green Mussel & Seaweed farming in Cox's Bazar.

ECOFISH II team worked in coordination with DoF to establish a resilient model-fishing village at Haloishar under Naria Upazila of Shariatpur district in 2020. ECOFISH II supported 110 fishers and fish farmers who received different livelihood support to improve their livelihoods as well as to conserve the biodiversity of the lower Padma and Meghna rivers. The government has declared this fishing village as an ideal fishing village. As a part of the special program 'My Village, My City', the government has established this 'Model Fishing Village' in honor of the father of the nation, Bangabandhu Sheikh Mujibur Rahman. The Ministry of Fisheries and Livestock (MoFL) has taken up the program under the activities on the occasion of the Mujib Year celebrations.

2.2.2.1.2 Access to finance for fisherwomen

Community savings group

ECOFISH-II implemented its gender strategy by focusing on women's empowerment and gender equality. ECOFISH-II ensured women-friendly livelihood options and formed 23 Community Savings Groups (CSGs) with 735 fisherwomen in ZOR and MPA in 2021 to involve fisherwomen in income-generating activities (Figure 17). So far, the CSGs saved US$ 25,754, including their own savings and matching funds. CSG members found these groups to be extremely useful for obtaining soft loans during critical periods (fishing ban periods, COVID lockdown, lean fishing seasons etc.) (Box 3). It has been documented that 15 CSG members received US$ 890 to begin cattle and poultry rearing, grocery, and dried fish businesses. The ECOFISH-II team continued to monitor CSG operations by attending meetings and assisting the Partner NGO. Various AIGAs assist fisherwomen in playing an important role in contributing to family income and nutrition. ECOFISH-II organized three (3) batches of financial management and capacity development training in Teknaf and Ukhiya to improve the capacities of CSG executives (91) in areas such as organizational development, CSG executive roles, fund management, savings, business plans, loan management, document maintenance, and leadership skills.

Figure 16. US ambassador handed over a bank cheque to the Community Savings Group (CSG) as matching fund during his visit to an ECOFISH II intervened fishing village in Cox's Bazar

Box 3. Community Savings Group (CSG): no more dependent on NGOs or local moneylenders

"We are no longer reliant on NGOs or local moneylenders for loans! CSG is our own organization, and we know how to run it. We disburse and refund loans as needed, especially during critical periods (fishing ban periods, COVID lockdown situation, lean fishing seasons etc.). This relieved us of the burden of high-interest loans, and our husbands are no longer involved in illegal fishing activities during fishing ban periods."- Mst. Amena Begum, who is the Champion of Char Chandra Prasad CSG of Bhola.

In 2016, the ECOFISH-BD project began working with 30 fisherwomen from Char Chandra Prasad village in Bhola to form a Community Savings Group (CSG) to practice savings behavior. For four years, the project nourished them by organizing monthly mobilization meetings and trainings for CSG members. They began soft loan disbursement and invested money in various women-focused income-generating activities after receiving a matching fund of BDT 25K. Despite the fact that ECOFISH-activities in that village have come to an end, CSG members have continued to carry out their group activities to this day. Now, 27 fisherwomen were continuing their savings and lending activities. Since its inception, every woman in this group has contributed BDT 100 per month. When their husband had a good catch from the river, they would deposit extra money in their bank account on a regular basis. Currently, they offer large loans ranging from BDT 25K to BDT 40K to CSG members, whereas previously, they only offered BDT 5K. So far, 23 women out of 27 have received loans for the second or third time. Char Chandra Prasad CSG's total capital is BDT 315K, which includes monthly savings, matching funds, loans, and bank interest.

Figure 17 A monthly CSG meeting was held in Ramu, Cox's Bazar.

Business literacy school

In addition to regular CSG activities, ECOFISH-II introduced the Business Literacy School (BLS) to help CSG members for improving their literacy and accounting skills. The BLS module was revised and contextualized in accordance with the ECOFISH II objectives and indicators. The new version of the module was also designed to be informative, with a focus on co-management, biodiversity conservation, nutrition, reproductive health, child marriage, and gender-based violence (GBV). This year, 20 facilitators were trained for 6-7 days on basic BLS (Business Literacy School) sessions. Through twenty-four (24) sessions, the primary goal of the training was to provide a thorough overview of basic literacy for fisherwomen (Figure 18).

Figure 18 USAID officials made a visit to a BLS session in Ukhiya, Cox's Bazar.

2.2.2.1.3 Access to improved technology and market linkages

Seaweed (sea vegetable) farming

With the collaboration of CVASU and Falcon International, ECOFISH II introduced seaweed farming practice in the coastal waters in Cox's Bazar, Bangladesh engaging coastal fishermen and women. Seaweed farming system requires a small investment or cheaper infrastructure and no feed but can fetch lucrative profit within 4 months.

In 2021, five farming sites were selected for seaweed farming in Rastarpara-Khuruskul (CXB Sadar), Nuniachara (protected beach between Sonadia and Moheskhali), Mudirchara (Moheshkhali), Sonarpara (Ukhiya) and Shahparir Dwip (Teknaf). Based on the suitability, *Gracilaria* (red seaweed) is considered for seaweed farming with four farming systems (Floating long-line, off-bottom long-line, floating net and off-bottom net) (Figure 19). Farming systems were designed based on site appropriateness factors like as salinity, transparency, tidal wave, and bottom sediments. The project selected 200 men and women based on factors such as members of fishing households, residence near the farming site, preference for women and youth, and willingness to support with seaweed management. Following the selection of beneficiaries, the project provided training in seaweed cultivation techniques, harvesting, processing, and marketing. The beneficiaries were then provided with input assistance for the installation of the cultural systems. Beneficiaries placed farming materials and tied seaweed seed collected from natural resources, since seaweed seed selection is crucial to their resilient growth. Correctly cutting and tying the seed will aid in its development and growth. The management of seaweed farming is also critical for minimizing siltation and contamination of other species. As a result, mobilizing trained beneficiaries is essential for farming success and ECOFISH II made the process easier.

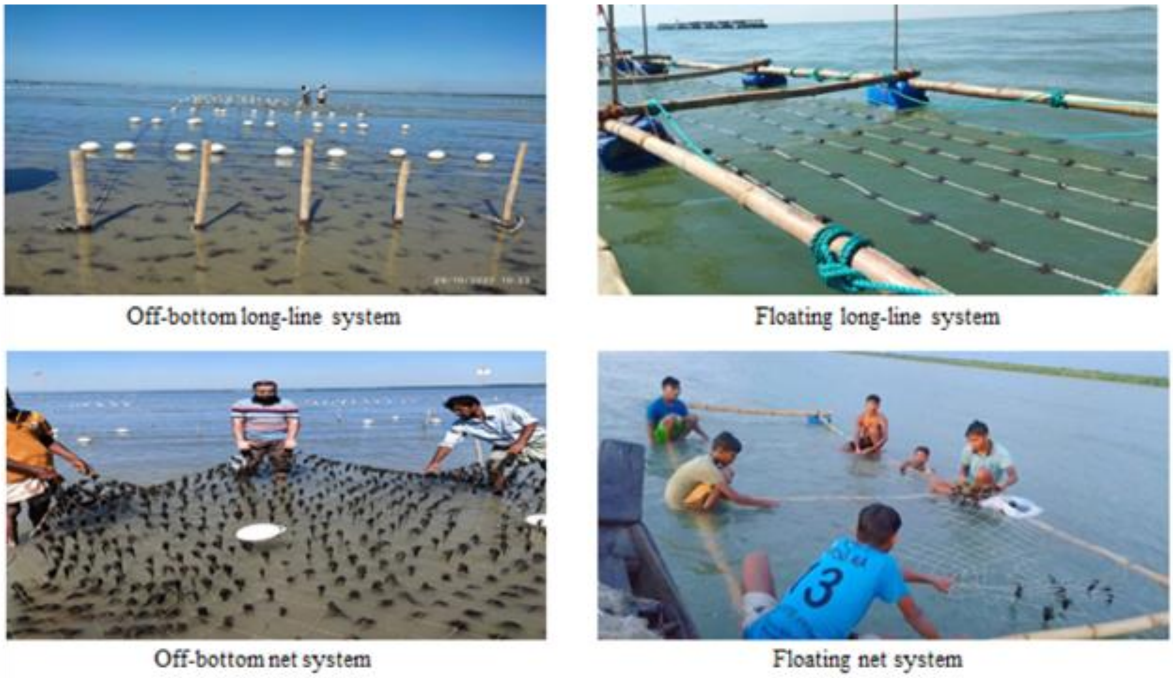

Figure 19 *Gracilaria* sp. was used to establish four farming systems (floating long-line, off-bottom long-line, floating net, and off-bottom net).

Beneficiaries began harvesting in five locations along the coast of Cox's Bazar in November. Total 9,350 kg (wet weight) of seaweed was collected till the end of December (7,064 kg from Nuniarchara site, 1,863 kg from Khurushkul site and 423 kg from Sonarpara site). Around the end of January, seaweed harvesting will take place in the Mudirchara and Shahparir Dwip areas. After harvesting, the beneficiaries thoroughly washed them with clean water. The harvested raw biomass either sell in local markets or process for a higher price during the lean season (Figure 20). The project supported seaweed producers improve their produce through the sun drying. Falcon International Limited (the private partner) assisted the producers in marketing the raw biomass and dried seaweed in the local markets. The partner has also been attempted to attract customers both at home and overseas. Diversifying the seaweed products would also help to expand the local market.

According to the primary findings, floating seaweed farming is a more productive strategy. However, after the production season (October to March), the production and economics will be studied to determine the optimal culture technique. The appropriateness of locations throughout the entire coastline will then be investigated, with the idea that seaweed farming can be expanded up over the entire coastline. A more secure tenure structure and expanded market opportunities would ensure robust seaweed farming systems and enhanced seaweed income for fishing families. Seaweed farming has benefited in the biodiversity conservation and it will accelerate climate resilience of aquatic food systems. As a result, ECOFISH II will continue to strengthen seaweed production and marketing systems, contributing to the country's blue development.

Figure 20 Growth monitoring of seaweed (top-left), Women beneficiaries harvested seaweed biomass every 15 days (top-right), staked after washing with clean water (bottom-left) and placed in solar drying racks (bottom-right).

Green mussel farming

ECOFISH II also introduced green mussel (*Perna viridis*) farming as another natural solution for the coastal men and women in Cox’s Bazar. The initiative not only increased farmers' income, but it also resulted in the creation of a delicious recipe for tourists visiting Cox's Bazar. Green mussels are naturally abundant along Bangladesh's southeast coast, and culture techniques for this species are inexpensive and simple. CVASU and Falcon International Limited assisted ECOFISH ll team in the selection and verification of new beneficiaries, as well as the establishment of culture systems. The three farming sites for green mussel were selected based on a site feasibility assessment completed by the CVASU team.

Currently, 102 fisher's households are actively engaged in green mussel farming and monitoring the culture systems. CVASU and Falcon International Limited organized training programs in three farming sites prior to establishing the culture systems. The project also provided all of the materials needed for the installation of the culture systems to the beneficiaries. Three types of culture systems were developed: raft system with hanging rope and plastic basket, raft system with hanging rope and plastic basket + mussel socks, and raft system with hanging rope and plastic basket + cages. Total 34 raft culture units were established at three farming sites, including 14 units established at Khurushkul, 8 units at Chaufaldandi, and 12 units at Mudirchara.

Green mussel harvesting has not yet been completed from any site because the green mussels have not yet reached harvesting size. Green mussels from the khurushkul site were partially harvested in December (Figure 21), and the final harvest will take place in March.

Figure 21 Settlement of Green Mussel spat in rope (tope-left) and cage (tope-right) in the culture sites; Harvestable sized green mussels in rope (bottom-left) and cage (bottom-right).

Apart from community-based participatory culture aspects, an experiment was set up to investigate the effects of culture depth on the green mussel's growth performance, nutritional quality, and food safety aspects. Green mussels were stocked at three depths and mussel socks were prepared for this study (1.5ft, 3.0 ft and 4.5ft). Three research sites (Khurushkul, Chaufaldandi, and Mudirchara) were selected, and 10 mussel socks were installed at each of the site. The experiment began in September 2021 and will last until June 2022. Water quality, as well as plankton and growth performance, are being closely monitored. Nutritional evaluation (proximate composition, amino acid profile, and fatty acid profile) and food safety will also be investigated at the conclusion of the experiment.

Improved dry fish production and market linkages

Small pelagic dried fish can be an important source of food and nutrition for the fishing communities and other coastal people. ECOFISH II introduced safe and hygienic pelagic small dried fish production technology to the underprivileged fishers' women to ensure women empowerment, income, food and nutrition security. So far, 1,014 fisherwomen were trained and supported hygienic dry fish production using marine pelagic small fishes in Teknaf, Ukhiya, Ramu, CXB Sadar and Moheshkhali (Figure 22).

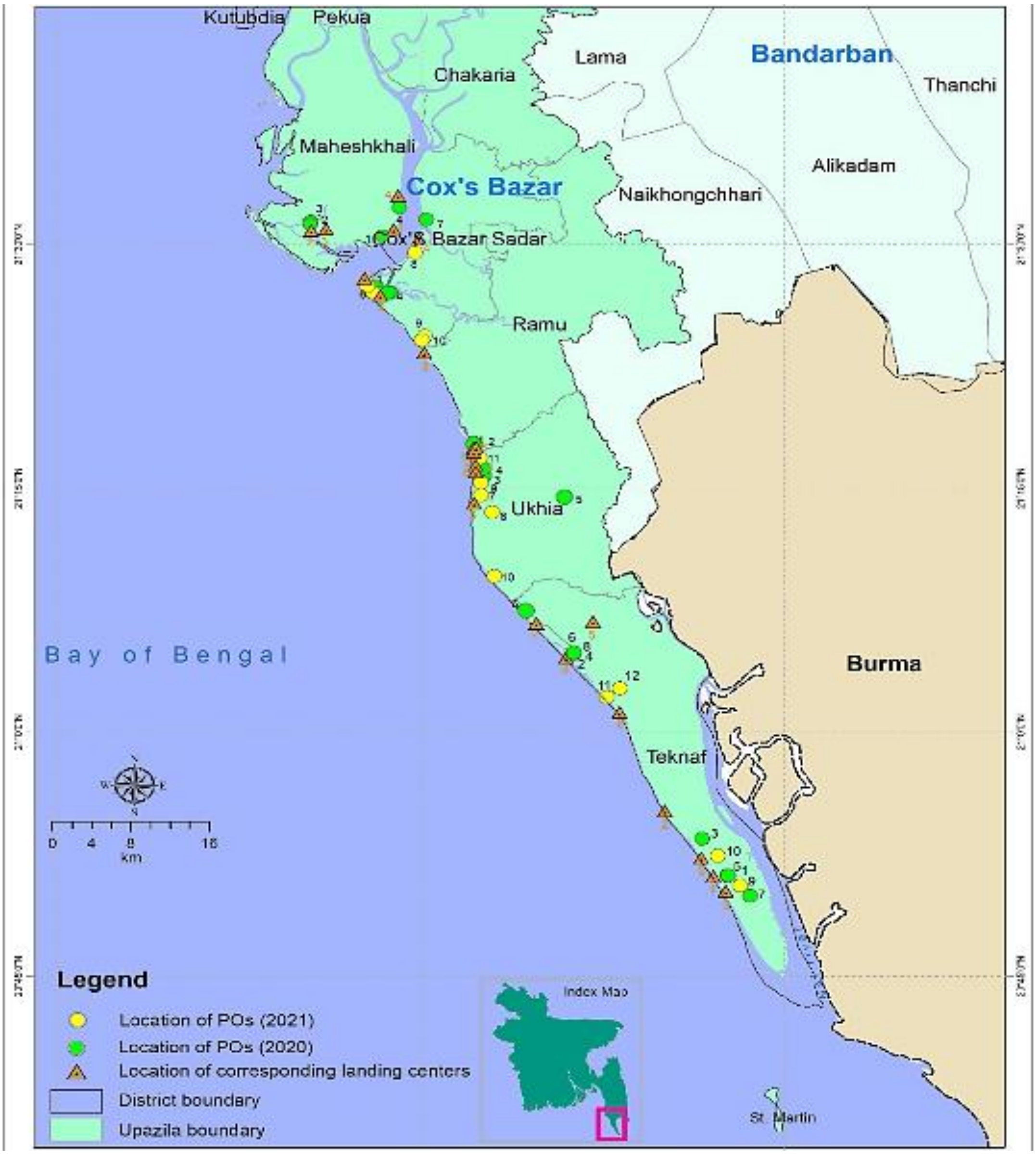

Figure 22 Women were trained and assisted in the production of hygienic dry fish using marine pelagic small fishes in Cox's Bazar.

Among the interventions, the small dry fish business is one of the major areas of work. ECOFISH II continued support to 500 women who were selected in 2020 for producing and marketing safe and hygienic dried fish from pelagic small fish. The project provided cash support (BDT. 1,600/Person) to prepare bamboo Macha *(*trellis) and 40 kg raw pelagic small fish (e.g. *Olua, Faisa, Sardine, Poa, etc.*) per person in 3-4 cycles and resulted in 5,468 kg of dried fish until April 2021. The women producers sold 3,973 kg of dried products in the local markets and earned US$ 12,965 during the production season. The fishing households, particularly young children and women, consumed the rest of the produced dried fish (1,385 kg) for getting the nutritional benefits. In 2021, the project selected 514 women in five Upazilas of Cox's Bazar and one Upazila in Bhola district for producing and marketing safe and hygienic dried fish from pelagic small fishes in this production season (October-March). Overall, the project trained 1,014 women producers and supported them in the preparation of bamboo Maccha (trellis) to make an improved fish drying rack with a covering net (mosquito net). In two cycles, the project delivered 23,546 kg of raw fish to 975 women producers out of 1,014 producers. In addition, after selling their dried fish, the 216 women producers purchased 1,143 kg to continue their microbusiness. The project made it possible to connect local raw fish sellers with neighboring fish landing stations (Figure 21) in order to purchase marine pelagic small fish. The women producers were able to purchase marine pelagic small fish from a nearby fish landing center, with the intention of connecting with a local level raw fish trader. However, 39 women producers have yet to initiate dried fish production due to a scarcity of marine pelagic small fish in Charfassion, Bhola.

The women artisans produced 7,147 kg of dried fish (Figure 23), of which 5,168 kg was sold in local markets. Some dried fish producers kept over 1,000 kg of dried fish in "plastic buckets and mosquito net coverings," which they plan to sell when the price is right. After the production season concludes, the economic analysis will be completed. However, project officials are looking for local market actors, in collaboration with fishing community leaders, to ensure long-term market linkage. In addition, the project encouraged fishing industry women to form savings groups based on the community savings group model (CSG).

Figure 23 In Cox's Bazar, women dried fish producers set up drying racks to produce safe and hygienic dried fish.

2.2.2.1.4 Improving food and nutrition benefits, focusing on women and young children

Dried fish is a popular and traditional dish among the people of Bangladesh. If prepared in safe and hygienic ways, it could be a good source of nutrients and nourishment. The common perception about the dried fish is that, harmful chemicals and insecticides are used, and this often demotivates them from eating it. However, a trustworthy channel for producing safe and hygienic dried fish would restore the dietary, nutritional and economic values of dried fish. ECOFISH II aims to create a channel for producing a safe and hygienic dried fish from underused small raw pelagic fish by providing training and technical support to poor and vulnerable fisherwomen in the project area. The project also aims to support the beneficiaries through a market link for their products. This support will not only be helpful for their livelihoods but will also ensure the best use of marine resources on the way to achieving a sustainable blue economy in Bangladesh.

ECOFISH II provided 2,750 kg dried fish and 250 kg fish powder among 3,000 fishing households as supplementary nutritional food aid to the fishing communities to complement the government's rice support during the 65-day marine fishing ban (Figure 24). This dried fish food aid to the most vulnerable fishing communities has been highly appreciated at all levels including the government officials due to its innovative nature. This food aid program during the hardship of the fishing families might have some policy implications.

Figure 24 During the 65-day marine fishing ban, a woman received supplemental nutritional food aid in the form of a composite dried fish powder to supplement the government's rice assistance.

ECOFISH II, in collaboration with Noakhali Science and Technology University (NSTU), developed a composite fish powder from three important pelagic small fish (40 percent anchovy, 30 percent sardine, and 30 percent Faisa) that could be used to supplement the children's diet with essential nutrients. In an ECOFISH II intervention fishing village, NSTU initiated a Randomized Control Trial (RCT) to assess the efficacy of the prepared fish powder. For this, the team used a stratified random process to choose two fishing villages (Intervened and Control) based on previously collected ECOFISH II household data. After that, the team selected the household with a healthy infant aged from 06 months to 18 months for feeding them the composite powder (5 g/person/day) in the intervened villages with different diets. It will be continued for a total of 16 weeks, with each family in the intervention site receiving 25 g of fish powder for infants per week. However, after collecting the data on household demographics, livelihoods, and consumption levels, the team collected anthropometric (height, weight, mid-upper arm circumference, head circumference, age, edema) and blood samples for biomarker data (Serum Hemoglobin, RBS -Random Blood Sugar, Ferritin, iron, serum retinol, calcium, Vitamin B12, CRP) from 57 infants (intervened and control) through a bio (Table 7). After centrifuging the blood samples, the serum was sent to the ICDDRB lab for biomarker analysis.

Table 7 Snapshot of the community with Anthropometric and Biochemical markers

Parameter	Intervention (n = 30)	Control (n = 27)
Female infant (number)	18	13
Male infant (number)	12	14
Edema	No	No
Average age of children (month)	12.05	13.78
Average weight of mother (kg)	51.04	57.19
Average weight of children (kg)	8.16	9.31
Average MUAC (mm)	14.08	14.31
Average head circumference (cm)	43.85	44.70
Average Hb (gm/dl)	12.23	11.88
Average RBS (mmole/L)	5.41	5.96

4 COVID-19 response

The COVID-19 pandemic is a global issue that has created a miserable situation all over the world. Bangladesh's government imposed countrywide shutdown time to time to stop the spread of the coronavirus. Since the lockdown began, the socioeconomic condition of fishers, boat and net owners, traders, input suppliers, ice suppliers and dry fish producers has been seriously affected. The ECOFISH II team raised awareness among the fishing communities in its intervention areas regarding such measures as physical and social distancing, wearing masks, washing hands frequently and using hand sanitizer.

5 Communications

As communication outcomes, the project produced 68,000 leaflets and 274,000 posters on Jatka conservation, 65-day marine fishing ban, 22-day brood hilsa fishing ban, biodiversity conservation, MPA management, and catfish conservation, and a one-pager on dry fish, sea weeds, and green mussels. The project organized, 1 media visit, received 98 media coverages, published 13 op-eds in leading Bangladeshi media, organized live TV talk show on: "*Hilsa and Marine Fisheries & Development: Potentials & Challenges*" & "*Impacts of 65 days fishing ban on marine biodiversity and fisheries conservation*," organized virtual round table discussion program titled "*Role of Hilsa in Blue Economy & Fishers' Livelihoods*," and organized a webinar. Forty-one pieces of social media content were created and published on various aspects of key interventions and thematic issues.

5.1 Media coverage

ECOFISH II attracted media attention for its comprehensive activities aimed at improving fishers' livelihood resilience, conserving biodiversity, and enhancing ecosystem resilience. Several front-page stories and op-eds were published in the country's most prestigious dailies. The following are links to various news stories.

Heading of the news	Name of the media	Links of media coverage
WorldFish hosts beach clean-up	The financial express	https://bit.ly/3uDf3Cm
WorldFish hosts beach clean-up	Dhaka Post	https://bit.ly/3sQgQnh
WorldFish hosts beach clean-up	Jugantor	https://bit.ly/3dUUVoS
WorldFish hosts beach clean-up	Samakal	https://bit.ly/3d3FJGH
Life jackets distributed in Cox's Bazar	The Daily Sun	https://cutt.ly/1kgOpZK
Life jackets distributed in Cox's Bazar	The financial express	https://cutt.ly/IkgI6IA
Life jackets distributed among fishermen	The Bangladesh Post	https://bit.ly/3fTgfO1
Life jackets distributed among fishermen	Samakal	https://cutt.ly/pkgORHm
Life jackets distributed among fishermen	Bhorerkagoj	https://cutt.ly/pkgOF9D
Life jackets distributed among fishermen	Jugantor	https://cutt.ly/1kgOOrU
WorldFish hosts beach clean-up	The Financial Express	https://bit.ly/3uDf3Cm
WorldFish hosts beach clean-up	Dhaka Post	https://bit.ly/3sQgQnh
Community fish guards to conserve	Jugantor	https://cutt.ly/Rc7UL3R
Jatka fishermen mend ways	Dhaka Tribune	https://cutt.ly/acHo7nA
Life jackets distributed in Cox's Bazar	The Daily Sun	https://cutt.ly/1kgOpZK
Read crab conservation at Kuakata	The Financial Express	https://cutt.ly/JbUWfj7
Life jackets distributed among fishermen	The Bangladesh Post	https://bit.ly/3fTgfO1
Life jackets distributed among fishermen	Samakal	https://cutt.ly/pkgORHm
Community fish guards to conserve	Bhorerkagoj	https://bit.ly/3igGVYA
Read crab conservation at Kuakata	Bangladesh Protidin	https://bit.ly/3kt955d
Read crab conservation at Kuakata	www.risingbd.com	https://tinyurl.com/4uh68hae
Discussion meeting on biodiversity c	bhorer-dak.com	https://bit.ly/2UPYmHo

Beach cleaning held in Cox's Bazar	Bhorerkagoj	https://bit.ly/3BeOaZN
Beach cleaning held in Cox's Bazar	Jugantor	https://bit.ly/3iFEmkP
Haloishar, the model fishing village of Naria	Kholakagoj	https://tinyurl.com/2p8tnwbb
Haloishar, the model fishing village of Naria	The Independent	https://tinyurl.com/rv7r2ffr
Haloishar, the model fishing village of Naria	Jugantor	https://cutt.ly/NQt85MT
Haloishar, the model fishing village of Naria	Dhaka Post	https://bit.ly/3rBKixs
Haloishar, the model fishing village of Naria	Rising BD	https://bit.ly/3kZZ5Rn
Dolphin-like animals float on Kuakata beach	Prothom Alo	https://cutt.ly/vQLl0Pb
Dead Dolphin found at the Kuakata beach	Jugantor	https://cutt.ly/wWikyk9
Poultry distributed among sea farers	Jai Jai Din	https://cutt.ly/eWrjvY4
Boat skippers training	Bangladesh Protidin	https://tinyurl.com/5672xdks
lifejackets distribution	Bangladesh Protidin	https://cutt.ly/rWik2b6
Numerous nets in river	Prothom Alo	https://cutt.ly/8WhxeG2
Blue Guards initiative on beach cleaning	Samakal	https://cutt.ly/Rml1hR8
Blue Guards initiative on beach cleaning	Jugantor	https://cutt.ly/Oml1zeO
Blue Guards initiative on beach cleaning	Inqilab	https://cutt.ly/tWcaAaD
Dead Delphine found in Kuakata sea beach	Bangla Tribune	https://cutt.ly/1WJNUbZ
Dead Delphine found in Kuakata sea beach	Jagonews	https://tinyurl.com/5dnr73ua
The density of Hilsa has increased	Prothom Alo	https://cutt.ly/sWJ3r1t
Beach cleanup & mini marathon	Bangladesh Protidin	https://bit.ly/3CklrBg
Beach cleanup & mini marathon	Jagonews 24.com	https://tinyurl.com/2zw28a38
Oath to stop plastic pollution	Bangladesh Protidin	https://tinyurl.com/2bmf222f
Beach cleanup & mini marathon	Daily Janakantha	https://bit.ly/3CoyX8b
Beach cleanup & mini marathon	Amader Shomoy	https://tinyurl.com/2kf5rwz3
Beach cleanup & mini marathon	Bangla News 24.com	https://cutt.ly/hEpdGUP
The fish sanctuary filled with silt	Desh Rupantar	https://tinyurl.com/yc5manzc
consultation meeting on MPA	bdcrime24.com.	https://tinyurl.com/4k75zfrv
Hilsa in Blue Economy & fisher's livelihoods	Prothom Alo	https://rb.gy/zaei4z

5.2 Op-ed article and blogs

- An Op-ed entitled "Scientific food systems help biodiversity, livelihoods" has been published in the SciDev.Net, link: https://tinyurl.com/3878928h
- Team Leader of ECOFISH II took part in a virtual discussion on "Sector-wide impact assessment (SWIA) of artisanal marine fisheries sector of Bangladesh" organized by Manusher Jonnyo Foundation and the Daily Star https://tinyurl.com/s8fkzta6
- One Op-ed titled "Why is conserving wetlands crucial? Was published https://cutt.ly/DkLd1XP)
- A blog on CSG published web site of WorldFish https://tinyurl.com/4nfvjavj
- Featuring ECOFISH II contribution regarding conserving water, an Op-ed has been published by leading English Newspaper named the Bangladesh Post. Link of the said article: https://cutt.ly/YvoY261
- An OP_ED written by ECOFISH staff titled Cleaning up the coast published in the Dhaka Tribune.
- An OP-ED written by ECOFISH II team titled "Why the St Martin's Island should be declared a marine protected area" and published in the Business Standard, the Financial Express, the Independent, the Prothom Alo, the Rising BD, the Bangladesh Post.

5.3 TV talk show

- Organized a live TV talk show on: "Hilsa and Marine Fisheries Development: Potentials & challenges" in ATN Bangla with expert panel of Additional Secretary (MoFL), Director (Marine) and Chief Scientific Officer (DoF), Deputy Chief (Hilsa) and ex-Project Director of ECOFISH- BD (DoF) and Scientists of ECOFISH II (WorldFish Bangladesh).
- Organized a live TV talk show on "Impacts of 65 days fishing ban on marine biodiversity and fisheries conservation" in *Prokrti O Jibon* of Channel –I with the expert panel of Additional Secretary (MoFL), former Director General (DoF), former Director- research and planning (BFRI), and Scientist (Fish Population Biology) of ECOFISH II, WorldFish (Figure 25).

Figure 25 TV talk show on Hilsa and Marine Fisheries Development: Potentials & challenges" in ATN Bangla (right); and Impacts of 65-day fishing ban on marine biodiversity and fish conservation" in *Prokrti O Jibon* of Channel–I (left).

5.4 Webinar

Organized a webinar on "*Marine Biodiversity Conservation and Fishers Livelihoods in Bangladesh*" as a part of World Ocean day 2021 observation. Fisheries experts and policy makers took part in the event and expressed their opinion on marine biodiversity and ecosystem conservation.

5.5 Virtual RoundTable

Organized a virtual roundtable discussion on "Role of Hilsa in Blue Economy & fisher's livelihoods" (ইলিশ, সাগরকেন্দ্রিক অর্থনীতি ও জেলেদের জীবিকা) with the leading Daily-Prothom Alo (Figure 26):

Figure 26 Participants in the virtual roundtable.

5.6 Printed materials

Produced 68,000 leaflets & 274,000 poster on Jatka conservation, 65 days marine fishing ban, 22 days brood hilsa fishing ban, biodiversity conservation and MPA management, catfish conservation, one pager on dry fish, sea weeds & green mussels.

Figure 27 Printed materials (posters and leaflets) were distributed to raise awareness among stakeholders about various aspects of biodiversity conservation.

5.7 Facebook post

Developed 41 social media posts on various aspects of key interventions and thematic issues for the Hilsa Facebook page 'Conserve Hilsa.' Figure 28 depicts screenshots of some of the posts.

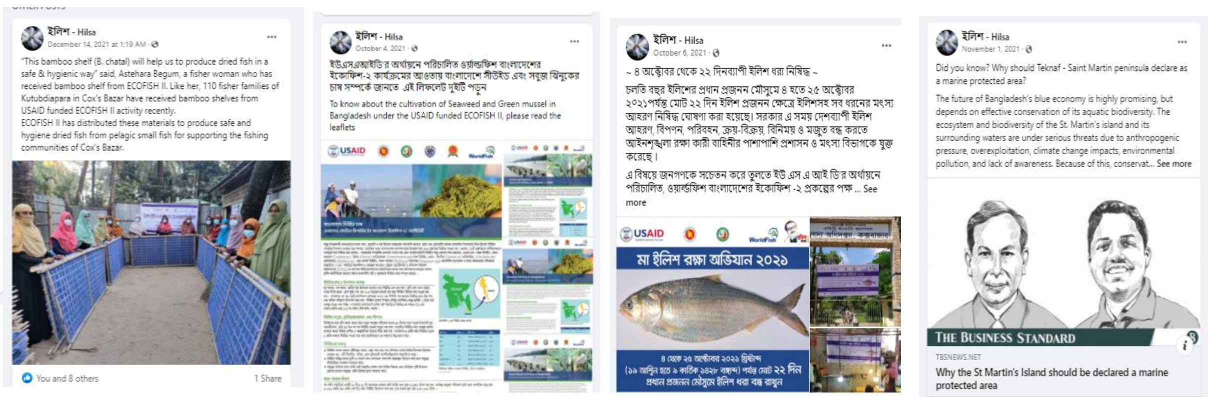

Figure 28 Screen shots of a few Facebook posts.

6 Environment

ECOFISH II developed an Environmental Monitoring and Mitigation Plan (EMMP) in accordance with the environmental compliance requirements of USAID for the activities it funds. This laid the groundwork for systematically putting in place the conditions for conducting an initial environmental examination (IEE) and an environmental assessment (EA). The EMMP was approved by USAID, and it was even shared with other projects as an example of what to do in the future. The EMMP's purpose is to determine whether the proposed interventions have any potential negative environmental consequences and to propose a mitigation plan to mitigate any environmental consequences. The EMMP guidelines were strictly followed throughout the project's implementation period.

7 Monitoring, evaluation and learning (MEL)

ECOFISH II created an example to visualize the theory of change in its first phase and integrated it with the central MEL system of the CGIAR Research Program on Fish Agri-Food Systems (FISH CRP). MEL system of the project is used to visualize the project outputs in various ways of communication along with relevant learning. MEL team finalized a robust MEL plan after incorporating USAID's suggestions. The plan includes six of USAID's standard indicators and seven of its custom indicators, which have been used to assess the project's performance. A centralized online system for data collection, storage and spreading information is in place. The database has other features, including village locations that can be seen using Google Earth. This information helps users to see the salient features of villages and specific ECOFISH II interventions for further planning and decision-making. The MEL team completed the activities outlined below for data acquisition and project performance measurements.

7.1 Summary of results: USAID and ECOFISH indicators

The project helped achieve predefined USAID standard and ECOFISH II custom indicators (Table 8 and Figure 29) as a result of assistance from the USG.

Table 8 Summary of ECOFISH II results to date with performance monitoring indicators.

Indicators	Target	Achievement (%)
Standard indicators		
EG.10.2-1 Number of hectares of biologically significant areas showing improved biophysical conditions as a result of USG assistance	69,274	96%
EG.10.2-2: Number of hectares of biological significance and/or natural resources under improved NRM as a result of USG assistance	203,888	97%
EG.10.2-3: Number of people with improved economic benefits derived from sustainable natural resource management and/or biodiversity conservation as a result of USG assistance	20,000	92%
EG.10.2-4: Number of people trained in sustainable natural resource management and/or biodiversity conservation as a result of USG assistance	3,000	105%
EG.10.2-5: Number of laws, policies or regulations that address biodiversity conservation and/or other environmental themes officially proposed, adopted or implemented as a result of USG assistance	1	100%
CBLD-9: Percentage of USG-assisted organizations with improved performance	80%	89%
Custom indicators		
Number of species newly appeared or reappeared or improved in fishers' catch along the coast of Cox's Bazar as a result of USG assistance	5	120%

Indicators	Target	Achievement (%)
Percentage increase in hilsa and other important marine species (CPUE) along the coast of Cox's Bazar as a result of USG assistance	5%	34%
Number of fishing households practicing better fisheries management	4,000	91%
Number of households with increased food and nutrition security (Household Dietary Diversity Score and Food Consumption Score) as a result of USG assistance	4,000	95%
Number of households with improved well-being and diversified sources of income as a result of USG assistance	4,000	92%
Number of people gaining employment from sustainable fisheries management	1,000	92%
Number of youths with access to improved technologies and market links in ZOR sites as a result of USG assistance	200	94%

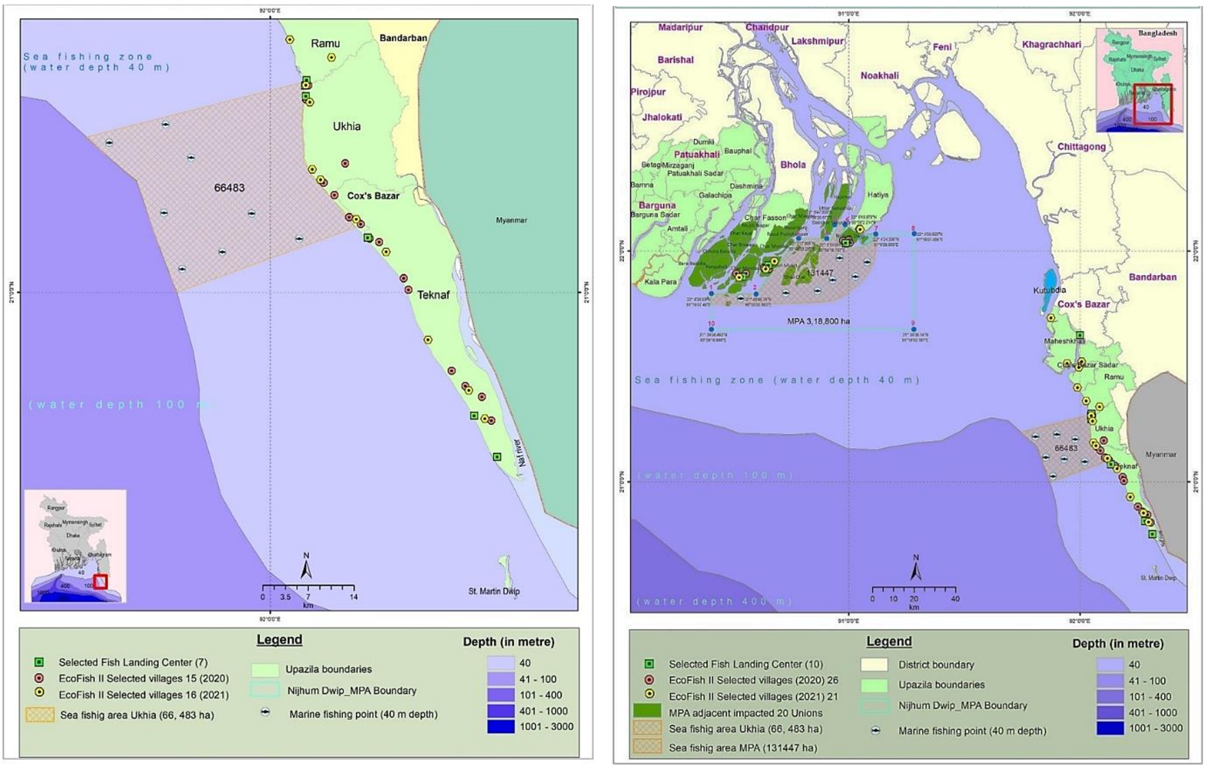

Figure 29 Biophysically improved areas as result of USG assistance.

7.2. Basic household information

ECOFISH II selected 15 fishing villages in the ZOR and 6 in the Nijhum Dwip MPA. This was done based on aggregating the fishing households and the willingness of fisher communities to participate in conservation practices, as well as the geophysical suitability of the villages. ECOFISH II followed a coherent GIS-based approach, using Google Earth, to finalize 21 villages for Year 2 interventions. For an initial assessment, both the census data and needs and preferences for AIGAs were completed in the ZOR and MPA. The project achieved the 3840 household profiles by collecting basic information from every household and storing them in the database.

7.3. Annual performance survey of fishing HHs

An annual performance survey was conducted with 465 sample fishers' households selected from the targeted 3844 HHs (supported in 2020) to measure various standard and custom indicators. This assessment considers the level of application or adoption of diverse livelihood opportunities, AIGA activities, and improved management practices as a result of ECOFISH II activities. According to the survey results, the average income from fishing (fish income), other income, and total income of fisher households increased significantly when compared to the baseline. Fish income for fisher households increased to BDT 22,537 per household after the project intervention, which was 27% higher than the baseline (the threshold income was BDT 84,092/household). The total income of fisher households was also increased to BDT 36,813 per household, a 43 percent increase over the baseline. It is also reported that after participating in the ECOFISH II project, the average number of income sources increased from 2.24 to 4.29, a 92 percent increase over the baseline status at 1% level of significance.

The project improved nutritional knowledge and practices. The household's dietary diversity was 5.30 at the start, and it has now increased to 6.81, which is 28% higher than the start. Households that adopt better fisheries management practices begin or improve their compliance with government rules and regulations for fish conservation. The Activity increases the capacity of targeted householders in improved natural resource management (NRM) and AIGAs through training sessions, group learning sessions, group meetings, and exchange. The sample survey results also revealed that after participating in the project, 91 percent of households (3654) practiced better management and learned how to combat IUU fishing.

7.4. Impact study on Model Resilient Village

Enhanced Coastal Fisheries in Bangladesh (ECOFISH II) had taken the initiative to conduct an impact assessment survey resilient fishing model village in the riverine three coastal districts. Standardized activities were done by ECOFISH in these villages to establish three model resilient fishing villages, one from each district. A panel survey method was followed where data was collected from surveying 640 fisher households (baseline= 320 and endline= 320) which was under ECOFISH I intervention villages that are Halioshar village (96 HHs) from Shariatpur district, Uttar Bogula (102 HHs), Haimchar from Chandpur district, and Balaramsura (122 HHs) from Bhola district. To analyze the multidimensional poverty situation in model villages, ten dimensions were evaluated: food & nutrition, education, health, sanitation & hygiene, water supply, housing, farm assets, non-farm assets, resilience to shocks, gender & social equality and each of the dimensions had several indicators. Each dimension is equally weighted. The panel survey results revealed that the different dimension of multidimensional poverty has changed significantly compare to baseline information among the fisher's communities in the villages. The panel survey also revealed that the headcount multidimensional poverty among the fisher's communities in the villages was 85% in 2016 baseline survey. It was reduced to 25% at the end of the project in 2021 due to the interventions made by ECOFISH. In conclusion, the interventions done by the ECOFISH project were able to reduce multidimensional poverty successfully among the fishermen's households.

8 Implementation challenges

8.1. Overall challenges

- The COVID-19 pandemic caused a delay in regular program implementation.
- Capacity-building activities have been delayed in order to maintain social distances and avoid large crowds.

8.2. Challenges in the ZOR

- Reducing IUU will be a major challenge. The project does not cover the industrial fishing fleet, and marine fisheries are a common pool resource.
- Building the capacity of boat skippers on biodiversity conservation remains a challenge, as fishers frequently go fishing except during the ban period.

- Ensuring safety and security measures of boat skippers and fishers is difficult when they are fishing at sea.
- Multi-stakeholders supporting host communities in the ZOR is another challenge to maintaining strong coordination and liaisons.
- Developing a smooth marketing channel/network on seaweed, green mussel and other coastal farming products as well as dried fish is a challenging task.
- Rohingyia refugees are taking over part-time fishing jobs and other job opportunities in the ZOR by offering cheaper labor.
- Water, sanitation and hygiene (WASH) practices are poor, and sufficient drinking water and improved sanitary facilities are needed.
- More than 80% of fishers live below the poverty line, and most have a large family, often seven to 10 people in a household.
- Motivating *arotder* and high-level stakeholders in the landing centers is difficult for introducing the PES.
- Women in the ZOR are reluctant to join FCGs and CSGs due to social and local cultural norms.
- Women's participation in co-management committees, marketing, control over assets, decision-making and mobility depends on the consent of their husbands or other men in their household.

8.3. Challenges in the MRE

- Fishers from non-intervened villages often engage in illegal fishing, so sustainable management of coastal resources will remain as a major challenge so long as all fishing villages are not included in the management approach.
- Fishing *Jatka* illegally by fishers outside of ECOFISH II intervention areas resulted in frustration among the fishers in the project villages during the *Jatka* fishing ban.
- Activities in the Nijhum Dwip MPA are difficult to follow up due to its remote location and poor accessibility.
- Erosion along riverbanks displaced some households. As a result, some fisherwomen opted to discontinue CSG activities in their areas. This makes it challenging to keep them in the group.
- Pollution from effluents and the garbage in Dhaka could threaten biodiversity, including hilsa.
- Conserving riverine catfish and protecting their juveniles is a big challenge.

9 Integrating crosscutting issues and USAID forward priorities

9.1 Gender equality and women's empowerment

A gender strategy was developed to ensure gender mainstreaming in the project. The gender strategy builds upon work carried out within the project and with partner organizations on gender dynamics and overcoming gender-based constraints. It also includes measuring tools (MEL indicators) of gender integrations in different activities aligned with the project's IRs and Sub-IRs. ECOFISH II conducted gender-formative research to better understand the ZOR and MPA's existing social and economic gender context. The research provided a solid foundation for the working area's gender context, which is assisting in identifying gender gaps and designing context-specific interventions to promote gender equity and women's empowerment.

ECOFISH II organized a two-day gender sensitization workshop on August 4-5, 2021, to improve project staff's knowledge and capacity on gender issues and to strengthen gender mainstreaming in ECOFISH II Activity. The training was attended by all project staff from WorldFish and its partners. Ms. Mahmuda

Rahman Khan, Mission Gender Specialist; USAID/Bangladesh, facilitated a session on gender.

To recognize women's contribution in fisheries sector ECOFISH-II has engaged 500 women in safe and hygienic dried fish production this year. It is promising that a good number of fisher's women are now producing seaweeds and green mussel in ZOR. They are selling dry seaweeds in local markets of Cox's Bazar thus contributing to family income. ECOFISH-II has been successful to ensure women participation in different AIGA trainings (71%), ecosystem health improvement as blue guards (37%), FCG training meetings (24%) and co-management committee meetings (18%). ECOFISH-II team is working to break the gender barriers in the conservative fisher communities of MPA and ZoR. Moreover, Facebook posts were published in ECOFISH II official page highlighting women's participation in the project activities focusing on "Dried fish distributed among fishers" and "Women in beach cleaning" aspects.

The project organized colorful and vibrant events to observe International Women's Day at community level with women's from Community Savings Groups and dried fish Producer groups. Five events were organized in Cox's Bazar Sadar, Ramu, Ukhiya, Teknaf, Patuakhali-Kalapara and Charfassion (Figure 30). 147 people were participated in those event (94% women) to build forward betterin aquatic food system.

Figure 30 Women and men from fishing households took part in colorful events commemorating International Women's Day 2021 in Ukhiya, Cox's Bazar.

During the COVID-19 lockdown, fishermen could not go out to fish, and households faced huge economic crises. During the pandemic, women took out loans to invest in AIGAs for their husbands. They also invested their income in activities such as vegetable gardening and poultry or goat rearing to purchase sewing machines. Savings groups support women's financial independence during COVID-19 in Bangladesh. A blog was also published highlighting "[Savings groups support women's financial independence during COVID-19 in Bangladesh]" in WorldFish' s official page. Anecdotal evidence suggests that CSG interventions and the economic empowerment of women reduced gender-based violence at the household level in the fishing communities. A study was conducted to determine whether community savings groups can truly improve the economic conditions of women, resulting in women empowerment in the fishing community or not. The findings confirm that CSG group members were more financially solvent and less reliant on Mahajan's loans when compared to non-CSG group members. Improved economic indicators (savings, income, and expenditure) of CSG households lay the foundation for achieving women empowerment in the intervened group. The findings revealed that CSG women outperformed non-CSG women in various dimensions of leadership capacity. Their confidence, speaking power, courage, and negotiating power have all increased, which has resulted in an improvement in their soft skills. Financial access and literacy, as well as a supportive environment for women's productive engagement, help to reduce gender inequality in the fishing community.

9.2. Sustainability mechanisms

The following steps have been taken to ensure the sustainability of the project:

- Mainstreaming the co-management committees and dissemination to ZOR and other GoB projects, specially the project is trying to formulate a TAPP with Gov. to implement the project activities jointly with DoF that will ultimately improve the sustainability of ECOFISH II outputs.
- Formation of Fisheries Management Committee (FMC) /Fisheries Conservation Groups (FCGs) in all intervened fishing villages.
- Strengthening the capacity of formal and informal institutions (i.e. CSGs & CFGs).
- ECOFISH recruited 400 CFGs (Community Fish Guards) that will remain as asset for DoF.
- Introduction of "Hilsa Conservation and Development Fund (HCDF)" and PES the landing centers.
- AIGAs, community savings and small soft loans for women in fishing villages will continue.
- Revised version of the Hilsa Fisheries Management Action Plan (HFMAP) will serve as guidelines for hilsa fish and biodiversity conservation until 2030.
- Management of the MPA in the Nijhum Dwip and establishing another MPA in the Teknaf-St. Martins' Island areas would sustain the benefits of the biodiversity conservation approach.
- Policy support in selecting the most effective brood ban period and the allowable mesh size (6.5 cm) for hilsa gillnetters will ensure sustainable hilsa management.
- Disaster preparedness focusing on cyclone, climate change and contagious diseases for human (COVID-19), domestic animals (e.g. foot and mouth disease) be strengthened for sustainable development.

9.3 Global climate change

ECOFISH II strengthens the resilience and adaptive capacity to climate change by supporting sustainable and climate resilient fisheries, AIGAs, gender equality and increasing social capital of the fishing communities. The impact of salinity intrusion, rising water levels, higher temperatures and increased frequency and magnitude of cyclonic storms will be given greater importance to cope with these issues, which are obviously related to climate change. ECOFISH II established seaweed farming in the Bay of Bengal to mitigate the effects of climate change on the ocean. Seaweed can sequestrate carbon about 30% of the dry weight. Based on this assumption, it is calculated that only 3,528 m^2 area sequestrate 402.2 kg atmospheric carbon in only 5 months.

9.4 Policy and governance support

ECOFISH II has been working in closely with different departments of the GOB, DOF, universities, national and international NGOs, and private organizations to run the project in a sustainable manner. The GOB raised the mesh size for hilsa gillnets from 4.5 cm to 6.5 cm, by notifying fishers through a gazette, based on the recommendations of the project to reduce the number of juveniles caught. Also based on the project's recommendation, the brood hilsa ban period was set in October. These policy supports will remain enormously useful in biodiversity conservation year after year. Additionally, the project has been contributing to policy development and has continued advocating for policies based on the data-driven management decisions.

- ECOFISH II prepared the draft Nijhum Dwip MPA management plan, which was approved by the MOFL through a consultative process.
- The project helped the DOF operationalize the implementation of the HCDF.
- On the request of the DOF, ECOFISH II established a Mujib *Barsho Adorsha Matshya Gram* in Haloishar village of Naria Upazila in Shariatpur District to commemorate the 100th anniversary of the birth of the Father of the Nation, Bangabandhu Sheikh Mujibur Rahman.
- The DOF started scaling the concept of resilient fishing villages through its Sustainable Coastal and Marine Fisheries Project (SCMFP), funded by the World Bank.

9.5 Local capacity development

The project tried to take different initiatives to strengthen the capacity of the local co-management bodies of different tiers and other stakeholders. During the pandemic, the team worked safely with people in the communities, as well as stakeholders, by maintaining safety measures. It also organized many virtual training sessions, as well as meetings with project partners, staff and others. The project also organized different kinds of meetings and training sessions for co-management committee members, local elites, GOB officials and private partners. These were held to attain good governance, increase capacity building and create accountability in the CSGs, CFGs, FMCs, and union, upazila and district co-management groups.

9.6 Public private partnership and Global Development Alliance impacts

Several consultations were convened with private entrepreneurs (such as Falcon International), the DOF, universities, fishers' associations and the IOM. The purpose was to explore the potential of private public partnerships (PPP) that create favorable business opportunities along the fish value chain and for high-potential AIGAs. In partnership with Falcon International and the DOF, the project is contributing remarkably in seaweed farming in the ZOR. In partnership with the CVASU, the DOF and Falcon International, the project is supporting the fishing communities in the ZOR for green mussel farming as an AIGA. These types of partnership initiatives have been continuing in crab farming, quality dry fish production and fish catch monitoring.

9.7 Science, technology and innovations

The project integrated the "improved science outputs for decision-making" component by assessing and improving ecosystem health, assessing and conserving biodiversity, and monitoring fisheries dynamics. This was done to generate high quality scientific information to support decision-making for sustainable fisheries management. In addition, the project developed some farming and production technologies for AIGAs through "research in development." To assist the project in research and innovation, four public universities and a private entrepreneur were engaged.

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10 Stakeholder participation and involvement

In partnership with different national and international organizations, ECOFISH II has been implementing project activities and will continue these partnerships throughout the project period. The project partnered with the DOF and other key partners, including universities, conservation organizations, fisher associations and NGOs. In all cases, fishers and other local stakeholders are playing key roles in planning and implementing the activities.

11 Management and administrative issues

WorldFish has been implementing the ECOFISH II project in close partnership with the DOF. Based in the WorldFish offices in Dhaka, the lead implementation team consists of the ECOFISH II team leader, three scientists, a senior gender specialist, a Senior nutrition specialist, a Senior MEL specialist, a project manager, a communication specialist and two data analysts. Fifteen research associates and research assistants have been implementing the project at 10 coastal sites.

There is a project office at the DOF headquarters in Dhaka, and 8 field offices associated with the relevant district or upazila fisheries offices of the DOF are located in the coastal regions. The field offices are located in the Upazilas of Cox's Bazar Sadar, Ukhiya, Teknaf, Ramu and Moheskhali in the ZOR and in the districts of Bhola, Barguna and Patuakhali in the MRE. At each of the offices, there is a three-member team consisting of one research associate, one research assistant and an office assistant.

12 Lessons learned

- Host community needs support to improve their livelihood as they are the most sufferers from the complete closure of fishing in the Naf river and Rohingyia influx in the ZOR.
- Livelihood supports encourage and improve ability of fishers to comply the biodiversity conservation efforts.
- Small pelagic fish drying by poor fishers' women becoming a great scope of AIGA that would improve nutrition status of poor fishing communities.
- Enterprise development is the key to the economic resilience of the community.
- Market linkages for marine products are crucial for sustainability.
- Savings among CSGs create an opportunity for soft loan sources during the fishing ban periods and other shocks, and CFGs also found effective as recognized by DoF and will remain asset even beyond project period.
- Cyclones like Amphan can negatively affect seaweed, green mussel and crab farming, as well as other AIGAs.
- COVID-19 made the socioeconomic condition of the fishing households worse.
- Boat skippers training on biodiversity conservation was an important and effective step to build awareness on marine biodiversity conservation and responsible fishing.
- Awareness building messages are effective against the use of illegal gears (*current, behundi jal*, etc.).
- Business literacy school (BLS) helped rural women in developing reading skills and simple calculation.
- Co-management approach creates mutual trust among the resource users and law enforcing agencies.
- A co-management approach can create mutual trust among resource users as well as law enforcement agencies.
- Official ties of ECOFISH II with DoF through TAPP may help in building more collaborative implementations of the activities, which will support more policy level contribution of the Govt.

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