Global Center on Adaptation

Investment Brief

Pathways to implementing the national roadmap and Global Tools for Nature-Based Solutions

February 2026

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Investment cases: context & limitations

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These investment cases represent a pre-feasibility identification of an adaptation and resilience investment pipeline, building on the analytical results of the infrastructure stress test and adaptation roadmap, as well as stakeholder consultations. Key limitations will need to be addressed in subsequent phases:

- **Pilot-to-Program Scaling Assumptions:** Financial and impact metrics are extrapolated from specific, data-rich pilot sites; localized environmental and economic baselines will vary across the broader target regions.
- **Simplified Climate and Economic Modeling:** The cost-benefit analysis utilizes standardized climate scenarios and exposure rates, which cannot fully capture unpredictable, compounding weather events or macroeconomic shifts.
- **Exclusion of Soft Infrastructure Costs:** Certain enabling components, such as institutional capacity building, long-term community monitoring frameworks, and specific early warning setups, are not fully costed in these preliminary models.
- **Preliminary Nature of Interventions:** Engineering designs, nature-based solutions, and structural hybrid measures are conceptual and have not yet undergone site-specific technical specifications.
- **Requirement for Detailed Feasibility Studies:** This analysis serves as a strategic, high-level investment case; comprehensive, site-specific engineering, environmental, and social feasibility studies are required before capital allocation.

Investment Case-1

Flood and Afal-Resilient Infrastructure in the North-Eastern Haor Basin

Investment Case Summary

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Context & climate risks:

- The remote Haor Basin is **critical for rice production and relies on annual monsoon flooding** but crops and livelihoods are increasingly exposed to climate hazards:
  - Increasingly erratic **pre-monsoon floods destroy crops** before harvest
  - Stronger **monsoon waves threaten homesteads** across the haors.

Proposed solution:

- **NbS:** Riparian buffers, embankment vegetation, wetland restoration
- **Hybrid:** Killa construction, grain threshers, settlement protection

Investment summary:

Pilot project level:
- Cost: **$14.6 million**
- CAPEX: **$6.3 million**
- OPEX: **$0.25 million** annually

Programme level:
- Cost: **$665 million**

Climate adaptation impact pathway:

Solution
- Green buffers + wetlands
- Vegetated embankments + killa
- Improved settlement protection

Key physical impact
- Reduced flood peak
- Additional days' protection
- Reduced erosion risk

Key economic impact
- Reduced crop loss
- Reduced repair costs

Economic case:

Pilot project level:
- ENPV: **$ 12 million**
- BCR: **2.7**
- EIRR: **22%**

Programme **level**
- ENPV: **$ 564 million**

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Programme Overview

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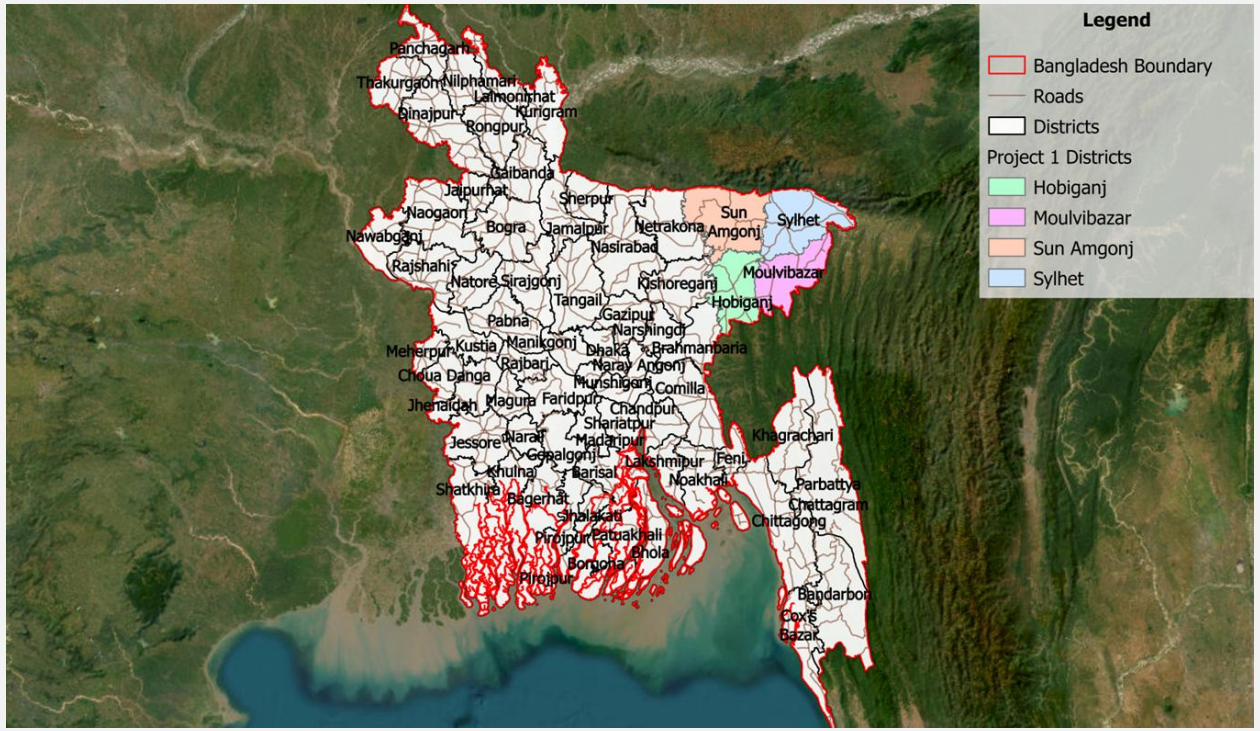
Objective: to strengthen resilience of crops to pre-monsoon flash floods and settlements to monsoon season wave action (afal)

Location: Haor Basin, North-eastern Bangladesh



Component by type of solution

Type	*Project intervention*
Hybrid	Killa construction + threshers
	Haati protection
NbS	Embankment vegetation
	Wetland restoration
	Green buffer zone planting
Enabling	Early warning + community response
	Community-led monitoring

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A “Pilot” was designed as an illustrative project within the broader programme

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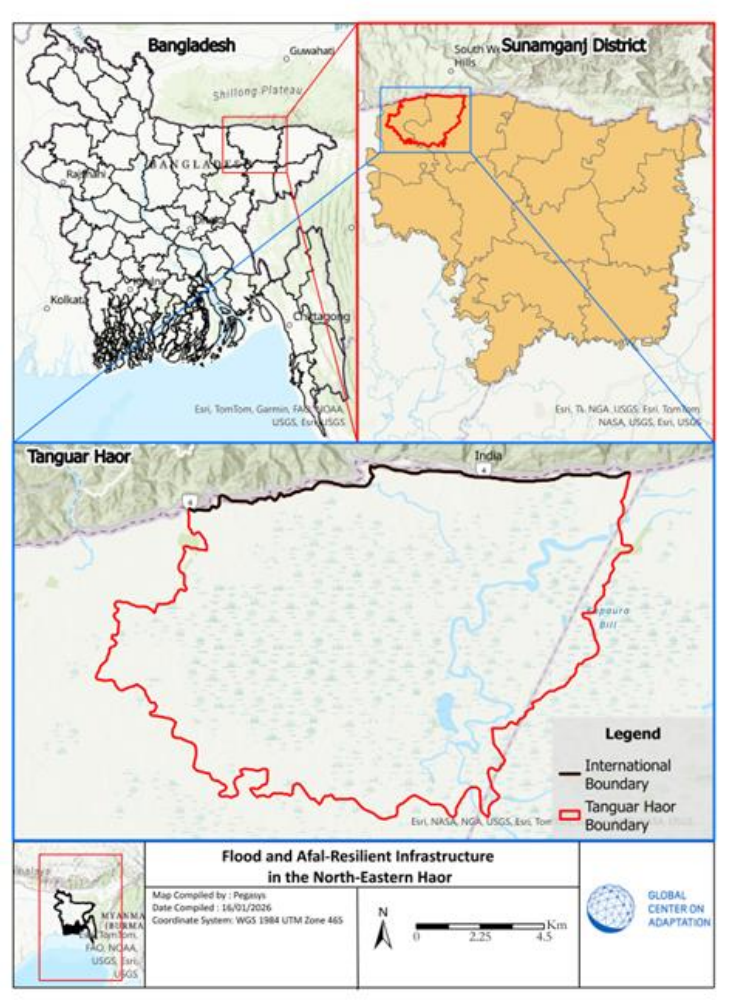
Given the broad nature of the programmes, we adopted a Pilot project approach to enable rigorous economic analysis.

Location:
Tanguar Haor, Sunamganj district



Rationale for selection

The haor…

- Is affected by **flash-flooding**
- Contributes to critical **supply of rice** during the dry season
- Has good **data availability** as Ramsar site

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Pilot Project – Context and Climate Risks

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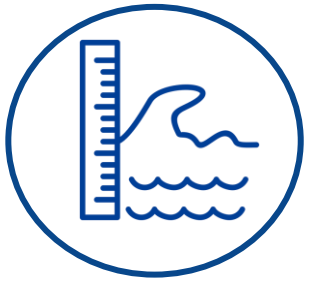
Baseline situation | Solution and investment costs | Benefits | Economic value | Robustness

The remote Haor is **critical for rice cultivation** and relies on annual monsoon flooding. However, crops and livelihoods are increasingly exposed to **pre-monsoon flash floods** and **Afal**.



Crop loss risk

- **Pre-monsoon flash floods** threaten rice crops
  - **10%** of **crops are lost** each year on average due to early flooding
  - **Emergency food** is more expensive than local rice (~**20%** more)

Embankment damage risk

- **Flash floods** damage protective embankments
  - Embankments require periodic **repair** and reconstruction **(~$150 000/km** every few years).

Settlement erosion risk

- ***Afal*** erodes earthen mounds on which settlements (*Haatis*) are built
  - Every year, households spend significant sums to **construct and repair protection** for the earthen mounds (**~USD 180** per household)

Each year, the **intensity and frequency** of these pre-monsoon flash floods and Afal increase due to **climate change**
It is expected that asset exposure to riverine flooding will increase by 7.5% by 2050

"Afal" refers to violent, high-intensity waves created by strong winds during monsoon seasons
"Haatis" are settlements built on raised earthen mounds within haors

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Pilot Project – Proposed Solution and Investment Costs

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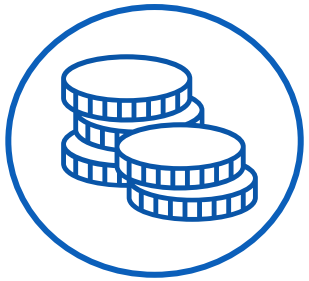
Solution and investment costs | **Benefits** | **Economic value** | **Robustness**

Total investment costs of the Pilot project are expected to be **$14.6 million**, in nominal terms over the project lifespan



Investments to reduce crop loss ~ $ 10 million

- Green **riparian buffer** zones to reduce flood peak
- **Wetland restoration** to reduce flood peak
- **Vegetated embankments** (vetiver grass) to reduce risk of failure
- **Killa construction + thresher** provision to allow additional days of protection before harvest

Investments to reduce embankment damage ~ $40 k

- **Vegetated embankments** (vetiver grass) to reduce erosion from floods

Investments to reduce settlement erosion ~ $ 4 million

- **Settlement protection** (RCC + vegetation) to reduce afal-induced erosion

- CAPEX: **$6.3 million** (incurred over two-year implementation period)
- OPEX**: $0.25 million annually** (calculated as a % of CAPEX)

A “Killa” is a raised earthen platform where harvested rice can be temporarily stored when flash floods occur.

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Pilot Project – Intervention Benefits

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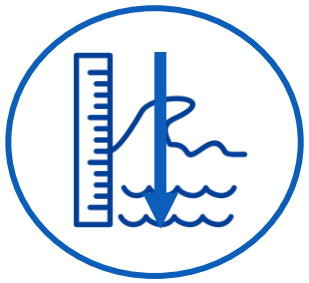
Benefits → Economic value → Robustness

Key adaptation benefits include **reduced flood peak, additional days of crop protection** and **improved erosion resilience**, which result in **avoided** costs of **crop loss, embankment repair** and **Haati repair**



Reduced costs of crop loss & food aid ~ $ 5 million (present value)

- Green buffers and wetlands **reduce flood peak**
- Vegetation **reduces probability of embankment failure** before harvest
- Killas and threshers provide **additional days of protection** before harvest

Reduced embankment repair costs ~ $2 million

- Vegetated embankments **reduce annual repair** costs

Reduced haati protection costs ~ $ 11 million

- Interlocking RCC + vetiver converts annual settlement protection repair costs to **lower, planned maintenance costs**

Co-benefits ~ $ 2 million

- Wetland restoration **improves habitat for fish, water filtration, and soil fertility,** among other ecosystem services.
- Green buffers **sequester carbon**

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Pilot Project – Economic Case

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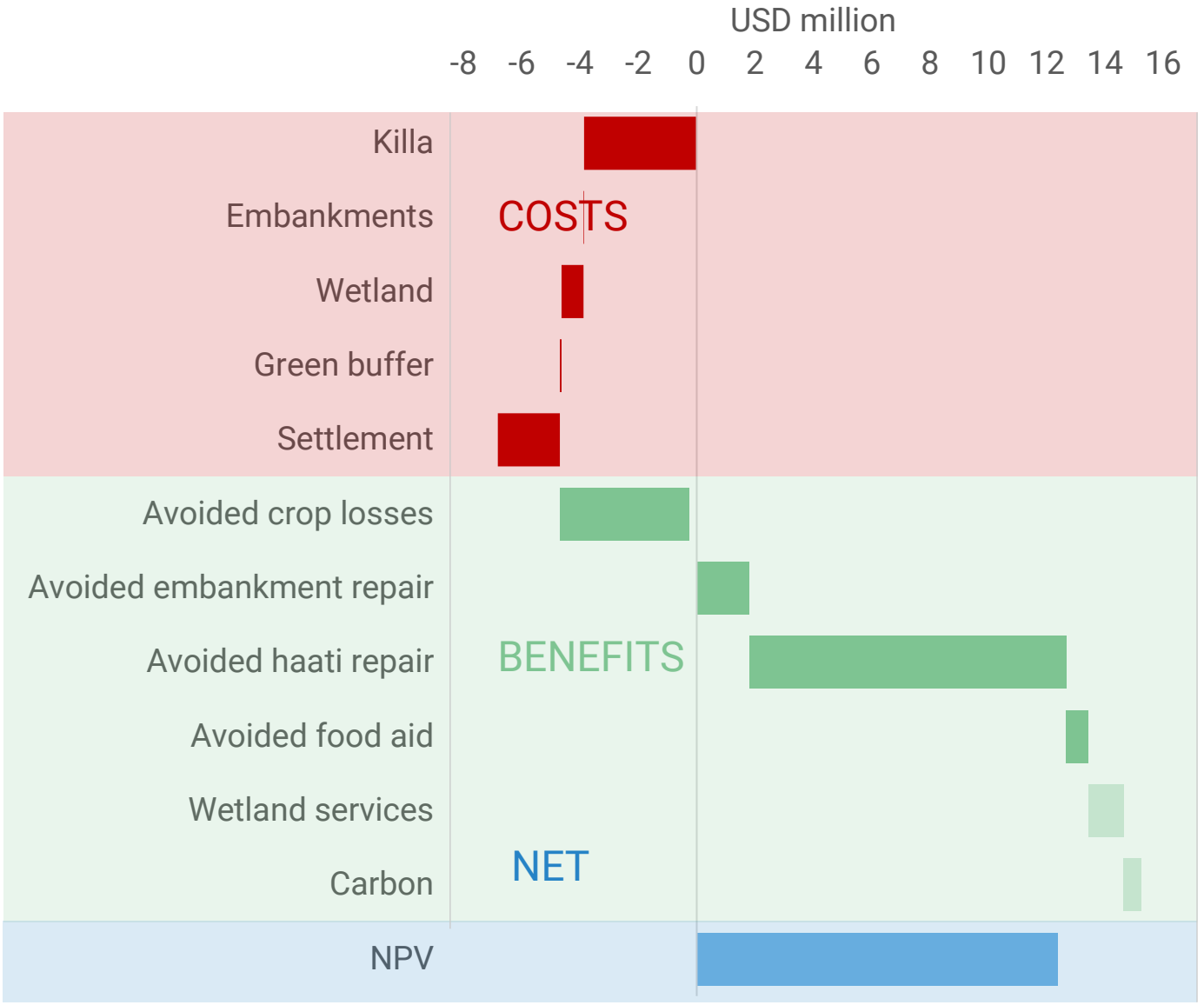
Economic value → **Robustness**

The intervention yields substantial *economic* benefits relative to the cost of investment

Indicator	Result
Benefit-Cost Ratio	2.7
Economic IRR	23%
Economic NPV	$ 12 million

Assumption	Value
Analysis Start Date	2026
Investment Start Date	2030
Investment Completion Date	2032
CBA Analysis End Date	2065
Prices	2024
Exchange Rate (2024 USD: BDT)	116
Discount Rate	7.25%
Increase in asset exposure by 2050 (RCP 4.5)	7.5%



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Pilot Project – Robustness of Results

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Robustness

Positive results across all three sets of assumptions show robust economic returns on investment

Indicator	Moderate assumptions	Optimistic assumptions	Conservative assumptions
Discount rate	7.25%	5%	12%
Analysis end date	2061	2071	2051
Increase in exposure to climate hazard	7.5%	11%	0%
ENPV	$ 12 million	$ 22 million	$4 million
BCR	2.7	3.2	1.7
EIRR	23%	23%	22%

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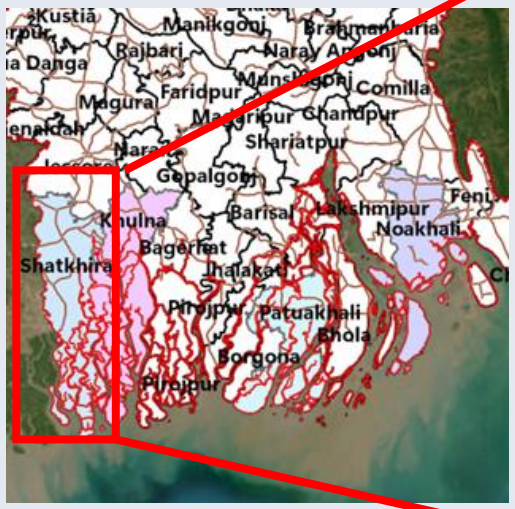
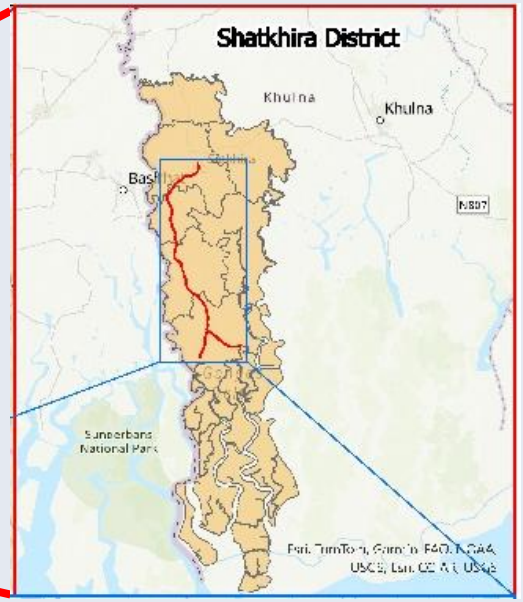
Programme level results – extrapolated from project results

	Programme	Pilot
Geography		
Scale	~455 km	72 km
Cost	~ $77 million	$12 million
ENPV	~ $83 million	$7.5 million

The pilot is highly scalable across the Haor region

- The potential programme is **45 times** the size of the pilot project
- This scaling assumes that, across all programme districts, 93% of markets are exposed to climate hazards that can be addressed by the intervention

Investment Case-2

Flood-Proofing Coastal Road Infrastructure with Nature-based Solutions

Investment Case Summary

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Context & climate risks:

- Road infrastructure **enables marketing of high-value agricultural products**
- But coastal roads are increasingly **exposed to storm surges, tidal flooding and saline intrusion**.
- This increases **infrastructural damage** and **road closure**, ultimately impacting producer livelihoods, food security and export volumes

Proposed solution:

- **Grey:** strengthened embankments (RCC), increased culvert capacity, all-weather road re-surfacing
- **NbS:** Mangrove restoration, vegetation planted over embankments

Investment summary:

Pilot project level:
- Cost: **$12.5 million**
- CAPEX: **$5.6 million**
- OPEX**: $0.2 million** annually

Programme level:
- Cost: **$66 million**

Climate adaptation impact pathway:

Solutions
- Strengthened embankments,
- Increased culvert capacity
- All-weather road resurfacing
- Mangrove restoration
- Vegetated embankments and culverts

Key physical impacts
- Reduced flood depth on road
- Reduced duration of inundation

Key economic impacts
- Reduced cost of **road maintenance and repair**
- Reduced **post-harvest** loss
- Reduced **service disruption**

Economic case:

Pilot project level:
- ENPV: **$7.5 million**
- EBCR: **2.2**
- EIRR: **17.5%**

Programme level:
- ENPV: **$39 million**

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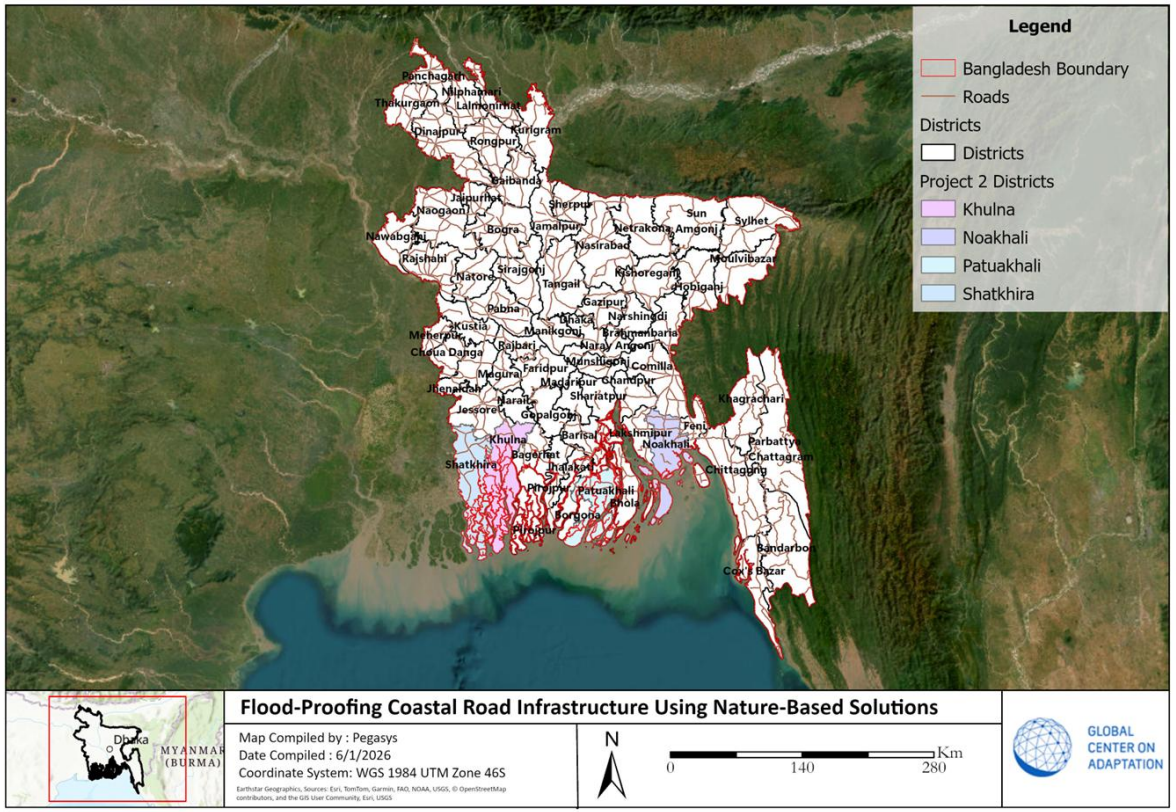
Programme Overview

Objective: to strengthen vulnerable coastal road corridor in Bangladesh to reduce flood damage, waterlogging, and maintenance costs.

Location: Selected coastal districts of Southern Bangladesh



Component by type of solution

Type	*Component*
Grey Solution	• All-weather road re-surfacing • Increased capacity of culverts • Strengthened embankments (RCC)
NbS	• Mangrove reforestation • Vegetating strengthened embankments

A “Pilot” was designed as an illustrative project within the broader programme

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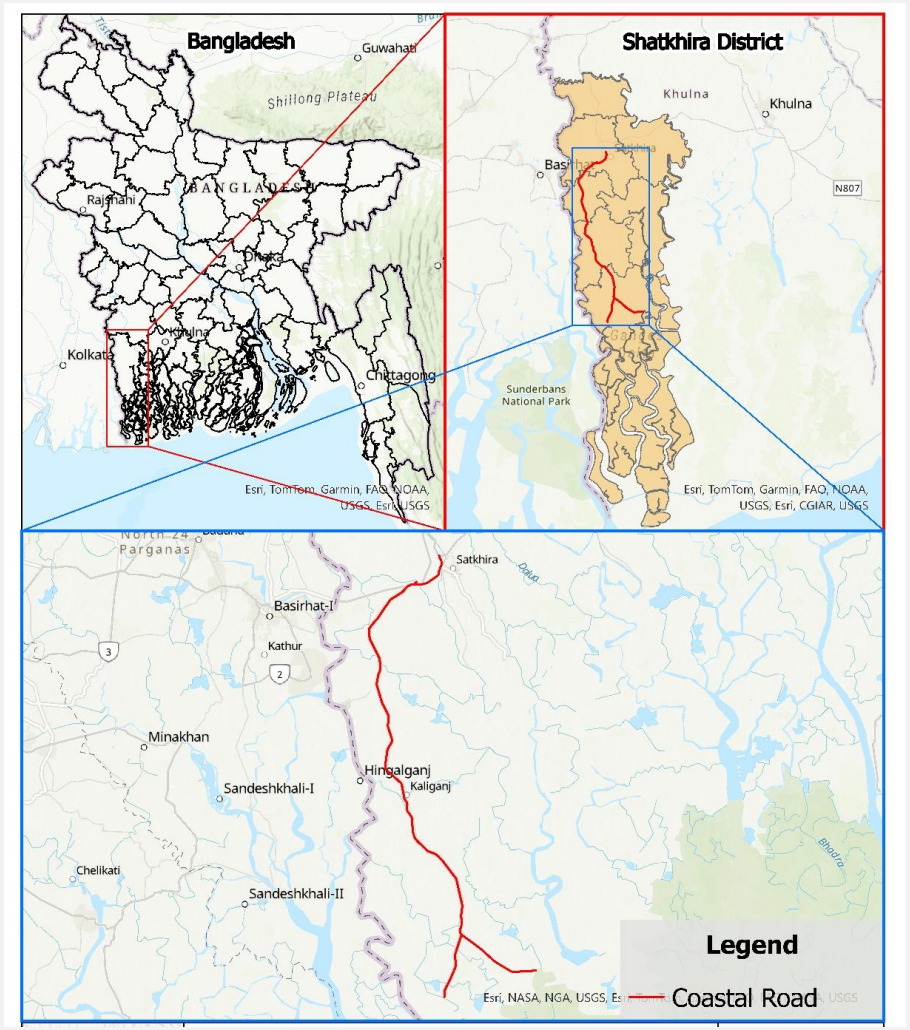
Given the broad nature of the programmes, we adopted a Pilot project approach to enable rigorous economic analysis.

Location:
Shyamnagar Upazila



Rationale for selection

The road...

- **Is affected by flooding**, which is expected to intensify with climate change
- **Connects the southern part of Satkhira** district (Sundarbans) to the northern part for critical trade
- **Transports shrimp, freshwater fish, and seasonable vegetables**, which are important to the agrifood system

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Pilot Project – Context and Climate Risks

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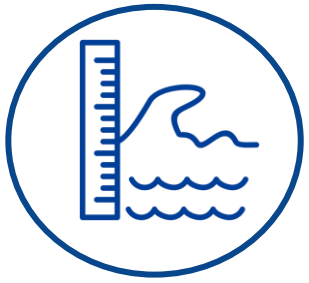
Baseline situation → Solution and investment costs → Benefits → Economic value → Robustness

The road section enables the **marketing of high-value agricultural products**, especially shrimp and brackish water fish, between coastal producers and Satkhira town but is exposed to **coastal flooding**



Road damage risk

- Coastal flooding inundates **the entire length of the** road up to **0.9m deep** in extreme events
- This is expected to cause average annual damage worth **~ $157 thousand** for this section of road

Road closure risk

- Coastal flooding is expected to cause up to **14 days of road closure** in extreme events
- This is expected to result in annual lost produce worth **$82 thousand**

Adjacent cropland waterlogging risk

- When coastal flooding occurs, **1300 ha of adjacent croplands** within the project's scope are exposed to **waterlogging**.
- This is expected to cost **$ 23 thousand**, on average, per year

- Each year, the **intensity and frequency** of flooding increase due to **climate change**
- This increases the **proportion of assets exposed**
- By 2050, the proportion of **roads exposed to coastal flooding is expected to increase by 3%**

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Pilot Project – Proposed Solution and Investment Costs

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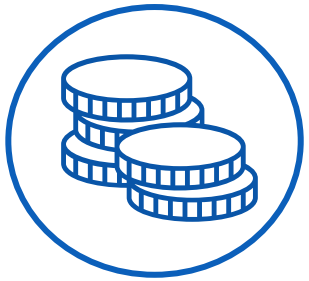
Solution and investment costs | **Benefits** | **Economic value** | **Robustness**

Total investment costs of the Pilot project are expected to be **$12.5 million**, in nominal terms, over the project lifespan



Vegetated + RCC embankments ~$ 0.7 million	Increase culvert capacity ~USD 0.08 million	All-weather road resurfacing ~$8.7 million	Mangrove restoration ~$3.1 million
• **Combine RCC core walls with vegetated outer slopes** to protect the most flood-prone sections of road from floods, reduce days of closure and reduce cropland waterlogging	• **Widen culverts to increase drainage capacity**, reducing upstream waterlogging and overtopping during floods	• **Resurface bitumen road with concrete** to reduce annual maintenance costs	• **Restore degraded mangrove forests in sparsely vegetated areas between the road and adjacent rivers** to reduce damage, days of closure and cropland waterlogging

- CAPEX: **$5.6 million** (incurred over two-year implementation period)
- OPEX**: $0.2 million annually** (calculated as a % of CAPEX)

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Pilot Project – Intervention Benefits

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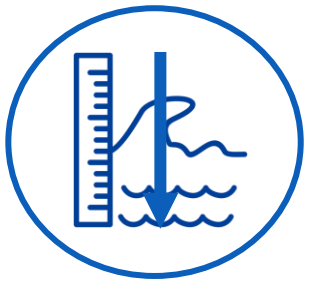
Benefits → **Economic value** → **Robustness**

Key adaptation benefits include **reduced depths and periods of flooding**, resulting in **avoided repair** and **maintenance costs**, agrifood **produce loss** and **cropland waterlogging**



Avoided road repair and maintenance costs ~ $ 12 million (present value)

- Hybrid embankments, increased capacity culverts and mangrove restoration **reduce flood depths and associated damage factors**
- Concrete roads are associated with **lower maintenance costs** in the face of climate hazards

Avoided agrifood produce loss ~ $0.4 million

- Hybrid embankments, increased capacity culverts and mangrove restoration **reduce days of road closure** and associated fresh food loss and service disruption

Avoided cropland waterlogging ~ $ 01 million

- Hybrid embankments, increased capacity culverts and mangrove restoration **reduce waterlogging of adjacent croplands**

Co-benefits ~ $ 1.4 million PV

- Restored mangrove forests **sequester carbon**

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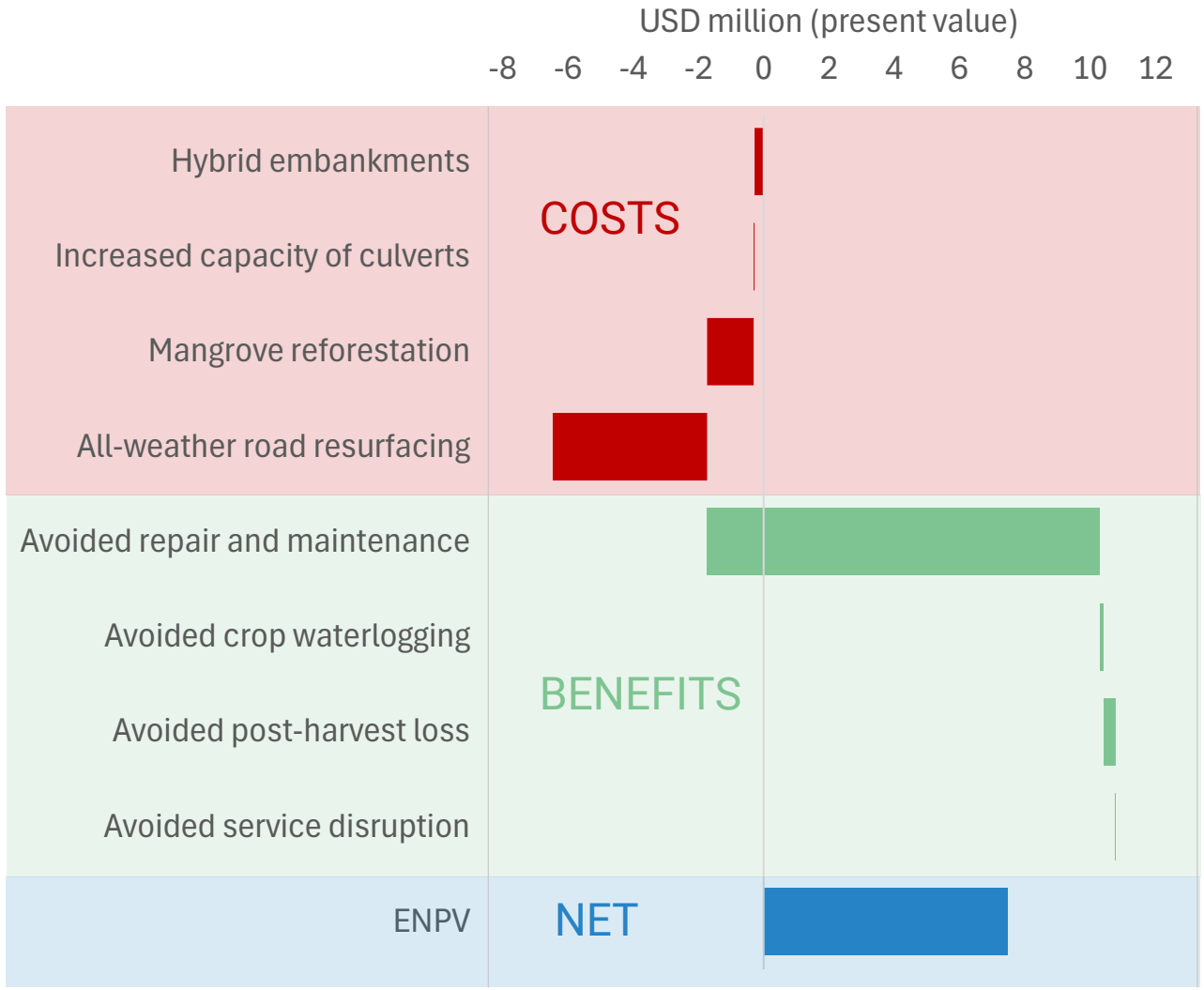
Pilot Project – Economic Case

Economic value → **Robustness**

The intervention yields substantial *economic* benefits relative to the cost of investment

Indicator	Result
Benefit-Cost Ratio	2.2
Economic NPV	$ 7.5 million
Economic IRR	17.5%

Assumption	Value
Analysis Start Date	2026
Investment Start Date	2030
Investment Completion Date	2032
CBA Analysis End Date	2065
Prices	2024
Exchange Rate (2024 USD: BDT)	116
Discount Rate	7.25%
Increase in asset exposure by 2050 (RCP 4.5)	3%



Pilot Project – Robustness of Results

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Robustness

Results across all three sets of assumptions are above investment viability thresholds – although only marginally under conservative assumptions

Indicator	Moderate assumptions	Optimistic assumptions	Conservative assumptions
Discount rate	7.25%	5%	12%
Analysis end date	2061	2071	2051
Increase in exposure to climate hazard	2.9%	3.06%	0%
ENPV	$ 7.5 million	$ 16 million	$0.2 million
BCR	2.16	3.41	1.03
EIRR	17.5%	17.7%	16.5%

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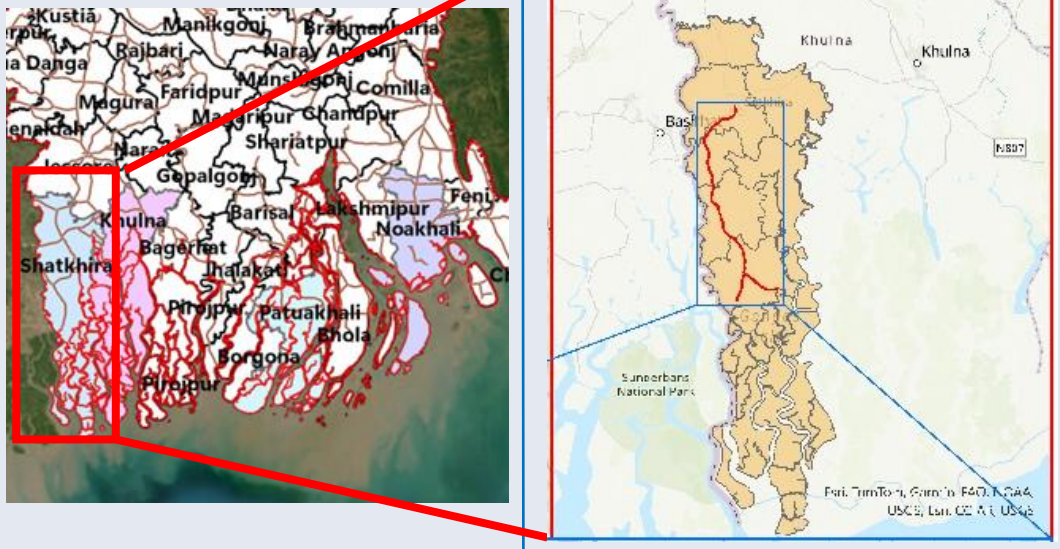
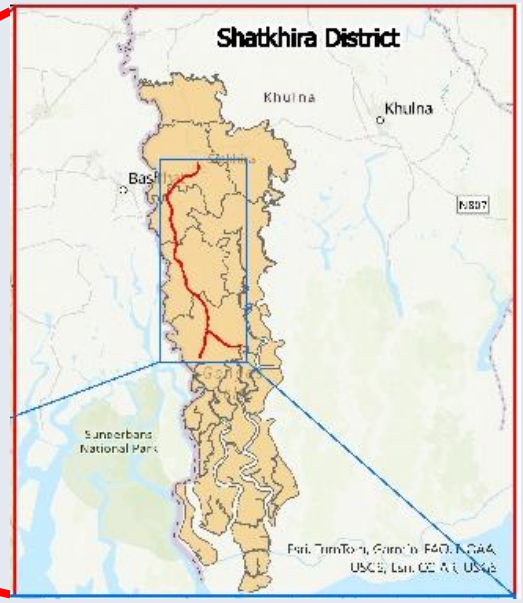
Programme level results – extrapolated from project results

	Programme	Pilot
Geography	 	
Scale	~455 km	72 km
Cost	~ $66 million	$12 million
ENPV	~ $39 million	$7.5 million

The pilot is scalable across several coastal district, with the potential programme more than six times the size of the project

- This scaling assumes that, across all four programme districts, 86% of the total road network is suitable for intervention

Investment Case-3

Reducing Damage to Market Centers
Against Coastal and Riverine Flooding

Investment Case Summary

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Context & climate risks:

- Market Centres **link farmers, fishers and traders** to district, national and, ultimately, international markets
- But many centres are located in coastal and riverine **flood zones**.
- Floods **damage market infrastructure**, cause **closures**, and lead to **spoilage** of high-value perishable goods

Proposed solution:

- **Hybrid:** Elevated platforms with vegetated slopes & drainage systems with vegetated channels
- **NbS:** Mangrove restoration & green buffer zones
- **Grey:** Rebuilding with flood-resilient materials

Investment summary:

Pilot project level:
- Cost: **$570 k**
- CAPEX: **$193 k**
- OPEX**: $12 k** annually

Programme level:
- Cost: **$168 million**

Climate adaptation impact pathway:

Solutions
- Elevated platforms with vegetated slopes
- Drainage systems with vegetated channels
- Mangrove restoration
- Rebuilding with flood-resilient materials

Key physical impacts
- Reduced flood depths
- Reduced days of flooding and market closure

Key economic impacts
- Avoided cost of infrastructure repair
- Avoided cost of replacing inventory
- Avoided vendor income loss

Economic case:

Pilot project level:
- ENPV: **$0.65 million**
- EBCR: **3.5**
- EIRR: **29%**

Programme level:
- ENPV: **$191 million**

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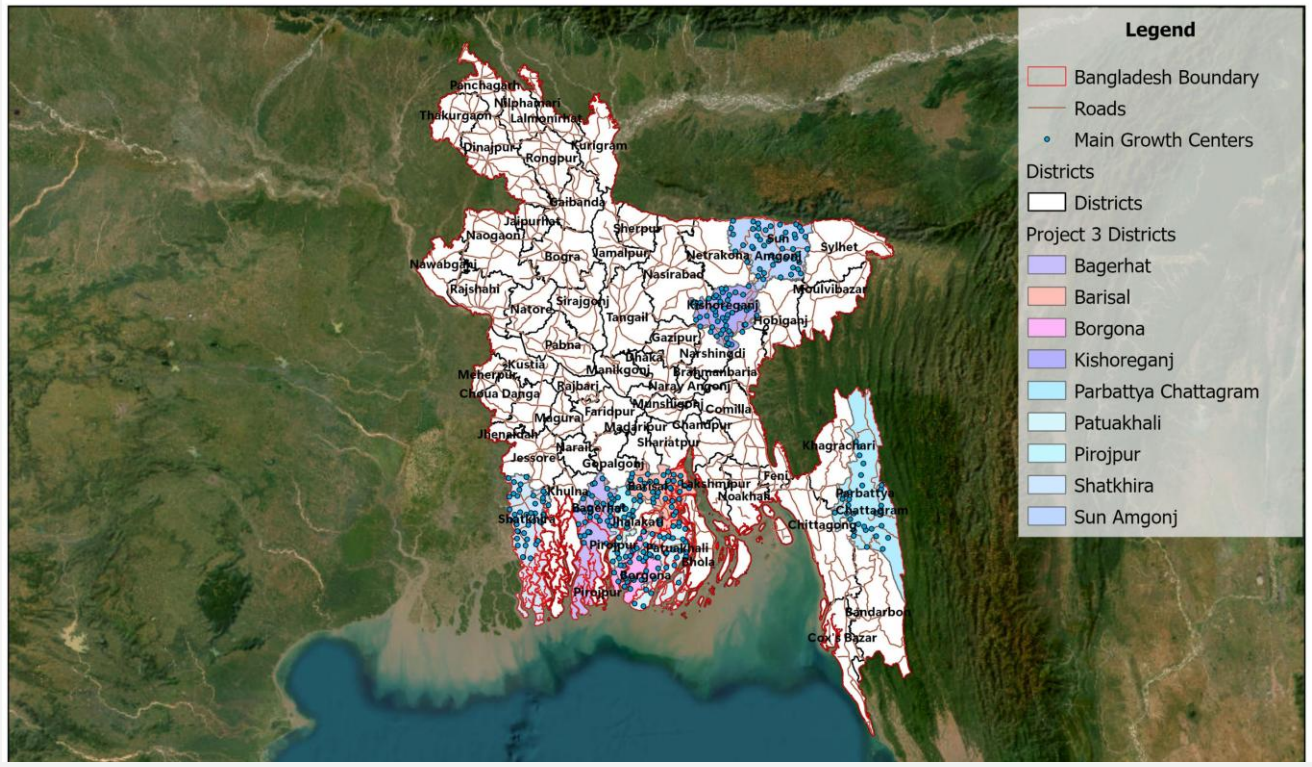
Programme Overview

Objective: to reduce infrastructural damage, inventory spoilage and agri-food marketing disruption by improving the resilience of vulnerable market centres.

Location: Southern, Eastern and North-Eastern Bangladesh



Component by type of solution

Type	Component
Hybrid	• Elevated platforms with vegetated slopes • Drainage systems with vegetated channels
NbS	• Mangrove reforestation • Green buffer zones
Grey	• Re-building with flood-resistant materials
Enabling	• Vendor insurance scheme

A “Pilot” was designed as an illustrative project within the broader programme

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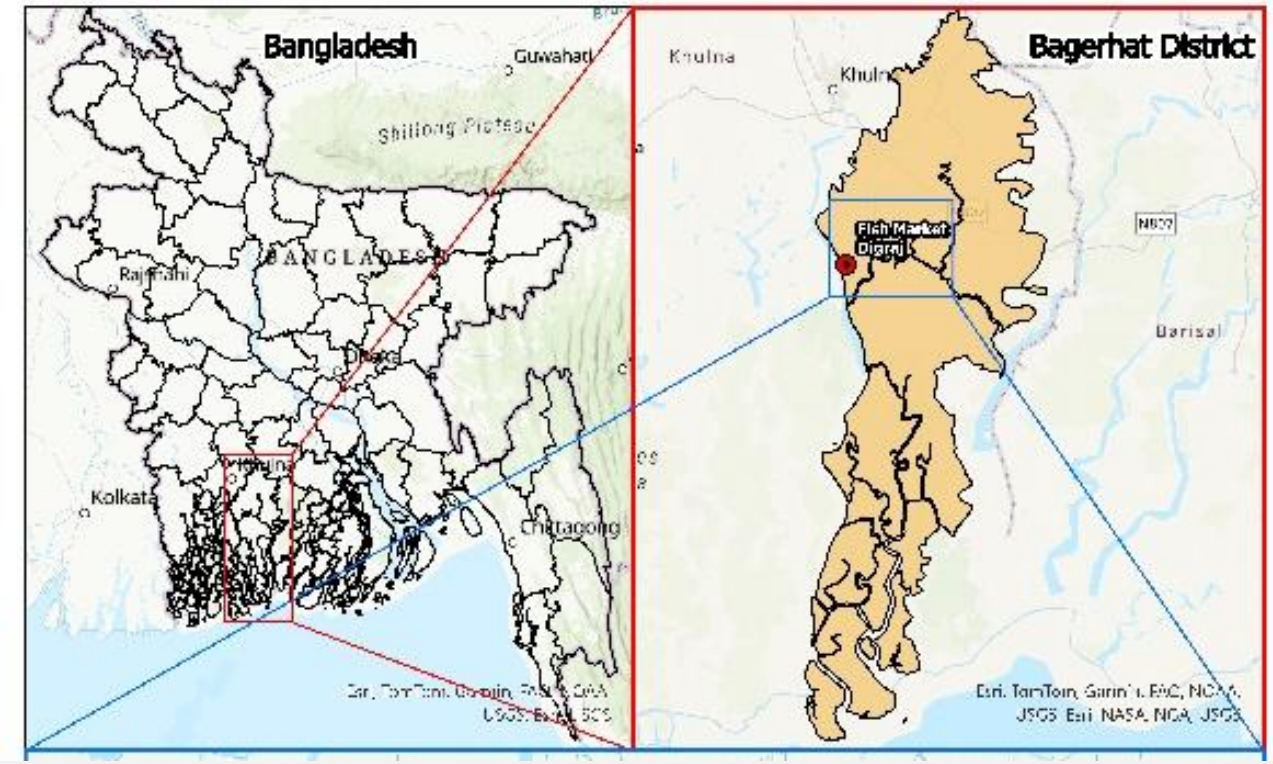
Given the broad nature of the programmes, we adopted a Pilot project approach to enable rigorous economic analysis.

Location:
Digraj Fish Market,
Upazila Mongla, Bagerhat, Southern Bangladesh



Rationale for selection

the market...

- Is **near Khulna-Mongla Port Road**
- Is **next to the river** which is both a source of open water catch and a pathway to bring brackish water shrimp for marketing
- Consists of **semi-permanent** market buildings, which can be improved
- Sells fish, so it is **used year-round**

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Pilot Project – Context and Climate Risks

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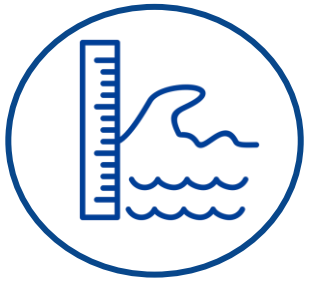
Baseline situation | Solution and investment costs | Benefits | Economic value | Robustness

Market Centres link farmers, fishers and traders to buyers, but many centres are exposed to floods, which damage market infrastructure, spoil goods and cause closures, leading to vendor income loss



Market infrastructure damage risk

- The **market centre** is flooded up to **3.92m deep** in extreme events
- This is expected to cause average annual damage worth **~ $67 thousand** for this market

Inventory loss risk

- When floods occur, inventory stored in the market is lost
- This is expected to result in annual lost produce worth **$35 thousand**

Market closure risk

- When coastal flooding occurs, markets are closed for up to **5 days**
- This is expected to cost **$ 20 thousand**, on average, per year

- Each year, the **intensity and frequency** of flooding increase due to **climate change**
- This increases the **proportion of assets exposed**
- By 2050, the proportion of **markets exposed to coastal flooding is expected to increase by 1.3%**

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Pilot Project – Key Solution and Investment Costs

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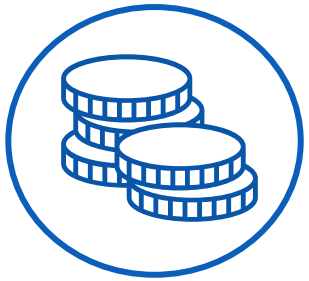
Solution and investment costs | **Benefits** | **Economic value** | **Robustness**

Total investment costs of the Pilot project are expected to be **$569 thousand**, in nominal terms, over the project lifespan



Elevated platforms with vegetated slopes ~$273 thousand	Drainage systems with vegetated channels ~$ 4 thousand	Mangrove reforestation ~$ 5 thousand	Flood-resistant rebuild ~$289 thousand
• **Construct raised platforms out of cement-stabilised blocks** to keep the market structure and goods above flood levels.	• **Construct internal market drainage channels and a roadside drainage channel** to improve surface drainage and reduce waterlogging during flooding.	• **Plant mangroves along the nearby riverbank** to absorb excess water and prevent storm surges.	• **Rebuild raised market structures using flood-resistant materials** to reduce damage from inundation.

- CAPEX: **$193 thousand** (incurred over two-year implementation period)
- OPEX**: $12 thousand annually** (calculated as a % of CAPEX)

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Pilot Project – Intervention Benefits

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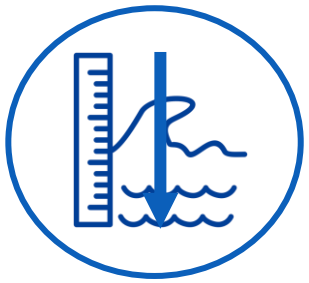
Benefits → **Economic value** → **Robustness**

Key adaptation benefits include **reduced depths and periods of flooding**, resulting in **avoided repair costs**, **inventory spoilage,** and **lost trading days**.



Avoided infrastructure repair costs ~ $ 445 thousand (present value)

- The interventions collectively reduce damage factors associated with flood events, **reducing infrastructural damage**

Avoided spoiled goods replacement costs ~ $262 thousand

- The interventions collectively **reduce the risk of damage to inventory stored at the market**

Avoided vendor income loss~ $ 152 thousand

- The interventions collectively reduce the period of inundation and consequently **days of market closure**

Co-benefits ~ $ 52.8 thousand

- Restored mangrove forests, green buffer zone and vegetated edges **sequester carbon**

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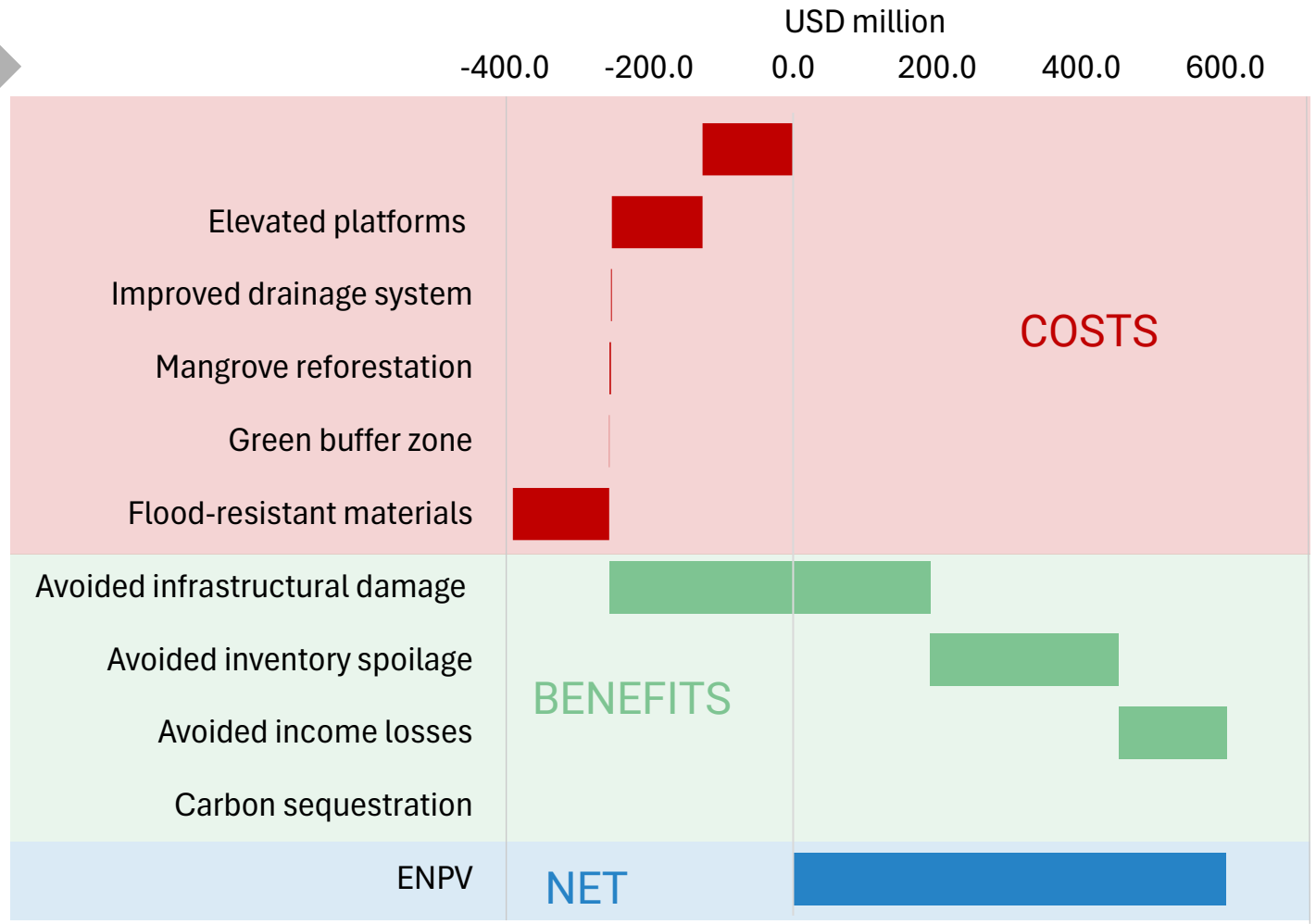
Pilot Project – Economic Case

Economic value → **Robustness**

The intervention yields substantial *economic* benefits relative to the cost of investment

Indicator	Result
Benefit-Cost Ratio	3.5
Economic NPV	$ 650 k
Economic IRR	29%

Assumption	Value
Analysis Start Date	2026
Investment Start Date	2030
Investment Completion Date	2032
CBA Analysis End Date	2065
Prices	2024
Exchange Rate (2024 USD: BDT)	116
Discount Rate	7.25%
Increase in asset exposure by 2050 (RCP 4.5)	1.3%



Pilot Project – Robustness of Results

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Robustness

Results across all three sets of assumptions are strong – showing a robust case for investment

Indicator	Moderate assumptions	Optimistic assumptions	Conservative assumptions
Discount rate	7.25%	5%	12%
Analysis end date	2061	2071	2051
Increase in exposure to climate hazard	1.25%	1.25%	0%
ENPV	$ 0.65 million	$ 1.2 million	$0.2 million
BCR	3.5	5.4	1.8
EIRR	29.4%	29.4%	29.2%

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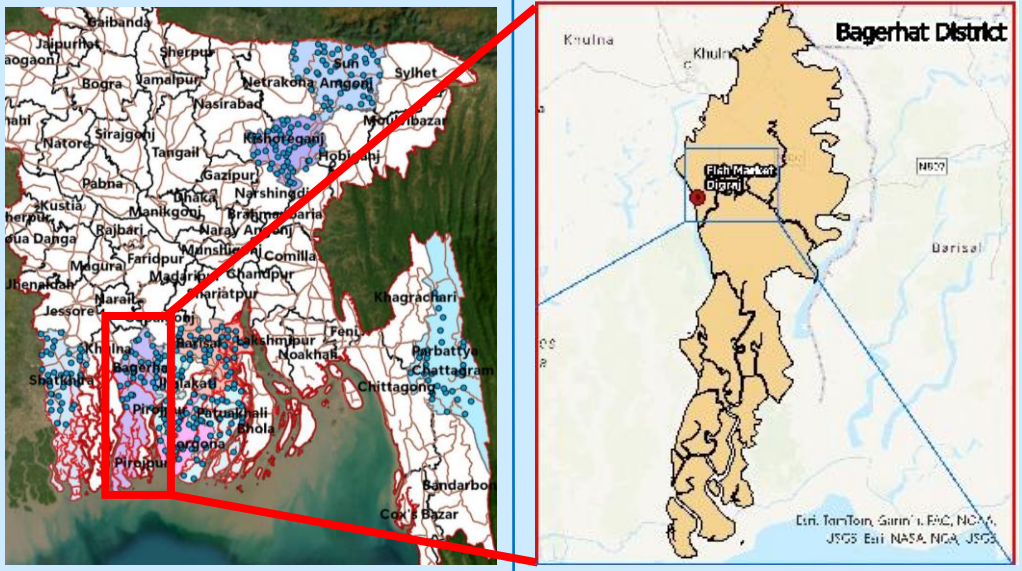
Programme level results – extrapolated from project results

	Programme	Pilot
Scale		
Coverage	~ 295 markets	1 market
Cost	~ $168 million	$570 k
ENPV	~ $191 million	$650 k

The pilot is scalable across just less than 300 markets

- This scaling includes the approximate number of markets exposed to climate hazards within the programme districts
- An estimated 93% of the 317 market centres are considered exposed to some form of climate hazard

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