

# GLACIER TO OCEAN INITIATIVE

## Annual Progress Report | Fiscal Year 2025

Reporting Period: April 2025 to March 2026

<b>Funder</b>	Ocean Policy Research Institute (OPRI), Sasakawa Peace Foundation, Tokyo, Japan
<b>Lead Implementing Partner</b>	International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal University of Dhaka, Bangladesh
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## AT A GLANCE | FISCAL YEAR 2025

<b>45%</b> Programme Targets Achieved	<b>7</b> Partner Institutions	<b>5</b> Countries Involved	<b>\$559K</b> Total Investment (FY2025-26)
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### Initiative Status Overview

Initiative	What It Studies	Status	Headline Achievement
<b>Glacier &amp; Hazard Monitoring</b>	Himalayan glaciers, lakes, landslides	<b>On Track</b>	10,280 landslide events mapped; 23-year glacier record published
<b>Community Vulnerability</b>	Bihar floodplain, India	<b>On Track</b>	12 flood sites validated; WhatsApp warning gap found
<b>River Basin Modelling</b>	Full Ganges Basin water & climate	<b>On Track</b>	Hydrology model running; erosion hotspots mapped
<b>Marine Biodiversity (eDNA Project)</b>	Bangladesh coast, Bay of Bengal	<b>On Track</b>	297 specimens, 101 species; eDNA pipeline operational
<b>Heavy Metal Awareness Study</b>	Chattogram coastal pollution, Bangladesh	<b>Completed</b>	Final report published; Journal manuscript ready

## 1 EXECUTIVE SUMMARY

**The Big Picture:** The Glacier to Ocean Initiative tracks how melting Himalayan glaciers affect water, floods, communities, and ocean life -- all the way from mountain peaks in Nepal and Tibet to the Bay of Bengal in Bangladesh. In its first year, the project has built the scientific foundation -- mapping hazards, engaging flood-affected communities, and documenting marine life -- ready to deliver actionable recommendations for governments and policymakers in Year 2.

### Why This Project Matters

The Hindu Kush Himalaya mountains supply freshwater to nearly 2 billion people across Nepal, India, Bangladesh, and China. Climate change is accelerating glacier melt, which creates a chain of consequences: more violent floods and landslides in the mountains, unpredictable water supplies for farmers in the plains, and changes in the fish populations that support coastal livelihoods. No single country can manage these risks alone -- they require shared scientific evidence and coordinated policy across the region.

### Year 1 (FY2025) Headline Achievements

- **Hazard baselines established:** First-ever 10,280-event landslide catalogue and 23-year glacier change record published for the Himalayan headwaters
- **Flood risk mapped:** Flood history at 12 community sites in Bihar, India (2019-2024) documented and field-validated
- **Critical warning gap discovered:** Bihar flood communities are relying on informal WhatsApp messages for flood warnings -- not official government systems
- **River model operational:** A computer model simulating the full Ganges water system from Himalayan snowmelt to the sea is now running
- **Marine biodiversity baseline set:** 297 fish specimens and 101 species documented along Bangladesh's coast using DNA fingerprinting techniques
- **Pollution study finalised:** First study of public awareness of heavy metal contamination in Chattogram, Bangladesh -- final report published; journal article ready

## 2 PROJECT OVERVIEW

The G2O Initiative is a two-year programme (2025-2027) funded by OPRI-SPF and led by ICIMOD, studying the full chain of climate impacts from Himalayan glaciers to the Bay of Bengal. It brings together seven institutions across five countries.

Component	What It Studies	Partners	Status
Glacier & Hazard Monitoring	Glacier retreat, dangerous lakes, landslides in Nepal/Tibet	ICIMOD + IIT Bhubaneswar, India	On Track
Community Vulnerability	Flood risk and adaptation needs of Bihar communities, India	ICIMOD + Caritas India	On Track

River Basin Modelling	Water flow, erosion, and future climate scenarios for the full Ganges system	ICIMOD + Tsinghua Univ. (China) + CEDAR India	In Progress
Marine Biodiversity (eDNA)	Fish species diversity along Bangladesh coast using water DNA	University of Dhaka + Ehime Univ. (Japan)	On Track
Heavy Metal Awareness Study	Public awareness of coastal contamination in Chattogram	Univ. of Chittagong + Keio Univ. (Japan)	Completed

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### 3 PROGRESS BY INITIATIVE

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#### 3A. Glacier and Hazard Monitoring | Status: On Track

**In brief:** Using satellites and artificial intelligence, we have produced the most detailed map of glacier retreat, glacial lakes, and landslides ever created for the Himalayan headwaters. These maps form the foundation for improved disaster early warning systems across Nepal, India, and Bangladesh.

##### What was done and what was found:

- **23-year glacier and snow record:** Continuously updated open-access dataset (2002-2025) published for the entire Ganges Basin -- the longest such record available
- **30-year glacier shrinkage evidence:** Measured acceleration in ice loss over 1990-2020, directly documenting the impact of climate change on the region's water tower
- **10,280 landslide events catalogued:** Most comprehensive landslide inventory ever produced for the Nepal Himalayan region -- essential for disaster risk planning and infrastructure investment decisions
- **Glacial lake hazard ranking:** IIT Bhubaneswar is identifying which glacial lakes pose the highest risk of sudden catastrophic flooding. Results expected December 2026

**Why this matters:** Landslides and glacier floods can destroy roads, bridges, and entire villages with little warning. This data gives governments and disaster planners the information needed to prioritise early warning investments and identify communities that may need relocation.

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#### 3B. Community Vulnerability and Adaptation | Status: On Track

**In brief:** Working with Caritas India -- one of India's largest community development organisations with 60+ years of grassroots presence -- the project has surveyed flood-affected communities in Bihar, India. The most striking discovery: people are using WhatsApp to warn each other about floods because official government warning systems are not reaching them.

##### What was done and what was found:

- **Flood history mapped (2019-2024):** Which areas flood, how often, and for how long -- validated at 12 sites in Bihar -- giving a clear picture of highest-risk communities
- **Community interviews and surveys completed:** Focus groups, household surveys, and expert interviews with flood-affected families in Bihar pilot sites
- **WhatsApp early warning gap identified:** Communities rely on unverified mobile messaging for flood alerts -- a serious gap that Year 2 will address with a properly designed system
- **Women and minorities most exposed:** Gender and social inclusion analysis confirms that the most marginalised groups have the least protection from flood risk -- informing more equitable planning

**Why this matters:** This finding about WhatsApp-based warnings -- while seemingly a small detail -- has major policy implications. It shows that government early warning infrastructure is failing to reach the most vulnerable people. Year 2 will co-design a replacement system with communities.

### 3C. River Basin Modelling and Water Assessment | Status: In Progress

**In brief:** A team from Tsinghua University (China) and CEDAR India is building a computer simulation of the entire Ganges River system -- from Himalayan snowmelt through the Indian plains to the Bay of Bengal. Year 2 will use this model to show governments what water supply and flooding will look like under different climate futures.

#### What was done and what was found:

- **Basin hydrology model running:** The integrated river model is producing credible simulations of seasonal flood peaks and dry-season water availability
- **Erosion hotspots identified:** CEDAR India has mapped where soil loss is most severe in Uttarakhand -- critical for understanding water quality and reservoir lifespans downstream
- **Sediment transport quantified:** How much soil the river carries has been calculated for the Upper Ganges -- directly relevant to delta formation and coastal ecosystem health
- **Shared analytical framework established:** All partners now use the SFURR framework (Source-Flow-Use-Risk-Response) to ensure science directly informs policy recommendations

**Why this matters:** Year 2 will run climate scenarios to show governments what water availability will look like in 2050 under 2, 3, and 4 degree Celsius warming. This is the core scientific product for transboundary water negotiations between Nepal, India, and Bangladesh.

### 3D. Marine Biodiversity Assessment -- eDNA Project | Status: On Track

**In brief:** The University of Dhaka is using environmental DNA ('eDNA') -- detecting species from DNA traces in seawater, without catching any fish -- to document the fish communities along Bangladesh's coastline. This establishes the first modern reference point against which future changes can be measured.

#### What was done and what was found:

- **5 coastal sites surveyed across Bangladesh:** Sundarbans, Kuakata, Sandwip, Chittagong, and Cox's Bazar -- all major coastal habitat types covered in the dry season
- **297 fish specimens, 101 species collected:** Physical reference collection including Hilsa shad (Bangladesh's national fish), mackerels, hairtails and 97 other commercially important species
- **DNA laboratory pipeline operational:** Full workflow from water sample to species identification standardised and validated at University of Dhaka laboratories
- **Genetic reference database under construction:** Species-specific genetic barcodes for Bangladesh coastal fish being compiled -- the key to matching water DNA samples to species names

**Why this matters:** Bangladesh's national fish -- Hilsa shad -- is sensitive to changes in freshwater river flow driven by Himalayan glacier dynamics. This project provides the first systematic biodiversity baseline that will allow detection of whether fish populations are shifting as the Himalayan water cycle changes.

### 3E. Heavy Metal Contamination Awareness Study | Status: Completed

**Publication status:** Final report PUBLISHED July 2024. Peer-reviewed journal manuscript READY FOR SUBMISSION.

Led by OPRI Research Fellow Santosh Kumar Rauniyar with the University of Chittagong and Keio University Japan. A survey of 400 residents and 40 expert interviews (government, NGO, academia) in Chittagong -- Bangladesh's main port city with one of the world's largest ship-breaking industries. Lead, cadmium, chromium, and arsenic contamination has been measured at levels up to 120 times above international safety limits.

Finding	Result	What It Means
Residents unaware of contamination	>50%	Despite living in one of the most polluted coastal zones in the region
Had been ill from contaminated water or food	54%	More than half have personal experience of illness - but most do not connect it to contamination
Had been hospitalised due to illness	40%	Major, largely invisible public health burden concentrated in low-income communities
No confidence or uncertainty in government action	77%	Deep erosion of public trust in environmental governance -- a barrier to community cooperation
NGO experts who believe government is acting effectively	8%	Dramatic gap vs. 50% of government officials who believe they are acting effectively
Cadmium contamination: worst case recorded	120x safety limit	Up to 120 times the European Quality Standard safety threshold

**Why this matters:** This is the first systematic study of its kind in Chattogram. The enormous divergence -- 8% of NGO experts vs. 50% of government officials trust that government is acting effectively -- reveals a deep breakdown in environmental governance communication. The peer-reviewed paper will bring this evidence to international scientific and policy audiences.

## 4 KEY FINDINGS AND POLICY IMPLICATIONS

**For board members:** The five most significant discoveries from Year 1, with plain-language explanations of what each means for policy and decision-making.

Discovery	What It Shows	Policy Implication
Glaciers retreating faster in recent decades	30-year data confirms acceleration -- not a natural cycle but a climate-driven trend	Nepal, India, and China need updated adaptation plans that account for accelerating water-cycle change in the Himalayan region
Bihar flood communities use WhatsApp for warnings	Official early warning systems are not reaching the most vulnerable people	Urgent investment needed in community-level warning systems that are accurate, timely, and reach everyone
10,280 landslides in one Himalayan basin alone	The scale of landslide risk is far larger than previously documented	Infrastructure investment decisions -- roads, dams, settlements -- must incorporate this landslide risk data
54% of Chattogram residents have been ill from pollution -- but most don't know it	A massive public health burden is invisible due to low awareness and weak monitoring	Environmental health communication, stricter industrial regulation, and independent monitoring of ship-breaking yards are needed urgently
Bangladesh coast hosts at least 101 marine fish species	First modern biodiversity baseline established for the Bay of Bengal	This data supports fisheries management decisions and serves as a benchmark for future monitoring of ecosystem change

## 5 YEAR 2 WORK PLAN (APRIL 2026 -- MARCH 2027)

**The shift in Year 2:** Year 1 built the foundation. Year 2 applies that foundation to produce outputs that decision-makers can act on: climate scenarios, community action plans, policy dialogues, and published research.

Initiative	Year 2 Priority Actions	Expected Output by March 2027
Glacier & Hazard Monitoring	Complete glacial lake hazard ranking; GLOF risk scenario modelling; field validation surveys	Ranked list of highest-risk glacial lakes; GLOF risk maps for disaster planning
Community Vulnerability	Design improved flood early warning system; finalise community action plans; pilot nature-based flood solutions	GESI-responsive flood management plans for Bihar; Early warning system design ready for implementation
River Basin Modelling	Run climate scenarios (2C, 3C, 4C warming); transboundary policy dialogues; peer-reviewed publications	Water availability forecasts for Ganges Basin; Policy recommendations for India-Nepal-Bangladesh cooperation
Marine Biodiversity	Wet-season sampling;	First seasonal fish biodiversity

(eDNA)	DNA sequencing (Ehime Univ.); biodiversity analysis	assessment for Bangladesh coast
Heavy Metal Study	Submit journal manuscript; disseminate findings to Bangladesh authorities and NGO partners	Peer-reviewed publication; Policy brief for Bangladesh environmental authorities

## 6 RISK SUMMARY

Risk	Rating	Management Approach
Cross-border scientific access - limited by geopolitics	Medium	ICIMOD's intergovernmental status provides diplomatic protection; informal channels maintained with all national partners
Extreme weather disrupts field campaigns	Medium	Seasonal scheduling built around weather windows; satellite data used as backup when field access is restricted
Heavy Metal manuscript peer-review delays	Low	Target journal identified; collaborator review planned prior to submission
Key personnel changes at partner institutions	Low	All contracts are institutional; knowledge documentation and team handover procedures in place

**Overall assessment:** The project is operating within normal risk parameters for a multi-country research initiative. No major risks have materialised in Year 1. The project is on track to meet its two-year objectives.

## 7 ANNEXES

### Annex A: Partner Institutions

Institution	Country	Role
ICIMOD -- Intl. Centre for Integrated Mountain Development	Nepal (Regional)	Lead implementer; all G20 components; 8-member intergovernmental organisation
Tsinghua University	China	River basin climate-hydrology computer modelling
CEDAR India	India	Soil erosion and sediment transport, Upper Ganges Basin
Caritas India	India	Community engagement, vulnerability surveys, GESI, Bihar
IIT Bhubaneswar	India	Glacial lake hazard mapping using AI and satellite data
University of Dhaka	Bangladesh	eDNA field sampling, lab analysis, fish species identification
Ehime University	Japan	DNA sequencing and bioinformatics for eDNA samples
University of Chittagong	Bangladesh	Heavy metal survey team lead in Bangladesh
Keio University	Japan	Academic supervision, heavy metal contamination study

### Annex B: Heavy Metal Contamination Levels vs. International Safety Standards (Chattogram)

Contaminant	Maximum Level Measured	Safety Limit	Standard Body	Exceedance Factor
Lead (Pb)	154.65 microg/L	15 microg/L	US EPA	Up to 10x above limit
Cadmium (Cd)	180.15 microg/L	1.5 microg/L	European Quality Standard	Up to 120x above limit
Chromium (Cr)	964.89 microg/L	100 microg/L	FAO	Up to 10x above limit
Arsenic (As)	195.40 microg/L	10 microg/L	WHO	Up to 20x above limit

### Annex C: Formal Agreements on File

Document	Parties	Date
OPRI-SPF Service Agreement with ICIMOD	OPRI-SPF & ICIMOD	20 Aug 2025
Joint Statement of Understanding	OPRI-SPF & ICIMOD	09 May 2025
Subcontract 1 -- Tsinghua University	ICIMOD & Tsinghua	30 Oct 2025

Subcontract 2 -- CEDAR India	ICIMOD & CEDAR	30 Oct 2025
Subcontract 3 -- Caritas India	ICIMOD & Caritas India	30 Oct 2025
Subcontract 4 -- IIT Bhubaneswar	ICIMOD & IIT Bhubaneswar	30 Oct 2025
SPF Service Agreement -- Univ. of Dhaka	OPRI-SPF & Univ. of Dhaka	20 Aug 2025

## Annex D: Technical Terms in Plain Language

Term	What It Means in Plain Language
eDNA / Environmental DNA	Genetic traces left in water by fish and other organisms -- detectable without catching any animals
Glacial Lake Outburst Flood	A sudden catastrophic flood when the natural dam around a glacial lake breaks
DNA Metabarcoding	Technique to identify many species at once from a water sample by reading their DNA
RUSLE / Erosion modelling	Standard formula for calculating how much soil rainfall is washing off the land
SPHY / THREW models	Computer programs that simulate river water flows -- snowmelt, glacier melt, rain, groundwater
SFURR Framework	Shared analytical framework: Source-Flow-Use-Risk-Response -- connects science to policy
Deep Learning / AI	Artificial intelligence trained to recognise features in satellite images (glaciers, lakes, landslides)
GESI	Gender Equality and Social Inclusion -- ensuring women and marginalised groups are central to planning
HKH / Third Pole	Hindu Kush Himalaya -- world's largest glaciated region outside the polar ice caps