

Inception Report

Project Title: Satellite and AI Driven Climate Resilience Tool.

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ACRONYMS

ADPC	Asian Disaster Preparedness Center
DDM	Department of Disaster Management
DRR	Disaster Risk Reduction
CCA	Climate Change Adaptation

1. INTRODUCTION

1.1 Background

In 2022, Geoneon, in partnership with the Department of Disaster Management (DDM) in Bhutan, successfully implemented a methodology to map the vulnerability of critical infrastructure in two regions of South Bhutan. The success of this implementation and the expressed interest for a broader application has led Geoneon, in consultation with the DDM, to embark on the development of an open-source tool. This new tool will enable the assessment of the exposure of critical infrastructure to multiple climate hazards, thereby enhancing climate resilience in Bhutan. Building on the previous achievement, this project aims to leverage advancements in satellite imaging and advanced algorithm to support informed decision-making in disaster risk reduction and climate change adaptation, as well as building capacity among the government.

The main objective of this project is to catalyze informed decision-making for enhanced climate resilience, achieving this by transforming complex concepts of natural hazards and risks into accessible, user-friendly formats. This endeavor aligns with our specific goals:

1. **Enhancing Climate Resilience:** Utilise advanced technology combining Earth Observation and Artificial Intelligence to understand and mitigate infrastructure vulnerability to climate hazards.
2. **Promote Cutting-Edge Technology Adoption:** Leverage Earth Observation and AI to empower stakeholders in adopting innovative climate resilience strategies.
3. **Provide Tailored Recommendations:** Offer bespoke guidance for the use of geospatial data for informed decision-making in climate resilience.
4. **Empower Local Capacities:** Train and equip local entities for sustainable and effective use of innovative tools.

As with any innovative approach, our project is accompanied by inherent uncertainties and risks, making our proposed methodology flexible and open to adaptation as the project evolves. This flexibility ensures that we can respond effectively to new insights and challenges, maintaining the project's relevance and effectiveness throughout its implementation.

The three key outcomes of this project include:

1. **Enhanced stakeholder engagement and Needs Identification:** Focused on deepening engagement and collaboration among stakeholders and the public, coupled with precise identification of data needs, technological capacities, and decision-making gaps for effective, locally-relevant disaster risk reduction and climate change adaptation strategies.
2. **Development and Utilisation of a Customised Geospatial Tool:** Creation and dissemination of a comprehensive, user-friendly tool tailored to Bhutan's specific climate threats and infrastructure needs, coupled with enhanced user understanding for accurate application in climate risk

assessment.

3. **Capacity Building and tool testing:** test of the tool and Enhance skills and knowledge among the workshop participants regarding the use of the open-source tool and its application to inform decision for DDR and CCA. This will lead to increased local capacity in effectively applying the tool for climate resilience, with a sense of ownership among the stakeholders.

1.2 Purpose of the Inception Report

The Inception Report serves as a foundational guide, aligning project activities with our proposed approach and measuring progress and impact. It suggests a preliminary approach that, inherent to the nature of innovation, may evolve as we co-design the tool with stakeholders. Variations in methodology are anticipated, typical of innovative projects. By clearly outlining expectations and providing a baseline, the report fosters a shared understanding of the project's objectives and methodologies among all parties, including the project team and external partners. This report has been developed in consultation with DDM, ensuring alignment with their insights and requirements.

1.3 Finding and Recommendations

The insights gathered from the inception report have been instrumental in refining our initial strategy for project implementation. These findings enabled us to more precisely align our project activities with broader organisational goals, ensuring that our efforts are not only targeted but also synergistic with overarching objectives. Notably, while the inception report brought about strategic adjustments and a deeper understanding of our approach, it confirmed that the original scope of the project remains as relevant and well-defined as initially planned. This alignment ensures that our project stays on course, adhering to its defined boundaries, yet benefits from a refined strategy that enhances its effectiveness and alignment with larger goals.

2. APPROACH AND METHODOLOGY

2.1 Approach

The project is centered on developing an open-source tool leveraging earth observation and data fusion aimed at mapping and analysing climate-related hazard exposure to infrastructure in Bhutan. This initiative is pivotal for advancing Disaster Risk Reduction (DRR) and Climate Change Adaptation (CAA) strategies within the region.

Crucial to the project's effectiveness is engaging with Bhutanese stakeholders, ensuring the tool is tailored to local needs and challenges. The integration of satellite imagery and algorithms in the tool will enable provision of actionable insights for bolstering Bhutan's resilience to climate impacts.

A core aspect of the project is focused on capacity building. By developing comprehensive training materials and conducting workshops, the project ensures the tool's effective use and longevity within Bhutan's climate risk management strategies.

The final phase involves formulating strategic recommendations to incorporate this technology into wider climate resilience efforts in Bhutan. The outcomes and achievements of the project will be disseminated globally, highlighting Bhutan's commitment to using advanced technology for climate resilience.

The project implementation is developed through three different phases and milestones as follow:

- 1. Stakeholder Engagement:** This phase centers around the thorough identification and active engagement of key stakeholders. Building on the initial identification done during the inception phase, a more detailed and refined stakeholder mapping will be conducted. The crucial point of this milestone is the execution of stakeholder and beneficiary engagement workshops, aimed at establishing sustainable relationships and ensuring continuous engagement throughout the project. The success of this milestone will be marked by effective stakeholder collaboration and a strong foundation for the project's future phases.
- 2. Development of Customised Geospatial Tool:** The key milestone here is the development and delivery of a customised geospatial tool, tailored to meet the specific needs of beneficiaries in mapping their exposure and risks to climate-related disasters. This phase encompasses the technical development of the tool and the creation of accompanying training materials. The completion of this milestone will be signified by the tool's readiness for deployment and the availability of materials necessary for its effective use by the beneficiaries over the long term. The development process will incorporate a co-design approach based on needs and priorities identified in the stakeholder engagement workshop, with regular update meetings planned to show progress and gather feedback.
- 3. Capacity Building and Tool Refinement:** This phase focuses on transferring knowledge and ownership to the stakeholders through a series of workshops and training sessions. An integral part of this phase is the testing and refinement of both the geospatial tool and the training materials based on feedback from the testing phase of the tool.

Each phase is designed to be a distinct and measurable step in the project, contributing to the overarching goal of enhancing climate resilience through informed decision-making and effective use of technology.

Figure 1 shows the phases of the project.



Figure 1 Phase of the Project

2.2 Methodology

The methodology presented below is a proposed methodology inherent to the nature of innovation, may evolve as we co-design the tool with stakeholders. Variations in methodology are anticipated, typical of innovative projects.

The proposed methodology of this project is described through the following activities:

1. **Beneficiaries Identification and consultation:** In collaboration with DDM, Geoneon will conduct a detailed identification of key government bodies, stakeholders, and partners, followed by inclusive stakeholder engagement workshops. These sessions aim to pinpoint specific data, technological needs, and capacity gaps in climate risk assessment. The outcomes will inform the selection of climatic threats and critical infrastructures for the tool's focus, ensuring alignment with local requirements. This activity will also ensure strong engagement and ownership from stakeholders.

2. **Open-Source Tool Development:** Geoneon will develop an open-source geospatial tool to analyse the exposure and risk of critical infrastructures to climatic-related hazards by:
- a. **Identifying climatic-related hazards and indicators:** during the project's inception phase, landslides, wildfires, and floods were identified as primary climatic-related hazards. Geoneon is set to develop an open-source geospatial tool, with an initial focus on these key hazards. However, this focus may be refined or expanded based on the findings from the upcoming beneficiaries' consultations. This flexibility ensures the tool is precisely tailored to the most pressing needs and risks identified by those directly impacted.
 - b. **Source Earth Observation Data:** Geoneon will primarily utilise publicly available Earth Observation Data, like Landsat and Sentinel, to cover larger regional areas. For prioritised areas, private satellite imagery might be used as needed. This approach, favoring public satellite imagery, is chosen to ensure the sustainability and cost-effectiveness of the tool, as private imagery is costly and would require ongoing support from Geoneon for model execution.
 - c. **Algorithm integration to develop hazard susceptibility indexes:** Geoneon will develop hazard susceptibility indexes using their proprietary algorithm. This algorithm combines satellite imageries, remote sensing data, advanced modeling, and deep learning techniques, specifically Convolutional Neural Networks (CNN). It will be integrated into a user-friendly pipeline for practical application.
 - d. **Algorithm integration for infrastructure:** Geoneon will develop a functionality to integrate critical infrastructure and assign key indicators (i.e. financial replacement value, production value, socio-economic value, etc.). The integration of the infrastructure can be a functionality to upload infrastructure shapefiles and/or API to depository of building footprints such as Planetary Computer. Initial Critical Infrastructure were discussed with DDM, such as building, powerlines and road. Those critical infrastructures will be refined during the Stakeholder Engagement phase.
 - e. **Algorithm integration to develop exposure and risk indexes:** Geoneon will use their proprietary algorithm to combined hazard susceptibility and critical infrastructure to assign an exposure score derived from the intersection with the hazard severity index, using the highest value from the intersecting index. Geoneon will use their proprietary algorithm to combined hazard susceptibility and indicators assigned to the infrastructure to assign a risk score.
 - f. **Update of QGIS Plug-In:** depending on the repository of the QGIS plug-In the updates will be managed as follow:
 - i. For updates from a public repository, open QGIS, navigate to the plugin management section, and use the interface to find and update the desired plugin. Users will be notified in a notification bar on opening QGIS if a plugin upgrade is available.
 - ii. For a private repository, a user must manually add the repository's URL, and if necessary, the repository credentials, in the plugin settings, then proceed as you would with a public repository to update the plugin.

- iii. If installing from a ZIP file, a user must first download the updated plugin version as a ZIP, then use the plugin management section in QGIS to install it directly from the ZIP file.

Geoneon will aim for hosting the tool in the public or private repository as it offers the convenience of in-client notifications for available updates. Ensuring that geospatial data is standardised and compatible with the plugin is a key focus of this project. While the specific system architecture and data parameters are still being finalized, our broad strategy includes the following elements:

- **ISO Metadata Standards:** Adopting ISO 19115 and ISO 19139 standards to guarantee that all data integrated into the plugin is thoroughly documented and complies with global metadata norms. This will make data related to critical infrastructure, hazards, and climate models consistent, reliable, and easily interpretable.
- **OGC Compliance:** We're aligning with Open Geospatial Consortium (OGC) standards, ensuring wide-ranging support for various geospatial data formats. Our goal is to offer the most compatible, user-friendly, modern, and efficient formats best suited for the final system architecture and user interface.
- **Data Modelling:** For the data models specific to critical infrastructure, hazards, and climate models, we are working on creating or adopting existing data models that reflect the complexity and diversity of these domains. The models aim to capture essential attributes and relationships, ensuring that the data is not only standardized but also meaningful for analysis and decision-making within the plugin.

By combining these approaches, we aim to establish a robust framework for data standardization that will enhance the plugin's functionality and ensure its compatibility with a wide range of geospatial information systems. This comprehensive approach to standardization is key to creating a tool that is both versatile and reliable for users working with critical geospatial data.

The proposed tool, which will be integrated as a QGIS plug-in, is designed to perform critical infrastructure integration and analyse exposure and risk to identified climate-related hazards. It is envisioned to generate scalable maps, similar to those produced during the Climate Innovation Challenge, but a lower resolution to enhance the tool's applicability across broader areas balancing between high-enough resolution and cost-effectiveness and sustainability on the longer term. This approach not ensures wide ranging and adaptability to various regional contexts within Bhutan.

To illustrate the tool's potential and previous success, Figure 2 showcases the results from the first implementation of a similar approach during the Climate Innovation Challenge. This example provides a tangible representation of what the project aims to achieve in its current iteration, demonstrating the tool's capabilities in real-world scenarios. Note that the tool will focus on exposure and risk rather than vulnerability.

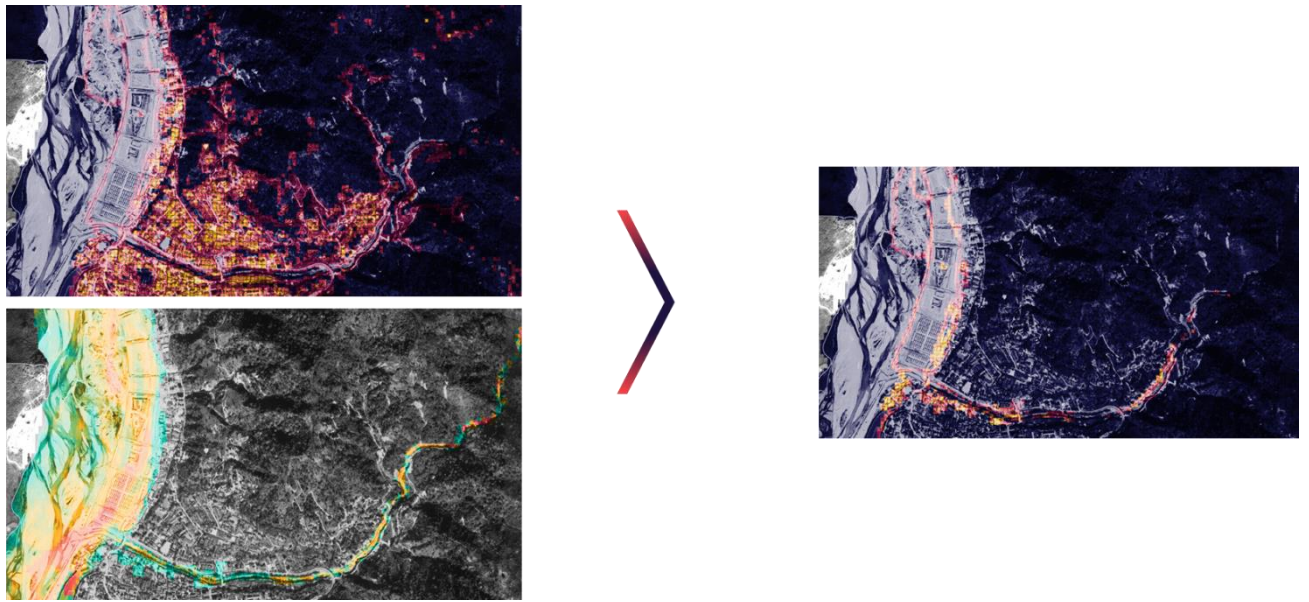


Figure 2: Results from the Climate Innovation Challenge. The figure shows the financial vulnerability of critical infrastructure to floods. The scope of the project was looking at vulnerability, rather than risk and exposure.

3. **User Manual:** Concurrent with tool development, Geoneon will create comprehensive user materials, detailing the tool's functionalities to facilitate effective use by local entities.
4. **Testing and Collecting Feedback:** A designated testing group, selected in consultation with beneficiary groups, will evaluate the tool's functionality. A systematic feedback collection and analysis system will be established to refine the tool based on user input.
5. **Capacity Enhancement Workshop:** Geoneon will conduct capacity enhancement workshops with key beneficiaries groups aiming to develop local capacity to use the open-source tool and how it can be used to support DDR and CCA strategies to use the tool. Those workshops aimed to share knowledge, capacity knowledge and transfer ownership.
6. **Finalisation of the Open Source Tool and Training Material:** Utilising the feedback analysis, Geoneon will finalize the open-source tool and training materials, ensuring they meet the end-users' needs and preferences.
7. **Recommendations:** Based on the project's learnings, Geoneon will provide strategic guidance for incorporating geospatial data and technology into DRR and CCA initiatives. Recommendations will be formulated to outline best practices in leveraging geospatial data for informed decision-making.

Figure 3 shows summarises the methodology of the project.

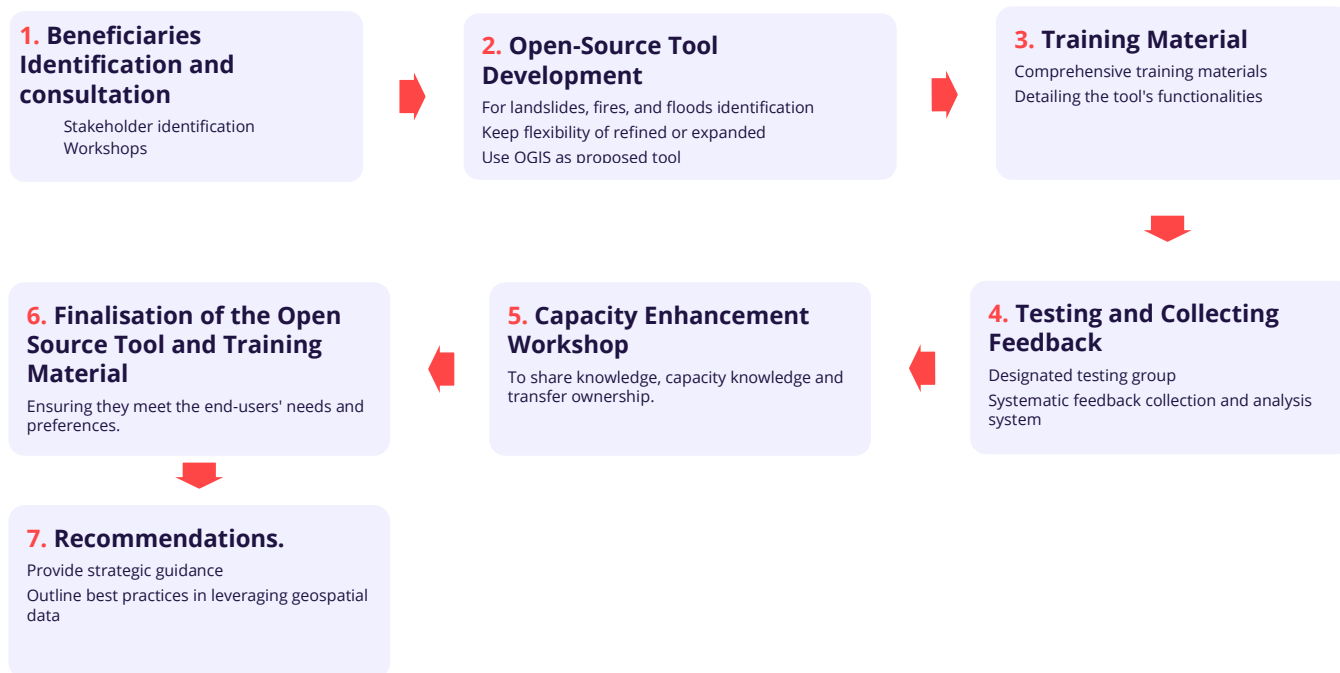


Figure 3: Methodology of the project

2.3 Project Site

The selection of project sites for this initiative is based on the experiences and findings from the initial implementation during the Climate Innovation Challenge, where Geoneon implemented their project in the Phuentsholing-Pasakha and Gelephu regions. These areas were initially chosen based on a prioritisation provided by the Department of Disaster Management (DDM). Following the project's completion, several other zones emerged as potential sites for further implementation, including the districts of Samtse, Thimphu, Bumthang, Zhemgang, Samdrupjongkhar, Pemagatshel, and Mongar.

After careful consideration and discussions with the DDM, the district of Thimphu has been identified as a priority area for the current project. This decision is based on a strategic assessment of the region's specific needs and vulnerabilities related to climate-related hazards. Thimphu, being the capital and a major urban center, presents unique challenges and opportunities in terms of DRR and CCA. The insights and experiences gained from this project's implementation in Thimphu are expected to provide valuable lessons that can be applied to other regions in Bhutan, aligning with the broader goal of enhancing nationwide climate resilience.

2.4 Partners and Beneficiaries

The main partner of this project is DDM.

However other national and subnational governments will benefit from this work as follow:

- Ministry of Home and Cultural Affairs:** Department of Civil Registration and Census, Department of Disaster Management, Department of Local Governance and Disaster Management

- **Ministry of Energy and Natural Resources:** Forest Resources Planning and Management Division and Forest Monitoring and Information Division and Nature Conservation Division.
- **Ministry of Infrastructure and Transport:** Department of Surface Transport, Department of Infrastructure Development, Department of Human Settlement
- **Thimphu Municipality:** City Environment Division, Infrastructure Division
- **Thimphu Dzongkhag Administration:** Environment Division

3. OVERVIEW OF THE INCEPTION PHASE ACTIVITIES

3.1 Inception Phase Activities

In the project's inception phase, we focused on refining key components for optimal execution. This included sharpening our project strategy, adjusting targets and expected results to be more precise and achievable, and fine-tuning our methodology and milestones for clarity and effectiveness. The next step is to conduct a formal kick-off meeting at the project's outset, which will align the team with these refinements and set a clear direction for our collaborative efforts moving forward.

3.2 Timeline and Workplan

The implementation plan is detailed in Table 1.

Table 1 Implementation Plan

Project Phase	Activities	Schedule	Deliverables
Stakeholder Engagement	Stakeholder Engagement: Consultation between DDM and Geoneon to identify Key Stakeholders and engage with them via a letter of Engagement.	15 th January 2024 - 28 th of February 2024	Comprehensive List of key Stakeholders
	Delivery of beneficiaries and consultation workshops: Development of consultation plan, feedback form, execution of beneficiaries consultation workshops and report outlining findings and data analysis of gender diversity attendance.	1 st February 2024 - 31 st of March 2024	Execution of Consultation Workshops
			Feedback Form
			Consultation Analysis Report
Stakeholder Consultation Plan			
Development of Customised Geospatial Tool	Open-Source Tool Development: Source existing data and analysis of data gaps and pipeline development.	15 th January 2024 - 30 th of June 2024	Geospatial Tool to map hazards and infrastructure exposure
	Training Material Development: Material Creation and Design	15 th January 2024 - 30 th of June 2024	Training Material
Capacity Building and Tool Refinement	Testing of tools and training material: Collecting feedback	1 st July 2024 - 31 st December 2024	Conclusion of Testing Phase
	Capacity Enhancement Workshop: Development of consultation plan, feedback form, interviews, teaching material, execution of capacity enhancement workshops and report outlining findings and data analysis of gender diversity attendance.	1 st December 2024 - 31 st December 2024	Execution of capacity building Workshops
	Finalisation of tool: Finalisation of tool	1 st October 2024 - 15 th of January 2025	Refinement of Open-Source Tool
			Refinement of Training Material
	Recommendation: Recommendation report	1 st October 2024 - 15 th of January 2025	Recommendations
Brief Documentation Development Report			
Consultation Analysis Report			

The timeline of the project is presented in Table 2.

Table 2 Timeline

Activity	2024												2025
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
Identify Key Stakeholders	█	█											
Beneficiaries Consultation		█	█										
Open Source Development Tool	█	█	█	█	█	█							
Training Material	█	█	█	█	█	█							
Collecting Feedback							█	█	█	█	█	█	
Capacity Enhancement Workshop												█	
Finalisation of the tool										█	█	█	█
Recommendation										█	█	█	█

3.3 Key Deliverables

The Key Deliverables are presented in Table 3.

Table 3: Key Deliverables

Project Phase	Deliverables	Format	Timeline
Project Inception and Planning	Inception Report	PDF Document	22 nd of December 2023
	Result Framework	PDF Document	22 nd of December 2023
	Monthly Report	PDF Document	5 th day of each month starting on the 5 th of February
	Six months Final Report	PDF Document	30 th of July 2024 30 th of January 2025
	Training Report	Excel Spreadsheet	15 th of January 2025
Stakeholder Engagement	Comprehensive List of key Stakeholders	PDF Document	31 st of March 2024
	Execution of Consultation Workshops	Workshops	31 st of March 2024
	Feedback Form	PDF Document	31 st of March 2024
	Consultation Analysis Report	PDF Document	31 st of March 2024
	Stakeholder Consultation Plan	PDF Document	31 st of March 2024
Development of Customised Geospatial Tool:	Geospatial Tool to map hazards and infrastructure exposure	QGIS Plug-In or Similar Interface	30 th of June 2024
	Training Material	PDF Document	30 th of June 2024
Capacity Building and Tool Refinement	Conclusion of Testing Phase	Spreadsheet with Feedback	15 th of January 2025
	Execution of capacity building Workshops	Workshops	15 th of January 2025
	Refinement of Open-Source Tool	QGIS Plug-In or Similar Interface	15 th of January 2025
	Refinement of Training Material	PDF Document	15 th of January 2025
	Recommendations	PDF Document	15 th of January 2025
	Brief Documentation Development Report	PDF Document	15 th of January 2025
	Consultation Analysis Report	PDF Document	15 th of January 2025

3.4 Milestones

In order to effectively implement our project and achieve our objectives, we have delineated the project execution into three distinct milestones as follows:

1. Milestone 1: Comprehensive Stakeholder Engagement

Goal: Conduct in-depth identification and active engagement with key stakeholders, building upon the initial identification from the inception phase.

Key Activities: Detailed stakeholder mapping and execution of engagement workshops with stakeholders and beneficiaries.

Indicator of Success: Establishment of sustainable relationships and continuous engagement marked by effective collaboration and a robust foundation for subsequent project phases.

2. Milestone 2: Development of Customized Geospatial Tool

Goal: Develop and deliver a customized geospatial tool specifically designed for mapping the exposure of beneficiaries to climate-related disasters.

Key Activities: Technical development of the tool and creation of training materials tailored to the tool's functionalities.

Indicator of Success: The tool is fully developed, tested, and ready for deployment, accompanied by comprehensive training materials for effective use by beneficiaries.

3. Milestone 3: Capacity Building and Tool Refinement

Goal: Enhance stakeholder capacity and refine the geospatial tool based on feedback.

Key Activities: Conducting workshops and training sessions for knowledge transfer and ownership; testing and refining the tool and training materials.

Indicator of Success: Stakeholders are proficient in using the tool, and the tool itself is refined to meet user needs and feedback effectively.

4. STAKEHOLDER ANALYSIS AND PARTNER MAPPING

Table 3 describes stakeholder analysis.

Table 3: Stakeholder Analysis

STAKEHOLDER GROUP	DESCRIPTION	ROLE AND RESPONSIBILITY	INTERESTS AND EXPECTATIONS	CAPACITY AND CONTRIBUTIONS	ENGAGEMENT OPPORTUNITY	ENGAGEMENT CHALLENGES	ENGAGEMENT STRATEGIES
Government agencies	Ministry of Home and Cultural Affairs Ministry of Energy and Natural Resources Ministry of Infrastructure and Human settlement Municipality Thimphu Dzongkhag Administration	DDM will be the primary liaison between the government agencies	Enhance interactions between government agencies for DDR and CCA strategies	Contribute to the stakeholder engagement enhancement	Opportunity to enhance collaboration	Difficulties to engage with all the departments	Stakeholder engagement workshops Ongoing engagement via update of the project
Civil Society	Community members	Engage with the project by accessing maps	Enhancement of awareness for CCA and DRR	Contribute to feedback	Engagement with government	Difficulties to engage with civil society members	Project Officer based in Bhutan to engage with society

5. KEY OUTCOME AND OUTPUTS OF THE PROJECT

5.1 Key Outcomes and Outputs

The proposed project is expected to contribute to the following outcomes:

1. **Stakeholder Engagement:** This outcome focuses on establishing robust engagement with all pertinent stakeholders and the public. It involves a thorough process to identify specific data requirements, technological capacities, and decision-making gaps that are crucial for crafting effective disaster risk reduction (DRR) and climate change adaptation (CCA) strategies that resonate with local needs.
2. **Open Source Development:** The overarching outcome of the Open-Source Tool Development activity is the creation of a comprehensive, accurate, and user-friendly tool that is customised to address the specific climatic threats and infrastructure vulnerabilities in Bhutan. It will contribute to enhance climate resilience in Bhutan and the promotion of the adoption of cutting-edge technology.
3. **Testing and finalisation of the tool and capacity enhancement workshop:** This outcome includes testing the geospatial tool and building the capacity of stakeholders in its use. The focus is on improving the skills and knowledge necessary to apply the tool in DRR and CCA decisions, fostering local expertise, and encouraging a sense of ownership among users.

Overall, beyond the project life-cycle, we anticipate that the project will contribute to the following outcomes:

1. **Enhanced Climate Resilience:** Increased resilience and adaptive capacity of critical infrastructure and communities in the test areas against climatic-related hazards, ensuring the sustainability of socio-economic development efforts in Bhutan.
2. **Empowered Decision-making:** Strengthened capacity of the DDM and other related departments to make informed decisions on DRR and CCA initiatives using state-of-the-art technology, leading to more effective risk mitigation and management strategies.
3. **Seamless Technology Integration:** Widespread adoption and use of the developed open-source tool by DDM and other stakeholders, driving a culture of data-driven, tech-enabled decision-making processes across Bhutan's disaster management ecosystem.
4. **Informed Stakeholder Engagement:** Enhanced engagement and collaboration between key stakeholders, beneficiaries, and the general public, leading to the co-creation of effective, locally relevant DRR and CCA strategies.
5. **Global Recognition:** Bhutan's proactive stance and innovative approach to disaster management and climate resilience recognized on an international platform, promoting the country as a leader

in leveraging technology for DRR and CCA.

6. **Knowledge Transfer and Upskilling:** Strengthened capabilities of local personnel through extensive training and consultation processes, ensuring the long-term sustainability and scalability of the project's innovations.

The anticipated outputs of this project include:

1. **Stakeholders Identification:** A comprehensive list identifying all critical stakeholders involved or affected by the project, which will serve as the basis for engagement and collaboration strategies.
2. **Stakeholder Engagement Workshop:** Execution of workshops aimed at consulting with beneficiaries to understand their needs, capabilities, and feedback, which will inform the tailoring of the project's interventions.
3. **Development of an Open-Source Tool:** The development phase of the open-source geospatial tool, which involves programming, design, and the integration of relevant data for Bhutan's climate resilience planning.
4. **Training Material Development:** Production of educational materials that will provide users with instructions and guidelines on how to use the newly developed geospatial tool.
5. **Testing of open-source tool and training material:** Rigorous testing of the geospatial tool and the accompanying training materials to ensure accuracy, user-friendliness, and effectiveness.
6. **Capacity Enhancement Workshop:** Workshops designed to enhance the capacity of stakeholders, providing hands-on experience with the tool and fostering a deeper understanding of its applications.
7. **Refinement of the open-source tool:** The completion and final refinement of the geospatial tool based on feedback and results from testing phases.
8. **Recommendations:** Development of strategic recommendations for the use of the tool and broader Earth Observation applications in the context of DRR and CCA.

5.2 Implementation Strategy and Data Collection and Analysis

Table 4 provides a clear and structured overview of the project's key phases, indicators, targets, data collection methods, sources, frequency, and the responsible positions. It ensures a systematic approach to tracking progress and achieving the project's objectives.

Table 4: M&E Plan

PROJECT PHASE	INDICATOR	TARGET	DATA COLLECTION METHOD	DATA SOURCE COLLECTION SOURCE	DATA COLLECTION FREQUENCY	POSITION RESPONSIBLE FOR COLLECTION
Stakeholder Engagement: establishment of robust engagement with all pertinent stakeholders and the public	Number and diversity of stakeholder engaged.	Engage with at least with 10 government officials with at least 30% female participation.	Feedback Form, Stakeholder Attendance List	Workshop Attendance Sheets, Feedback Forms	Post Workshop	Project Officer
Development of Customised Geospatial Tool	Functionality of the tool	Successful assessment of at least two climate-disaster hazards and three types of critical infrastructure	Tool Functionality Assessment	Tool Development Phase Deliverable	On-going during development phase	Senior Geospatial Engineer
	Production of Training Manual	Deliver one comprehensive training manual	Review of Final Deliverable	Project Documentation	End of Tool Development Phase	Project Manager
Capacity	Number of	At least 4		Feedback Forms	After Testing	Senior Geospatial

PROJECT PHASE	INDICATOR	TARGET	DATA COLLECTION METHOD	DATA SOURCE COLLECTION SOURCE	DATA COLLECTION FREQUENCY	POSITION RESPONSIBLE FOR COLLECTION
Building and Tool Refinement	participants in tool testing	participants (2 men and 2 women)	Testing Records, Feedback Forms	from Test Participants	Phase	Engineer
	Number of trained users, disaggregated by gender	Train 10 males and 7 females	Training Completion Records, User Assessments	Capacity Building Session Records	Post Capacity Building	Project Manager
	Tool refinement based on feedback	Address at least 80% of relevant feedback	Feedback Analysis, Stakeholder Input	Feedback Forms, Stakeholder Report	Ongoing during Refinement Phase	Senior Geospatial Engineer
	Number of strategic recommendations made	Develop at least 5 recommendations	Analysis of Recommendation Report	Recommendation Documentation	Throughout Recommendation Phase	Project Manager

5.3 Roles and Responsibilities

Table 5 shows the roles and responsibilities for the project.

Table 5: Roles and responsibilities

Name	Role
Roxane Bandini-Maeder	Project Manager, Stakeholder Engagement, and Disaster Risk Reduction
Dr Alex Bandini-Maeder	Technical Lead, Engineering Geologist and Geohazard Specialist
Huy-Thong Phan	Computer Vision Engineer, segmentation deep learning model
Cameron Poole	Senior Geospatial Engineer, Geospatial Delivery, Risk Index Development, Open-Source Tool Development
Twiggy Yao	Project Officer
Brad Johnson	Applied Sciences Developer
Sonam Tshewang	Project Liaison Bhutan

5.4 Reporting and Feedback

Reporting and feedback will be implemented as follow:

- Stakeholder Engagement Feedback Collection:** Post Stakeholder Engagement Workshop, the Project Officer will collect and analyze feedback using forms completed by participants. This will assess the diversity and number of stakeholders engaged. Monthly reports on these findings will be submitted to ADPC to ensure continuous oversight and adjustment for future engagement activities.
- Continuous Tool Development Feedback:** during the development phase of the Customised Geospatial Tool, the Senior Geospatial Engineer will regularly assess tool functionality against the set targets. This ongoing evaluation, involving iterative testing and refinements based on user input and technical assessments, will be documented in monthly reports to ADPC.
- Post-Training Feedback and Assessment:** After each capacity-building session, the Project Manager will collect feedback from participants to assess the training's effectiveness and the tool's usability. This feedback, gathered through forms and training completion records with a focus on gender-disaggregated participation, will be summarized in monthly reports to ADPC.
- Tool Testing and Refinement Feedback:** During the tool testing phase, feedback from a diverse group of test users will be collected and analyzed by the Senior Geospatial Engineer. The aim is to address at least 80% of relevant feedback, ensuring the tool's effectiveness. Monthly updates on this process will be reported to ADPC.

6. PROJECT MANAGEMENT AND OVERSIGHT

6.1 Project Management Structure

The project management structure for this initiative is designed to ensure effective coordination, decision-making, and execution of activities. It comprises various roles and committees, each with specific responsibilities:

1. Project Team:

- **Project Manager:** Oversees the entire project, ensuring that activities align with objectives, timelines are met, and resources are efficiently utilised. Responsible for coordinating between different team members and stakeholders. Oversees financial reporting, and ensures that all expenditures align with the project's financial guidelines.
- **Senior Geospatial Engineer:** Leads the technical development of the geospatial tool, ensuring its functionality and alignment with stakeholder needs.
- **Project Officer:** Manages stakeholder engagement and communication, organizing workshops and collecting feedback to guide the project's direction, and support project manager
- **Training Coordinator:** Develops and implements training programs, ensuring that stakeholders are effectively trained to use the new tool.
- **Technical Authority:** responsible for the quality insurance.

2. Steering Committee:

- Composed of key stakeholders, including representatives from the Department of Disaster Management (DDM) and Geoneon. This committee provides strategic guidance, ensures that the project aligns with goals, and offers insights into the local context and stakeholder needs.

6.2 Quality Insurance and Risk Management

To ensure the highest standards of quality and effective risk management throughout the project, we have established specific roles and procedures:

1. Quality Assurance by Technical Authority: The Technical Authority is responsible for overseeing the quality assurance of the project. This involves the continuous monitoring and review of all technical outputs to ensure they meet established quality standards. The Technical Authority will:
 - Regularly evaluate the technical aspects of the project.
 - Provide guidance and feedback to the technical team to maintain high-quality deliverables.
2. Risk Management by Project Manager: The Project Manager is tasked with maintaining and updating the risk register. The Project Manager will:
 - Continuously identify and assess potential risks.
 - Develop and implement mitigation strategies.
 - Regularly update the risk register, ensuring all team members are aware of risks and mitigations. Table 4 shows the initial risk matrix developed during the inception phase.
3. Lessons learned by Project Officer: The project officer is tasked to keep track of lessons learned.

Table 6: Risk Matrix

RISK	LIKELIHOOD	CONSEQUENCES	MITIGATION
Stakeholder not engaged	MEDIUM	HIGH	<ul style="list-style-type: none"> Engage government stakeholders from the project's inception through regular meetings and updates. Clearly demonstrate the project's alignment with national priorities and its benefits for Bhutan. Hire a Project Officer in Bhutan that can do the liaison between Geoneon and the Government.
Technical Challenges with the Open-Source Tool	HIGH	LOW	<ul style="list-style-type: none"> Conduct thorough testing and quality assurance before tool deployment. Expertise of Geoneon in developing open-source tool and exposure mapping.
Resistance to New Technology Among Local Stakeholders	LOW	HIGH	<ul style="list-style-type: none"> Implement comprehensive training programs and workshops to increase familiarity with the technology. Adapt the tool's interface and functionalities to local needs and contexts to enhance usability.

6.3 Knowledge Management and Learning and Innovation Practices

This is project aims at developing five knowledge products:

1. Open-Source Geospatial Tool

- Description:** This is a geospatial tool designed to integrate with a free-for-use Geographic Information System (GIS) software (QGIS). It is developed to provide comprehensive, data-driven insights into various climate-related hazards and their impacts on critical infrastructure in Bhutan. The tool is designed to be user-friendly, making advanced geospatial analysis accessible to a wide range of users.
- Timeframe:** The development of the tool is scheduled to take 5 months. This phase will focus on building the core functionalities, ensuring data integration, and designing an intuitive user interface. Following the development phase, the tool will undergo testing and refinement over a period of two months. This stage is crucial for ensuring accuracy, reliability, and ease of use.
- Objective:** The primary aim of this tool is to enhance technological knowledge among its users, particularly in understanding and managing the relationship between critical infrastructure and various climate hazards. It will serve as a vital resource for government bodies, disaster management authorities, and local communities in making informed decisions for climate resilience and infrastructure planning.

2. Beneficiaries Engagement Workshop and Findings Report

- Description:** This knowledge product encompasses a series of engagement workshops with key beneficiaries, followed by a comprehensive report detailing the findings. The workshops are designed to facilitate interactive discussions, gather insights, and understand the specific needs, capacities, and gaps of stakeholders in terms of data usage, technological capabilities, and decision-making processes for climate resilience.
- Timeframe:** The workshops and the subsequent analysis and report compilation are planned

to be completed within two months. This period will involve organising the workshops, conducting them, gathering data, and analysing the findings to produce a detailed report.

- **Objective:** The primary goal of these workshops and the report is to achieve a deeper understanding of the beneficiaries' requirements and challenges in the realm of climate resilience. This will inform the development of tailored strategies and tools that effectively address these needs. Additionally, the workshops aim to enhance the capacity of participants, empowering them with the knowledge and skills to effectively utilise technological tools for climate resilience and decision-making.

3. Training Material for the Open-Source Geospatial Tool

- **Description:** This knowledge product is a comprehensive training manual designed to guide users on how to effectively use the open-source geospatial tool. The manual will cover all aspects of the tool, including installation, navigation, data interpretation, and application of the tool for various climate resilience and risk assessment. It will be structured to cater to users with varying levels of technical expertise, ensuring accessibility and ease of understanding.
- **Timeframe:** The development of the training manual is expected to be concurrent with the development of the tool, ensuring that the manual is reflective of the tool's final functionalities and features. This is estimated to take approximately three months. It will then be revised after the testing of the tool.
- **Objective:** The objective of this training manual is to provide a reliable and easy-to-understand resource that enhances the users' capacity to effectively employ the geospatial tool in their work. It aims to ensure that all potential users, regardless of their technical background, can leverage the full capabilities of the tool for informed decision-making in climate resilience and disaster risk management.

4. Capacity Enhancement Workshops

- **Description:** This knowledge product involves a series of capacity enhancement workshops conducted by Geoneon with key beneficiary groups. These workshops are designed to develop local capacity and support disaster risk reduction (DRR) and climate change adaptation (CCA) strategies. The focus of these workshops is on knowledge sharing, capacity building, and the transfer of ownership of the open-source tool.
- **Timeframe:** the whole activity has a span of time of 2 months, including finalisation of materials for the workshops, the delivery of the workshop and the post-workshop reports.
- **Objective:** the objective is to develop local capacity in disaster risk reduction (DRR) and climate change adaptation (CCA) by equipping key beneficiaries in Bhutan with the skills and knowledge to effectively use the open-source geospatial tool.

5. Recommendation Report

- **Description:** This knowledge product will be a comprehensive set of recommendations focused on the application of Earth Observation technologies in Disaster Risk Reduction (DRR) and data gathering.
- **Timeframe:** The development of these recommendations is expected to start in December, with the final document with completion towards the end of the project timeline.

The dissemination of knowledge and information will be as follow:

1. **Through conferences:** present findings and insights at relevant local and international conferences. This includes sharing experiences from the Capacity Enhancement Workshops, key features of the Open-Source Geospatial Tool, and strategic recommendations for Earth Observation use. Conferences offer a platform for networking and engaging with a diverse professional audience.
2. **Through digital material:** Publish digital materials on Geoneon website for accessing the training manual easily for end user's.
3. **Through Case Studies on Geoneon Website:** Publish detailed case studies on the Geoneon website, highlighting the project's success stories, challenges, and lessons learned. This could include case studies on the application of the Open-Source Tool in specific scenarios or the outcomes of the Capacity Enhancement Workshops.
4. **Through promotion via social media:** Use social media platforms to share project updates, key findings, infographics, etc. Social media can be used to promote academic papers, digital materials, and case studies, reaching a broader and more diverse audience, including the general public and non-specialised stakeholders.
5. **Through Press Releases:** Coordinate the release of press statements in collaboration with prominent figures, such as the Ambassador of Bhutan in Australia. These press releases can highlight significant milestones of the project, like the launch of the Open-Source Geospatial Tool or key findings from the Beneficiaries Engagement Workshop. Using notable figures in press releases can garner attention from a broader audience, including policymakers, international stakeholders, and the media, thus amplifying the project's visibility and impact.

7. ANNEXURES

- Presentation from the Inception Meeting (4 December 2023)



M&E Plan

Project Title: Satellite and Ai-Driven Climate Resilience Tool for Bhutan

Indicator Description	Indicator definition	Target	Data Collection Method	Data Collection Source	Data Collection Frequency	Position Responsible for Collection
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<p>Government agencies and Citizens who have access to climate-resilient solutions tested under the project (Number)</p>	<p>This indicator measures the extent to which government agencies and citizens have access to and use tested or verified climate-resilient solutions that are supported by the project.</p> <p>Innovations' (broadly defined) are products, processes, tools, approaches, service delivery models, and/or other interventions that have the potential to achieve significant improvements in development outcomes versus existing alternatives and are intended to improve the lives of ultimate beneficiaries.</p> <p>A tested and verified climate-resilient solution is a solution that has been proven to work in different climatic conditions and has been validated by rigorous methods and criteria. A</p>	<p>Access to Climate Resilient Solution: 5 government agencies which include a minimum of 10 government officials with at least 30% female participation</p>	<p>The project team will collect data on the access and use of tested or verified climate-resilient solutions by government agencies and citizens. The tested or verified solutions are selected based on their effectiveness, efficiency, sustainability, scalability, and alignment with the project objectives and outcomes. The data will be collected using the following approaches and methods:</p> <ul style="list-style-type: none"> • Documentary evidence from government agencies: The project team will request letters from the government agencies that have implemented or adopted a tested or verified solution. The letters should be on the official letterhead of the agency, signed by the authorized official, and include the name, description, and date of the solution. The letters should also indicate the positive outcomes or benefits of using the solution, such as improved service delivery, increased resilience, reduced vulnerability, etc. • Interviews with government officials: The project team will conduct 10 interviews with a sample of citizens who have accessed or used a tested or 	<p>Sub Grantees database and progress reports; Official letters issued by the government agencies</p>	<p>During the last phase of the project: Once during the tool testing with the testing group, and after the capacity enhancement workshop .</p>	<p>Geoneon</p>
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tested and verified climate-resilient solution is designed to reduce the negative impacts of climate change on the target population and environment, while also contributing to sustainable development goals.

The indicator is based on both quantitative and qualitative data sources, such as letters, progress reports, and interviews. The indicator aims to capture the diversity and complexity of access modalities, such as direct, indirect, or facilitated access, as well as the value and depth of support provided by the project for each innovation. The indicator also recognizes that different innovations may have different levels or types of access across different contexts and stakeholders.

Access to results published for the project:

1000 males including government officials, community members and farmers.
1000 female including government officials and community members and farmers.

verified solution. The interviews will be based on field missions and will follow a semi-structured questionnaire. The interviews will aim to capture the satisfaction, perception, and experience of the citizens with the solution, as well as the challenges or barriers they faced in accessing or using it. The interviews will also seek to verify the claims and evidence provided by the government agencies and the innovators.

The project team will triangulate the data from these sources to ensure the validity and reliability of the indicator. Triangulation means comparing and cross-checking the data from different sources, methods, and perspectives to identify consistencies and discrepancies. The project team will use qualitative and quantitative methods to analyze and interpret the data.

The indicator progress along with the narrative will be shared and reported in the following documents and places:

- Indicators Tracking Sheets (ITS), for internal monitoring.

- Implementation Support Review Mission(s)
- Aide Memoire(s)
- Implementation Progress Reports (Bi-Annual, and Final Project Report)
- Implementation Completion and Results Report

The iCARE team will review the documents provided by the grantees, such as progress reports etc., to verify the data. The iCARE team will also verify the data during field missions to project countries.

Indicator Description	Indicator definition	Target	Data Collection Method	Data Collection Source	Data Collection Frequency	Position Responsible for Collection
<p>Number of people trained (in person) (by sex, country, topic, year, participant category)</p>	<p>This indicator measures the number and characteristics of people who have received training from the project, either in person or online. The training is intended to enhance their knowledge, skills, and attitudes related to the project objectives and outcomes. The indicator disaggregates the data by sex, country, topic, year, and participant category. The participant category refers to the type of stakeholder that the person belongs to, such as government official, civil society representative, private sector actor, beneficiary, etc. The indicator tracks the reach and diversity of the project's training activities and outputs. Training is defined as a learning activity involving: 1) a setting intended for teaching or transferring knowledge, skills, or approaches; 2) a formally designated</p>	<p>Number of people trained online prior testing test: At least 4 participants (2 men and 2 women)</p>	<p>The following information will be collected for each training counted toward this result and retained in internal documentation:</p> <ul style="list-style-type: none"> •the name, date, and location of the training. •the learning objectives; and •the names, type of organization, and gender. <p>The Information collected will be verified against the training certificates issued by innovator. The project team will ensure the quality and overall delivery of the trainings. There will be pre and post-assessment to record training participants' observations and feedback regarding the overall quality of the training and the knowledge and skills imparted through the training. Participants' feedback received through pre, and post-training surveys will also be analyzed and reported while reporting progress on this indicator.</p> <p>The indicator progress along with the narrative will be shared and reported</p>	<p>Project participant training records as well as their pre and post-test results</p>	<p>. Twice: at the beginning of the testing phase and at the end of capacity enhancement workshop</p>	<p>Geoneon</p>
<p>Number of people trained (online) (by sex, country, topic, year, participant category)</p>	<p>ally designated</p>	<p>Number of people trained during the Capacity Enhancement Workshop: At least 10 people with 30% of female participation</p>	<p>The indicator progress along with the narrative will be shared and reported</p>			

Indicator Description	Indicator definition	Target	Data Collection Method	Data Collection Source	Data Collection Frequency	Position Responsible for Collection
	<p>instructor(s) or lead person (s); and 3) a defined set of learning objectives, or outcomes.</p> <p>A training is a structured process by which a group of people is provided with the knowledge and taught the skills that are needed for a particular job, activity or area of work. Trainings must be delivered according to a clear curriculum or session plan with stated learning objectives.</p> <p>Trainings can be delivered in two main ways:</p> <ul style="list-style-type: none"> • In-person training: These are trainings consisting of at least six hours of in-person instruction on a topic related to innovation. The six hours can be undertaken in a single period (e.g. a day) or spread over a number of sessions (e.g. over a number of days). To 		<p>in the following documents and places:</p> <ul style="list-style-type: none"> • Indicators Tracking Sheets (ITS), for internal monitoring. • Implementation Support Review Mission(s) • Aide Memoire(s) • Implementation Progress Reports (Bi-Annual, and Final Project Report) • Implementation Completion and Results Report. 			

Indicator Description	Indicator definition	Target	Data Collection Method	Data Collection Source	Data Collection Frequency	Position Responsible for Collection
	<p>meet quality standards, in-person trainings are best limited to a class size of not more than 30 participants.</p> <ul style="list-style-type: none"> Online training: These are trainings in which a computer or electronic device is used as the primary means of delivering training content on a topic related to innovation. <p>Coaching and mentoring, meetings or other efforts that could have educational value but do not have a defined set of learning objectives are generally not considered to be training unless they meet the three definitional standards for training identified above. Only people who complete the training course are counted for this indicator. People who</p>					

Indicator Description	Indicator definition	Target	Data Collection Method	Data Collection Source	Data Collection Frequency	Position Responsible for Collection
	<p>attend multiple, non-duplicative trainings can be counted once for each training they completed in the reporting period.</p> <p>In line with ADP C's gender and diversity framework and CARE for South Asia gender mainstreaming strategy, the project aims to include female nominees in an equal proportion to male nominees to have gender-balanced participation in the trainings.</p>					
<p>Number of knowledge products provided (by type of product, theme, country)</p>	<p>This indicator tracks the quantity and quality of knowledge products that the project produces and disseminates to its intended users and beneficiaries.</p> <p>Knowledge products are specific products developed fully by the project or jointly with partners and provided to targeted recipients and stakeholders for their use.</p>	<p>5 which includes: open-source Geospatial Tool, Beneficiaries Engagement Workshops and Finding Reports. Training Material for</p>	<p>The project will use document review as the main data collection method for the indicator. The project will maintain a master file of all the knowledge products that it produces and disseminates to its intended users and beneficiaries. The master file will include the following information for each knowledge product: The type of product, such as a report, a curriculum, an infographic, a case study, etc.</p>	<p>Training curricula and materials, case studies, fact sheets, profiles, fliers, posters, op-eds, or other forms of documentation</p>	<p>Information will be available at each knowledge production but recorded Monthly -</p>	<p>Geoneon</p>

Indicator Description	Indicator definition	Target	Data Collection Method	Data Collection Source	Data Collection Frequency	Position Responsible for Collection
	<p>Knowledge products include tools, guidance, publications, research/studies, databases, resource maps and audio-visual resources delivered to a recipient or set of recipients. This only includes products that are developed for external target groups and does not include products developed for the purposes of project management (e.g. situation analyses, needs assessments, baseline studies etc. developed for project's use).</p>	<p>the Open-Source Geospatial Tool, Capacity Enhancement workshop and Recommendation Report</p>	<p>The theme or topic that the product addresses, such as climate change, gender equality, etc. The country of origin or focus of the product, such as where it was produced or where it is relevant or applicable The date of production or dissemination of the product. The agenda or purpose of the product, such as what it aims to achieve or communicate The written materials or content of the product, such as the main findings, recommendations, or best practices.</p>			
<p>Number of people / organizations provided with knowledge products (by recipient category, type of knowledge product, country, theme)</p>	<p>This indicator measures the reach and diversity of the project's knowledge products among different types of users and beneficiaries. The recipient category refers to the type of stakeholder that receives the knowledge product, such as government official, civil society</p>	<p>Open Source Tool: Minimum of 10 people Beneficiaries engagement workshop: at least 20 people</p>	<p>As above</p>	<p>as above</p>	<p>Information will be available at each knowledge product distributed but recorded Monthly</p>	<p>Geoneon</p>

Indicator Description	Indicator definition	Target	Data Collection Method	Data Collection Source	Data Collection Frequency	Position Responsible for Collection
	<p>representative, private sector actor, etc.</p> <p>The type of knowledge product refers to the format or medium of the knowledge product, such as a report, a curriculum, an infographic, a case study, etc.</p> <p>The theme refers to the main subject or issue that the knowledge product addresses, such as climate change, gender equality, health, etc. The indicator tracks the project's output in terms of generating and sharing knowledge and learning.</p>	<p>User Manual: at least 10 people</p> <p>Recommendation Report: At least 10 people</p>				
<p>Number of events supported (by type, year, theme, country)</p>	<p>This indicator captures data on events that the project organizes or participates in to showcase or disseminate its innovation.</p> <p>The events are any type of activity or platform that allows the project to communicate or interact with its target</p>	<p>6 Facebook and LinkedIn Posts</p> <p>2 press releases</p> <p>1 conference</p>	<p>The project will use event records such as the agenda, concept note, recording of the event etc. The project will use a standardized event monitoring form to collect and document the relevant information for each event.</p> <p>The form will include the following fields for each event:</p>	<p>The project team, who will be responsible for filling out the form after each event they</p>	<p>Information will be available at each event and will be recorded Monthly</p>	<p>Innovators</p>

Indicator Description	Indicator definition	Target	Data Collection Method	Data Collection Source	Data Collection Frequency	Position Responsible for Collection
	<p>audience or stakeholders, such as conferences, workshops, webinars, blogs, information portals, social media networks, etc. The indicator disaggregates the data by the type, year, theme, and country of the events. The type refers to the format or mode of the event, such as in-person or online. The year refers to the calendar year when the event took place. The theme refers to the main subject or issue that the event addressed, such as climate change, gender equality, health, etc. The country refers to the location where the event was held or where it was relevant or applicable. The indicator tracks the project's output in terms of promoting and sharing its innovation.</p>	<p>2 stakeholder s engagement workshops</p>	<ul style="list-style-type: none"> The type of event, such as in-person or online The date of the event The theme or topic of the event, such as climate change, gender equality, health, etc. The country where the event was held or where it was relevant or applicable The number and characteristics of the participants, such as their stakeholder category, sex, etc. The objectives and outcomes of the event, such as what the project aimed to achieve or communicate, and what feedback or impact it received <p>The project will ensure the quality and validity of the data collected by using the following measures:</p> <ul style="list-style-type: none"> Data triangulation, which means comparing and cross-checking the data from different sources, methods, and perspectives to identify 	<p>organize or attend The event organizers or hosts, who will be asked to provide the details and logistics of the event, such as the agenda, the speakers, the venue, etc.</p>		

Indicator Description	Indicator definition	Target	Data Collection Method	Data Collection Source	Data Collection Frequency	Position Responsible for Collection
			<p>consistencies and discrepancies.</p> <ul style="list-style-type: none"> Data validation, which means verifying the accuracy and completeness of the data by checking for errors, gaps, or inconsistencies. 			
<p>Number of people participating in supported events (by participant category, sex, year, theme, country)</p>	<p>This indicator measures the extent and diversity of the project's outreach and engagement through its supported events. The supported events are any type of activity or platform that showcases or disseminates the project's innovation, such as conferences, workshops, webinars, blogs, information portals, social media networks, etc. The indicator tracks the project's output in terms of reaching and influencing its target audience or stakeholders.</p>	<p>Facebook and LinkedIn Post: at least 20 reactions Press release: at least one news agency in Australia and in Bhutan Stakeholder engagement : at least 20 people participation</p>	<p>same as above</p>	<p>same as above</p>	<p>Information will be available at each event and recorded monthly.</p>	<p>Innovators</p>

Indicator Description	Indicator definition	Target	Data Collection Method	Data Collection Source	Data Collection Frequency	Position Responsible for Collection
		Conference: at least one conference				
Number of people participating at the stakeholder engagement at the beginning of the project.	This indicator measures how many stakeholders will be present during stakeholder engagement workshop.	10	Data will be collected through feedback form and attendance list during the stakeholder engagement workshop.	Attendance List Feedback Form Stakeholder engagement analysis report	Once during the stakeholder engagement phase	Geoneon
Number of hazard and Critical Infrastructure which will be identified during the stakeholder engagement workshop	This indicator measures how many climate related hazards and critical infrastructure which will be integrated in the geospatial tool.	3 hazards and 3 critical infrastructure type	Data will be collected during discussions during the stakeholder engagement workshops	Discussion notes	Once during the stakeholder engagement phase	Geoneon
Geospatial Tool Developed to map exposure and risk of infrastructure to climatic related disasters	Number of geospatial tool which is functional and ready to be tested.	1 functional tool with relevant 3 hazards and 3 infrastructure.	We will document how the tool has been developed.	Methodology	Once at the end of the tool development	Geoneon

Project Title: Satellite and Ai-Driven Climate Resilience Tool for Bhutan

Results Framework

LEVEL	EXPECTED RESULT	INDICATORS	BASELINE	TARGET
Project Development Objectives	To contribute to an enabling environment for climate-resilient policies and investments in select sectors and countries in South Asia.	Government agencies and Citizens who have access to climate-resilient solutions tested or access to the results of the climate resilient solutions under the project (Number)	0	5 Government Agencies 1000 males citizen 1000 females citizen
OUTCOME 1:	Enhanced stakeholder engagement and Needs Identification: Focus on deepening engagement and collaboration among stakeholders and the public, coupled with precise identification of data needs, technological capacities, and decision-making gaps for effective, locally relevant disaster risk reduction and climate change adaptation strategies.	Number of stakeholder engaged	0	10
		Hazards, Indicators and Critical Infrastructure Identified		3 hazards 2 indicators 3 infrastructure type
Output 1:Stakeholder Engagement	Establishment of a comprehensive network of diverse stakeholders from various agencies, ensuring a wide	Number and diversity of stakeholders engaged.	Three male government officials engaged across one agency.	Engage with at least 10 government officials with at least 30% female

LEVEL	EXPECTED RESULT	INDICATORS	BASELINE	TARGET
	representation that contributes to effective, inclusive, and informed decision-making for disaster risk reduction and climate adaptation strategies.			participation across multiple agencies.
OUTCOME 2:	Development and utilisation of a customised geospatial Tool and training manual	Number of geospatial tool which is functional and ready to be tested.	0	1 functional tool with relevant 3 hazards and 3 infrastructure.
Output 2.1: Open-Source Tool Development	A functional open-source geospatial tool that is widely used for assessing climate-related risks to infrastructure, improving preparedness and response strategies in Bhutan.	Functionality of the tool Number of people accessing the first open-source tool	0	Deliver to 4 people (number of people in testing phase).
Output 2.2: Training Material Development	Availability of a training manual that enhances the capacity of stakeholders to utilize the geospatial tool effectively for climate risk assessment and planning.	Number of people with training manual delivered	0	Deliver to 4 people (number of people in testing phase).

LEVEL	EXPECTED RESULT	INDICATORS	BASELINE	TARGET
Outcome 3	Capacity Building and tool testing: test of the tool and Enhance skills and knowledge among the workshop participants regarding the use of the open-source tool and its application to inform decision for DDR and CCA. This will lead to increased local capacity in effectively applying the tool for climate resilience, with a sense of ownership among the stakeholders.	Number of Government Agencies that have accessed to the open-source tool	0	Access: 5 government agencies which include a minimum of 10 government officials with at least 30% female participation
		Number of Citizen accessing the results of the open-source tool during the project	Access to results: 1000 males including government officials, community members and farmers. 1000 female including government officials and community members and farmers.	1000 males including government officials, community members and farmers. 1000 female including government officials and community members and farmers.
Output 3.1:	Completion of testing phase of tools	Number of people trained online prior testing test	0	4 participants (2 men and 2 women) in tool testing.
		Number of people testing the tool	0	4 people (2 men and 2 women) in tool testing.

LEVEL	EXPECTED RESULT	INDICATORS	BASELINE	TARGET
Output 3.2:	A trained cohort of stakeholders capable of using and disseminating knowledge about the tool, promoting gender-balanced capacity building in the local context.	Number of trained users, disaggregated by gender	0	Train 10 males and 7 females in the use of the tool.
Output 3.3	Finalisation of the tool	Tool refinement based on feedback	0	Address at least 70% of relevant feedback for tool refinement.
Output 3.3: Recommendation	Increased understanding on the use of geospatial data for increasing climate resilience strategies	Number of strategic recommendations made	Recommendations from previous projects primarily focused on vulnerability analysis.	Develop at least 5 strategic recommendations for using geospatial data for increasing climate resilience strategies
Additional Outputs	The project will bring some engagement to promote it through various events such as social media post, press release, conference participation	Number of Facebook and LinkedIn Posts	0	6 Facebook and LinkedIn Post
		Number of outreach of Facebook and LinkedIn Posts	0	20 reactions
		Number of press Release	0	2
		Number of media agency with press release	0	1
		Number of conference	0	1

Work Plan and Budget per Activities

Outcome Description	Output Description	Activities Description	Budget ¹ <i>(in US\$)</i>
Enhanced stakeholder engagement and Needs Identification: Focused on deepening engagement and collaboration among stakeholders and the public, coupled with precise identification of data needs, technological capacities, and decision-making gaps for effective, locally-relevant disaster risk reduction and climate change adaptation strategies.	Output 1.1: Stakeholder Engagement	Activity 1.1.1: Consultation between DDM and Geoneon to identify Key Stakeholders and engage with them via a letter of Engagement	\$ 6,400
	Output 1.2: Delivery of beneficiaries; consultation workshops	Activity 1.2.1: Development of consultation plan, feedback form, execution of beneficiaries consultation workshops and report outlining findings and data analysis of gender diversity attendance.	\$31,700
Development and Utilisation of a Customised geospatial Tool: Creation and dissemination of a comprehensive, user-friendly tool tailored to Bhutan's specific climate threats and infrastructure needs, coupled with enhanced user understanding for accurate application in climate risk assessment.	Output 2.1: Open-Source Tool Development	Activity 2.1.1: Source existing data and analysis of data gaps and pipeline development.	\$88,770
	Output 2.2: Training Material Development	Activity 2.2.1 Material Creation and Design	\$13,230
Capacity Building and tool testing: test of the tool and Enhance skills and knowledge among the workshop participants regarding the use of the open-source tool and its application to inform decision for DDR and CCA. This will lead to increased local capacity in effectively applying the tool for climate resilience, with a sense of ownership among the stakeholders.	Output 3.1: Testing of tools and training material	Activity 3.1.1 Collecting feedback	\$7,930
	Output 3.2 Capacity Enhancement Workshop	Activity 3.2.1: Development of consultation plan, feedback form, interviews, teaching material, execution of capacity enhancement workshops and report outlining findings and data analysis of gender diversity attendance.	\$35,654

¹ Budget from Grant Contribution. Geoneon and DDM will contribute in kind.

	Output 3.3: Finalisation of tool	Activity 3.3.: Finalisation of tool	\$37,890
	Output 3.4: Recommendation	Activity 3.4.1: Recommendation report	\$3,435