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PORTFOLIO MONITORING MISSION REPORT

ADAPTATION TO CLIMATE-INDUCED WATER STRESSES THROUGH INTEGRATED LANDSCAPE MANAGEMENT IN BHUTAN

CONTENTS

PROJECT INFORMATION 3

PROJECT BACKGROUND AND OBJECTIVES 4

PROJECT COMPONENTS 5

PROJECT RESULTS & OUTCOMES 6

KEY FEATURES OF THE PROJECT 9

- Laying a solid foundation for sustainability 9
- Project replication and scale up 9
- Innovation through adaptive engineering 10
- Social inclusion for effective project outcomes 11
- Enhancing local adaptive capacity 12
- Risk management 13

LESSONS LEARNED 14



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PROJECT INFORMATION

Project Title	**Adaptation to Climate-induced Water Stresses through Integrated Landscape Management in Bhutan**
Country	**Bhutan**
Sector	**Water Management**
Implementing Entity (name and type)	**Bhutan Trust Fund for Environmental Conservation (National Implementing Entity)**
Executing Entity(ies)	• **Department of Agriculture & Department of Forests & Park Services, Ministry of Agriculture and Forests** • **Department of Engineering Services, Ministry of Works and Human Settlement** • **Department of Local Governance, Ministry of Home and Cultural Affairs**
Funding Amount	**US$ 9,998,955 million**
Project start date	**30 May 2023**
Project completion date	**30 May 2028**
Portfolio Monitoring Mission Date	**9 January – 9 August 2025**

PROJECT BACKGROUND AND OBJECTIVES

Water resources in Bhutan are increasingly affected by the impacts of climate change, including erratic rainfall, extended dry periods and the drying of natural water springs. These challenges have resulted in seasonal shortages of drinking and irrigation water across rural areas, and a growing struggle for limited water resources. More than 99 per cent of the country's topography is mountainous. Combined with its fragile ecosystems, this topography exacerbates the impacts of changing precipitation patterns, leading to landslides, erosion and degradation of watersheds.

In response to these vulnerabilities, the Adaptation Fund (the Fund) project aims to strengthen the resilience of water resources and dependent communities in three priority districts (Dzongkhags: Paro, Dagana and Tsirang), which are among the most water-stressed areas of the country. The project seeks to enhance adaptive capacity and water security through an integrated landscape approach; improve the climate resilience of water and agricultural infrastructure; and build institutional capacity for inclusive, climate-informed planning, operation and maintenance of assets.

By addressing both the supply and demand dimensions of water management, the project contributes to Bhutan's National Adaptation Plan, Water Flagship Programme and Nationally Determined Contribution commitments. In this way, it fosters reliable water access, improved agricultural productivity and stronger institutional capacity for climate-resilient development.



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Micro meteorological station in Dagana District.
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PROJECT COMPONENTS

The project is structured around four components:

Component 1: Adaptive management of watersheds to enhance the climate resilience of communities. This component aims to strengthen ecosystem resilience and water security by rehabilitating priority watersheds through ecosystem-based adaptation measures and by improving hydrological monitoring and collection of weather and climate data.

Component 2: Climate-resilient water infrastructure for uninterrupted supply of water for drinking and irrigation. This component focuses on strengthening the climate resilience of water supply and irrigation systems. It supports the design, construction, and upgrading of water infrastructure adapted to local terrain and climate hazards, ensuring reliable and equitable access to safe water for domestic and agricultural use.

Component 3: Climate-smart agriculture through sustainable land management and informed agrometeorological services. This component promotes sustainable land management (SLM) to stabilize slopes, conserve soil moisture and reduce land degradation. It also supports agrometeorological services and inter-agency coordination to provide farmers with timely climate information for improved planning.

Component 4: Improved local governance for effective climate change adaptation mainstreaming with a focus on water management at the grassroots. This component strengthens local government mechanisms for mainstreaming climate change adaptation and gender needs in local development plans.

PROJECT RESULTS & OUTCOMES

Component 1

Integrated investments under this component have advanced steadily across the three target districts, improving ecosystem and community resilience through watershed management and groundwater recharge measures. Gender-sensitive awareness-raising sessions and training were held in all 13 sub-districts (Gewogs), helping to address barriers to participation and support more inclusive watershed planning and implementation. These efforts were followed by the construction of check dams, catch pits, trenches and terraces, as well as revegetation activities. Collectively, the investments have climate-proofed 600 ha of watershed, identified two additional degraded watersheds for rehabilitation, and assessed nine drying water springs for groundwater recharge interventions.

In Dagana, which had no existing payment for ecosystem services (PES) schemes, the project organized consultations and training in three sub-districts to explore its introduction. This was based on long-standing implementation of such PES in other target districts (Tsirang and Dagana). An inventory of resources was completed to inform a possible implementation of such a scheme in Dagana, creating financial incentives for communities to adapt watersheds to the impacts of climate change.

To strengthen the scientific basis for watershed planning, a micro-meteorological station was established in Dagana to collect data on rainfall intensity and distribution, evapotranspiration, and soil moisture. These data feed into a broader climate-informed monitoring system that ultimately informs the technical design of watershed management and groundwater recharge interventions such as water intake reservoirs, check dams, recharge pits and terraces. They also contribute to early warning systems for droughts and floods. Finally, they help guide crop water management in downstream agricultural areas, linking hydrological monitoring with practical decision-making on the ground.

A community-led, water-discharge monitoring initiative, with technical support from the Department of Water, was also launched to assess the effectiveness of both watershed management and groundwater recharge measures. Communities are collecting and sharing water-discharge data monthly, fostering both accountability and ownership. Such a participatory approach supports evidence-based decision-making and also strengthens local capacity to sustain watershed health beyond the project's timeline. Preliminary findings indicate that the integrated measures improved soil moisture and reduced surface run-off. The community-based discharge monitoring system was introduced only after the construction of the scheme. Therefore, it was not used actively to mitigate specific environmental or social risks during infrastructure development. However, empowering communities with the technical skills and tools to measure discharge has already yielded notable institutional benefits. These include increasing community ownership of both the infrastructure and the catchment; reducing the need for frequent technical field visits; and laying the foundation for sustained local monitoring, stewardship and adaptive management.



Drujeygang Irrigation Channel in Dagana District.

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Component 2

Component 2 has strengthened community access to both climate-resilient drinking water supply and irrigation systems across all three districts.

In Tsirang, the project is nearing completion of a storage tank (250 cubic meters) and osmosis filtration system. This connects to a 30-kilometre (km) pipeline network, providing safe and reliable drinking water to Tsirangtoe School and surrounding communities. These investments directly benefit approximately 4,700 individuals, who can now rely on safe drinking water and benefit from improved hygiene conditions, reduced waterborne diseases and enhanced resilience to dry-season water shortages.

In Paro, ongoing works include the installation of 33 km of drinking water transmission and distribution pipelines. Once completed, these interventions will provide reliable and safe drinking water to an estimated 33,000 residents of this district. Previously, one single water access point was shared by three households. The number of beneficiaries is expected to reach around 51,000 following complementary investments by district and sub-district authorities. In all, 32 engineers and technicians were trained in climate-resilient water supply infrastructures, ensuring that future infrastructures reflect climate change adaptation considerations.

In addition to the above drinking water infrastructures, the project has established climate-resilient irrigation infrastructures. In Dagana, it completed a 5.65-km irrigation channel with a new intake weir and desilting chamber in Lajab sub-district. It also installed micro-irrigation systems, quadrupling the number of households able to irrigate their fields. This shifted the community from an increasingly unreliable and unpredictable rain-fed agricultural system to a stable, climate-resilient irrigated one. In Tsangkha sub-district, two intake weirs, a desilting chamber, and a 2.1-km water pipeline replaced an open irrigation channel. This enables farmers to adopt sustainable rice intensification practices, allowing them to grow rice twice a year and reducing irrigation time from a month to one week. This enhances both productivity and water use efficiency.

To ensure long-term sustainability, the project has identified formal and informal Water User Associations (WUAs) in all districts. It has also supported registration of informal WUAs with local government authorities to improve local governance and maintenance of water infrastructures. Awareness-raising and training-of-trainers sessions built WUA capacities and reactivated previously dormant WUAs affected by water shortages.



Dagana District community members measuring water flow from the Drujeygang Irrigation Channel during field monitoring activities

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Component 3

Component 3 has enhanced land productivity and strengthened resilience of agricultural landscapes to climate change through implementation of SLM measures aimed at reducing erosion, landslides and drought impacts.

Structural measures included bench terracing, check dams, catch pits, trenches and contour hedgerows to control soil erosion and to manage water flows during extreme weather events. Vegetative measures such as vetiver grass and native species plantation were carried out to stabilize soils, reduce water run-off and facilitate water infiltration. In total, 174 ha of farmland have been brought under SLM, increasing resilience of both ecosystems and communities to climate change. Capacity-building activities and technical support for farmers and district staff, where 41 per cent of women participated, have improved the implementation and monitoring of SLM practices. Specifically, these techniques have enhanced soil moisture retention, reduced erosion and contributed to more resilient agricultural systems.

The component also supported expansion of the national Agrometeorological Decision Support System to the target districts, integrating sub-district weather forecasts and crop calendars. Since project inception, over 100 agrometeorological advisory bulletins for key crops grown in the target districts have been generated and disseminated through agricultural extension services across 13 sub-districts. Women represented 53 per cent of participants in awareness-raising events.

Component 4

Mechanisms to mainstream climate change adaptation and gender considerations into local governments systems have advanced under component 4. In 12 sub-districts, 117 local government officials were trained in adaptation planning, investment and mainstreaming tools. Training and sensitization sessions were also conducted on integrating gender, climate change, disaster risk reduction and poverty concerns into local development plans. These efforts are strengthening institutional capacity for inclusive and climate-responsive local planning, with further activities planned directly within target communities in the coming year.





Pipe network in the Paro Valley.

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KEY FEATURES OF THE PROJECT

Laying a solid foundation for sustainability

Strong community and government engagement from the onset of implementation has significantly strengthened long-term ownership, stakeholders' participation and financial planning, laying solid foundations for sustainability.

The project provided sub-districts and communities with financial packages to support both cash and in-kind contributions for the constructions of reservoirs, water catch pits and slope stabilization works, alongside technical guidance on climate-resilient water infrastructures. This approach supports the environmental, social and technical sustainability of Fund investments, while demonstrating shared responsibility and reinforcing the likelihood of long-term maintenance. The use of 30 years of hydrometeorological data in the districts informed the design of infrastructures, ensuring they can cope with climate change-related risks. Technical sustainability is also underpinned by the legal obligations of private contractors to comply with their warranties.

The project has begun handing over completed infrastructure to district administrations, which incorporated operation and maintenance costs into their annual budgets. In addition to demonstrating decentralized adaptation planning, this handover supported synergies with Fund interventions. In Paro, for instance, the Fund financed installation of the main 33 km drinking water transmission and distribution pipelines. At the same time, district and sub-district authorities constructed related reservoirs and household-level distribution networks. This joint investment illustrates shared ownership of Fund infrastructures, reinforcing both institutional and financial sustainability through local government engagement.

As WUAs are being revitalized and formalized, they are assuming greater responsibility in local water management schemes. These associations are expected to play a central role in the planning, operations and maintenance of water infrastructures, ensuring long-term governance sustainability at community level.

Project replication and scale up

The project has generated strong momentum for replication and expansion of Fund investments at both district/sub-district and national levels.

At district/sub-district levels, the project's integrated watershed management approach, successfully piloted in Dagana, where such an initiative took place for the first time, has drawn significant interest from local authorities.





Project beneficiaries accessing improved irrigation systems developed under the project in Dagana District.

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Project beneficiaries accessing improved irrigation systems developed under the project in Paro District.

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They now seek to replicate this model in other sub-districts.

At the national level, the Fund investments are being scaled up through a complementary initiative. The project, "Climate Adaptation, Resilience and Engagement in Local Governments (CARE-LG)," is funded by a USD 10 million grant from the Green Climate Fund (GCF) and is implemented by the Bhutan Trust Fund for Environmental Conservation (BTF). Building on lessons learned from the Fund project, this initiative will establish a grant facility to support 60 sub-districts in implementing nature-based solutions that enhance ecosystem services and community resilience.

The project has also informed the design of two major national initiatives. In the first, a Concept Note for a USD 35 million project to be implemented by the Food and Agriculture Organization of the United Nations (FAO) was recently submitted to the GCF. In the second, the Global Environment Facility (GEF) funded "Advancing Climate Resilience of Water Sector in Bhutan (ACREWAS)". The initiative, supported by a USD 8,932,420 grant and USD 25,132,000 of co-financing, will be implemented by the United Nations Development Programme (UNDP). The ACREWAS project aims to restore catchment areas; climate-proof small-scale water infrastructures in rural and peri-urban areas; and strengthen local government capacity to manage and maintain these systems in three districts, including Tsirang, a district already targeted by the Fund project.

As National Implementing Entity, BTF has also expressed interest in scaling up this project in close collaboration with the Designated Authority. It would do so through other Fund financing windows, including the regular single-country and regional ones, potentially associated with a scale-up grant, as well as the Innovation and Locally Led Adaptation (LLA).

Innovation through adaptive engineering

Although the main innovative output (# 2.3 "Innovative technology for tapping water") has yet to begin, innovation has been a defining feature of project implementation to date.

One such example is the adoption of International Standard Organization (ISO)-rated pipelines instead of the commonly used Indian Standard (IS), following an unsuccessful attempt with IS materials in steep terrain. Similarly, in Paro, the project opted for Ductile Iron (DI) rather than the conventional High-Density Polyethylene (HDPE) pipes. This engineering decision, informed by climate risks, ensures greater resistance to hydrostatic burst pressure and increasing risks from climate-induced forest fires. Conversely, HDPE pipes were used in remote, hard-to-reach



Students at Tsirangtoe Central School benefiting from the drinking water system developed in Tsirang District.

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areas due to their lighter weight and ease of installation, an appropriate and cost-effective solution in areas with limited road access.

The project also introduced the construction of small-scale reservoirs and check dams to capture monsoon run-off and provide a reliable source for irrigation during dry seasons. While common in water-scarce countries, this practice remains relatively new in Bhutan. It represents a significant innovation in climate-resilient water resource management.

Equally noteworthy has been the project's adaptive and incremental implementation approach: starting small and refining interventions based on field experience. This iterative learning process has fostered innovation and ensured that technical solutions remain responsive to local needs and on-the-ground realities.

Finally, the project also introduced a five-year community-led discharge monitoring programme that combines citizen science with hydrological data collection. This participatory feedback mechanism enables an assessment of the effectiveness of watershed rehabilitation measures; supports adaptive management; and generates valuable insights for future infrastructure design and water governance initiatives.

Social inclusion for effective project outcomes

The project has actively sought to mainstream gender equality and social inclusion throughout its design and implementation. This commitment is reflected in the deliberate engagement and representation of vulnerable groups, including women and persons with disabilities, in decision-making and benefit-sharing mechanisms.

Women have played a central role in consultations and implementation, accounting for at least 30 per cent of membership in WUAs; 41 per cent of participants in SLM trainings; and 53 per cent of participants in agrometeorological awareness-raising sessions. Notably, the project has involved women in leadership roles. In Paro, for example, the active engagement of a sub-district leader exemplifies the growing participation of women in local governance. Previously, three households shared a single water point in her sub-district. Now, water reaches every household. She anticipates that reduced time spent fetching water will enable women

to pursue livelihood and income-generating opportunities.

In Tsirang district, an awareness campaign and training programme on hygiene and sustainable water use has been planned under component 4. This complements the recently completed storage tank (250 cubic meters), osmosis filtration system and 30-km pipeline network that now provides drinking water to 700 students at Tsirangtoe School.

Traditional knowledge, cultural practices and local rituals have been integrated into community engagement processes, strengthening trust and social legitimacy. Functional grievance redress mechanisms established at district and sub-district levels have further ensured that community concerns are addressed promptly and equitably at relevant levels.

Building on these efforts will enhance the potential of achieving the project gender and inclusion targets by project completion.

Enhancing local adaptive capacity

Capacity development has been a central pillar of project implementation, pursued across all components to strengthen institutional, technical and community-level capacities for climate-resilient water and land management. Through targeted training, technical assistance and participatory learning, the project has fostered a strong foundation for sustained adaptive capacity in the targeted districts.

Across 12 sub-districts, 117 local government officials were trained on adaptation planning, investment and mainstreaming tools. In parallel, 32 engineers and technicians from the Department of Water were trained in design and management of climate-resilient water supply infrastructures. The same department also equipped community members with practical skills in water-discharge measurement, and in operating and maintaining both the drinking water and irrigation infrastructures constructed. This, in turn, strengthened local ownership and technical self-reliance.

Contractors and district engineers received hands-on guidance on environmental and safety compliance, leading to improvements in infrastructure standards and occupational safety practices. In addition, agricultural extension officers provided beneficiaries with agricultural inputs and trained 546 individuals in SLM techniques, enabling farmers to optimize productivity in newly irrigated areas.

At the broader project level, BTF intends to facilitate annual knowledge-sharing events to disseminate lessons learned across implementing partners.





Pipe network infrastructure and pressure valve installation in Dagana District.

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Risk management

The Implementing Entity applied its Environmental and Social Management System to ensure compliance with the Fund's Environmental and Social Policy (ESP) and Gender Policy (GP). An Environmental and Social Management Plan (ESMP) was developed during the design stage to monitor potential risks and guide associated mitigation measures.

During implementation, the ESMP was updated to address an unforeseen need for an access path road in Tsirang to install a critical section of the drinking water pipeline. Potential environmental and social risks and impacts were assessed and mitigation measures defined accordingly to ensure compliance with the ESP. A limited number of grievances were received and recorded, with the vast majority successfully resolved at the sub-district level. The remaining cases were expected to be resolved at district level, without having to be escalated to the Project Management Unit, the next level in line under the BTF Grievance Redress Mechanism.

From a broader project risk management perspective, preventive asset management has been actively pursued. Spare pipes were procured and strategically stored near project sites to enable timely replacement and minimize service disruptions in the event of a climate-induced network failure. In addition, during one of the regular field inspections, a cracked valve was detected along a gravity-fed section of the pipeline. The issue was promptly resolved through installation of a stronger valve, demonstrating effective technical oversight and adaptive management. In addition, the use of DI and HDPE pipes, selected according to site-specific exposures to climate risks such as forest fires and terrain accessibility, further reflects a tailored approach to minimizing climate vulnerabilities and ensuring long-term resilience of the infrastructures.

Financial and operational risks have been mitigated through continuous and smooth coordination among local and national stakeholders, supported by strong institutional commitment and ownership at all levels. This has helped to maintain momentum despite rising risks.



Project beneficiary from one of the project-supported communities in Paro District.

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LESSONS LEARNED

Direct access projects can catalyze access to climate finance:

Following its accreditation as a National Implementing Entity, BTF secured approval of a USD 25,000 Readiness Grant that enhanced its capacity to comply with the Fund's ESP and GP. This support proved instrumental not only during the design of this project, but also in managing emerging ESP-related risks and grievances during implementation. BTF also secured a Project Formulation Grant that facilitated development of a robust fully developed proposal, directly contributing to the project's approval by the Board. The experience and institutional capacity built through this process subsequently enabled BTF to secure additional resources, including a USD 250,000 innovation small grant, the endorsement of an LLA Concept Note, and the approval of a USD 10 million project from the GCF. Building on the lessons learned from the design and implementation of its first regular Fund project, BTF is now leveraging its capacity to further expand national access to climate finance and support accreditation of a second National Implementing Entity: the Royal Society for Protection of Nature.

Integrated, landscape-based approaches are essential for climate-resilient watershed management:

The project clearly demonstrates the value of strong integration across the water-agriculture nexus when intervening in watersheds exposed to climate change. Combining engineered structures (such as check dams, water reservoirs and irrigation systems) with ecosystem-based adaptation measures (including catch pits, trenches, contour hedgerows and erosion-controlling vegetation) generates lasting watershed benefits. When such interventions are embedded within appropriate landscape scales, supported by strong ownership from local and national authorities, they enhance both ecosystem and community resilience to climate change.

Voluntary additional financing strengthens ownership and sustainability:

Similar to the initiatives of UN Habitat in Lao and Malaysia and the UNDP-implemented initiative in the Western Balkans (all documented in the 2025 PMM reports), district and sub-districts provided both financial and in-kind contributions to the project through granting permits. This supported the operations and maintenance of infrastructures, and complemented Fund investments by providing household-level drinking water transmission systems in Paro. In-kind contributions for this project were estimated at USD 80,000. Such additional financing reinforces ownership of communities and government and increases the likelihood of sustainability.

Adaptive feedback loops strengthen implementation quality:

Flexibility in implementation proved essential to allow teams to address unforeseen technical challenges in real time. When a valve cracked along a pipeline section, rapid adaptive action enabled its replacement with a better suited model, preventing service disruption. Similarly, practices such as community-led discharge, monitoring and procurement of spare pipes for timely replacement demonstrated how embedding feedback loops into project design enhances responsiveness and technical reliability during implementation.

Integrated monitoring frameworks require synchronization:

The project's multilevel monitoring structure, spanning communities, sub-districts, districts and national-level institutions, has proven effective in tracking progress and ensuring transparency. However, different reporting timelines across levels have occasionally resulted in overlapping data collection and fragmented reporting.

Topographical constraints must inform technical design and procurement:

The project confirmed that steep slopes, dispersed settlements and limited road access significantly constrain the transport and installation of heavy construction materials such as pipes, concrete and reservoir components. Incorporating these logistical realities into technical designs, procurement specifications and contractor planning from the outset is critical to ensure adaptation interventions' cost efficiency, prevent implementation delays and ensure infrastructures are suited to their local contexts.

Early engagement and consultation with beneficiaries facilitate compliance with land rights:

Proactive engagement with local communities and landowners, conducted both during project preparation and at the onset of implementation, proved instrumental in ensuring compliance with formal and informal land rights. Early clearances from local authorities and landowners involved in Tsirang helped expedite construction of an access road and water pipelines. This approach established a foundation of mutual trust between BTF and local authorities, landowners and communities. Maintaining such participatory approaches throughout implementation has proven vital to align with local project interventions with land rights, while ensuring local ownership of project benefits.

Integrated adaptation interventions enhance both resilience and social cohesion:

Combining infrastructure investments with capacity-building and inclusive governance mechanisms has produced both environmental and social benefits. Communities reported tangible improvements in water access and agricultural productivity, along with reduced tensions and enhanced cooperation in managing shared resources. This synergy between physical assets and social processes underscores that resilience is as much about relationships as it is about infrastructure.



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SEE MORE ABOUT THE PROJECT HERE

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