



Outcome 2: Reduced risks of GLOF from Thorthormi Lake through an artificial lake level management system



Background

The most significant impact of climate change in Bhutan is the formation of supra-glacial lakes due to the accelerated retreat of glaciers with increasing temperatures. Glaciers in Bhutan are receding at a rate of 30-60 meters per decade. The melting ice from these receding glaciers is increasing the volume of water in glacial lakes, and the melting of ice-cored dams is destabilizing them, pushing the hazard risk for Glacial Lake Outburst Floods (GLOFs) to critical levels. The risk of potential disasters inflicted by GLOFs, pose new threats to lives, livelihoods and development. The risks are mounting as water levels in several glacier lakes approach critical geostatic thresholds.

A significant portion of the country's revenue, projected to 60%, is derived from hydropower, which has involved huge investments in infrastructure and requires sustainable water resources. Other sectors are also highly vulnerable to the adverse effects of climate change. Agriculture in Bhutan provides livelihoods and employment to 79% of the population. The majority of the people practice subsistence farming on small marginal land holdings which are extremely vulnerable to flood impacts.

Objective

As a follow up to the UNDP-supported National Adaptation Programme of Action (NAPA, 2006), Bhutan is currently implementing the first project funded by the Least Developed Countries Fund on Climate Change Adaptation titled "*Reducing climate change induced risks and vulnerabilities from glacial lake outburst floods*".

Outcome 2: "*Reduced risks of GLOF from Thorthormi Lake through an artificial lake level management system*" of the project takes a practical approach to reduce GLOF risks from Thorthormi Glacier Lake, one of Bhutan's most dangerous glacier lakes with a worst-case-scenario outburst projection as early as 2010.

The **goal** of the overall project is to enhance adaptive capacity to prevent climate change-induced GLOF disasters in Bhutan.

The **development objective** of the project outcome 2 is to reduce risks of GLOF from Thorthormi Lake through an artificial lake level management system.

Implementation

Project implementation started in 2008 and will continue until 2012.

Project outcome 2 is implemented by the Department of Geology and Mines (DGM), Royal Government of Bhutan. The UNDP Country Office in Bhutan is ensuring oversight, monitoring, evaluation and technical guidance, along with the Project Board (PB) and the Technical Support Advisory Team (TSAT) comprising of key stakeholders from the Royal Government of Bhutan and funding agencies.

Source of funding

- GEF-LDCF 3,445,050
- UNDP 396,224
- Government (in-kind) 2,680,000
- Austrian Development Agency 800,000
- WWF Bhutan 30,000

Achievements

Preparatory studies for the artificial lowering of Thorthormi glacial lake were carried out in 2008. Since 2009, a multidisciplinary team and approximately 350 workers have been working from July to October every year to drain water out of the lake to release the pressure on the moraine dam.

The practical approach to artificially lowering is simple and innovative. Since use of heavy machinery at the site would further destabilize the moraine dam of the glacial lake, the excavation work at Thorthormi Lake is done manually with simple tools and instruments to dig ice and remove boulders, thereby, creating a channel to drain out water. This approach, has provided income to more

than 350 local workers and contributes to local enterprise development through their savings.

The lowering of Thorthormi Lake has reduced water volume by 3.63m out of the expected target of 5m, decreasing the hydro-static pressure on the thinning moraine dam and thereby avoiding the earlier prediction of a GLOF event as early as 2010.

The artificial lowering of Thorthormi Lake is increasing safety for downstream communities and infrastructure. With a majority of Bhutan's population, economic activities and infrastructure development concentrated in large river valleys, climate-induced GLOFs could cause colossal human and economic devastations. The reduced risks of GLOFs will not only benefit vulnerable communities in the Punakha-Wangdue valley in Bhutan, but also communities that are located further down the river, such as the northern states of India.

Key challenges and lessons

Thorthormi Lake is located 9 days trek from the road, and therefore poses challenges related to transportation, equipment, and limited accessibility to the project as well as the health and safety of project staff and workers.

As a result of the limited accessibility to the work site - only 3-4 months a year because of extreme weather conditions - the project has gained experience in planning field work well in advance to optimize the working period and to maintain the interest and motivation of workers. No heavy machinery or vehicles could be used due to the mountainous terrain and high altitude. The artificial lowering is therefore carried out manually with simple tools and equipment. Since helicopter freight safety is not available in Bhutan, transportation of equipment and rations are done by hiring mules, horses and yaks. The project's use of these modes of transportation contributes to the economy of local yak- and horsemen.

Health risks associated with working conditions in the remote, high-altitude environment, combined with extreme weather conditions, led to three casualties (in the 2010 working season) - two of which were related to altitude sickness - despite

preventive measures such as medical screenings, briefings and the presence of medical staff during the trek and work site. The project implemented and strengthened various health and safety measures, such as strict pre-departure medical screenings, the purchase of high-altitude pressure bags and acclimatization stopovers including consultation with the project medical doctor to prevent altitude sickness.

Best practices

The involvement, ongoing cooperation and consistent support of stakeholders from different government departments to create appropriate adaptation measures have been crucial in the successful implementation of the project. Similarly, early consideration during project design involving district authorities and local communities, planning field work in advance, and recruitment of labor from a wide geographic range have benefitted project implementation.

Facing challenges related to a harsh, high-altitude working environment above 4,300 m. the multi-disciplinary team responsible for planning and carrying out the artificial lowering has established a strong partnership between various government agencies (Department of Geology and Mines, Ministry of Health, Departments of Forest and Park Services, and Department of Roads), the Royal Bhutan Army, central monastic body and district authorities. This partnership contributes not only to building the nation's capacity in artificial drainage design, but also to effective planning, conduct and monitoring of the workforce, including aspects of the environment, health and safety.

An Environmental Impact Assessment was carried out prior to the project. and Recommendations were made, among others, for waste management and collection of firewood as the project site falls under a protected area. An ecological footprint study has been recommended by the end of the project to assess the impact of the project, identify trade-offs and incorporate lessons learned for future projects.

Resources

<http://www.bhutanglofproject.gov.bt>
<http://www.undp-adaptation.org/project/glof/>



Austrian
Development Cooperation

