Artificial lowering of glacial lakes

Challenge: Too much water **Adaptation response:** Glacier lake outburst prevention

Description

Global warming is resulting in the world's glaciers melting at a rapid rate, filling glacial lakes and increasing the likelihood of outburst floods (GLOFs). Floods and mudslides caused by GLOFs can have devastating impacts on communities lying below the lakes, posing a threat to both lives and infrastructure.

The artificial lowering of glacial lakes is the process of draining water from those vulnerable to overflowing by digging a canal from the lake to a nearby river. Drainage reduces water level and decreases pressure on moraine dams. This in turn reduces the risk of burst events, which are increasingly likely as glaciers continue to melt.

Implementation

Implementation begins with a lake assessment to determine hazard potential that is usually carried out by a multidisciplinary team, including hydrological experts, geological experts and engineers. If a channel is warranted, the next step identifies a suitable excavation site. This may also include removal of the large boulders from the area. Rubble, loose rocks and turf are often used to build the channel walls. Construction typically requires heavy machinery, though in some cases manual labour is used avoid further wall destabilization. Regardless of the intervention scale, the lake's water level should be monitored continuously to minimize outburst flood risks. Early warning systems and disaster preparedness plans than include community awareness and trainings s can complement this work.

Environmental Benefits

- Reduces the risk of flooding and landslides, maintaining water storage capacity

Socioeconomic Benefits

- Protects people and infrastructure against the destructive (and expensive) effects of flooding and landslides.
- Avoids the need to undertake other risk management measures, such as the resettlement of nearby communities.

Opportunities and Barriers

Opportunities:

- Implementing it in coordination with flood early warning systems and awareness raising campaigns for local communities improves its effectiveness

Barriers:

- High cost technology
- Heavy machinery may further destabilize moraine lake dams, therefore making it a complex and high risk intervention
- Making changes to natural systems can have negative consequences elsewhere, for example. reducing water flow upstream can lead to shortages downstream
- It is costly and complex due to the limited accessibility of many glacial lakes and lack of regular monitoring in remote areas

Implementation considerations*

Technological maturity:	3-5
Initial investment:	2-5
Operational costs:	2-3
Implementation timeframe:	3-4

* This adaptation technology brief includes a general assessment of four dimensions relating to implementation of the technology. It represents an indicative assessment scale of 1-5 as follows:
Technological maturity: 1 - in early stages of research and development, to 5 – fully mature and widely used
Initial investment: 1 – very low cost, to 5 – very high cost investment needed to implement technology
Operational costs: 1 – very low/no cost, to 5 – very high costs of operation and maintenance
Implementation timeframe: 1 – very quick to implement and reach desired capacity, to 5 – significant time investments needed to establish and/or reach full capacity
This assessment is to be used as an indication only and is to be seen as relative to the other technologies included in this guide. More specific costs and timelines are to be identified as relevant for the specific technology and geography.

Sources and further information

ADB (2014). Technologies to Support Climate Change Adaptation. Asian Development Bank. Available at: https://www.adb.org/publications/technologies-support-climate-change-adaptation-developing-asia

CTCN (n.d.). Artificial lowering of a glacial lake. Climate Technology Centre & Network. Available at: https://www.ctc-n.org/products/artificial-lowering-glacial-lake

ICIMOD (2011). Glacial lakes and glacial lake outburst floods in Nepal. International Centre for Integrated Mountain Development, Kathmandu. Available at: http://www.icimod.org/dvds/201104_GLOF/reports/final_report.pdf

UNDP (n.d.). Reducing Climate Change Risks and Vulnerabilities from Glacial Lake Outburst Floods in Bhutan. United Nations Development Programme. Available at: http://www.undp.org/content/bhutan/en/home/ourwork/ccaadaptationanddrr/successstories/glofprevention.html

Matambo, S. and Shrestha, A. (n.d.). World Resources Report Case Study. Nepal: Responding Proactively to Glacial Hazards. World Resources Report, Washington DC. Available at: http://www.wri.org/our-work/project/world-resources-report/nepal-responding-proactively-glacial-hazards

Rana, B., Shrestha, A., Reynolds, J., Aryal, R., Pokhrel, A.and Budhathoki, K. (2000). Hazard Assessment of the Tsho Rolpa Glacier Lake and ongoing remediation measures. *Journal of Nepal Geological Society*, 2000, Vol. 22, pp. 563-570. Available at: www.reynolds-international.co.uk/uploads/files/rana-et-al-2000.pdf

Singh, S. M. (2009). The Cost of Climate Change: The Story of Thorthormi Lake in Bhutan. World Wildlife Fund. Available at: https://wwf.fi/mediabank/1047.pdf