

Young Researcher

Rejuvenating research among young aspiring minds

GLACIAL HAZARDS IN THE NEPAL HIMALAYAS

Nepal is rich in water resources because of its monsoon, snow-covered area, and a number of glaciers in the Himalayas. However, the hydrological responses of the snow-covered and glaciated zones are distinct from the other zones of Nepal. The water resource of Nepal is heavily dependent on monsoon dynamics and the state of the snow and glacier ice in the Himalayas. Climate change affects both monsoon dynamics and snow and glacier ice in the Himalayas. In addition to this, climate change is also responsible for the increasing number of glacial hazards recently in Nepal.

Glacier is a moving body of snow and ice that has been formed as a recrystallization of snow and a glacial lake is a lake that is formed by glacial activity. Glacial hazard includes any hazard in a glaciated region such as snow and ice avalanche, flash flood due to supraglacial lake draining, and rapid melting of snow and ice of a glacier, Glacial Lake Outburst flood (GLOF), ground subsidence due to rapid thawing of permafrost and heavy snowfall in a glaciated region, etc.

Many studies have shown retreat of glaciers, expanding existing glacial lakes and forming new lakes and altitude of a lower limit of permafrost are shifting upward in the Nepal Himalayas. There are 19 glacierized sub-river basins from east to west in which there are 3,808 glaciers and 2,070 glacial lakes in Nepal (Bajracharya et al., 2020). Total 47 glacial lakes in Nepal, Tibet, China, and India are classified as Potentially Dangerous Glacial Lakes to Nepal because if these glacial lakes are drained, the flood water will enter into Nepal and damage considerably. Out of 47 potentially dangerous glacial lakes in the Himalayas, 25 are in Tibet, China, 21 in Nepal, and 1 in India. This renders much of the infrastructure along the rivers originating from these lakes at immediate risk.

A 2011 study by ICIMOD reported 24 GLOF events in the past, 14 of which had occurred in Nepal, while 10 were caused by overflows due to flood surges across China (TAR)–Nepal border (ICIMOD, 2011). On 4 August 1985, a Dig Tsho GLOF event swept away three persons, one hydropower plant, 14 bridges, and 35 houses along the Dudh Koshi River. Table 1 shows major GLOF events since the 1980s that have caused damages in Nepal. Since GLOF events are increasing recently, in order to reduce the risk from such events again the Department of Hydrology and Meteorology, Government of Nepal has reduced the water level of Tsho Rolpa Glacial Lake in Dolakha district by 3 m in 2000 and that of Imja Glacial Lake in Solukhumbu district in 2016 by 3.4 m successfully.



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Table 1. GLOF events since the 1980s that have caused damages in Nepal.

S. No.	Date	River basin	Location
1	23 June 1980	Tamor	Nagma Pokhari
2	11 July 1981	Bhote Koshi	Cirenmacho Lake, Zhangzangbo Valley
3	4 August 1985	Dudh Koshi	Dig Tsho
4	12 July 1991	Tama Koshi	Chubung
5	3 September 1998	Dudh Koshi	Sabai Tsho (Tam Pokhari)
6	5 July 2016	Bhote Koshi	TAR, China
7	20 April 2017	Barun Valley	Near Lower Barun

In the recent past, also a few flash flood events in the glacierized river basins of Nepal are occurring mainly due to irregular monsoon activity and sudden warming epochs in some regions. Seti flash flood on 5 May 2012 due to snow, ice, and rock avalanche, a Glacial Lake Outburst Flood (GLOF) on 5 July 2016 in Bhotekoshi River in Tibet, China, and a flash flood on 20 April 2017 in Barun River are a few examples. Such events have increased the risk of glacial hazards, especially in the high mountain areas. Therefore, it is high time to monitor weather, snow, glaciers, glacial lakes of the high Himalayas by establishing suitable stations and need to install early warning systems in downstream of such glacierized river basins in Nepal.

Snow and weather monitoring stations at high altitudes will be also useful to analyze possible snow hazards and then flash floods in the downstream as such occurred in Seti River in Nepal on 5 May 2012, heavy rainfall resulting rapid melting of snow and ice from Chorabari Glacier in Kedarnath, India on 16 June 2013, heavy snowfall by Cyclone Hudhud on 13 October 2013 in the Annapurna region, Nepal, and the recent Chamoli flash flood in Uttarakhand in India on 7 February 2021 due to snow, ice, and rock avalanche. Since weather, snow, glacier, and glacial lake monitoring stations are very rare in the Nepal Himalayas, it is very high time to establish such stations across Nepal to reduce and prevent damages caused by glacial hazards in Nepal.

References:

Bajracharya, S. R., Maharjan, S. B., Shrestha, F., Sherpa, T.C., Wagle, N., Shrestha, A. B.(2020). Inventory of glacial lakes and identification of potentially dangerous glacial lakes in the Koshi, Gandaki, and Karnali River Basins of Nepal, the Tibet Autonomous Region of China, and India. Research Report. ICIMOD and UNDP.

ICIMOD (2011). Glacial lakes and glacial lake outburst floods in Nepal. Kathmandu: ICIMOD.

Understanding the spatial and temporal variation of streamflow in the headwater streams

Headwater streams are small and numerous capillaries of stream networks and comprise a significant portion of aquatic ecosystems. Headwaters are defined as a watercourse within the first 2.5 km of its furthest source, occurring over a range of climate, geology, hydrology, and biogeographical settings (Callanan et al., 2008). In contrast to downstream reaches, headwater streams are characterized by their close interactions with the hill slopes processes, more spatiotemporal variation, and their extra need for different means of protection from land use (Gomi et al., 2002). Headwaters streams are necessary for understanding and protecting downstream ecosystems as they are intimately linked. Given their importance and growing pressures on aquatic resources, understanding the drivers of headwater flow must be improved to facilitate wise land and water management decisions.

In the Kathmandu Valley (Valley), headwaters are mostly present in the outskirts of the developed areas and are near natural land uses. Headwaters are clean and pure and provide water to meet the domestic and irrigation demands of the population living in the Valley. The domestic water demand in the Valley was 415.5 million liters per day (MLD) in 2016, which is expected to increase to 540.3 MLD by 2021 (Udmale et al., 2016). To supply fresh water to the entire Valley population, Kathmandu Upatyaka Khanepani Limited (KUKL) has tapped headwater streams and springs into reservoirs. Regardless of their significance, headwater streams are underestimated and poorly managed compared to the downstream streams. These streams are channelized, diverted, polluted, and at worst destroyed. The headwaters should be conserved in order to sustain the downstream population.

Therefore, Smartphones for Water Nepal (S4W-Nepal) has started monitoring these headwater streams since 2018 by involving young researchers and citizen scientists. As a part of headwater stream monitoring, S4W-Nepal has been collecting hydrological data that includes stream water level, stream discharge along with their water quality of the 14 different headwaters of the Kathmandu Valley.

Figure 1 shows the monitoring sites of the S4W-Nepal. Every month, young researchers from S4W-Nepal perform United States Geological Survey mid-section method discharge measurements with a SonTek FlowTracker Acoustic Doppler Velocimeter and measure the water level from a staff gauge installed in the streams. Furthermore, they also collect few water quality parameters such as temperature, EC, pH, and TDS. All the data are recorded using an android application called Open Data Kit (ODK) Collect. S4W-Nepal intends to increase its stream monitoring network in the future by involving a greater number of citizen scientists.

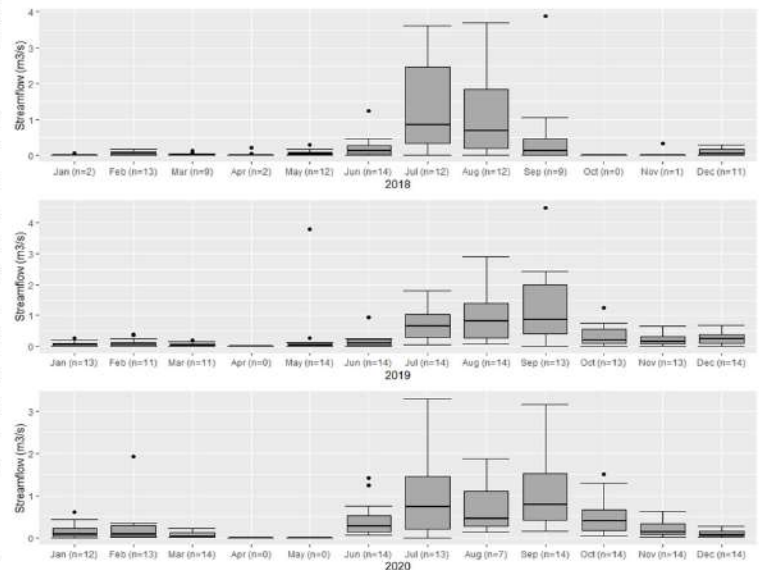


Figure 2: Boxplot showing flow dynamics of all headwaters of the Kathmandu Valley from (2018 - 2020)

The trend in the streamflow of the headwaters was almost identical in all three years. Kathmandu Valley receives 80% of total annual rainfall within the monsoon season i.e. June-September. As per the data, streamflow in the headwaters gradually increases with the onset of the monsoon in all three years. The streamflow in the headwater streams ranged from 0.00079 to 4.4487 m³/s.

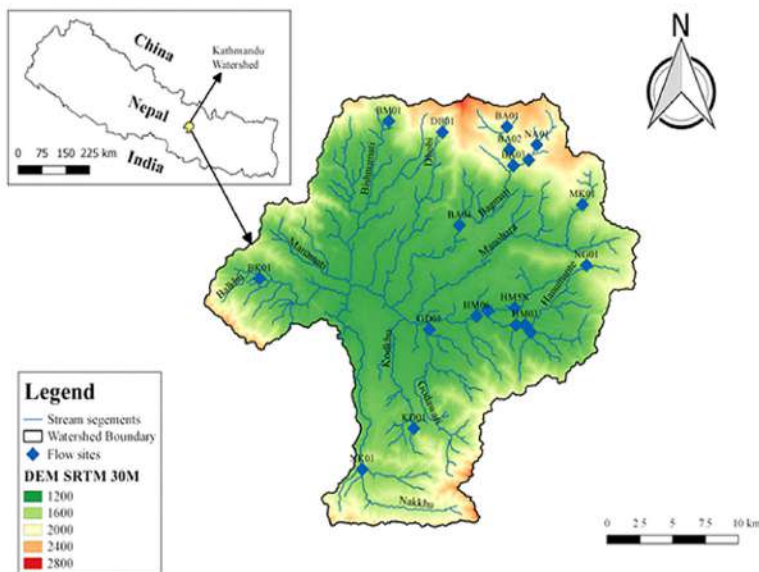


Figure 1: Study area watershed showing streamflow measurement sites

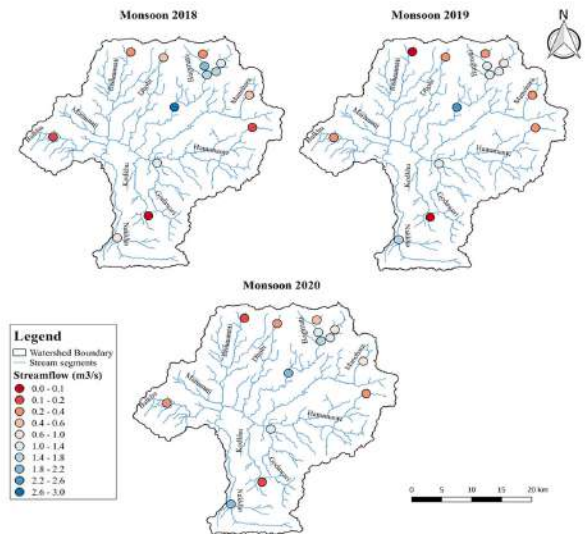


Figure 3: Spatial map showing a comparison of the average monsoonal streamflow in the headwaters streams of Kathmandu Valley from 2018-2020

The spatial map suggests that the streamflow was observed to be very low in the Kodku and Bishnumati streams, even during the monsoon season which corresponds to their smaller catchment area while in Nakkhu and Bagmati streams, it was found to be higher comparatively which corresponds to their larger catchment area. Furthermore, it can also be deduced that the streamflow was comparatively higher in 2018 in most of the sites from the above map.

Hence, understanding the omission of the headwaters in different conservation programs and various integrated water management strategies in the Valley, wise and timely attempts should be made to draw the attention of the concerned authorities. Furthermore, the hydrological data generation of these streams should be continued.

References

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Citizen Scientist's Story

Namaste! I am Shrena Shrestha from Gatthaghar, Bhaktapur. I am currently studying Environmental Science (first year) at Khwopa College, Dekocha, Bhaktapur. I came to know about S4W-Nepal from an outreach event conducted at my college. I became a Citizen Scientist through that outreach event and since then, I have actively been engaged with S4W-Nepal. I have been sending regular daily precipitation measurement data for about a year now. Talking about the data collection, I find the use of the mobile application Open Data Kit (ODK) very convenient and time-saving. I was also awarded as "CITIZEN SCIENTIST OF THE YEAR 2020" of the S4W-Nepal monsoon expedition for sending regular and accurate daily precipitation measurements.

I am fascinated by the citizen science approach of S4W-Nepal and its creativity in making the best use of smartphones. I like the way they update us on our collected data every week via SMS and motivate us to get involved even more actively. After monitoring rainfall for a year, I have learned several things, specifically about water resource management. It has also made me more aware and responsible towards the environment. Besides that, I really appreciate the concept of reusing plastic bottles for making a cost-effective rain gauge. I believe that the work of S4W-Nepal would be more fruitful if youngsters and local people outside the Valley are also approached through similar outreaches. Lastly, I am very glad to be a part of S4W-Nepal and I encourage everyone to get involved in the various campaigns conducted by S4W-Nepal.

88 species of Birds counted at Barekot

Barekot rural municipality in Jajarkot is found to be home to various species of rare birds. During a study that was conducted on the community forests located at an altitude from 1,891 to 2,309 meters, the presence of 88 species of birds was recorded. Bearded vulture (*Gypaetus barbatus*), himalayan griffon (*Gyps himalayensis*), black eagle (*Ictinaetus malaiensis*), kalij pheasant (*Lophura leucomelanos*), crested serpent eagle (*Spilornis cheela*), and so on were found at Barekot-based community forests, said Bhupal KC of Red Panda Network. Barekot is rich in biological diversities and the study spanned for three days. The bird survey was economically assisted by the network and was held in partnership with the Danfe Youth Club.



March 3

<https://risingnepaldaily.com/detour/88-species-of-birds--counted-at-barekot>

Over 10 million displaced by climate disasters in six months

A humanitarian organization on 17th March mentioned that about 10.3 million people were displaced by climate change-induced events such as flooding and drought in the last six months. The majority of the people displaced belonged to Asia (60%). In addition, during the same period of time, 2.3 million people were displaced by conflict. Although the data are based on a six months period, it clearly reflects the accelerating global trend of climate change-related displacement, said Helen Brunt from Asia Pacific Migration and Displacement Coordinator. It was also reported by McKinsey and Consulting firm that Asia stands out as being more exposed to physical climate risks than other parts of the world. Furthermore, more than 1 billion people are expected to face forced migration by 2050 due to conflict and ecological factors, as per a report by the Institute for Economics and Peace found last year.

March 17

<https://thehimalayantimes.com/environment/over-10-million--displaced-by-climate-disasters-in-six-months-report>

Green Banking

There has been enough discussion about green banking across the globe, but the concept has yet to find mass approval. Green banks could be of great help in reducing perceived financing risks, financing underserved markets, attracting international investment, meeting national renewable energy targets, and ensuring commitments to international climatic change deals. Green banking is not just about reducing carbon-emitting equipment, it deals with a green mortgage and green loans, too. Green banking also means the use of credit cards and debit cards, mobile banking, internet banking, recycling, and reducing paper usage. Mobile banking is getting popular in Nepal. Third-party apps like E-Sewa, Connect IPS, etc. are also promoting green banking by reducing over-the-counter transactions. The use of QR codes across the nation for payment will be the next way.

April 7

<https://thehimalayantimes.com/blogs/green-banking>

Women moving Nepal's climate activism

A generation ago, 'climate change' was a foreign term in Nepal and there was very little understanding or awareness of it in the media and in society. Climate change is known to impact women in remote, rural areas more severely, but little



knowledge or awareness is available to those regions in terms of how they can combat its impact. This saddened Bindu Bhandari, a student of veterinary science, Bhandari began to see the linkages between climate change and what she was studying and it made her think about Nepal's position as one of the most vulnerable countries to the global impact. Shilshila Acharya is with the Himalayan Climate Initiative (HCI), which reaches out to young people. She has engaged in education and engagement activities related to youth in climate issues through three to five-day courses on climate change in different parts of Nepal, reaching more than 1,100 students so far. Sagarika Bhatta, who founded Power Shift Nepal, often leads such public campaigns. Educational programs about the relationship between climate change, city, gender, mountain, and agriculture are some of the areas of their work. With young women in urban centers stepping up activism and awareness, there is newfound hope that their work will help spread understanding on the issue.

March 3

<https://www.nepalitimes.com/banner/women-moving-nepals--climate-activism/>

Extinction: Elephants driven to the brink by poaching

The decline over decades of the African forest elephants and Savanna elephants number have driven the two species into the highest categories of extinction threat. The Integrated Union for the conservation of Nature



(IUCN) revealed that the African elephants are now critically endangered. IUCN estimates that 415,000 elephants remain in Africa. But, the population of African elephants has declined by more than 86% in the last three decades while the savanna elephants have declined by at least 60 % over the past five decades. Dr. Ben Okita, who co-chairs the IUCN elephant specialist group, called the latest assessment an "alarm bell". He mentioned that a high level of attention is required as poaching activities, land degradation, and fragmentation are the silent killer of these giant mammals.

March 25

<https://www.bbc.com/news/science-environment-56510593>

Water should not be judged by its history, but by its quality.

- Dr. Lucus Van Vuuren

Third of Antarctic ice shelf area at collapse risk due to global warming

If the global temperature reaches four degrees Celsius above pre-industrial levels, then around half a million square kilometers including 67% of ice shelf areas on the Antarctic Peninsula would be at risk of collapsing into the sea. It has been noted that limiting temperature rise to two degrees Celsius rather than four degrees Celsius would halve the area at risk and potentially avoid significant sea-level rise. One of the four ice shelves that are particularly threatened by warmer climate is Larsen C. Ella Gilbert, one of the prominent researchers, who has said that if the temperatures continue to rise at current rates, we may lose more Antarctic ice-shelves in the future.

April 9

<https://economictimes.indiatimes.com/news/environment/global-warming/third-of-antarctic-ice-shelf-area-at-collapse-risk-due-to-global-warming/articleshow/81982936.cms>

67 vultures found dead in Parasi

33 white-rumped vultures (*Gyps bengalensis*), 31 Himalayan griffons vultures (*Gyps himalayensis*), two cinereous vultures (*Aegypius monachus*), and one slender-billed vulture (*Gyps tenuirostris*) were found dead at Jitpur of Ramgram Municipality Ward No. 4 in Nawalparasi (West) near a local pond. Meanwhile, the remains of two dogs were also found where the vultures were lying dead. The carcasses were found near the vicinity which led the locals to believe that the dogs had been fed poison-laced food. The municipality, however, said it was unaware of the killing of the stray dogs, as the local unit has not launched any program to manage stray dogs and urges police investigation on the matter. "The death of 67 endangered vultures is a huge loss for vulture conservation. Proper investigation and study should be conducted to avert such a tragedy in the future", says an environmental conservationist.

April 21

<https://kathmandupost.com/province-no-5/2021/04/21/as-many-as-67-vultures-found-dead-in-jitpur>



**S4W-Nepal
MONSOON
EXPEDITION
2021**

S4W-Nepal Monsoon Expedition 2021 is a citizen science project that starts from May to September 2021. Through this expedition, we aim to generate spatio-temporal rainfall data across Nepal mostly focused on Kathmandu, Pokhara, Hetauda, Dharan, Biratnagar, and Chitwan and share the gathered information to the public through <http://data.smartphones4water.org/>.

Citizen Science occurs when ordinary people like you help to conduct real scientific research. By participating, you can contribute to our understanding of our world and make it a much better place.

Education



Learn about the water resources of Nepal while contributing.

Networking



Get connected with like-minded research loving people

Fun



Win exciting gift hampers through Weekly Photo Contest and Citizen Scientists of the Month

A few ways you can participate:

You don't have to have an advanced degree to contribute, and it's something that you can do in your spare time. All you need is a smartphone and two minutes per day.



Install ODK Collect from play store and a local rain gauge in your roof and start measuring the rainfall



Become a S4W-Nepal Ambassador: be involved in recruiting citizen scientists in your network



"You can't manage a resource, you don't measure"

- Lord Kelvin

S4W-Nepal 

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Nothing is softer and flexible than water, yet nothing can resist it. - Lao Tzu