GLACIERS IN THE UPPER GANGA BASIN

The Upper Ganga Basin (UGB) in the Indian Himalaya contains a significant concentration of glaciers that form the headwaters of the Ganga River system. Major glaciered regions occur within the Bhagirathi-Alaknanda, Yamuna, and Ghaghara sub-basins, which together sustain important Himalayan river networks.

Among these, the Bhagirathi-Alaknanda basin contains the largest number and area of glaciers, with about 645 glaciers covering nearly 1,984 km². This region includes several well-known valley glaciers such as Gangotri, Satopanth, Pinder, Doodh Ganga, Khatling and Chorabari, which play an important role in regulating river discharge and maintaining perennial flow in the Bhagirathi and Alaknanda rivers before their confluence at Devprayag.

The Ghaghara basin hosts approximately 271 glaciers with a glacierized area of about 729 km², while the Yamuna basin contains around 52 glaciers covering nearly 144 km². In terms of basin extent, the Bhagirathi-Alaknanda basin covers about 18,718 km², followed by the Yamuna basin (~7,511 km²) and the Ghaghara basin (~5,825 km²).

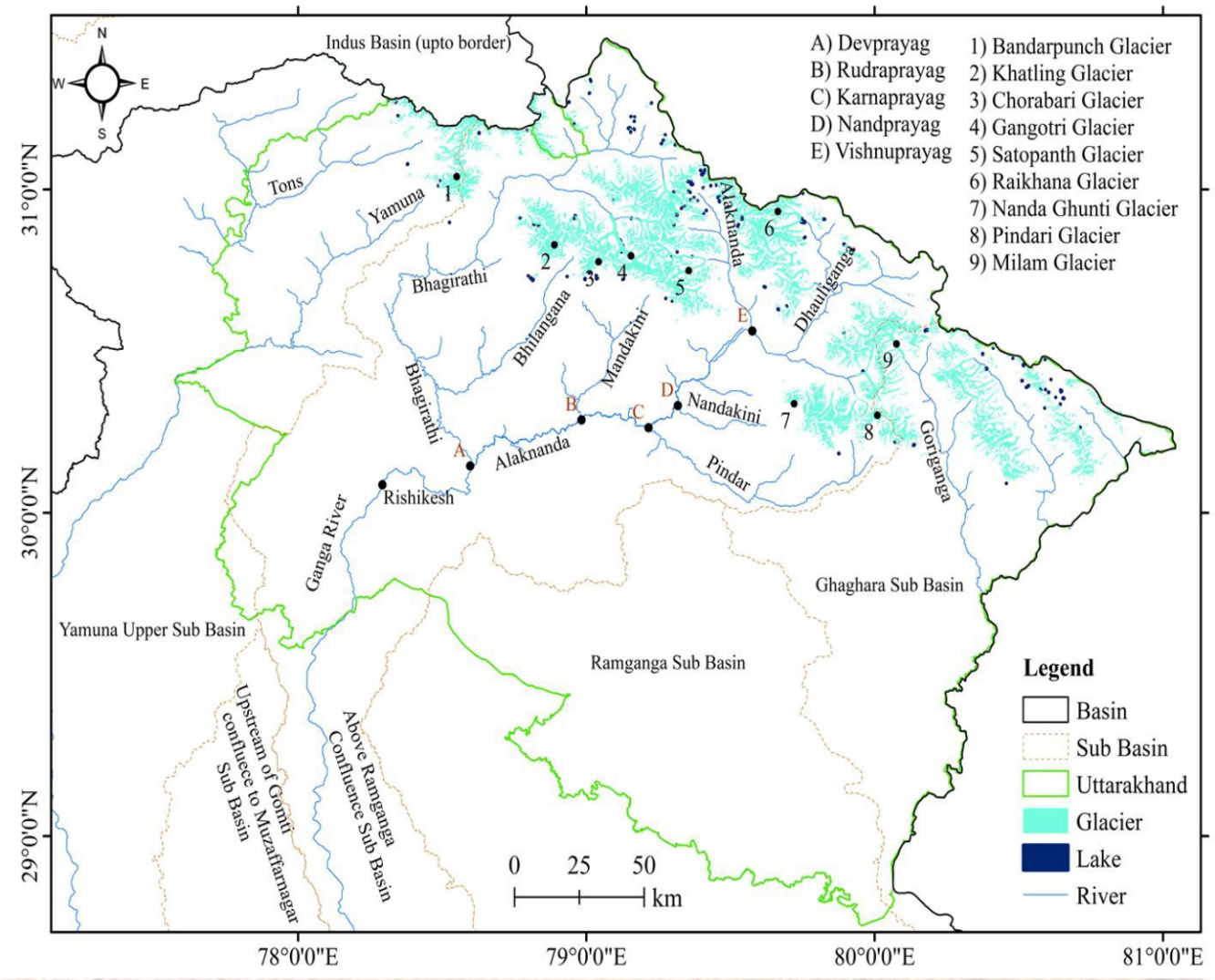
Glaciated area percentages indicate that glaciers occupy roughly 11-12% of the Bhagirathi-Alaknanda and Ghaghara basins, whereas the Yamuna basin has a comparatively smaller glacier cover (~2%). Numerous high-altitude glacial lakes are also present, particularly in the Bhagirathi–Alaknanda basin, which contains 118 lakes, compared to 22 lakes in the Ghaghara basin and 9 lakes in the Yamuna basin.

These glaciers occur across a wide elevation range, extending from about 312 m to 7,801 m above sea level, highlighting the complex topographic and climatic conditions that govern glacier distribution in the Upper Ganga Basin. Valley glaciers dominate the Upper Ganga Basin, including major glaciers such as Gangotri, Satopanth, Pindari and Milam that occupy well-defined mountain valleys.

Key Points:

- Bhagirathi-Alaknanda basin hosts the largest glacier concentration in the Upper Ganga Basin.
- Glacier coverage exceeds 10% in the Bhagirathi-Alaknanda and Ghaghara basins.
- More than 100 glacial lakes occur in the Bhagirathi-Alaknanda basin, indicating active glacier-lake systems.
- Glaciers occur across a wide elevation range (~3,200-7,800 m) reflecting strong altitudinal control on glacier distribution.
- Gangotri and Milam glaciers are among the largest valley glaciers of the Upper Ganga Basin, serving as major sources of the Bhagirathi and Goriganga rivers, respectively.

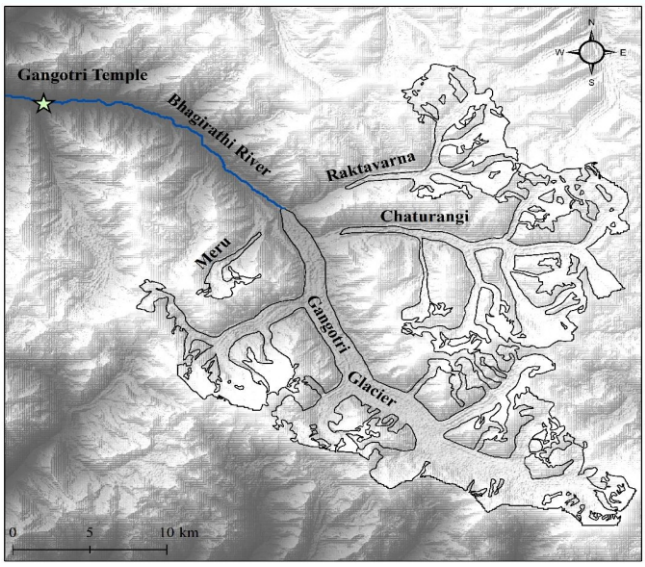
GLACIERS IN THE UPPER GANGA BASIN



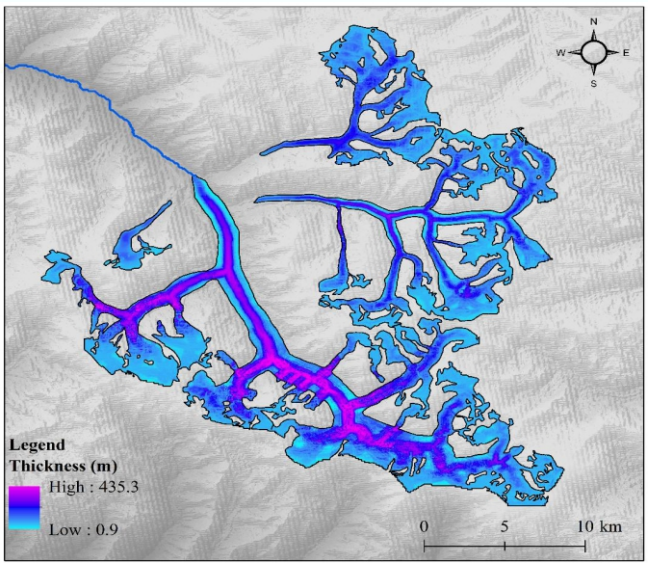
Basin	Bhagirathi & Alaknanda Basin	Yamuna Basin	Ghaghara Basin
No. of Glaciers	645	52	271
Glacier Area (km^2)	1,984	144	729
Basin Area (km^2)	~18,718 (upto Devprayag)	~7,511 (upto Dakpathar)	~5,825 (upto Jauljibi)
Glaciated Area (%)	~11	~2	~12
No. of Lakes	118	9	22
Elevation Range (m)	312-7,801	453-6,271	590-7,320

"Safeguard the glaciers of the Ganga Basin, for they are the first heartbeat of the Ganga"

GANGOTRI GLACIER



Gangotri Glacier Boundary



Gangotri Glacier Thickness

The Gangotri Glacier, located in the Uttarkashi District of Uttarakhand, stands as the largest glacial system in the central Himalayas and the primary source of the Bhagirathi River.

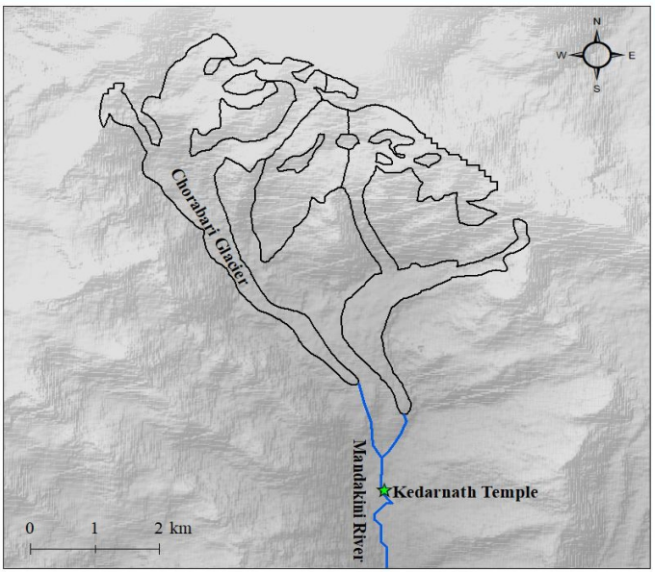
The Gangotri Glacier serves as the perennial headwater for the Bhagirathi River, providing a consistent meltwater base that sustains the hydrological regime of the entire Upper Ganga basin. This massive valley-type glacier extends approximately 30 km in length, with a total main glacier area estimated between 134-140 km². It originates in a high-altitude cirque near the Chaukhamba peaks at an elevation of roughly 7,000 m, descending to its terminus at Gaumukh, situated at approximately 4,100-4,200 m.

The Gangotri Glacier system is fed by major tributary glaciers such as the Chaturangi (63.07 km^2), Raktvarna (30.46 km^2), and Meru (4.29 km^2). Scientific monitoring, including recent studies confirmed that the glacier has been in a state of continuous retreat since 1950. The Gangotri Glacier receded by approximately 20 m yr^{-1} between 1935 and 2022.

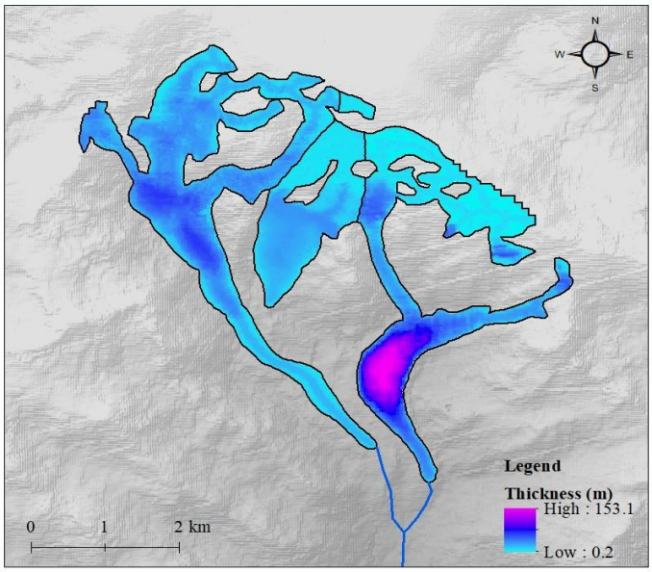
Key Features of the Gangotri Glacier

Parameters	Description
Type	Valley Glacier
Location	30° 47' 43.44" N, 79° 09' 18.71" E
Approximate Length (km)	~30
Approximate Main Glacier Area (km^2)	~134
Mean Glaciation level (m)	~5,120
Terminus Elevation (m)	~4,085

CHORABARI GLACIER



Chorabari Glacier Boundary



Chorabari Glacier Thickness

The Chorabari Glacier, located in the Rudraprayag District of Uttarakhand, is a medium-sized compound valley-type glacier but hydrologically significant glacier in the central Himalayas. It lies in close proximity to the sacred pilgrimage site of Kedarnath Temple and forms an important source of the Mandakini River.

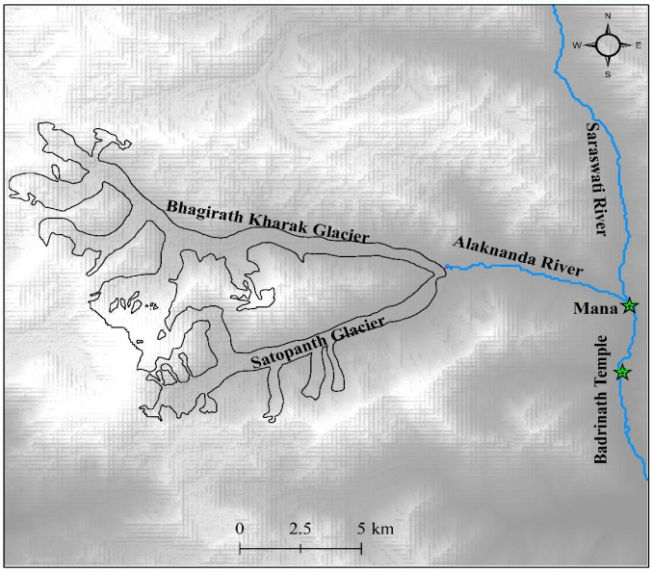
The Chorabari Glacier acts as a perennial source of meltwater for the Mandakini River. This valley-type glacier extends approximately 6-7 km in length, with a glacierized area of 6-7 km². The glacier originates from the high-altitude snowfields and cirques surrounding Kedarnath Peak and Kedar Dome, at elevations exceeding 6,500 m, and descends to its snout near Chorabari Tal at an elevation of approximately 3,800-3,900 m above sea level.

Changes in the glacier and the associated Chorabari Tal have also been linked to hydrological hazards, including the catastrophic flood event in the Mandakini valley during the 2013 Kedarnath floods. Long-term average retreat rate of the Chorabari Glacier has increased significantly from 6.4 (1962-2003) to 9.3 m yr^{-1} (2003-10).

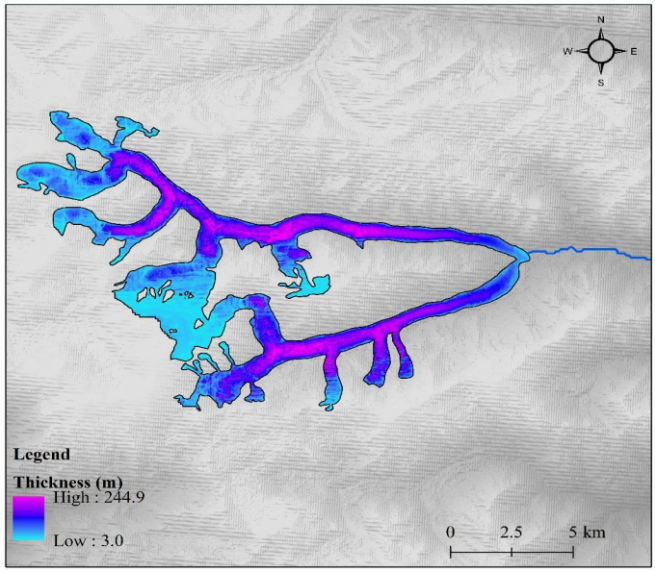
Key Features of the Chorabari Glacier

Parameters	Description
Type	Valley Glacier
Location	30° 46' 37.20" N, 79° 02' 34.08" E
Approximate Length (km)	~6.9
Approximate Main Glacier Area (km^2)	~6.3
Mean Glaciation level (m)	~ 5,190
Terminus Elevation (m)	~3,851

SATOPANTH GLACIER



Satopanth Glacier Boundary



Satopanth Glacier Thickness

The Satopanth Gglacier, located in the Chamoli District of Uttarakhand, represents one of the major glacier systems in the central Himalayas and forms an important headwater source of the Alaknanda River. The glacier system is closely associated with the nearby Bhagirathi-Kharak Glacier.

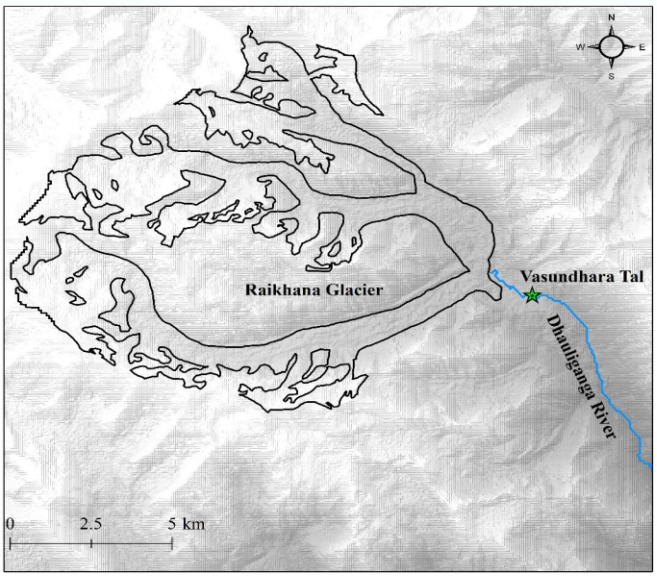
The Satopanth Glacier functions as a perennial source of meltwater that contributes significantly to the hydrological regime of the upper Alaknanda basin. This valley-type glacier extends approximately 13-14 km in length, with a total glacierized area of 19-20 km². The glacier originates from the high-altitude cirques and snowfields surrounding the Chaukhamba Peak at elevation exceeding 6,500 m, and descends to its snout near Mana village at an elevation of approximately 3,900-4,000 m above sea level. The glacier is located close to the sacred pilgrimage site of Badrinath Temple, which lies downstream along the Alaknanda River.

The Satopanth Glacier showed an average retreat rate of approximately 4.8 m yr^{-1}, while the Bhagirathi-Kharak Glacier exhibited an average retreat rate of approximately 3.7 m yr^{-1} during the period 1968-2017.

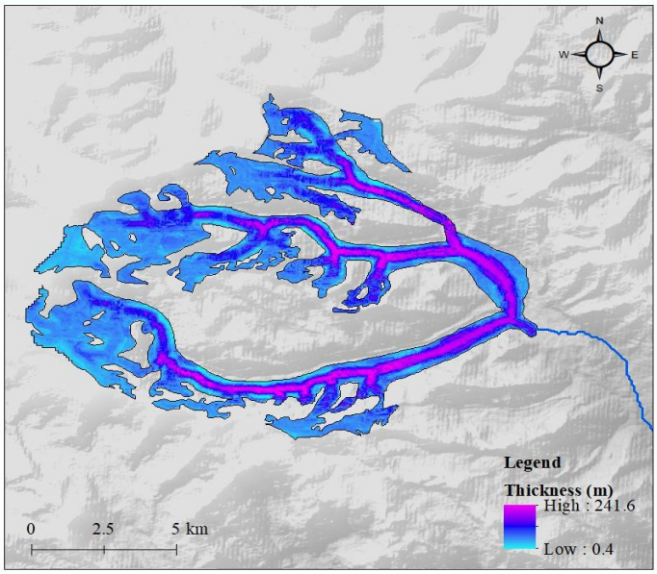
Key Features of the Satopanth Glacier

Parameters	Description
Type	Valley Glacier
Location	30° 44' 57.84" N, 79° 21' 19.44" E
Approximate Length (km)	~13
Approximate Main Glacier Area (km^2)	~19
Mean Glaciation level (m)	~ 4,950
Terminus Elevation (m)	~3,918

RAIKHANA GLACIER



Raikhana Glacier Boundary



Raikhana Glacier Thickness

The Raikhana (or Raykana) Glacier, located in the Chamoli District of Uttarakhand, is an important glacier in the upper Dhauliganga River basin of the central Himalaya. The glacier contributes meltwater to the Dhauliganga River, which eventually joins the Alaknanda River. The glacier lies in the high-altitude region near Vasudhara Tal, a glacial lake situated close to the Indo-Tibetan border.

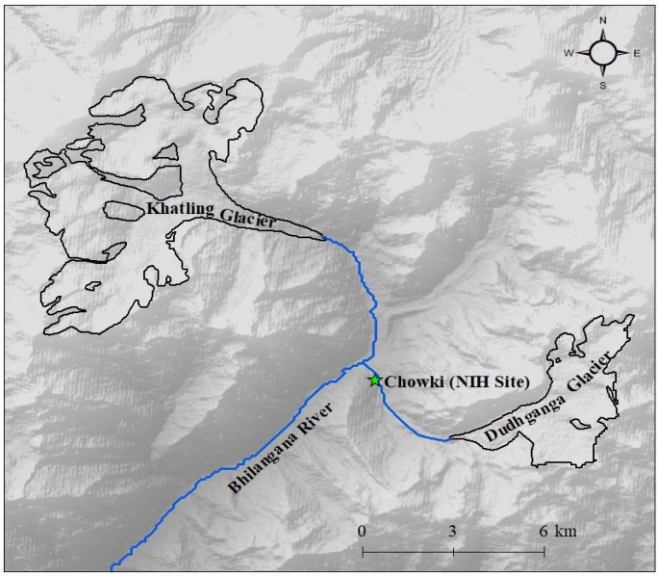
The Raikhana Glacier functions as a perennial source of meltwater that helps sustain the hydrological regime of the upper Dhauliganga basin. This valley-type glacier extends approximately 17–18 km in length, with an estimated glacierized area of 58-60 km². The glacier originates from high-altitude accumulation zones of the Kamet peak at elevation exceeding 7,000 m above sea level, and descends to its snout at an elevation of approximately 4,600-4,800 m.

The Raikhana Glacier has showed noticeable retreat in recent decades, with an average retreat rate of approximately 7.19 m yr^{-1} during the period 1968-2016.

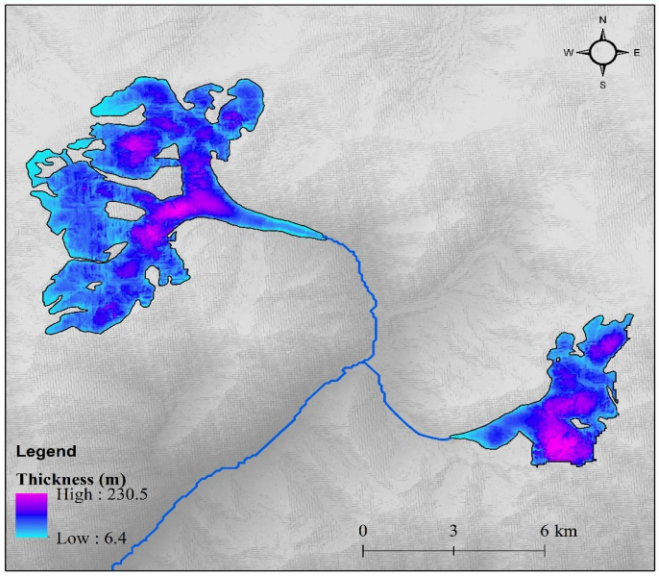
Key Features of the Raikhana Glacier

Parameters	Description
Type	Valley Glacier
Location	30° 55' 56.64" N, 79° 39' 52.93" E
Approximate Length (km)	~17
Approximate Main Glacier Area (km^2)	~59
Mean Glaciation level (m)	~ 5,230
Terminus Elevation (m)	~4,720

KHATLING GLACIER



Khatling Glacier Boundary



Khatling Glacier Thickness

The Khatling Glacier, located in the Tehri Garhwal District of Uttarakhand, is one of the prominent glaciers of the central Himalayas. It lies in the upper catchment of the Bhilangana River, which later joins the Bhagirathi River. The glacier system is also associated with the nearby Dudhganga Glacier.

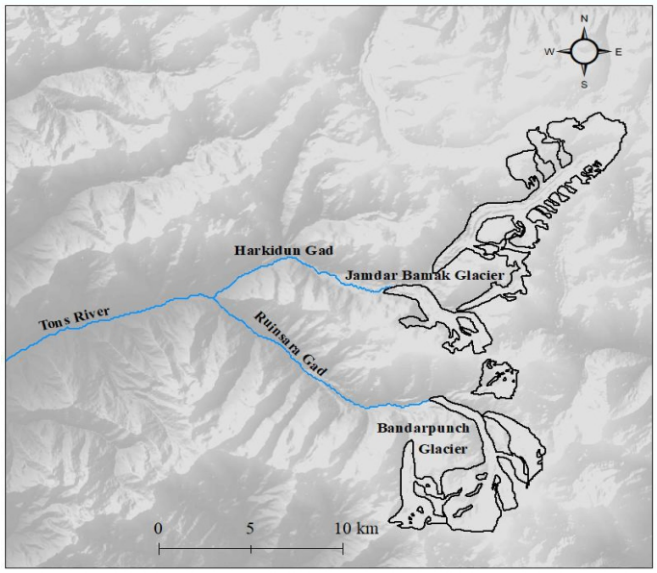
The Khatling and Dudhganga glacier serves as a perennial source of meltwater for the Bhilangana River, contributing significantly to the hydrological regime of the Bhagirathi basin. This valley-type glacier extends approximately 10-11 km in length, with a glacierized area of about 31-32 km². The glacier originates from high-altitude accumulation zones near the Jogin Peak at elevation exceeding 6,300 m above sea level, and descends to its snout at an elevation of roughly 4,000-4,100 m.

The total recession of Khatling Glacier measured along the central flow line of the glacier showed that the glacier snout receded between 1965 to 2014 is 31 m yr^{-1}. Most of the debris-covered glaciers in this valley exhibited a significant rate of retreat in the last two decades.

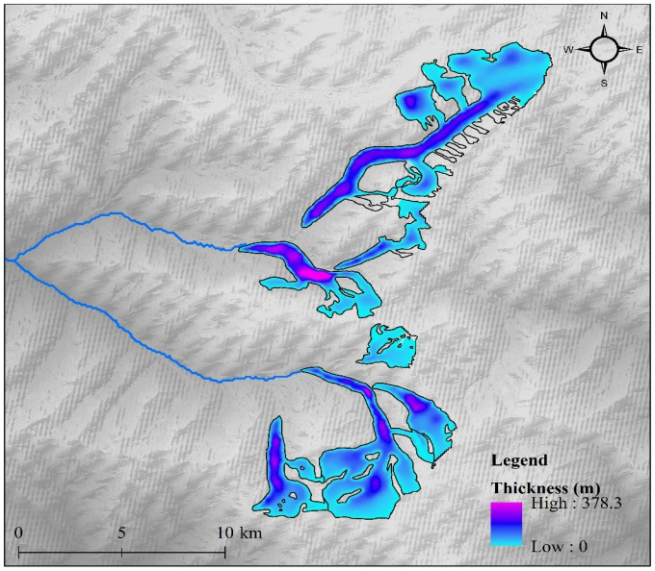
Key Features of the Khatling Glacier

Parameters	Description
Type	Valley Glacier
Location	30° 49' 45.12" N, 78° 53' 22.93" E
Approximate Length (km)	~10
Approximate Main Glacier Area (km^2)	~32
Mean Glaciation level (m)	~ 5,070
Terminus Elevation (m)	~4,082 m

BANDARPUNCH GLACIER



Bandarpunch Glacier Boundary



Bandarpunch Glacier Thickness

The Bandarpunch Glacier, located in the Uttarkashi District of Uttarakhand, is one of the important glaciers of the central Himalayas. It lies in the upper catchment of the Yamuna River basin and forms a significant source of the Tons River.

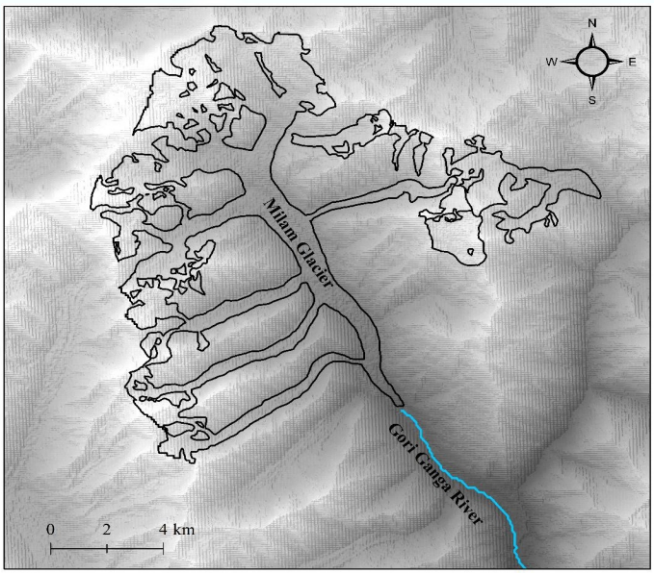
The Bandarpunch Glacier functions as a perennial source of meltwater that contributes to the hydrological regime of the upper Yamuna basin. This valley-type glacier extends approximately 12-13 km in length, with a glacierized area of about 29-30 km². The glacier originates from the high-altitude snowfields and cirques surrounding the Bandarpunch Peak at elevations exceeding 6,200 m above sea level, and descends to its terminus at an elevation of approximately 3,700-3,800 m.

The Bandarpunch Glacier has exhibited significant retreat over the past several decades. Scientific monitoring and recent studies confirm that the glacier has been in a state of continuous recession. Observations indicate that the glacier retreated at an average rate of approximately 25.5 m yr^{-1} between 1960 and 1999.

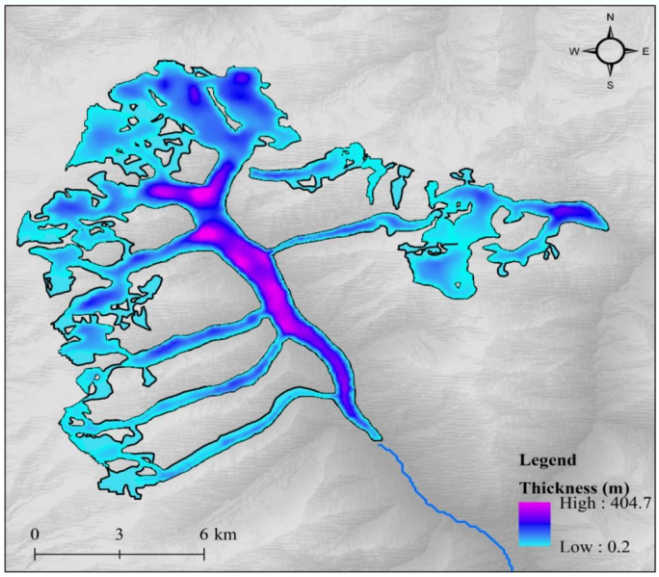
Key Features of the Bandarpunch Glacier

Parameters	Description
Type	Valley Glacier
Location	31° 02' 24.00" N, 78° 33' 03.61" E
Approximate Length (km)	~13
Approximate Main Glacier Area (km^2)	~30
Mean Glaciation level (m)	~ 5,230
Terminus Elevation (m)	~3,750

MILAM GLACIER



Milam Glacier Boundary



Milam Glacier Thickness

The Milam Glacier is located in the Munsiyari Valley in the Pithoragarh district of Uttarakhand. It is one of the largest glaciers of the Kumaon Himalaya and lies in the upper catchment of the Gori Ganga River, which later joins the Kali River along the Indo-Nepal border.

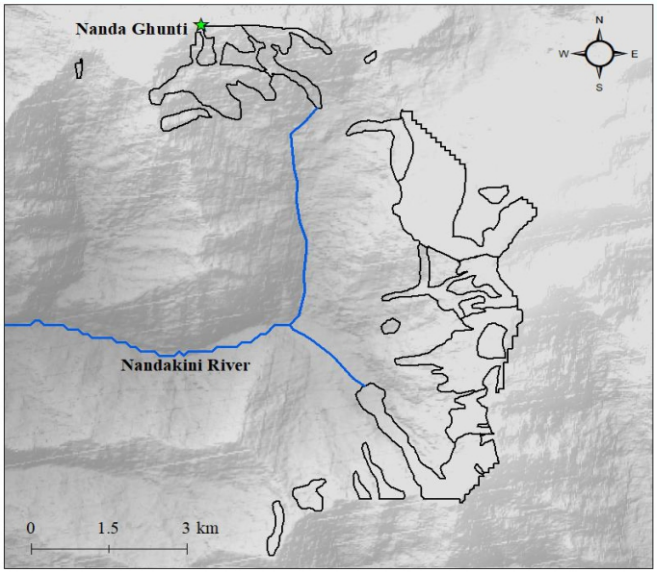
The Milam Glacier serves as a perennial source of meltwater for the Gori Ganga River and plays a significant role in sustaining the hydrological regime of the eastern Himalayan river systems. This valley-type glacier extends approximately 15-16 km in length, with a glacierized area of about 55-60 km². The glacier originates from high-altitude snowfields and cirques at elevations exceeding 6,500 m above sea level, and descends to its snout at an elevation of around 3,600-3,700 m, forming an extensive glacial valley system.

Long-term observations indicate that the Milam Glacier has experienced significant retreat over the past several decades. During the last 70 years, the Milam Glacier has showed an average recession rate of approximately 20.90 m yr^{-1}.

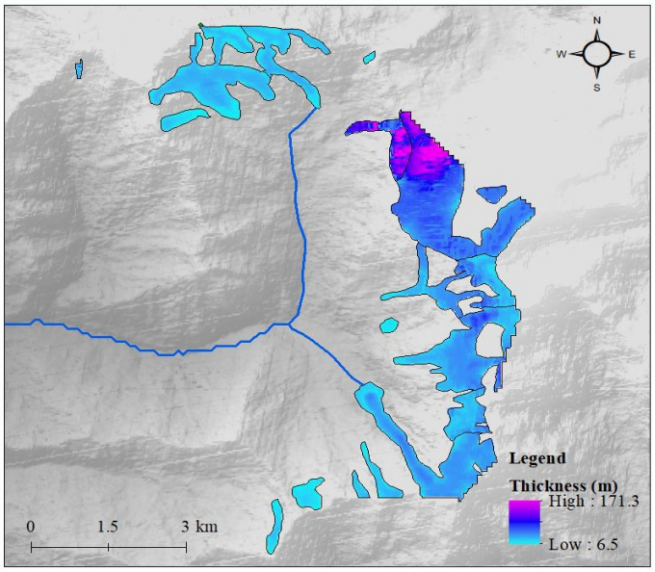
Key Features of the Milam Glacier

Parameters	Description
Type	Valley Glacier
Location	30° 31' 22.08" N , 80° 04' 33.23" E
Approximate Length (km)	~16
Approximate Main Glacier Area (km^2)	~59
Mean Glaciation level (m)	~5,145
Terminus Elevation (m)	~3,695

NANDA GHUNTI GLACIER



Nanda Ghunti Glacier



Nanda Ghunti Glacier Thickness

The Nanda Ghunti Glacier, located in the Chamoli District of Uttarakhand, is an important glacier of the central Himalayas. The glacier lies in the vicinity of the Nanda Ghunti Peak and contributes meltwater to tributaries that eventually drain into the Alaknanda River.

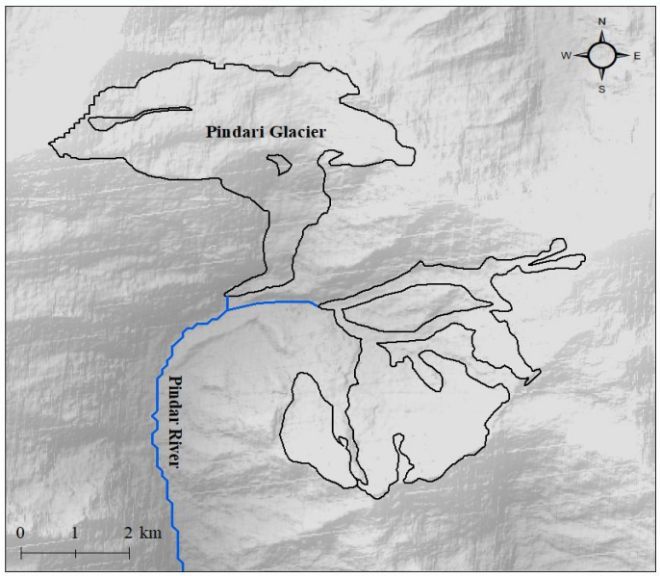
The Nanda Ghunti Glacier acts as a perennial source of meltwater that supports the hydrological regime of the upper Alaknanda basin. This hanging-type glacier extends approximately 2-3 km in length, with a glacierized area estimated to be around 2-3 km². The glacier originates from the high-altitude snowfields and cirques surrounding Nanda Ghunti Peak, at elevations exceeding 6,300 m above sea level, and descends to its terminus at an elevation of approximately 4,600-4,700 m.

Limited scientific monitoring and available studies suggest that the Nanda Ghunti Glacier has been experiencing a gradual and continuous retreat over the past several decades, with an estimated average retreat rate of approximately 8–10 m yr^{-1}.

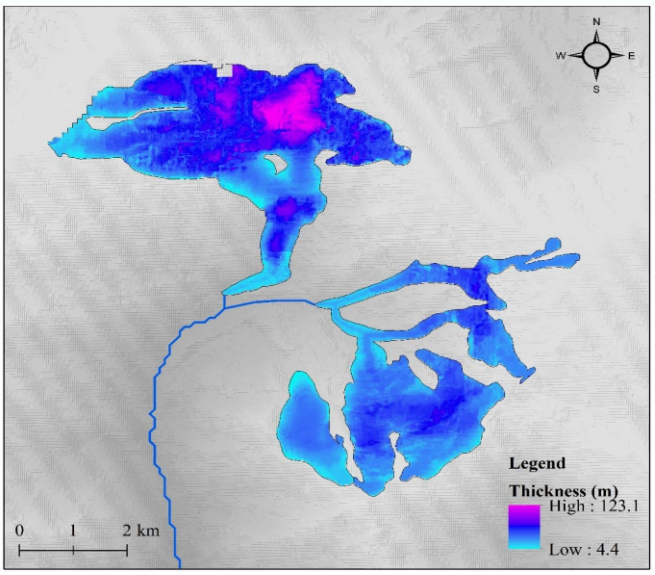
Key Features of the Nanda Ghunti Glacier

Parameters	Description
Type	Hanging Glacier
Location	30° 20' 15.00" N, 79° 43' 15.60" E
Approximate Length (km)	~2
Approximate Main Glacier Area (km^2)	~2
Mean Glaciation level (m)	~ 5,400
Terminus Elevation (m)	~4,650

PINDARI GLACIER



Pindari Glacier Boundary



Pindari Glacier Thickness

The Pindari Glacier, located in the Bageshwar District of Uttarakhand, is one of the well-known glaciers of the Kumaon Himalaya. It lies in the upper catchment of the Pindar River, which later joins the Alaknanda River, an important headstream of the Ganga River.

The Pindari Glacier serves as a perennial source of meltwater for the Pindar River and contributes significantly to the hydrological regime of the upper Alaknanda basin. This valley-type glacier extends approximately 4-5 km in length, with a glacierized area of about 11-12 km². The glacier originates from the high-altitude snowfields and cirques surrounding prominent Himalayan peaks such as Nanda Devi East and Nanda Kot, at elevations exceeding 6,400 m above sea level, and descends to its snout near Zero Point (Pindari Glacier snout) at an elevation of approximately 3,900-4,000 m.

The Pindari Glacier, located in the Alaknanda Basin, showed an average retreat rate of about 9.4 m yr^{-1} during the period 1958-2001.

Key Features of the Pindari Glacier

Parameters	Description
Type	Valley Glacier
Location	30° 18' 06.12" N, 80° 00' 35.65" E
Approximate Length (km)	~4
Approximate Main Glacier Area (km^2)	~11
Mean Glaciation level (m)	~ 5,350
Terminus Elevation (m)	~3,982