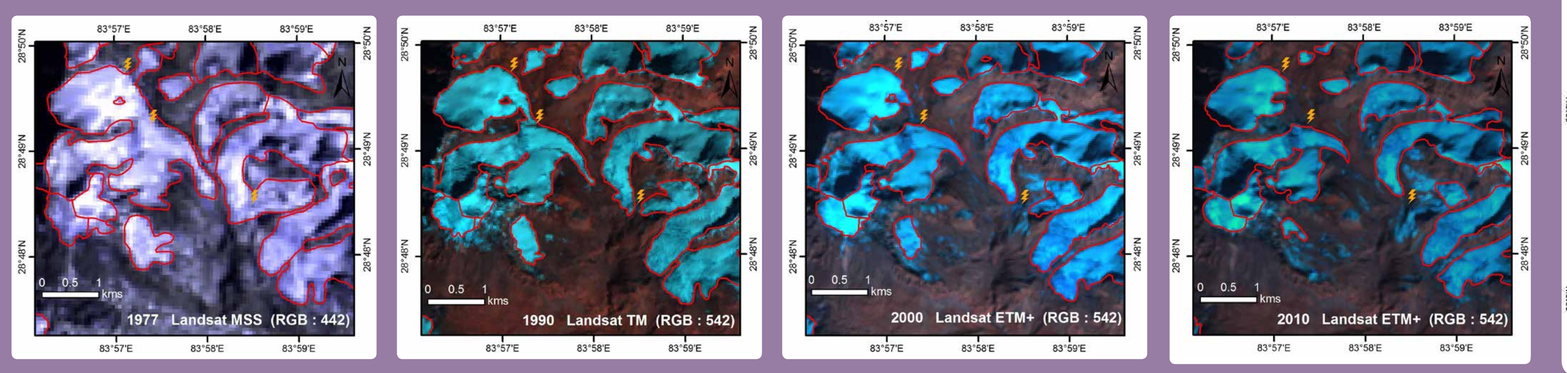
Glacier Status in Nepal and Decadal Change from 1980 to 2010 based on Landsat Data

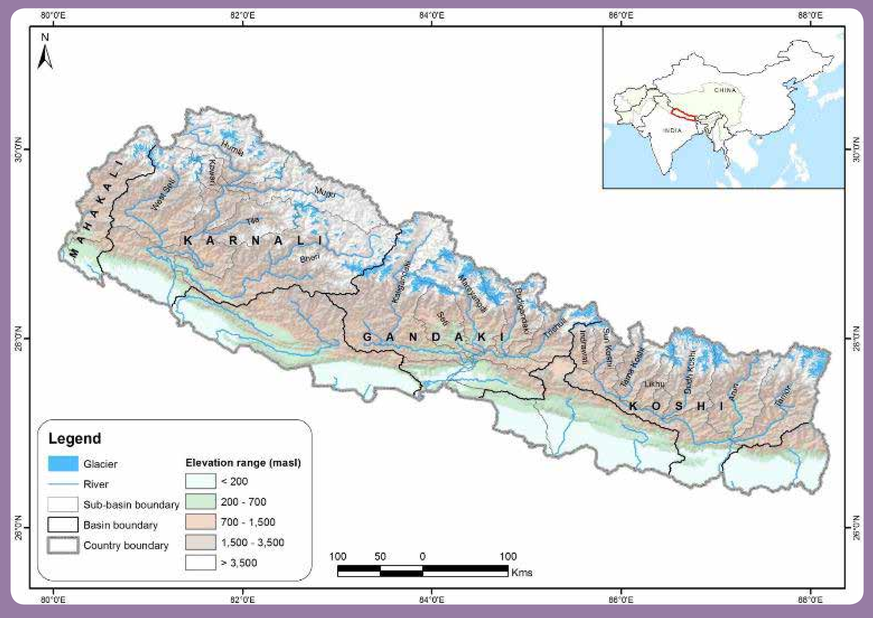
ICIMOD 30

THREE DECADES
FOR MOUNTAINS AND PEOPLE

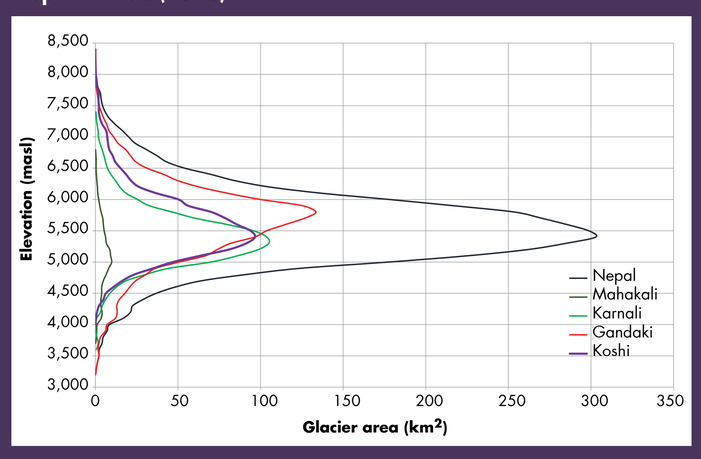
The increased availability of satellite and advanced remote sensing tools and techniques has made the mapping and monitoring of glaciers in Nepal relatively simpler compared to the past. Mountain areas are particularly vulnerable to climate change, and the Nepal Himalayas are no exception. An assessment of the status and recent rates of change in the glaciers of Nepal has enabled us to understand the changes in glaciers and project future scenarios.

The comprehensive inventory of glaciers of Nepal in 2010 was prepared using semi-automatic multi resolution segmentation of Landsat images and digital elevation model. Based on the 2010 data the status of 1980, 1990, and 2000 were developed and the results were compared to understand the trends. An example of the status of glaciers in 1980, 1990, 2000 and 2010 are shown in the figure.

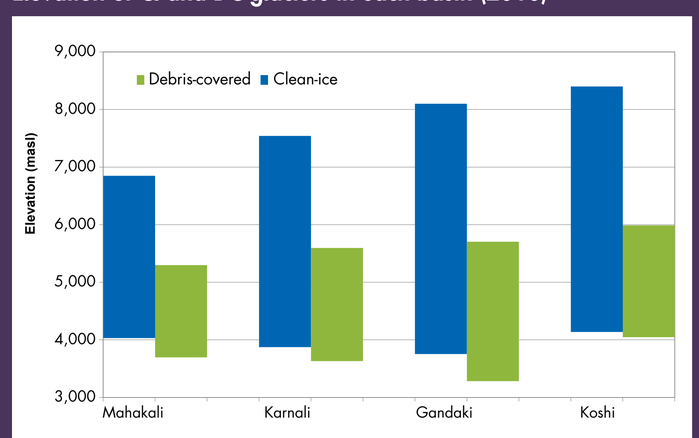




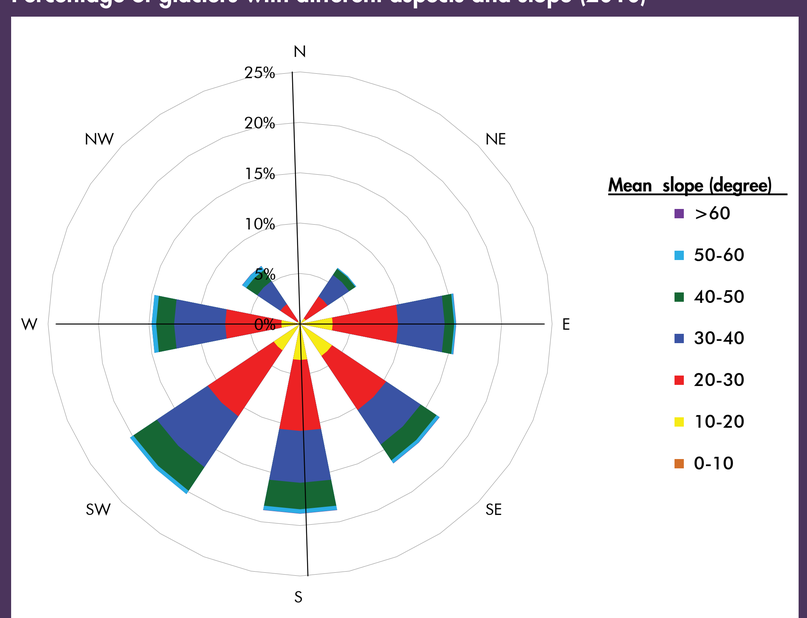
Area-altitude distribution of glaciers in the major basins and Nepal overall (2010)



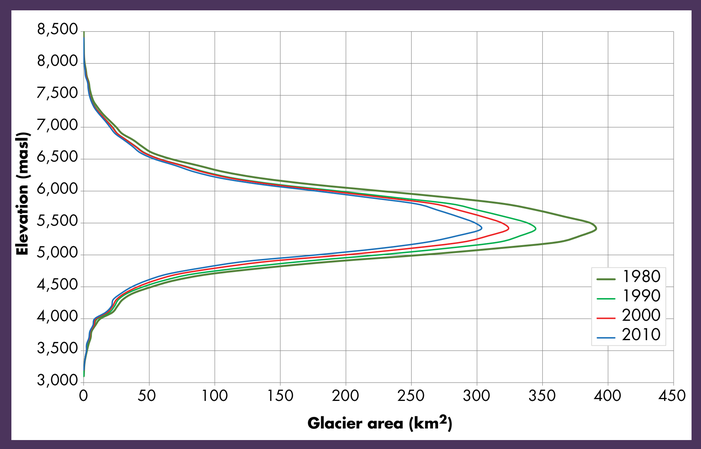
Elevation of CI and DC glaciers in each basin (2010)



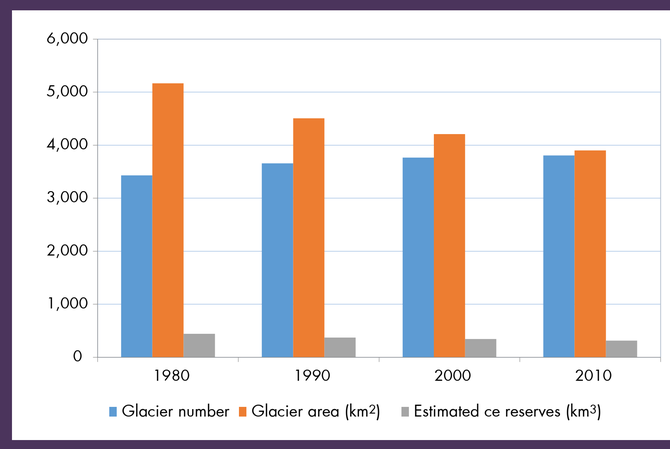
Percentage of glaciers with different aspects and slope (2010)



Area-altitude distribution of glaciers in Nepal in 1980, 1990, 2000, and 2010



Glacier number, area, and estimated ice reserves in Nepal in 1980, 1990, 2000, and 2010



Status and change in glaciers in Nepal in ~1980, 1990, 2000, and 2010

Glacier attribute	Decade (Year)				Decadal change							
	~1980	1990	2000	2010	~1980–1990		1990–2000		2000–2010		~1980–2010	
Number	3,430	3,656	3,765	3,808	226	7%	109	3%	43	1%	378	11%
Area (km^2)	5,168	4,506	4,211	3,902	-662	-13%	-295	-7%	-308	-7%	-1266	-24%
Estimated ice-reserves (km^3)	441	370	343	312	-72	-16%	-27	-7%	-31	-9%	-129	-29%

- In 2010, a total of 3,808 glaciers were identified with a total area of 3,902 km^2 and estimated ice reserves of 312 km^3. The average area of individual glaciers is 1 km^2. The Ngojumba glacier in the Dudh Koshi sub-basin is the largest single glacier with an area of 79 km^2.
- The total glacier area decreased by 24% (1,266 km^2) between 1980 and 2010, and the estimated ice reserves by 29% (129 km^3). The number of glaciers increased by 11%, a result of fragmentation following shrinkage.
- The glaciers receded on average by 38 km^2 per year.
- The rate of loss of glacial area between 1980 and 1990 was almost twice compared to the subsequent two decades (1990–2000 and 2000–2010).
- The overall glacier area decreased from 3.6% of the total land area of Nepal to 2.6%
- Approximately 80% of the glacier area was found in the elevation range 5,000 to 6,500 masl in all decades with the greater part (65%) between 5,000 and 6,000 masl.
- The glacier area decreased in all bands in all decades, with the greatest loss in area between 5,000 and 6,000 masl (823 km^2 between 1980 and 2010; 24% of the total in the band and 65% of the total lost)
- Less than 50 km^2 of glacier area was found above 6,000 masl and below 4,700 masl.

Glacier number and area change ~1980–2010

		Glacier number		Glacier area (km^2)	
		2010	Change ~1980–2010	2010	Change ~1980–2010
Area class (km^2)					
≤ 0.10		781	602	50.3	37.2
0.11–0.50		1,739	216	431.4	10.1
0.51–1.00		556	-167	394.2	-117.3
1.01–5.00		606	-225	1,234.10	-453
5.01–10.00		64	-32	444.3	-218.7
≥ 10.01		62	-16	1,348.10	-524.1
Total		3,808	378	3,902.40	-1,265.90
Aspect					
North		14	9	1.7	0.9
Northeast		255	84	89.1	-8
East		590	73	466.6	-69.9
Southeast		634	-54	754.6	-387
South		717	9	1,078.70	-485.2
Southwest		773	90	991.3	-198.4
West		561	68	412.6	-133.1
Northwest		264	99	107.8	14.8
Total		3,808	378	3,902.40	-1,265.90
Mean slope (degree					
0–10		7	5	18.6	3.5
10–20		625	243	1,031.20	372.4
20–30		1,455	-9	2,056.20	-1090.5
30–40		1,162	20	618.4	-480.7
40–50		464	75	152.1	-72.3
50–60		89	38	24.9	0.8
>60		6	6	1	1
Total		3,808	378	3,902.40	-1265.9
Glacier type					
Mountain	Miscellaneous	18	1	8.2	-1.8
	Ice Apron	943	137	245.5	-75.3
	Cirque	24	-7	4.9	-8.4
	Niche	315	8	39.6	-70.6
	Basin	2,396	237	2,163.40	-709.3
Valley trough		112	2	1,440.80	-400.5
Total		3,808	378	3,902.40	-1,265.90

International Centre for Integrated Mountain Development, GPO Box 3226, Kathmandu, Nepal, **Tel** +977 1 5003222, **Email** info@icimod.org

http://apps.geoportal.icimod.org/nepalglacier

www.icimod.org