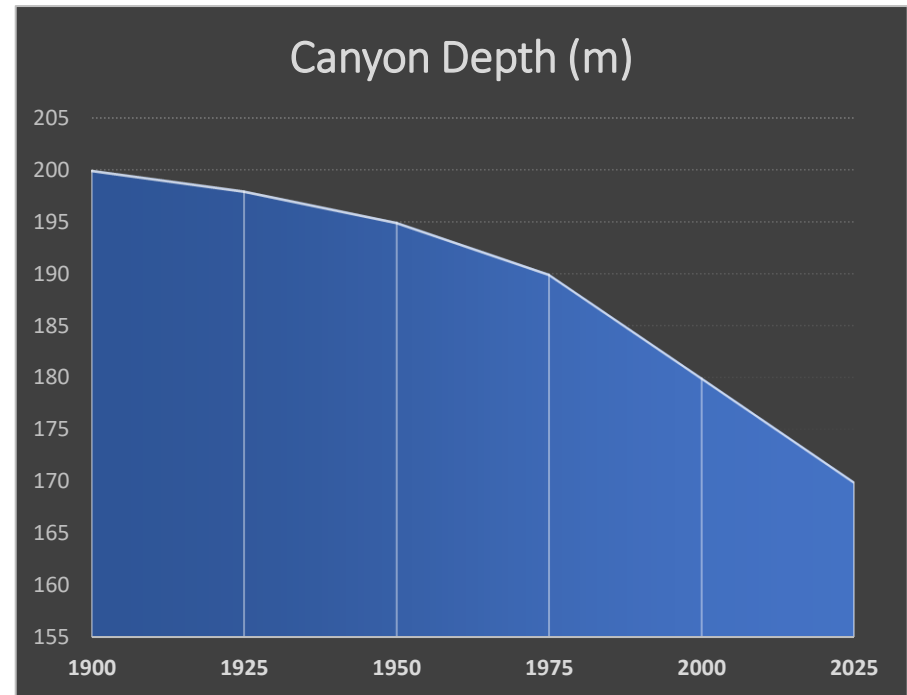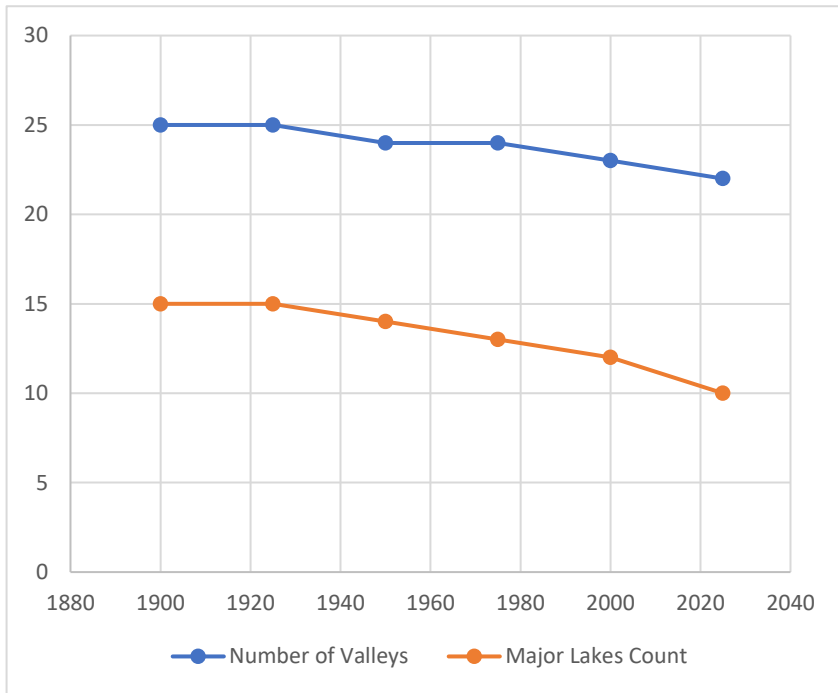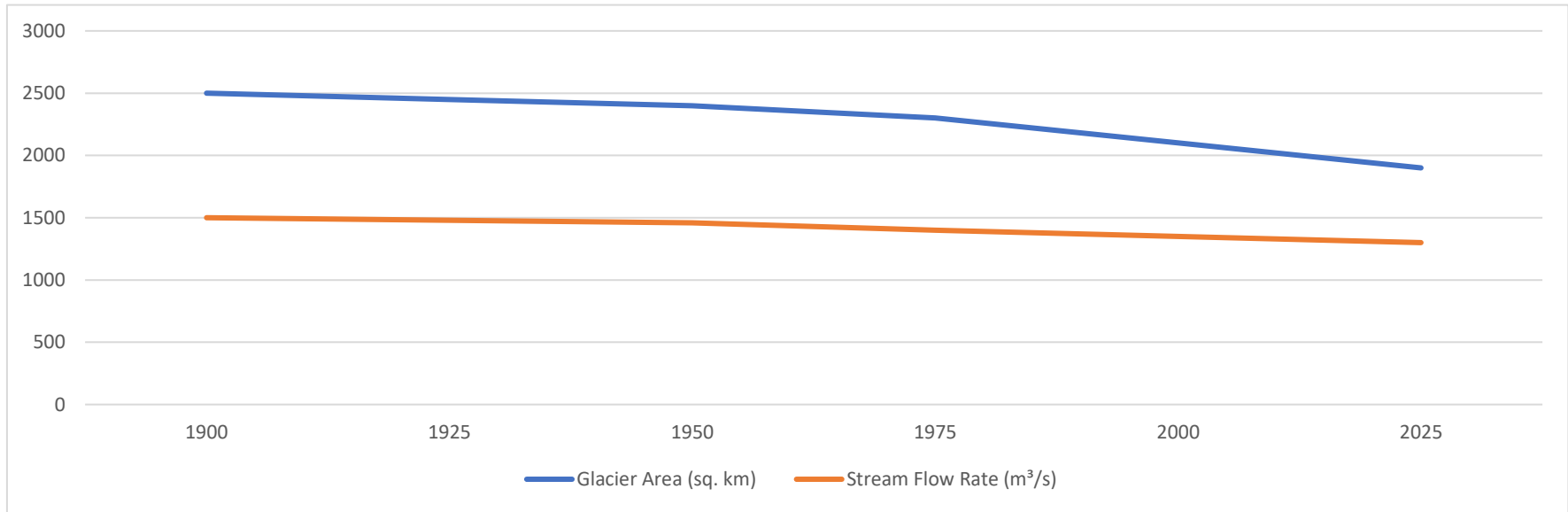# Geological and Topographical Factor

Topographical Factors of Uttarakhand

Year	Glacier Area	Number of Val	Major Lakes C	Canyon Depth (n	Stream Flow Rate (m³/s)
1900	2500	25	15	200	1500
1925	2450	25	15	198	1480
1950	2400	24	14	195	1460
1975	2300	24	13	190	1400
2000	2100	23	12	180	1350
2025	1900	22	10	170	1300

Geological Factors of Uttarakhand

Year	Dominant Ro	Major Rock Con	Lateral Facies C	Landslides per year
1900	Granite, Qua	Lesser Himalaya	Minimal sedime	8
1925	Granite, Qua	Lesser Himalaya	Slow changes in	12
1950	Schist, Phyllit	Higher Himalaya	Increased erosio	17
1975	Schist, Phyllit	Higher Himalaya	River sedimenta	23
2000	Gneiss, Schist	Higher Himalaya	Accelerated fac	40
2025	Gneiss, Schist	Higher Himalaya	Major sediment	65

Landslides per year

Glacier Area (sq. km) — Stream Flow Rate (m³/s)

Number of Valleys — Major Lakes Count

Canyon Depth (m)
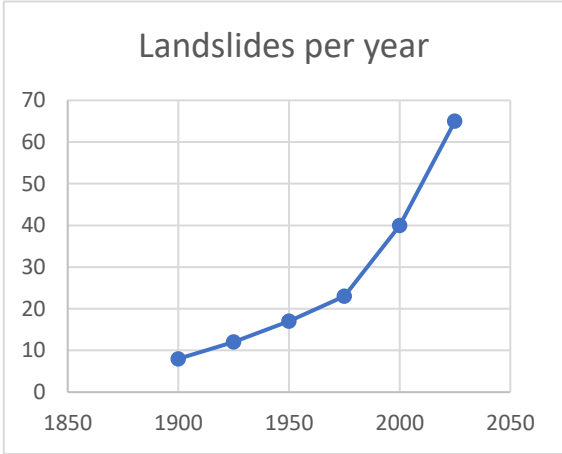
Climate Conditions of Uttarakhand

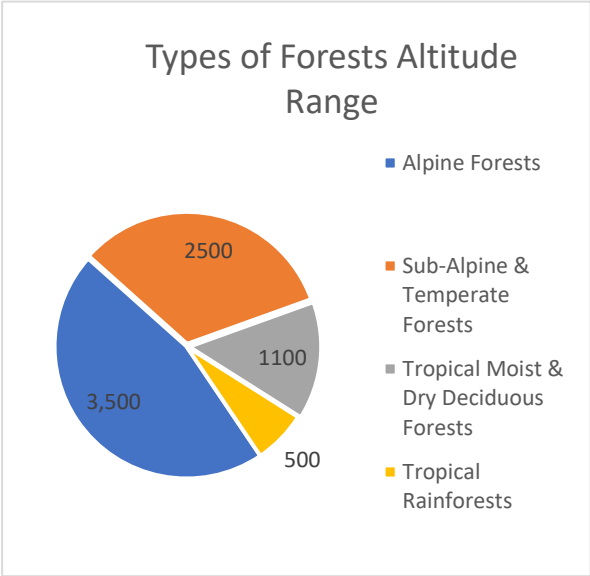| Month	Temp(°F) - 2015	Temp(°F) - 2024	Rainfall (in) 2015	Rainfall (in) 2024	Snowfall (in) 2015	Snowfall (in) 2024	Humidity(%)2015	Hum..2024
January	49	52.7	4.7	5.5	4	1.5	75	70
February	60	65	3.9	5.1	2.5	1	70	68
March	69.7	71.2	3.1	4.3	2	0.8	65	62
April	75.25	79.4	2.3	3.5	1	0.5	60	55
May	84.25	87	1.6	2.8	0	0	55	50
June	87.5	88	3.9	5.9	0	0	60	58
July	79	83.6	13.8	15	0	0	85	80
August	79.2	80.6	12.6	14.6	0	0	83	78
September	78.5	79	5.9	8	0	0	80	75
October	69	72.8	3.1	4.5	2	0.8	70	65
November	63	65	2	3.5	1.9	1.7	65	60
December	55.5	53.4	3.5	4.6	3	2.4	72	68

2015 vs 2024 Temperature

2015 vs 2024 Humidity
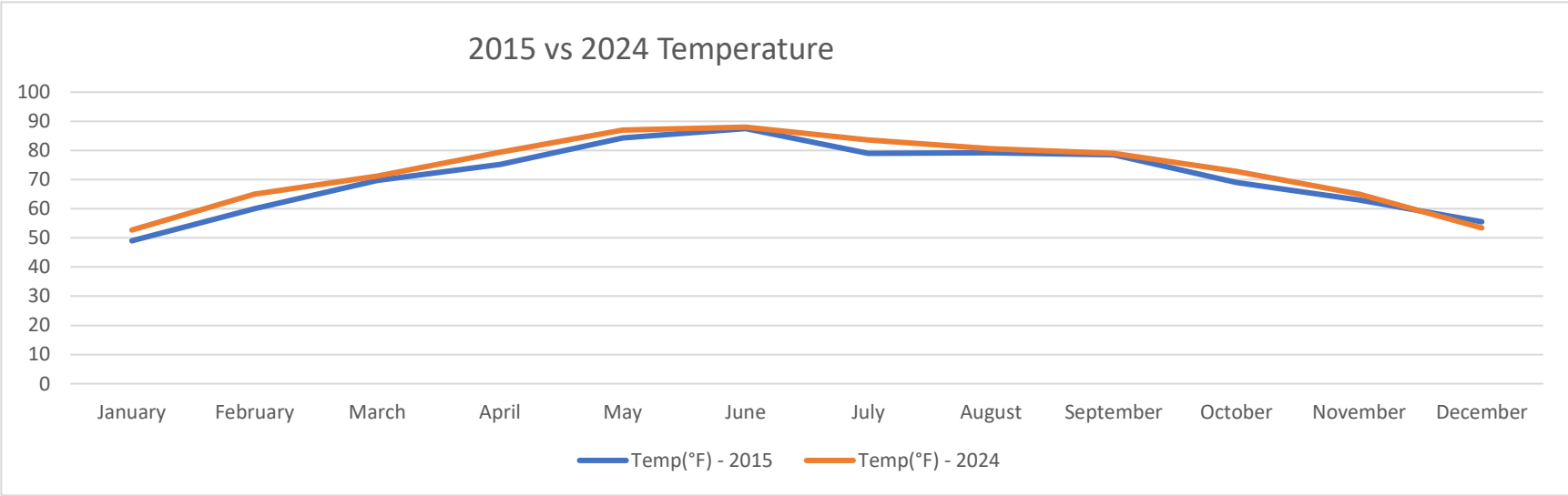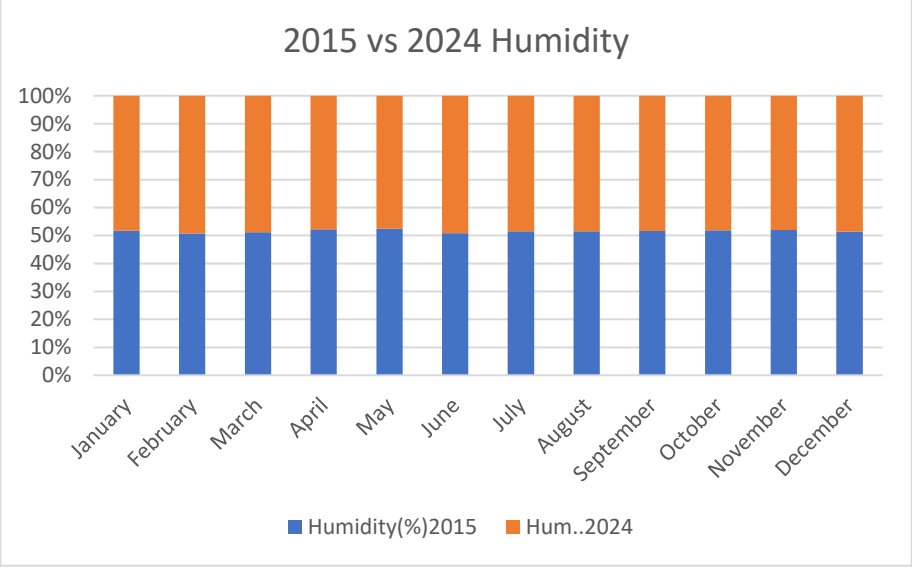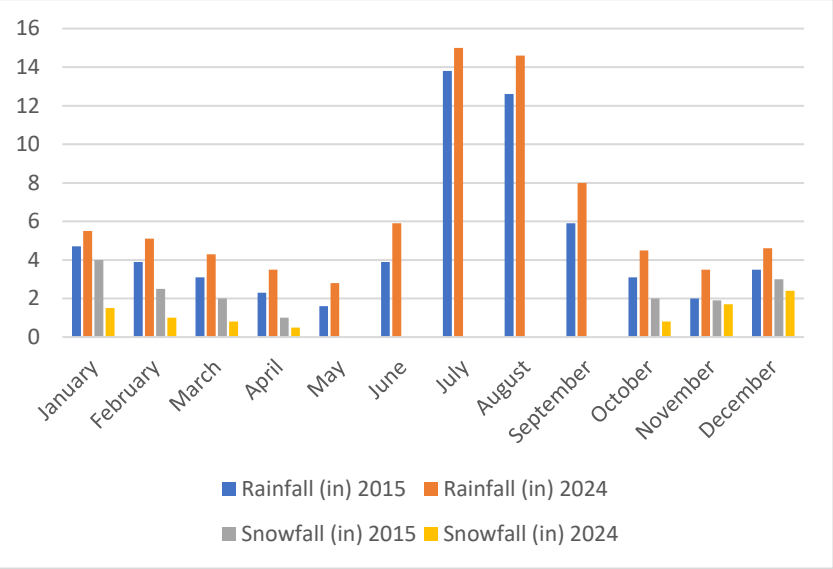
Forests and Biodiversity					
Biodiversity Changes					
Year	**Forest Cover (%)**	**No. Plant Species**	**Animal Species**	**Microorganisms**	**Endangered**
1900	80%	7,150	700	500	5
1925	78%	6900	690	520	7
1950	75%	6550	660	550	10
1975	70%	6340	620	600	15
2000	65%	6000	580	700	25
2025	60%	5700	550	750	40

Types of Forests Altitude Range

- Alpine Forests
- Sub-Alpine & Temperate Forests
- Tropical Moist & Dry Deciduous Forests
- Tropical Rainforests

2500
1100
3,500
500

Forest Cover				
Type	**Altitude Range**	**Area in 2000 (sq. km)**	**Area in 2025 (sq. km)**	**Change (%)**
Alpine Forests	3,500	5,500	5,046.76	-8.24%
Sub-Alpine & Temperate Forests	2500	13,500	12,805.24	-5.15%
Tropical Moist & Dry Deciduous Forests	1100	6,800	6,451.04	-5.13%
Tropical Rainforests	500	25,800	24,303.04	-5.80%

Chart Title

- Alpine Forests — 3,500
- Sub-Alpine &... — 2,500
- Tropical Moist & Dry... — 1,100
- Tropical Rainforests — 500

Line chart legend: Area in 2000 (sq. km), Area in 2025 (sq. km)
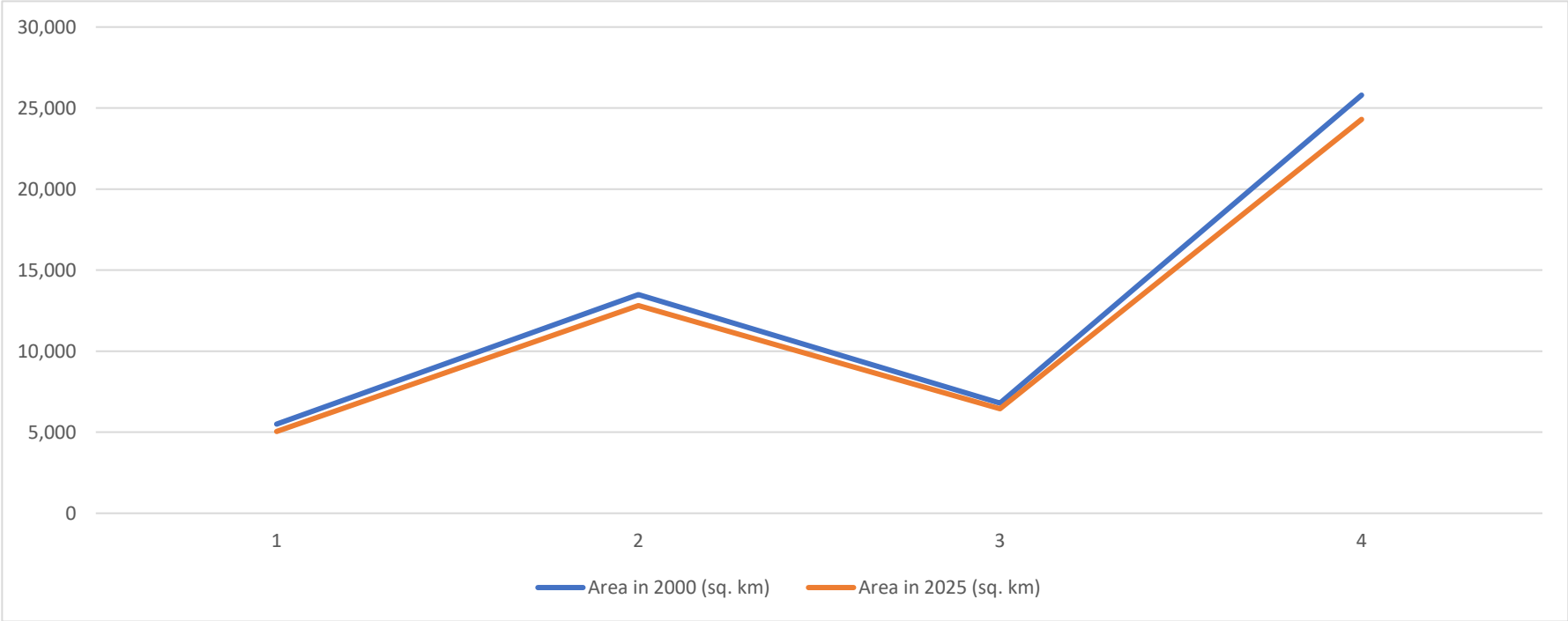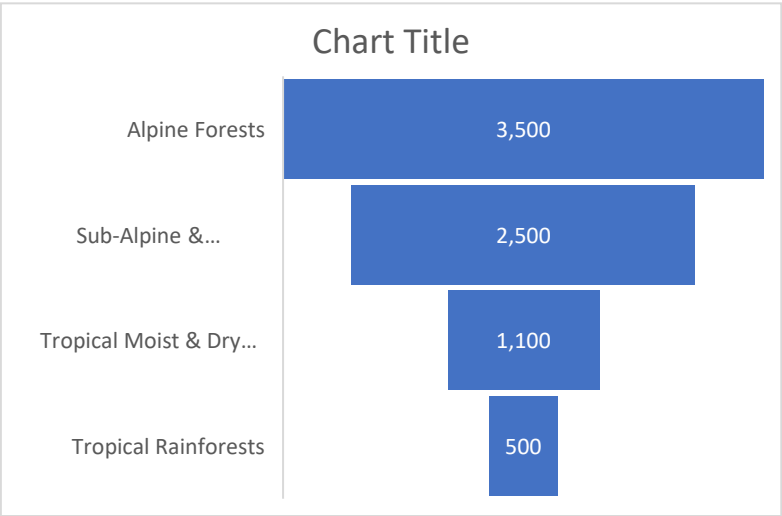
Water Resources

Water Resource	Description	2000	2025	Change (%)
Glacier Area	Covers the Himalayan region, source of major rivers	2,500 sq. km	1,900 sq. km	-24%
Number of Major Rivers	Large rivers originating from glaciers	16	16	0%
River Flow Rate	Average stream flow rate (m³/s)	1,500 m³/s	1,300 m³/s	-13.30%
Major Lakes	Natural and artificial lakes	12 lakes	10 lakes	-16.70%
Springs	Natural water sources in foothills	2,000+	1,600+	-20%
Groundwater Level	Depth of groundwater reserves	40m depth	60m depth	-50%

Water Resource 2000 vs 2025
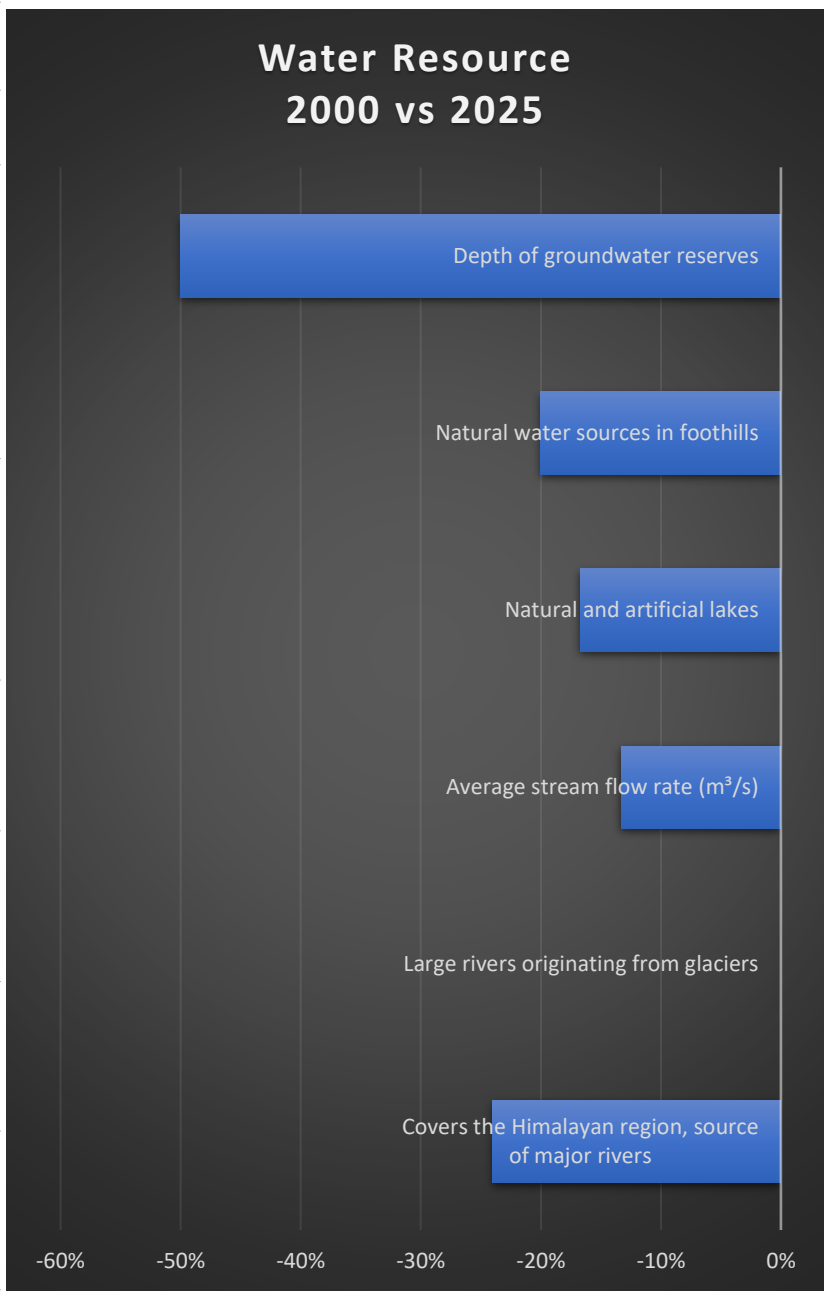
Land Use and Urbanization

| Category	Description	2000 (sq. km)	2025 (sq. km)	Change (%)
Forest Cover	Majority of the land covered by forests	35,600	34,500	-3.10%
Agricultural Land	Primarily in the plains and Tarai region	8,500	7,800	-8.20%
Barren Land	Steep mountainous terrain with little vegetation	6,000	6,500	8.30%
Urban Area	Expanding cities, towns, and settlements	1,500	2,800	86.70%
Water Bodies	Lakes, rivers, and reservoirs	1,200	1,100	-8.30%
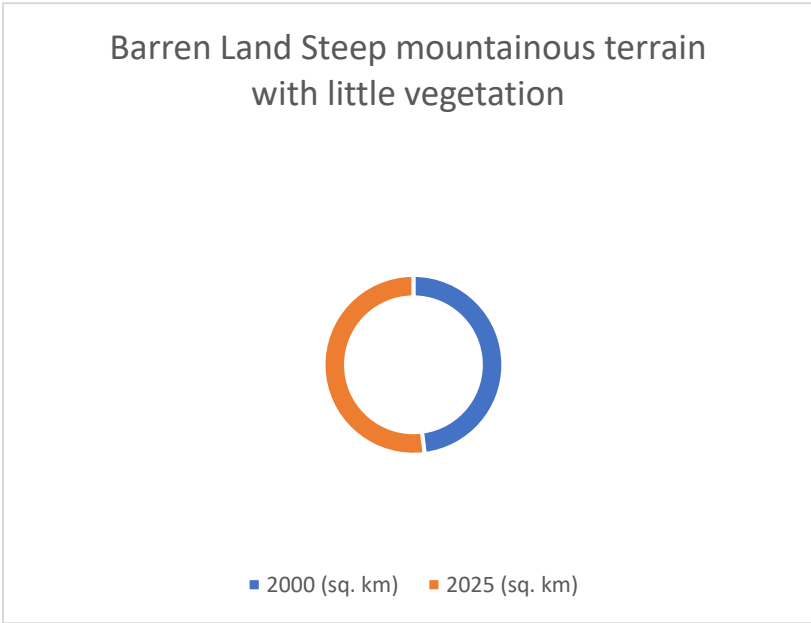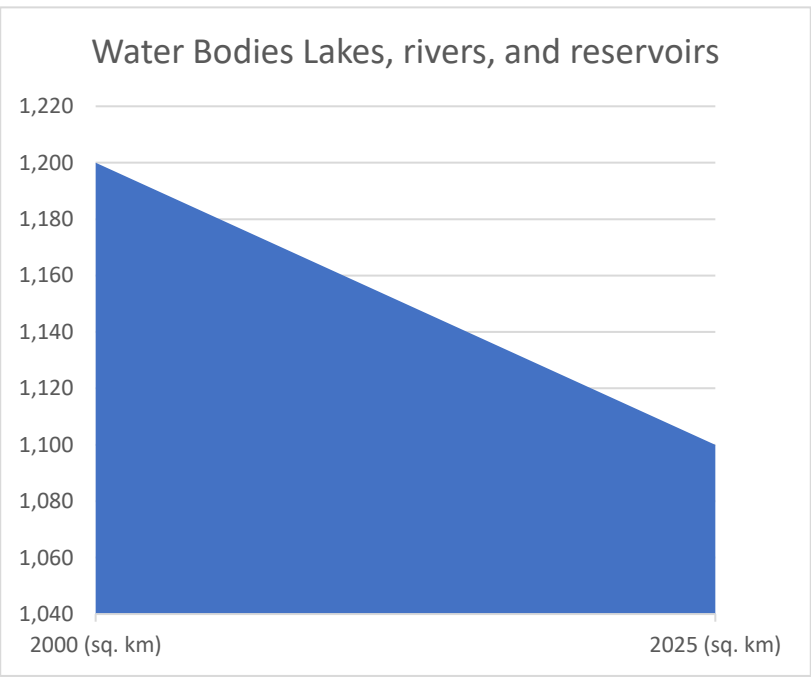
Water Bodies Lakes, rivers, and reservoirs

Barren Land Steep mountainous terrain with little vegetation

Expanding cities, towns, and settlements

- 2025 (sq. km)
- 2000 (sq. km)

Forest Cover Majority of the land covered by forests

35,600   34,500   34,500

■ 2000 (sq. km)   ■ 2025 (sq. km)

Agricultural Land Primarily in the plains and Tarai region

7,800   8,500

■ 2000 (sq. km)   ■ 2025 (sq. km)
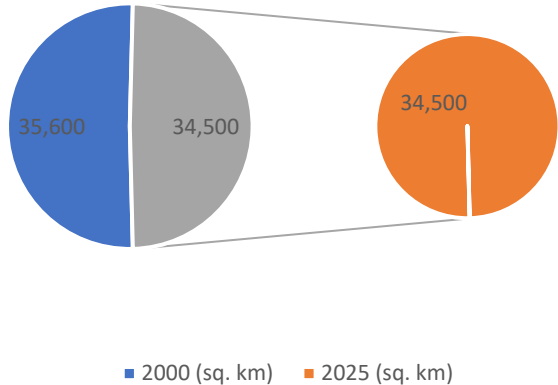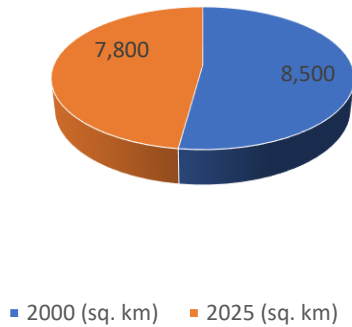
Disaster Risk and Management								
ster	Year	Cause	Impact	Preparedness Measures After the Event	Risk Factor	2000 (Moderate Risk)	2025 (Higher Risk or Reduced Risk?)	Trend
				- Stricter building regulations	Deforestation	Forest loss due to population growth	Urban expansion, hydropower projects affecting ecosystems	Increased Risk

Kedarnath Floods	2013	Cloudburst, Glacial Lake Outburst Flood (GLOF)	5,700+ deaths, massive destruction in Kedarnath	- Improved early warning systems	Landslides & Soil Erosion	Increased due to road construction & deforestation	More frequent due to infrastructure expansion & climate change	Increased Risk
				- River channelization efforts	Earthquake Preparedness	Basic retrofitting of buildings	Seismic codes strictly implemented in new constructions	Decreased Risk
Uttarkashi Earthquake	1991	6.8 magnitude earthquake	768 deaths, 3,000+ homes destroyed	- Seismic zoning regulations	Floods & Glacial Outburst	Flooding due to glacier melting, but not extreme	Increased glacier melting due to rising temperatures	Increased Risk
				- Awareness and training programs	Forest Fires	Moderate frequency, mostly natural causes	More frequent due to rising temperatures and human activities	Increased Risk
Malpa Landslide	1998	Heavy rainfall, unstable terrain	221 deaths, entire village wiped out	- Monitoring landslide-prone zones	Urbanization & Construction	Expanding, but still controlled	Unplanned urbanization leading to environmental stress	Increased Risk

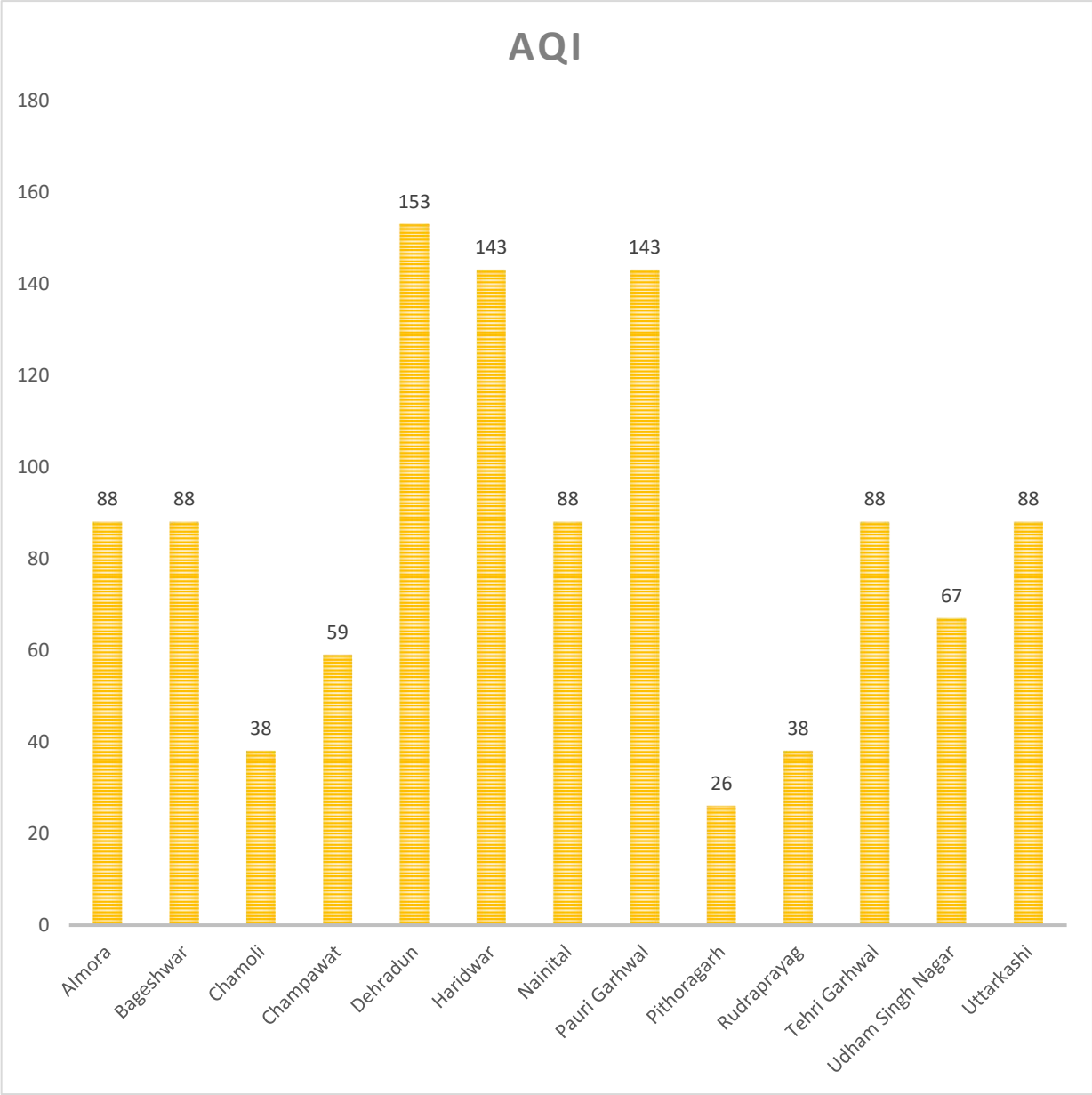| Event	Year	Cause	Impact	Measures	Sector	Before	After	Risk Status
				- Better drainage planning	Hydropower & Dams	Few large projects, minimal impact	Increased dam construction leading to higher risks	Increased Risk
Joshimath Land Subsidence	2023	Unscientific construction, water seepage	Buildings cracked, 600+ families displaced	- Halted new constructions	Road & Tunnel Construction	Limited expansion, minimal environmental damage	Rapid expansion increasing landslide risks	Increased Risk
				- Relocation plans for affected families				
Chamoli Flash Floods	2021	Glacier collapse, climate change	80+ deaths, power projects destroyed	- Better monitoring of glacial movements				
				- Strengthening dam safety protocols				

Kedarnath Floods — 2013
Uttarkashi Earthquake — 1991
Malpa Landslide — 1998
Joshimath Land… — 2023
Chamoli Flash Floods — 2021
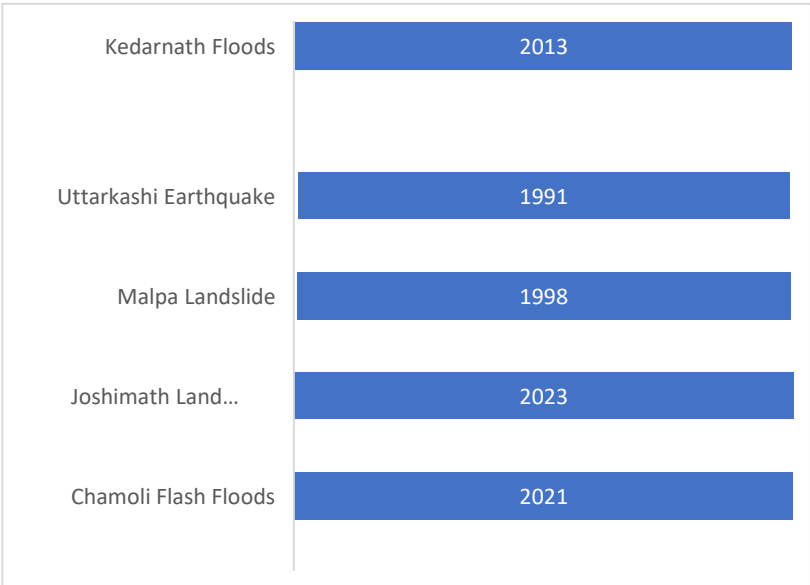
Pollution and Environmental Degradation

AQI of Uttarakhand				Water Quality Status				
District	**AQI**	**Air Quality Level**		**River Name**	**Major Locations**	**Water Quality Index (WQI)**	**Water Quality Status**	**Key Issues**
Almora	88	Moderate		Ganga	Haridwar, Rishikesh	100-150	Moderate to Good	High pilgrimage activity, untreated sewage, industrial waste
Bageshwar	88	Moderate		Yamuna	Vikasnagar, Kalsi	90-140	Moderate	Agricultural runoff, industrial pollutants
Chamoli	38	Good		Tons	Dehradun, Chakrata	110-160	Good	Seasonal nitrate fluctuations, some turbidity
Champawat	59	Moderate		Bhagirathi	Gangotri, Tehri	80-130	Moderate to Good	Glacial melt influence, hydropower projects

District	AQI	Category		River	Location	Range	Water Quality	Causes
Dehradun	153	Unhealthy		Alaknanda	Chamoli, Rudraprayag	90-140	Moderate	Hydropower projects, occasional contamination
Haridwar	143	Unhealthy		Mandakini	Kedarnath, Rudraprayag	100-150	Good	Natural sediment load, minor tourism impact
Nainital	88	Moderate		Saryu	Bageshwar	120-160	Good	Minor pollution, relatively cleaner river
Pauri Garhwal	143	Unhealthy		Kosi	Almora, Ramnagar	90-140	Moderate	Agricultural runoff, increasing urbanization
Pithoragarh	26	Good		Ramganga	Pithoragarh, Jim Corbett	80-130	Moderate	Pollution from human settlements, deforestation effects
Rudraprayag	38	Good		Gola	Haldwani, Nainital	100-150	Moderate to Good	Seasonal variations, urban runoff
Tehri Garhwal	88	Moderate						

Udham Singh Nagar	67	Moderate
Uttarkashi	88	Moderate
Factor	**2000**	**2025 (Projected)**
Forest Cover Loss	Moderate	High due to deforestation & wildfires
Glacial Retreat	Slow	Faster, major glaciers shrinking rapidly
Water Pollution	Low to Moderate	High, especially in urban rivers
Air Quality (AQI)	Good (AQI ~50-70)	Poor (AQI ~100-200 in cities)
Urbanization Rate	~20%	~30-35%, with uncontrolled expansion
Landslide Frequency	Low	High due to road construction & mining

AQI

District	AQI
Almora	88
Bageshwar	88
Chamoli	38
Champawat	59
Dehradun	153
Haridwar	143
Nainital	88
Pauri Garhwal	143
Pithoragarh	26
Rudraprayag	38
Tehri Garhwal	88
Udham Singh Nagar	67
Uttarkashi	88

Socio-Economic & Policy Aspects

Sector	Key Features	Challenges
Agriculture	Wheat, rice, pulses, fruits (apples, peaches)	Limited arable land, dependence on monsoon
Tourism	Religious (Char Dham Yatra), Adventure (trekking, rafting)	Seasonal dependency, over-tourism impact
Hydropower	Rich water resources, major power projects	Ecological damage, displacement of communities
Industry	Small-scale industries, handlooms, handicrafts	Limited infrastructure, lack of large-scale industries

Education

Metric	2015	2025
Literacy Rate	78.82%	85%
Number of Universities	11	18
Primary Schools	15,000	16,500

Service Sector	IT, education, and health services	Uneven growth across districts		Higher Education Enrollments	2,00,000	3,20,000

	Tourism				Agriculture	
Metric	**2015**	**2025**		**Metric**	**2015**	**2025**
Domestic Tourists (in million)	22	35		Total Agricultural Land (hectares)	⬆ 7,00,000	⬇ 6,50,000
International Tourists	1,50,000	5,00,000		Major Crops	Rice, Wheat, Sugarcane	Rice, Wheat, Horticulture
Tourism Revenue (INR) (in Cr)	23,000	45,000		Food Grain Production (million tonnes)	▼ 1.5	▲ 1.8
Employment in Tourism	2,00,000	3,50,000		Horticulture Production	⬇ 0.5	⬆ 1.2

Tourism