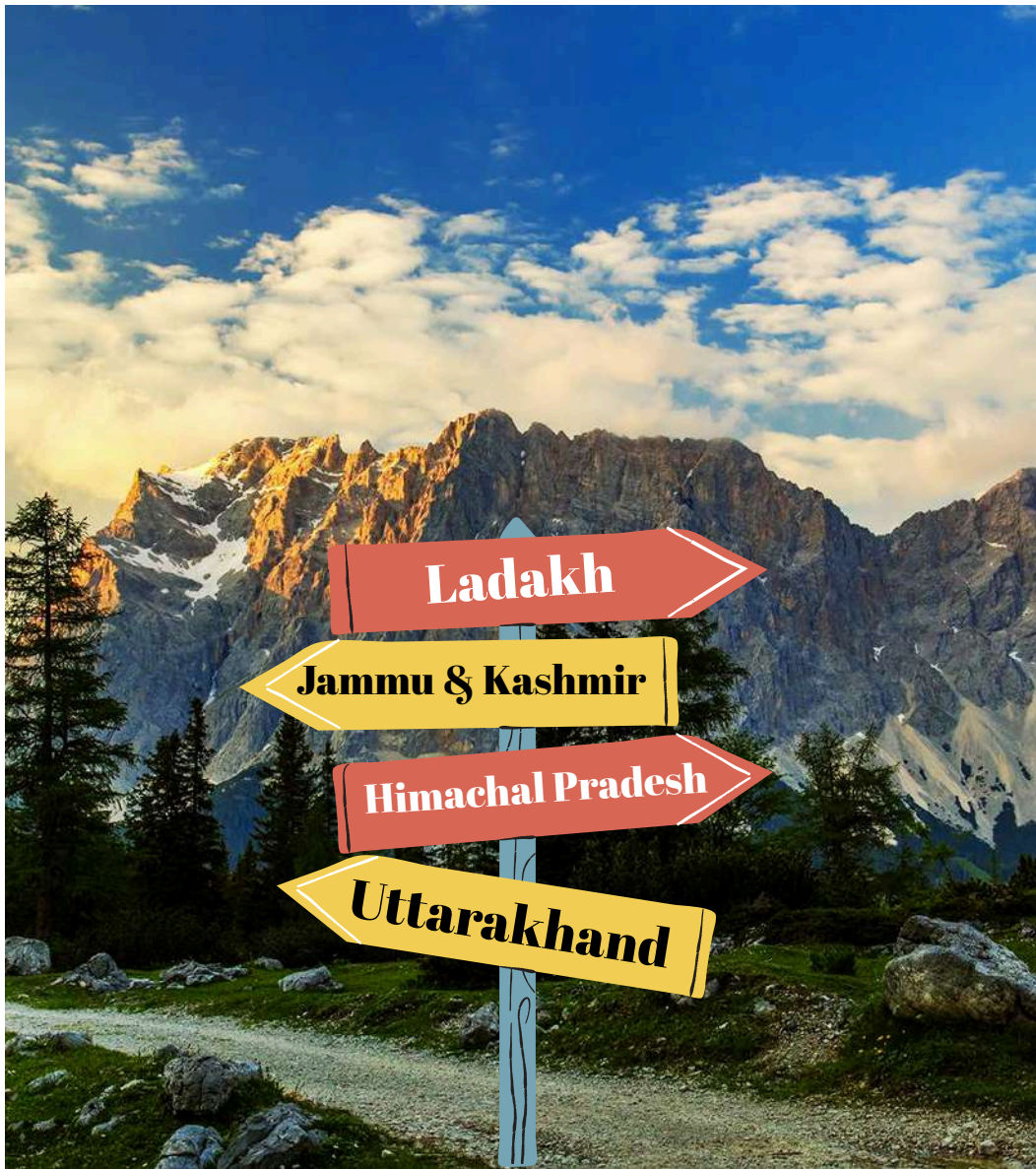
Policy WATCH

Volume XIV, Issue IV
April 2025, New Delhi

Environment, Natural Resources and Sustainability



In this issue

Contents

RAJIV GANDHI
INSTITUTE FOR CONTEMPORARY STUDIES

I Editorial

The Rajiv Gandhi Institute for Contemporary Studies (RGICS), the knowledge affiliate of the Rajiv Gandhi Foundation, conducts research, analysis, and policy advocacy on contemporary challenges facing India. RGICS currently focuses on five key themes:

- Constitutional Values and Democratic Institutions
- Growth with Employment
- Governance and Development
- Environment, Natural Resources and Sustainability
- India's Place in the World

RGICS publishes the monthly Policy Watch, rotating through each theme, with every sixth issue serving as a Special Issue featuring articles from all themes. This issue centers on Environment, Natural Resources and Sustainability.

This edition presents four articles, all written by RGICS Head of Research, Jeet Singh, examining the natural environment in and two Union Territories (Ladakh and Jammu & Kashmir) and two states (Uttarakhand and Himachal Pradesh) in the western Indian Himalayan region. Spanning over 200,000 sq km within a global biodiversity hotspot, this region shapes the Ganga-Yamuna and Indus river basins.

The IPCC's sixth assessment report notes that the Hindu Kush Himalaya is warming faster than other areas and could lose 60% of its glaciers by 2100. Therefore, four state specific article carried by this issue of policy watch assesses interconnectedness of degradation of natural capitals- water, forest, soil and land with changing climate in the Western Indian Himalaya.

The first article assesses anthropogenic and climatic threats to Ladakh's water resources, forests, and land. It finds that glacier melt is accelerating, yet snowmelt water is insufficient due to population growth and tourism. Forest cover is minimal, with most forests lying outside officially recorded areas. Soils, already low in micronutrients, now rely on chemical fertilizers for improved yields.

The second article on Jammu & Kashmir observes that climate change is severely impacting the territory's natural, social, and economic wealth. The Climate Change Action Plan reports that most of the glaciers are rapidly degrading. Snowfall has dropped to 0.6 meters from 3 meters over the past 40 years. Other impacts include erratic weather and reduced snowfall, which are harming apple production and rain-fed agriculture.

Images Courtesy:
Google Images (free to use images)
freepik

The Himachal Pradesh article explores changes in forest canopy density, land degradation and desertification, landslides, declining soil nutrition, soil erosion, and the drying up of water sources as well as climate change impacting the State's apple economy.

The fourth article on Uttarakhand discusses the ecological services provided by its extensive forests, mountains, rivers, and glaciers to nearly 1 billion people in Uttarakhand and the Gangetic plain. These natural resources are under threat from excessive human pressure and climate change. The article briefly outlines the state of these resources and the major challenges they face.

The final article is a Call to Action, written by the undersigned. It is addressed to five levels of stakeholders:

- Individuals by themselves; as citizens, as activists, as thinkers and influencers
- Individuals by joining local community Social Groups; and by individuals joining organised NGOs/Civil Society Institutions
- Gram Panchayats/Zilla Parishads/Town Wards / Municipalities
- State and Central Government departments and specialised agencies
- International Cooperation at the Regional and Global level

For each stakeholder, we delineate what needs to be done.

We hope readers find these articles informative and that policymakers draw on these insights to design better policies and programs with active public participation.

Vijay Mahajan
Director, Rajiv Gandhi Institute for Contemporary Studies

2 Status of the natural environment in Ladakh

Source: Image

Of the two states and two Union Territories in the Western Indian Himalayan region, Ladakh has the largest geographical area. Comparing the natural environment of Ladakh with other three States and UT, it is very different and unique in the entire Himalayan region.

The very cold and dry climatic condition of Ladakh due to its location in the region makes it a cold desert with very less vegetation, dearth of water resources and un-fertile soil. Despite this, the unique ecosystem of Ladakh supports the lives of more than three lakh population of the region and invaluable wildlife such as snow leopard, Kiang, Blue Sheep and Ladakh Urial.

Glaciers have been the lifeline of people and wildlife in Ladakh as snowmelt water feeds their streams and rivers. However, due various natural and anthropogenic factors, glaciers are melting at a faster rate leading to social, economic and ecological imbalance in the region.

This chapter briefly highlights the state of the natural environment of Ladakh, especially the state of forest, soil, water and climate.

2.1 Jal - State of water resources

The most part of Ladakh drains in the Indus river basin except a small portion of its extreme north that drains towards Tibet. The total geographical area of the Indus river basin is about 3.21 lakh sq.km of which Ladakh shares nearly 80,000 sq. km. Indus is the main river in Ladakh that originates from Mansarovar lake in Tibet and covers a distance of nearly 801 km in India before entering in Pakistan.[1] It enters in Leh flowing northwest and passes important towns of the UT such as Nyoma, Upshi and Leh. While its course in Ladakh it meets thousands of small rivers, streams and nallas. Major rivers in the UT merge with Indus are Zansksr river, Shyok, Suru and Nubra. All these major contributories of the Indus in Ladakh are perennial rivers originating from different glaciers.

Shyok is the second longest river in Ladakh that originates from Depsang and passes through the north western part of Ladakh for about 280km. Gilgit and Shigar are another two rivers in the north and north western Ladakh. Shigar (south), Zaskar and Hanle are major left bank tributaries of Indus in the UT.

For a very large part of the northern and north western part of Ladakh, data is not available due to disputes on internal boundaries. Yet, as per central water commission, the area of Ladakh under the Indus basin is sub-divided into three sub basins.[2] These are Gilgit sub basin, Shyok sub basin and Indus upper sub basin. The Upper Indus sub-basin is largely located in Ladakh but also covers areas of Himachal Pradesh. It is the largest sub-basin in Ladakh with 46,450 sq km area. Indus river is the main river in this sub basin. The Shyok river forms another sub-basin in Ladakh. Its total geographical area is 38,545 sq km and falls entirely in Ladakh UT. The third sub basin of the Indus river basin is Gilgit sub basin. Gilgit sub basin is very large and spread in the area of Jammu & Kashmir and Ladakh. The total geographical area of Gilgit sub basin is 27,088 sq km. Major rivers of this sub basin are Gilgit and Huza.

Table 1: Major Water Statistics of Jammu and Kashmir

Number of major river catchments	Number	3
Number of Glaciers	Number	2257
Watersheds	Number	160
Average annual Rainfall	MM	210
Number of lakes and water bodies	Number	665
Water Demand	Lakh Gallons/Day	63
Actual water supply	Lakh Gallons/Day	39

Source: compiled from different Govt sources

[1] Central Water Comission, 2014, 'Indus Basin' Ministry of Water Resources, Government of India. https://indiawris.gov.in/downloads/Indus%20Basin.pdf

[2] Central Water Comission, 2014, 'Indus Basin' Ministry of Water Resources, Government of India. https://indiawris.gov.in/downloads/Indus%20Basin.pdf

The upper Indus sub basin has 70 watersheds of different sizes between 383 sq km to 974 sq km. Shyok sub basin has 53 watersheds and Gilgit sub basin has 37 watersheds. The Indus river basin feeds water to nearly five crore Indians of different states and UT. Of the total geographical area of the basin nearly 60% lies in Jammu & Kashmir and Ladakh. While the total annual average water potential of the basin is 73 BCM, it is disproportionately distributed across regions. Despite sharing the largest and mass of the Indus river basin in India, Ladakh has high water scarcity. Such scarcity of water in the UT is because of its unique geography, cold desert, low level of vegetation and very low level of precipitation.

Source: Image

Both districts of Ladakh namely Leh and Kargil are very dry and receive very less rain. The annual average rainfall in Ladakh is just 210 mm. Unlike in other parts of western Himalayan region, the precipitation in Ladakh is uniformly distributed across three seasons – pre-monsoon, south-west monsoon and winter. Ladakh receives nearly 90% of rain in these three seasons.

Only 10% of the total rainfall it receives in the post-monsoon season. Kargil receives more rainfall compared to Leh district. The average annual rainfall in Kargil is 320 mm, whereas the annual precipitation in Leh district is just 97mm.[3] Average annual rainy days in Kargil are around 26 days compared to just 11 days in Leh districts.

The very little rainfall in Ladakh makes it dry and desert leading to shortage of water for drinking and agricultural activities. Further the region is also not very conducive for groundwater recharge.

According to the Central Ground Water Board, the UT has only 965 sq km area worthy for ground water recharge. As per CGWB, “Ground water in Leh district occurs in porous formations that include moraines and fluvio-glacial deposits of Ladakh. Ground water in Kargil District occurs in the porous formation.”

[3] Ministry of Earth Science, 2014, ‘Climate of Jammu and Kashmir’, Government of India. https://diragrijmu.nic.in/CSS%20GUIDELINES/FINAL_CLIMATE%20OF%20JAMMU%20AND%20KASHMIR_e%20book.pdf

The annual ground water recharge has decreased in the last few years from 0.12 BCM in 2020 to 0.09 BCM in 2023. However, the data shows that the annual groundwater extraction has increased from 0.02 BCM in 2020 to 0.03 BCM in 2022 and 2023. Alarmingly, the stage of ground water extraction is increasing in the UT. It increased from 17.9% in 2020 to 41.36% in 2022. However, it observed marginal decreased in 2023.[4] The extraction of groundwater in Ladakh is mainly for domestic purpose apart from very little for industrial purpose (0.0002 BCM).[5]

Table 2: Ground Water Recharge and Extraction in Ladakh

Attribute	GWRA 2020	GWRA 2022	GWRA 2023
Total Annual Ground Water Recharge (bcm)	0.12	0.08	0.09
Annual Extractable Ground Water Resources (bcm)	0.11	0.07	0.08
Annual Ground Water Extraction (bcm)	0.02	0.03	0.03
Stage of Ground Water Extraction (%)	17.90	41.36	37.05

Source: CGWB

Low precipitation and limited groundwater resources makes UT heavily depend on glacier water. Most perennial rivers in Ladakh are fed by glaciers. According to the climate action plan of Jammu & Kashmir and Ladakh there are more than 4500 glaciers in Nubra, Shyok and Upper Indus sub basins. However, these sub basin cut across Himachal Pradesh and UT of Jammu & Kashmir and Ladakh.[6] Another study observed 2,257 glaciers in UT of size more than 0.5 sq km. These glaciers cumulatively cover a total geographical area of 7923 sq km in Ladakh. Of these, 2,033 glaciers are of size between 0.5 sqkm to 5 sq km.

There are seven glaciers in the UT which have size more than 100 sq km.[7] Siachen glacier is the most known glacier located in Ladakh. This is the second longest glacier (nearly 74km) outside the Polar Regions. Other prominent glaciers of the UT include Drang-Drung, Shafat, Chong Kumdan, Rimo and Nubra glaciers. A study published in Earth System Data Science in 2022, observed that glaciers are retreating at very high speed in Leh, Tsokar, Tsomoriri. However, it also observed that glacier melting speed is relatively low in Shyok sub basin.[8] The climate action plan of erstwhile state of Jammu and Kashmir also observed that glaciers are alarmingly retreating in Ladakh region.[9]

[4] Central Ground Water Board, 2024, Dynamic Groundwater Resoruces of Ladakh, Government of India: https://www.cgwb.gov.in/cgwbpnm/public/uploads/documents/17056458402762584 99file.pdf

[5] rajya sabha unstarred question no. 1690 to be answered on 18/12/2023: https://sansad.in/getFile/annex/262/AU1690.pdf?source=pqars&utm_source=chatgpt.com

[6] Ministry of Environment and Climate Change, 2017, 'State Action Plan on Climate Change, GoI: https://moef.gov.in/uploads/2017/08/Jammu-Kashmir.pdf

[7] Soheb, M., Ramanathan, A., Bhardwaj, A., Coleman, M., Rea, B. R., Spagnolo, M., Singh, S., and Sam, L.: Multitemporal glacier inventory revealing four decades of glacier changes in the Ladakh region, Earth Syst. Sci. Data, 14, 4171–4185: https://essd.copernicus.org/articles/14/4171/2022/?utm_source=chatgpt.com#&gid=1&pid=1

[8] Soheb, M., Ramanathan, A., Bhardwaj, A., Coleman, M., Rea, B. R., Spagnolo, M., Singh, S., and Sam, L.: Multitemporal glacier inventory revealing four decades of glacier changes in the Ladakh region, Earth Syst. Sci. Data, 14, 4171–4185 https://essd.copernicus.org/articles/14/4171/2022/?utm_source=chatgpt.com

[9] Ministry of Environment and Climate Change, 2017, 'State Action Plan on Climate Change, GoI https://moef.gov.in/uploads/2017/08/Jammu-Kashmir.pdf

Ladakh has been traditionally dependent on snow melt water for its domestic use and agro-pastoral requirements. According to a study conducted by BORDA in 2019, traditionally, Ladakh used to meet its 90% water demand from snow melt water locally called *Yurea* and remaining 10% from natural streams. However, the increase in local population and sudden jump in tourist influx in Ladakh along with adverse impacts of climate change on water resources have impose excessive pressure on natural water resources of the Union Territory.[10]

The study further observes that these changes have led to excessive extraction of groundwater especially in Leh city. As per the study, now nearly 92% of domestic water of Leh is met from underground water resource.[11] In summer, when water is very limited, tourist visiting Leh consume nearly 20% of total available water.[12] The water consumption in the UT has suddenly increased and it has gone beyond the carrying capacity of dry Ladakh. Currently major cities of UT such as Leh are meeting its domestic water demand from ground water resources, which is highly un-stainable in the absence of effective regulations.

The index prepared by NITI Aayog has categorized entire Ladakh as a water scarcity region where the per capita availability of water is limited. The vision plan of the Ladakh UT reveals that the total water supply in the UT is just 39 lakh gallons per day against total demand of 63 lakh gallons per day.[13] In other words, there is a deficit of nearly 38% in supplying water for various uses. While the government of India claims that nearly 90% rural households in Ladakh has now connected with tap water after implementation of the Jal Jeevan Mission,[14] but the vision plan of UT reveals that 96% households in Ladakh are without functional tap water connection.[15]

Source: Image

[10] Hirra Azmat, 2024, ' Rapid urbanisation and climate change threaten groundwater resources in Ladakh, says study', Mongabay: https://india.mongabay.com/2024/07/rapid-urbanisation-and-climate-change-threaten-groundwater-resources-in-ladakh-says-study/

[11] BORDA, 2019, 'Water in Liveable Leh', BORDA South Asia: https://ladakh.iisdindia.in/pdf/Leh%20Water%20Report%202019%20BORDA%20LEDeG.pdf

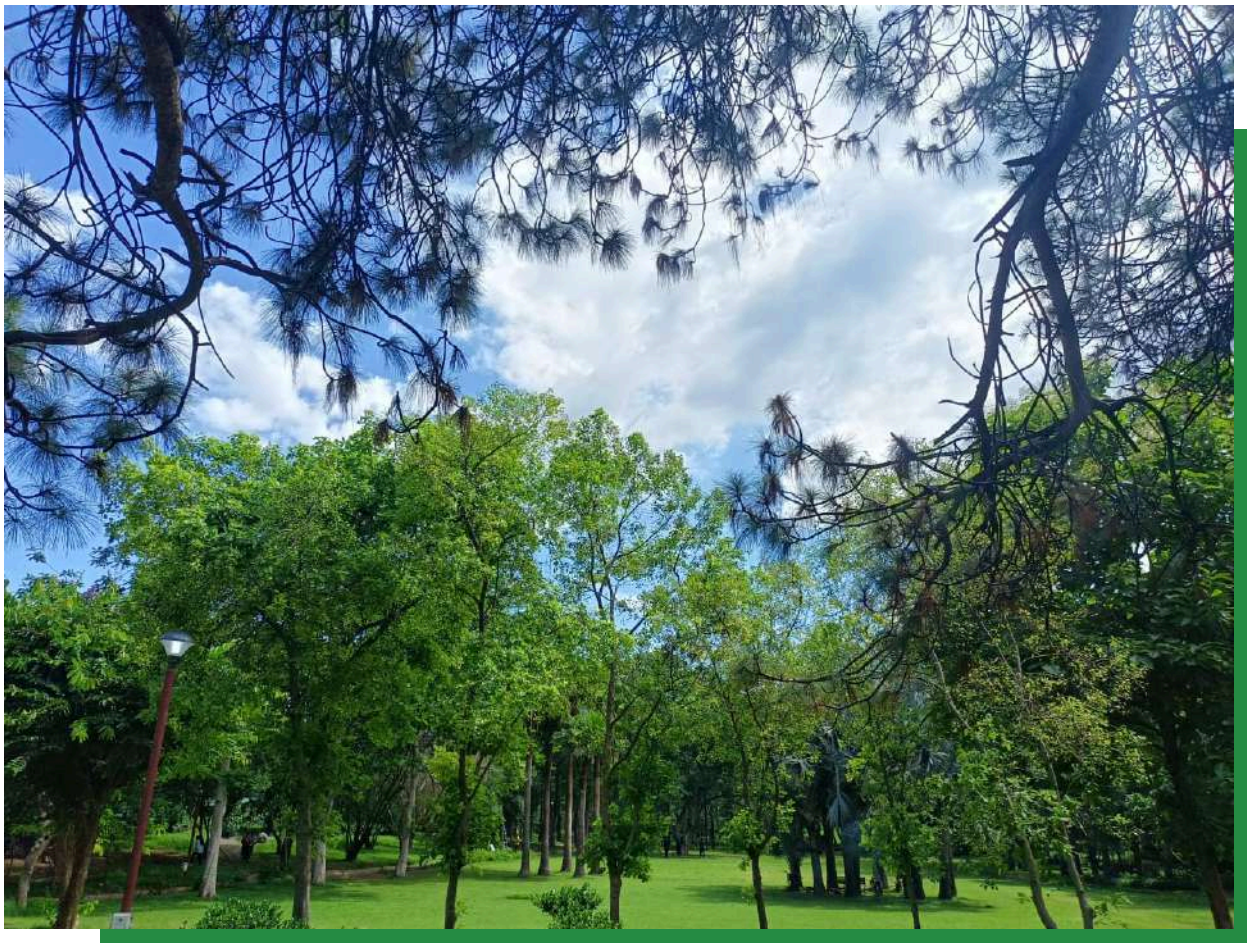
[12] Hirra Azmat, 2024, ' Rapid urbanisation and climate change threaten groundwater resources in Ladakh, says study', Mongabay: https://india.mongabay.com/2024/07/rapid-urbanisation-and-climate-change-threaten-groundwater-resources-in-ladakh-says-study/

[13] EY, Vision 2050 for UT of Ladakh: https://cdnbbsr.s3waas.gov.in/s395192c98732387165bf8e396c0f2dad2/uploads/2020/09/2020092627.pdf

[14] Rajya Sabha unstarred question no. 1690 to be answered on 18/12/2023: https://sansad.in/getFile/annex/262/AU1690.pdf?source=pqars&utm_source=chatgpt.com

[15] EY, Vision 2050 for UT of Ladakh: https://cdnbbsr.s3waas.gov.in/s395192c98732387165bf8e396c0f2dad2/uploads/2020/09/2020092627.pdf

2.2 Jangal - State of forests in Ladakh



Ladakh is a dry desert with very limited vegetation. Moreover, a large part of Ladakh is also under permanent snow cover. Its dryness, deserts, snow cover, glaciers and limited vegetation contributes to a unique Himalayan ecology and biodiversity. According to India's State of Forest Report, 2023 released by the Forest Survey of India, its total forest cover is just 2285 sq km out of its total geographical area of 1,69,421 sq km. Forests in Ladakh are governed by two territorial forest divisions namely Leh forest division and Kargil forest division. The UT has two wildlife sanctuaries.

There are a lot of inconsistencies in data related to forest area and area of recorded forests, total forest cover and area of wildlife sanctuaries in Ladakh. For example the ISFR-2023 report reveals that the UT has just 7 sq km of recorded forest. However, the same report further declares that its total forest cover inside recorded forests is 794.58 sq km.[16] Furthermore, the website of Wildlife Institute of India (WII) claims that the UT has two wildlife sanctuaries in Ladakh and cumulatively these sanctuaries covers more than 15% of the total geographical area of the UT.[17]

Amid these data discrepancies, the India's State of Forest Report (ISFR), 2023 claims that the UT has forest cover on its 2,296 sq km landmass. Of this, a substantial portion (65%) is located outside the recorded forest. Data further reveals that most of the forest is in the category of open forest with canopy density between 10 and 40. Only 23% of the forest in UT is categorized as dense forest by the ISFR-2023.

[16] ISFR, 2023, FCI, Dehradun

[17] Wildlife Institute of India: https://wii.gov.in/wildlife_sanctuaries

Table 3: Quality of Forest inside and outside recorded forests in Ladakh

Forest Cover Category	Inside the Recorded Forest Area (or Green Wash) (km^2)	Outside the Recorded Forest Area (or Green Wash) (km^2)	Total (km^2)	% Distribution Inside RFA	% Distribution Outside RFA
Very Dense Forest (VDF)	2.20	0.07	2.27	0.28%	0.00%
Moderately Dense Forest (MDF)	183.53	325.54	509.07	23.10%	21.83%
Open Forest (OF)	608.85	1,165.73	1,774.58	76.62%	78.17%
Total Forest Cover	794.58	1,491.34	2,285.92	100%	100%

Ladakh has a unique cold desert ecosystem, which has very less canopy density. However, of the total forest area in the UT more than 52% forests are in the category of west Himalayan subalpine fir forest and Dwarf juniper scrub. These forests are followed by dry alpine scrub which contribute nearly 21% of the total forest area in Ladakh. Dry broad leaved and coniferous forest accounts for nearly 9% of the total forest area in the UT. The ISFR-2023 categorizes the forest of Ladakh into 14 different categories. Of these forest types in Ladakh, the above-mentioned three forest ecosystems account for about two third of the total forest area in the UT.

Table 4: Forest Types in Ladakh

Sl. No.	Forest Type (Champion & Seth Classification, 1968)	Area (km²)	% of the Total Mapped Area
1	12/C1c Moist deodar forest (Cedrus)	2.91	0.11
2	12/C1d Western mixed coniferous forest	7.04	0.27
3	12/C1f Low-level blue pine forest (P. wallichiana)	1.73	0.07
4	12/C1/DS1 Oak scrub	0.10	0.00
5	12/C1/DS2 Himalayan temperate secondary scrub	31.93	1.22
6	13/C1 Dry broadleaved and coniferous forest (Quercus ilex - P. gerardiana)	231.30	8.84
7	13/1S2 Populus/Salix forest	201.99	7.72
8	14/C1a West Himalayan sub-alpine fir forest	703.77	26.90
9	14/2S1 Sub-alpine blue pine forest (P. wallichiana)	171.76	6.57
10	16/C1 Dry alpine scrub	540.60	20.67
11	16/E1 Dwarf juniper scrub	681.52	26.05
12	TOF/Plantation	36.76	1.41
Total (Forest Cover & Scrub)		2,611.41	99.83
Grassland Forest Type (outside forest cover)			
13	14/DS1 Sub-alpine pastures	4.51	0.17
14	15/C3 Alpine pastures	0.02	0.00
	Grand Total (Forest Cover, Scrub & Grasslands)	2,615.94	100.00

A very small part of Ladakh has vegetation recognized as forest as per the definition of Forest Survey of India. Major tree species in the UT include Salix species, Populus species, Prunus species, Salix alba and Populus ciliat. Of these salix species are in abundance providing resources such as fuel wood and timber in Leh and Kargil regions of the UT.

Source: Image

2.3 Jameen: State of land in Ladakh

The entire region of Ladakh is rugged and mountainous with little vegetation. Mountains are sedimentary rocks and are disintegrating due to weathering. Soil of the UT does not support healthy agriculture as its soils are sandy and loamy in nature. Largely soils in Ladakh is deficient in organic matter and low in important minerals such as phosphorus and potash.[18] Being the sandy nature of the soil, it is highly vulnerable to erosion. Furthermore, it restricts the agricultural season in the UT.

Ladakh is categorized as a 'cold arid' agro ecological zone, which produces crops like barley, wheat and apricot. The limited agricultural production and short crop seasons led people to practice agro-pastoral occupations in the UT. A study conducted by Defence Institute of High Altitude Research (DIHAR) found that soils in both Kargil and Leh have very low water holding capacity. Moreover, they found that soils in both the districts of Ladakh are high in potassium and low in phosphorus. Micronutrient in soil such as zinc, iron, copper and manganese were also found below critical level.[19]

Table 5: Agro Ecological Zones of Ladakh

Agro Ecological Zone	Region	Area
Cold Arid	Leh and Kargil	The area varies in elevation from 3500 to 8400 meter above sea level and conducive for production of crops such as Barley, Wheat and Apricot. Nearly 100 per cent agricultural land in this region is irrigated majorly using spring water.

https://www.jkapd.nic.in/pdf/agendaa.pdf

The land use pattern of two districts of Ladakh remains largely static in the last couple of decades. The net cropped area has marginally increased from 18.1 thousand hectare in 1998-99 to 20 thousand hectare in 1998-19. Such marginal increase was also observed in the case of total land not available for cultivation and total fallow land during these two decades. Such insignificant change in land use pattern in Ladakh is attributed to limited land for agriculture and higher dependency of communities on agro-pastoral occupations for subsistence living.

[18] Central Groundwater Board, District Ground Water Information Brochure, Leh district: https://www.cgwb.gov.in/old_website/District_Profile/JandK/Leh.pdf

[19] DIHAR, 2012, 'improving soil health status of cold desert ladakh region': http://cazrienvis.nic.in/lehpdf/240001.pdf

Table 6: Classification of Land of Ladakh (000 Hectare)

Year	Land Not available for Cultivation			Other Uncultivated Land Excluding Fallow Land	Total Fallow Land	Net Area Sown	Cropped Area
	Area under Non Agricultural Use	Barren and Unculturable Land	Total				
1998-99	4084	29746	33830	9683	1893	18156	19087
2018-19	7903	27640	35543	6973	2347	20072	21567

https://data.desagri.gov.in/weblus/classification-of-area-report-web

While the land use pattern has not changed significantly in Ladakh in the last couple of years, the land holding is highly skewed as in other parts of the country. However compared to Jammu and Kashmir the average land holding size in Ladakh is higher. Data shows that of the total 38,612 land owners in the UT more than 80% (31,005) are marginal farmers with land holding less than 1 hectare. Less than one percent of farmers have land holding above 10 hectares.

Table 7: Land Holdings Size in Ladakh

Class Size	Holdings		
	Leh	Kargil	Total
Marginal (upto 1 ha)	17306	13699	31005
Small (1-2 ha)	2875	2244	5119
Semi Medium (2 to 4 ha)	1124	833	1957
Medium (4 to 10 ha)	160	143	303
Large (10ha and above	219	9	228
Total	21684	16928	38612

Source: Agricultural Census 2010–2011

The total food grain production in Ladakh is around 1 lakh quintals and fruit production is 1.6 lakh quintals per year. This production is grossly insufficient for people in the UT. To meet its demand of food grains and fruits, Ladakh imports 73% of its food grains and 85% of its fruits.[20]

Despite this shortage, the area under principal crops in Ladakh has decreased in the last three decades. Data shows that the area under wheat production in Leh district has decreased from 28% of the total cultivation area in 1999-00 to 14.83% in 2012-13. Similar, but lesser decline was also observed in wheat production in Kargil district during the period.

[20] EY, Vision 2050 for UT of Ladakh https://cdnbbsr.s3waas.gov.in/s395192c98732387165bf8e396c0f2dad2/uploads/2020/09/2020092627.pdf

Table 8: Area under principal crops in Ladakh (in thousand hectares)

(Area in terms of percentage to total cropped area)

Year & District	Wheat	Barley	Gram	Other Millets and Pulses	Fruits & Vege-tables	Oilseeds	Fodder Crop	TCA (hect-ares)
Leh								
1999–00	28.23	1.69	52.69	5.56	3.14	0.24	8.45	9152
2004–05	28.36	0.72	42.15	5.22	3.04	0.61	19.91	10499
2009–10	25.37	0.38	43.81	5.65	4.22	0.81	19.76	10604
2012–13	14.83	0.05	38.97	11.00	5.55	1.17	28.43	7363
Kargil								
1999–00	16.27	39.68	9.24	3.42	–	–	31.39	9852
2004–05	14.08	37.29	11.08	2.47	–	–	35.09	9923
2009–10	15.99	32.14	11.95	3.66	–	0.52	35.79	10010
2012–13	12.13	39.80	11.00	–	3.53	–	33.54	10914

Source: Padma Dolker [21]

Barley is commonly grown in Leh and Kargil. Largely it is being cultivated in Kargil district. Its cultivation in Leh district is very less. Barley has great resilience properties in dry ecological conditions such as Ladakh. Therefore, people continue to grow barley in the UT. Area under Barley cultivation in Kargil has remained around 39% of the total cultivation area in the last three decades. A study conducted by Dolker (2018) reveals that the increasing dependency on the PDS system gradually phased out traditional cultivation of climate resilient millets. Moreover, the study observed that people have shifted from traditional millet cultivation to cultivation of cash crop and fodder crop. This shift was brought in to meet local demand of Indian armed force.[22]

Source: Image

[21] Padma Dolker, 2018, An Overview of Transition in Traditional Agriculture of Ladakh, J. Himalayan Ecol. Sustain. Dev. Vol. 13 (2018) ISSN 0973-7502 26: https://envirsc.uok.edu.in/Files/ab1ac1f1-07e3-42a2-85bc-83717ef39155/Menu/Final_copy_Journal_2018-28-50_compressed_967e6ad7-6477-42da-8d50-62d5ffd8df25.pdf

[22] https://cdn.s3waas.gov.in/s3291597a100aadd814d197af4f4bab3a7/uploads/2018/09/2018090728.pdf

Table 9: Fertilizer Off-take (Quantity in 000 Quintals), Leh

Year	Nitrogen (000 qtls)	Phosphorus (000 qtls)	Total (000 qtls)
2011–12	3.9	4	7.9
2012–13	3859	3780	7639
2013–14	3900	3260	7160
2014–15	3721	2818	6539
2015–16	3408	2967	6377

Source: District Statistical Handbook, Ladakh, 2016-17

A study on agricultural patterns in Ladakh published by Journal of Himalayan Ecology reveals that traditional agricultural practice declined recently and use of chemical fertilizers and mechanization started (Dolker, 2018). This statement is further validated by the fertilizer off-take data of Leh district compiled from district statistical handbook. The data suggest that the total nitrogen and phosphorus purchasing has increased from just 7.9 thousand quintals in 2011-12 to over 6000 thousand quintals in 2015-16.

Changes in climatic conditions, agricultural practices and land use change are some major factors that have affected local soil and land. The soil which had low micronutrient is now dependent on chemical fertilizers for better yield. The degradation of land and soil is also evident in data released by the Space Application Centre of ISRO. According to their data as much as 42.31% of Ladakh's geographical area is degraded and deserted. More importantly, since 2003-05 more than 3% of Ladakh's land has degraded, which indicates the intensity and pace of land degradation in the UT.

Source: Image

Table 10: Desertification / Land Degradation Data

Process of Desertification / Land Degradation	2018–19 Area (ha)	2018–19 Area (%)	2011–13 Area (ha)	2011–13 Area (%)	2003–05 Area (ha)	2003–05 Area (%)
Vegetation Degradation	1,122,940	6.68	1,115,514	6.64	1,098,797	6.54
Water Erosion	9,243	0.05	9,243	0.05	9,243	0.05
Wind Erosion	1,738,937	10.34	1,673,347	9.95	1,653,634	9.84
Mass Movement	941,083	5.60	929,710	5.53	845,213	5.03
Frost Shattering	3,082,140	18.32	2,964,674	17.64	2,752,763	16.28
Barren / Rocky	219,725	1.31	219,058	1.30	207,234	1.22
Total Area under Desertification	7,111,968	42.31	6,911,573	41.12	6,576,853	39.11
No Apparent Degradation	9,513,355	56.59	9,714,757	57.79	10,044,881	59.76
Total Geographical Area	16,809,700	–	16,809,700	–	16,809,700	–

https://vedas.sac.gov.in/static/atlas/dsm/DLD_Atlas_SAC_2021.pdf

Major factors responsible for desertification and degradation in Ladakh include vegetation degradation, water erosion, wind erosion, mass movement and frost shattering. Because of the cold weather, the frost shattering is a major cause of land degradation in Ladakh. Estimates of SAC reveal that more than 18% of land has been degraded in Ladakh due to frost shattering. Frost shattering is followed by wind erosion as the second most land degrading factor responsible for degradation of more than 10% of the total land mass of the UT. From 2003-05 to 2018-19, both of these major factors behind land degradation and desertification have degraded an additional 2.54% of Ladakh.

Source: Image

2.4 Jalvayu Parivartan - Climate change in Ladakh

Both districts of Ladakh namely Leh and Kargil are located on the Himalayas' rain-shadow side but at very high elevation. It receives very cold and dry wind after leaving its humidity and water content in the plain and other Himalayan regions. All these natural climate conditions make the climate very harsh. The average elevation of Ladakh is 3650 meter above sea level therefore its minimum temperature ranges from -20 degree centigrade to -40 degree centigrade in the months from December to February. The highest temperature of Ladakh also goes very high in summer. The temperature in summer goes as high as +35 degree centigrade.[23] Ladakh is also known as cold desert because of its harsh, arctic and desert climates.

January is the coldest month in Ladakh when the mean minimum temperature is about -14.4 degree centigrade and man maximum temperature is about -2 degree centigrade. The temperature rises gradually from March onwards till August. August is the hottest month with mean maximum temperature 25.3 degree centigrade and mean minimum temperatures about 10 degree centigrade.

Table 11: Mean rainfall (mm) and number of rainy days

District	Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Kargil	Rain	35.0	38.9	44.2	31.7	30.0	12.9	22.9	32.1	10.1	13.4	24.0	24.2	319.4
Kargil	Day	3.2	3.3	4.3	2.9	3.2	1.3	1.4	1.2	1.1	1.0	1.7	2.0	26.6
Leh	Rain	7.1	7.7	9.9	8.1	7.9	5.3	15.6	12.5	10.1	4.1	2.8	5.6	96.7
Leh	Day	1.0	1.0	1.2	0.9	0.9	0.7	1.6	1.6	1.0	0.4	0.3	0.8	11.4

While Ladakh is very cold, it receives very less precipitation. The annual rainfall in Kargil is 319mm and in Leh is just 96mm. Rainy days in Kargil in a year are around 26 days, whereas, it is just 11 days in Leh. Pre monsoon showers the region most. In this season, Ladakh receives 32% of its total precipitation. Moreover, both winter and south west monsoon season contributes 29% each of total rainfall.[24]

A study by Qin et al (2018) published in the Journal of Mountain Science observed that the temperature of Ladakh is steadily increasing. More importantly, the winter temperature is increasing. Such an increase is threatening glaciers as they are melting at a higher rate. Moreover, the study found variability in snowfall and unpredictable seasonal precipitation in recent decades.[25] Another study by Ahmed and Mir (2019) also found seasonal variation in precipitation in Ladakh adversely affecting agriculture and water availability.[26]

[23] Padma Dolker, 2018, op.cit.

[24] Padma Dolker, 2018, op.cit.

[25] Qin, D., Liu, C., & Li, P. (2018). Observed climate variability in the Trans-Himalayan region (Ladakh) and its implications for water resources. Journal of Mountain Science, 15(4), 753–767

[26] Romshoo, S. A., Rashid, I., & Shah, R. A. (2012). Impact of climate change on the melting of Dokriani and Siachen glaciers in the Indian Himalayas. Current Science, 103(3), 317–324.

3 Status of the natural environment in Jammu & Kashmir

Source: Image

The complexity and variations in hydrology, geo-hydrology, physiographic and location of Jammu and Kashmir makes the UT very diverse and endowed with numerous natural wealth ranging from lakes, rivers, forests, hills, mountains and glaciers. Such variations have also diversified social, cultural and economic life in this newly formed UT.

Largely, the UT is divided into two regions namely Jammu and Kashmir. Jammu has landforms like plains, valleys and hills, which makes its soil fertile and productive for crops like wheat and maize.

However, most of its agriculture is rain fed. Kashmir has high mountains, lakes and snow covered areas. Its land is fertile and suitable for production of apple, rice, maize and saffron.

The entire UT is located in the Indus river basin with hundreds of small rivers and streams feeding major rivers like Jhelum, Ravi, Chenab and Indus. Both regions have rich forested areas. These forests have been used for timber extraction as the UT forests have an abundance of trees such as Deodar, Kail, Chir and Fir.

This chapter provides a brief overview of the state of the natural environment in Jammu and Kashmir.

3.1 Jal - State of water resources

The entire Union Territory of Jammu and Kashmir drains into the Indus river basin. It is the largest river basin in the Indian Himalayan region covering part of Himachal Pradesh, entire UTs of Jammu & Kashmir, Ladakh and part of Punjab, Haryana and Rajasthan. In total Indus basin has a total geographical area of 1081 thousand square kilometers. Further the Indus river basin is subdivided in eleven sub-basins. Of these six sub basins namely Upper Indus, Lower Indus, Jhelum, Chenab, Gilgit and Ravi are substantially part of UT of Jammu & Kashmir.

Glaciers play an important role in feeding almost all rivers in the Indus river basins. According to ICIMOD nearly 50% of river flow in the Indus basin is from glacier melt. Which is very high compared to other two major Himalayan river basins – Ganga and Brahmaputra. According to this study glacier melt contribute only 12% of river flow in Brahmaputra basin and 9% in Ganga basin. Major rivers in the UT are Jhelum, Chenab, Indus, Tavi and Ravi. A large area in Jammu & Kashmir is permanently snow covered and houses hundreds of glaciers.[27] The undivided UT of Jammu & Kashmir had nearly 60% of its geographical area under permanent snow cover. However, it has substantially decreased after bifurcation of the state.

The good precipitation (both rain and snow) keeps water resources of the state alive. According to rainfall data the UT receives more rain in Jammu division compared to Kashmir valley. The annual average rainfall of the UT is 1028 mm but it varies significantly from one district to another due to high variation in topology. District like Badgam, Bandipura, Pulwama and Srinagar receives average rainfall around 600mm. However districts like Udhampur, Reasi and Kathua receive more than 1400 mm rain in a year.

Source: Image

[27] https://lib.icimod.org/record/28401

Rainfall is also unevenly distributed across the region and time. For example the Jammu region receives about 68% of its total rainfall during Monsoon as part of southwest monsoon season. In winter it receives 15% of its total annual rainfall. Further the Kashmir valley receives as much as 40% of its total annual rainfall in the pre-monsoon season. Winter rain and snowfall contribute 25% of the total rainfall in the region.

Table 1: Major Water Statistics of J&K

Number of major river catchments	**Number**	**3**
Watersheds	Number	440
Micro-watersheds	Number	4195
Average annual Rainfall	MM	1011
Number of lakes and water bodies	Number	565
Number of villages with springs	Number	3313

Source: compiled from different Govt sources

The Indus river basin drains 42,241 sq km of Jammu and Kashmir along with a large area of Ladakh, Himachal Pradesh and other states. In total the basin has a total capacity of 73,330 MCM water, out of which nearly 46,000 MCM is utilizable surface water in the form of streams, rivers, ponds and lakes. A substantial part of this water is available in Jammu and Kashmir.[28]

Groundwater is not a major source of water in the union territory; however, as in any region the hydrogeology of Jammu and Kashmir play important role in ecological services. The CGWB reveals that the hydro geological set up of Jammu and Kashmir is highly complicated. Both Jammu and Kashmir region have very distinct aquifer characteristics. The hydro geological formations of the UT are broadly divided into two categories namely porous formation and Fissured formation. The maximum groundwater level in Kashmir region was 15.66 mbgl in August 2021. In Jammu region the water depth in August 2021 was in the range of 0.85 mbgl to 35.6 mbgl.

Jammu and Kashmir is also famous for its large lakes, streams and waterfalls. These water resources not only contribute to the picturesque beauty of the region but are also linked to local culture, economy and subsistence. According to the first water body census conducted in 2021 the UT has 9,765 water bodies. More than 48% of these water bodies are owned by individual, community groups and other private bodies.[29] Compared to its neighbouring state Himachal Pradesh, these numbers are very less, however, they contribute immensely to provide water for various usages. Out of these water bodies 7,493 water bodies are fully functional. Of the 7493 in use water bodies of the UT, 5986 water bodies are used for drinking water. Only 719 water bodies out of total are used for irrigation in the Union Territory.

[28] https://www.cgwb.gov.in/old_website/GW-Assessment/GWR-2022-Reports%20State/Jammu%20_%20Kashmir.pdf

[29] https://cdnbbsr.s3waas.gov.in/s3a70dc40477bc2adceef4d2c90f47eb82/uploads/2023/04/2023040672.pdf

Table 2: Census of Water Bodies- J&K

Type of Water Body	Number
Pond	5256
Tanks	179
Lakes	37
Reservoirs	441
Water Conservation structures	29
Other	3823
Total	9,765

Source: Water Body Census, 2023

Before the nationwide census of water bodies conducted by the Union Ministry of Water Resources, the Jammu and Kashmir government had also conducted a survey of lakes and ponds in the erstwhile state of Jammu and Kashmir.[30] According to this state specific census, there are 565 lakes and ponds in the UT. Of these, 415 lakes are located in Kashmir region and 150 lakes and ponds are in Jammu division. This census report has raised concerns relating to drying of water bodies due to the number of regions. The report found that catchment areas of these lakes are highly compromised and also dumping of sewage waste in these water bodies has polluted the Lake Ecosystem.

Source: Image

[30] https://ssdi.jk.gov.in/profiles/dkan/themes/nuboot_radix/templates/page/homepage/Directory%20of%20Lakes%20&%20Waterbodies%20of%20J&K%20State.pdf

Springs in the entire Himalayan region play an important role in rural and urban life. According to an estimate of the NITI Aayog in 2018, there are around 3 million springs in the Indian Himalayan region. The first census of springs in India reveals that about 50% villages in Jammu and Kashmir have one or more springs meeting water demands of villagers.[31] According to this census 3313 villages out of 6553 villages of Jammu and Kashmir have springs.

Jammu and Kashmir is a water surplus UT with range of water sources and abundance of permanent snow cover, glaciers, rivers, streams and lakes and groundwater aquifers. Most o the river of Indus basin passes through the UT. However, both climatic challenges and anthropogenic pressure have increased vulnerability of these water resources. The receding of glaciers in the Himalayan region and decreasing area under permanent snow cover will affect water flow in rivers. Moreover, encroachment in the catchment area of lakes and springs has threatened these two major sources of water in the UT.

3.2 Jangal - State of forests in Jammu & Kashmir

Nearly 47.8% of the total geographical area of Jammu and Kashmir (42,241 sq km) is forest in the records of administration of the Union Territory. The total forest in the UT is 20,199 sq km out which 17,648 sq km is reserved forests. These records are based on limited reporting of land use in the UT due to number of complex issues. The Forest Survey of India has been reporting state of forest based on 38,433 sq km area of Jammu and Kashmir. The ratio of forests to the total geographical area of State/UT is relatively less in Jammu and Kashmir compared to Himachal Pradesh and Uttarakhand. However, forests in the UT have always been integral part of subsistence life and major source of income for the state. Shepherd communities of UT such as Bakarwal, Gaddi and Chopan have been using both high altitude and low altitude forests of the state for sheep rearing. They usages alpine grasslands in summer as grazing land for sheep.

Source: Image

[31] https://ifcjmu.gov.in/PPT_pdf/1st%20Springs%20census%2020-08-2023.pdf

Moreover, communities in both Jammu and Kashmir divisions have been using local forests for a number of minor forest products both for their subsistence life, cultural practices and commercial sale of minor forest products.

More than 72% of the UT's population lives in villages dependent largely on agriculture and allied activities such as livestock, horticulture and agricultural labour. All these occupational sectors are highly dependent on local forests and their resources. In other words as high as 70% of the population of the state have been dwelling in forests for their subsistence.

The UT of Jammu and Kashmir was formed in 2019 after bifurcation of erstwhile state of Jammu and Kashmir. There is no data to compare the state of forest in the newly carved out UT, yet based on available information of forests in Ladakh and Jammu & Kashmir, it can be argued that the UT has not observed any drastic change in its forest cover in the last two decades.

The total forest cover including tree cover of Jammu and Kashmir in 2001 was 21,237 sq km, which remains same in 2023 at 21,346 sq km in 2023.

Table 3: Forest Cover in Indian Himalayan States

State/UT	2001(Area in sq km)			2023(Area in sq km)		
	Dense Forest	Open Forests	Total Forest Cover	Dense Forest	Open Forests	Total Forest Cover
Ladakh	NA	NA	NA	511.34	1,774.58	2,285.92
Himachal Pradesh	10,429.00	3,931.00	14,360.00	10,397.89	5,182.46	15,580.35
Jammu & Kashmir	11,848.00	9,389.00	21,237.00	12,215.35	9,131.04	21,346.39
Uttarakhand	19,023.00	4,915.00	23,938.00	17,784.21	6,519.62	24,303.83
Sub Total (West Himalayas)	41,300.00	18,235.00	59,535.00	40,908.79	22,607.70	63,516.49
Manipur	5,710.00	11,216.00	16,926.00	7,121.6	9,463.86	16,585.46
Meghalaya	5,681.00	9,903.00	15,584.00	9,618.65	7,348.19	16,966.84
Mizoram	8,936.00	8,558.00	17,494.00	8,897.28	9,093.18	17,990.46
Nagaland	5,393.00	7,952.00	13,345.00	5,718.19	6,504.28	12,222.47
Sikkim	2,391.00	802.00	3,193.00	2,659.2	699.2	3,358.40
Arunachal Pr.	53,932.00	14,113.00	68,045.00	50,600.41	15,281.16	65,881.57
Sub Total (East Himalayas)	82,043.00	52544	134587	84,615.33	48389.87	133005.2
Grand Total (Himalayas)	1,23,343.00	70,779.00	1,94,122.00	125,524.1	70,997.57	1,96,521.69

Source: ISFR, 2001 and ISFR, 2023

Deodar, Kail, Chir and Fir are major commercial tree species available in forests of Jammu and Kashmir. More than 40% of the mapped forest area in Jammu and Kashmir has these tree species. These commercially viable tree species are found in forests like Lower Chir pine forests, Himalayan chir pine forests, Moist deodar forests and blue pine forests. Himalayan Silver Fir, also known as Budul in Kashmir valley is widely used by carpenters for furniture and construction. This is the most extracted timber in the UT according to the annual report of the Jammu and Kashmir forest department, it extracted 74,000 cu.m Fir in2022-23 of worth Rs. 170.43 crore.

The forest department of the UT has invested a lot in planting these tree species as they have high commercial value. Moreover, it also has Northern dry mixed deciduous forest, Ban oak forest, western mixed coniferous forest, alpine and subalpine pastureland that plays a crucial role in promoting and supporting local subsistence and lifestyle. Cumulatively, these forests in the UT account for more than 36% of the total area mapped (TMA) by the Forest Survey of India (FSI) in 2023. More than 17% of the mapped area of the UT has pasture land used by traditional forest dwellers such as Chopans, Bakrwal and Gaddi as grazing land in summer.

Table 4: Forest Types in J&K

Type	Area (sq km)	% to TMA
Northern dry mixed deciduous forest	1,579.40	6.03
Dry deciduous scrub	419.47	1.6
Lower or Siwalik chir pine forest	2,609.06	9.97
Upper or Himalayan chir pine forest	1,094.78	4.18
Ban oak forest (Q. incana)	603.96	2.31
Moist deodar forest (Cedrus)	1,675.08	6.4
Western mixed coniferous forest (spruce, blue pine, silver fir)	3,557.18	13.59
Low-level blue pine forest (P. wallichiana)	2,168.28	8.28
Dry deodar forest (Cedrus)	650.22	2.48
West Himalayan high level dry blue pine forest (P. wallichiana)	1,271.03	4.86
West Himalayan sub-alpine birch/fir forest	1,426.28	5.45
Dry alpine scrub	606.45	2.32
Grasslands		
Himalayan Temperate Pastures	798.28	3.05
Alpine Pasture	2,637.42	10.08
Sub-alpine pastures	1,133.77	4.33

There are discrepancies regarding the status of forest land in Jammu and Kashmir. According to the annual report of Jammu and Kashmir forest department it has 4861 sq km as protected forests. However the India's State of Forest Report (ISFR)- 2023 published by Forest Survey of India (FSI) claims that only 2,551 sq km of forests in the UT has the status of Protected forests. The UT administration claims that it has four national parks (2430 sq km), 14 Wildlife Sanctuaries (1,754 sq km), 16 conservation area (520 sq km) and 14 wetland reserves (156 sq km).[32]

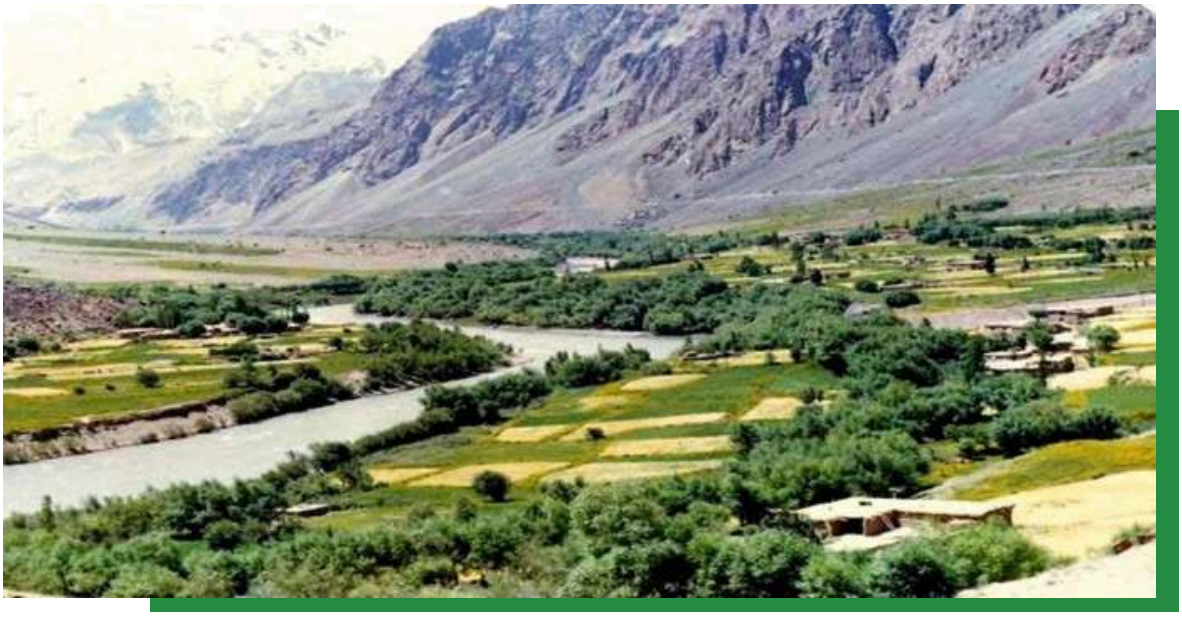
According to information provided by the UT administration, it has a sizable forest land as protected land. However, the ISFR-2023 reports that the UT has 2,551 sq km of protected forest which is just above 12% of the total forest area. The reserved forest according to the ISRF report is 17,648 sq km and there is no area under the unclassified forest.

Table 5: Forests by Category

Forests according to Management	Area (in sq km)
Reserved Forests	17,648
Protected Forests	2,551
Unclassified Forests	0
Total	20,199

Source: ISFR, 2023

J&K has 20,199 sq km of forest land and all of it is either protected or reserved forest. Yet, a large portion of this forest land has no forest as per records of India's State of Forest Report (ISFR), 2023. According to this report, 7,087 sq km of forest land has no forest cover in the state. In other words more than 35% of forest land in the UT has no tree cover. This unaccounted forest land in the UT is less compared to Himachal Pradesh and Uttarakhand. A lot of this land may be under permanent forest cover and also consists of rocks and mountains therefore not suitable for vegetation. Yet, a large portion of this unaccounted forest land is without tree cover despite the possibility of vegetation.



Source: Image

[32] https://www.jkforest.gov.in/assets/pdf/publications/Handbook%202022-23%20Final%2016%20march-1.pdf

The forest cover of Jammu and Kashmir as reported by the Forest Survey of India is 21,346 sq km in 2023. This accounts for nearly 40% of the total geographical area of the UT. However, out of this total forest cover only 13,112 sq km is on the forest land owned by the government and its agencies. The report further reveals that 8,234 sq km forest cover is outside the recorded forest area of the UT. This constitutes nearly 39% of the total forest cover in the state. The ratio of forest cover outside recorded forest in Jammu and Kashmir is significantly high compared to Uttarakhand and Himachal Pradesh. The share of forest cover outside the recorded forest in these two states is about 30% of their respective total forest cover.

Table 6: Forests as per recorded status

Forest Status	Area in sq km
Total Geographical Area of J&K	54,633
Total Recorded Forest	20,199
Actual Forest Cover in Recorded Forests	13,112
Un Accounted Forests (missing forests)	7,087
Actual Forest cover in Forest outside Recorded Forests	8,234
Total Tree Cover	3,666

Source: ISFR, 2023

The formation of UT and bifurcation of erstwhile state has changed the administrative system and political boundary of Jammu and Kashmir in 2019. Moreover, disputes on international boundaries and illegal occupation of Pakistan in certain parts of Jammu and Kashmir makes the situation very complicated to assess data, especially data related to land and forests. Because of these reasons we don't have old time series data to compare the status of forests in Jammu and Kashmir. However, the available data from 2001 onwards reported in different ISFR reports suggest that there has been no significant change in the total area and quality of the forest in this UT.

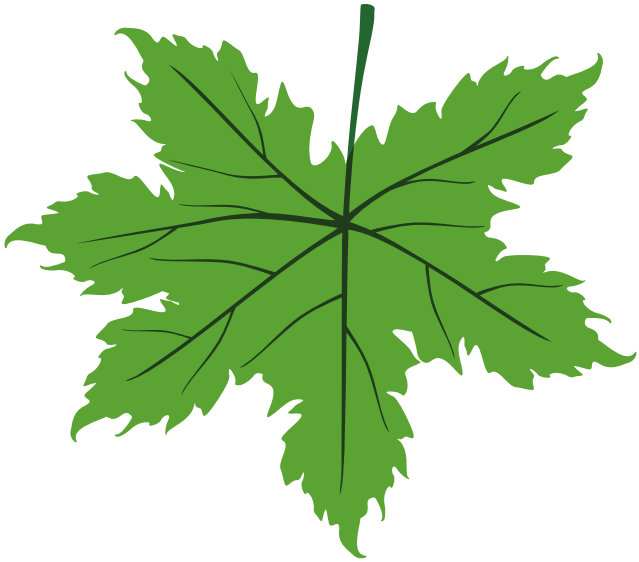


Table 7: Quality of Forest inside recorded forests in J&K

Year	Total Forests(in sq km.)	Dense Forest (Canopy Density more than 40%) (in sq km.)	Open Forest (Canopy density between 10 to 40%) (in sq km.)
2019	13239	8407	4832
2021	13111	8426	4685
2023	13076	8424	4652

Compiled from ISFR, 2019, 2021, 2023

Unlike in Himachal Pradesh and Uttarakhand, where the canopy density of dense forests is gradually deteriorating, forests of Jammu and Kashmir remain almost static despite a high level of extraction for timber and other minor forest produce. From 2019 to 2023 for which we have UT specific forest data, there is negligible fluctuation in quality and quantity of forest cover in Jammu and Kashmir.

Commercialization of forests and minor forest products in Jammu and Kashmir is very common. The UT administration earns huge revenue from sale of timber, firewood, resin, grazing fee and minor forest produce. In timber trees like pine, fir and deodar are extracted at large scale every year. A lot of it is also exported through forest Development Corporation. Moreover, firewood is also commercialized both for industrial use and domestic purposes.

Minor forest produce like resin, harar, bamboo, jamun, curry leaf, arjun tree, amla and camphor are extracted and sold. The sale of firewood has been a major source of income for the state in the last five years. In the year 2022-23, it received Rs. 924 lakh.

Source: Image

Table 8: Forest Resources Extracted

Forest Resources	2018-19	2019-20	2020-21	2021-22	2022-23
	Rs. in Lakh				
Timber	119.63	130.38	112.07	165.13	244.36
Firewood	266.59	285.2	332.2	386.45	924.15
Resin	0	0.03	835.8	52.65	0.30
Minor Forest Produce	186.68	43.09	18.19	17.9	52.65
Grazing Fee	7.92	247.99	9.05	9.44	8.22

https://www.jkforest.gov.in/assets/pdf/publications/Handbook%202022-23%20Final%2016%20march-1.pdf

The Jammu and Kashmir Forest Development Corporation (JKFDC) founded in 1978 has a variety of roles to sustainably extract forest resources in the UT. Its function includes removal of fallen wood from forests, exploitation of forest resources and undertaking research programs related to forest and forest products.

However, as per the latest audit report of C&AG, the entity is only undertaking function of removal of trees from forests and carrying out sale of timber.[33] For this function, the JKFDC pays a handsome royalty to the UT government. From 2020-21 to 2022-23 the JKFDC paid Rs. 400 core as royalty to the forest department.[34]

[33] https://cag.gov.in/uploads/download_audit_report/2020/11-Chapter%206%20TBA%20on%20JKSFC-0624fc828a883a5.18976848.pdf

[34] https://www.jkforest.gov.in/assets/pdf/publications/Handbook%202022-23%20Final%2016%20march-1.pdf

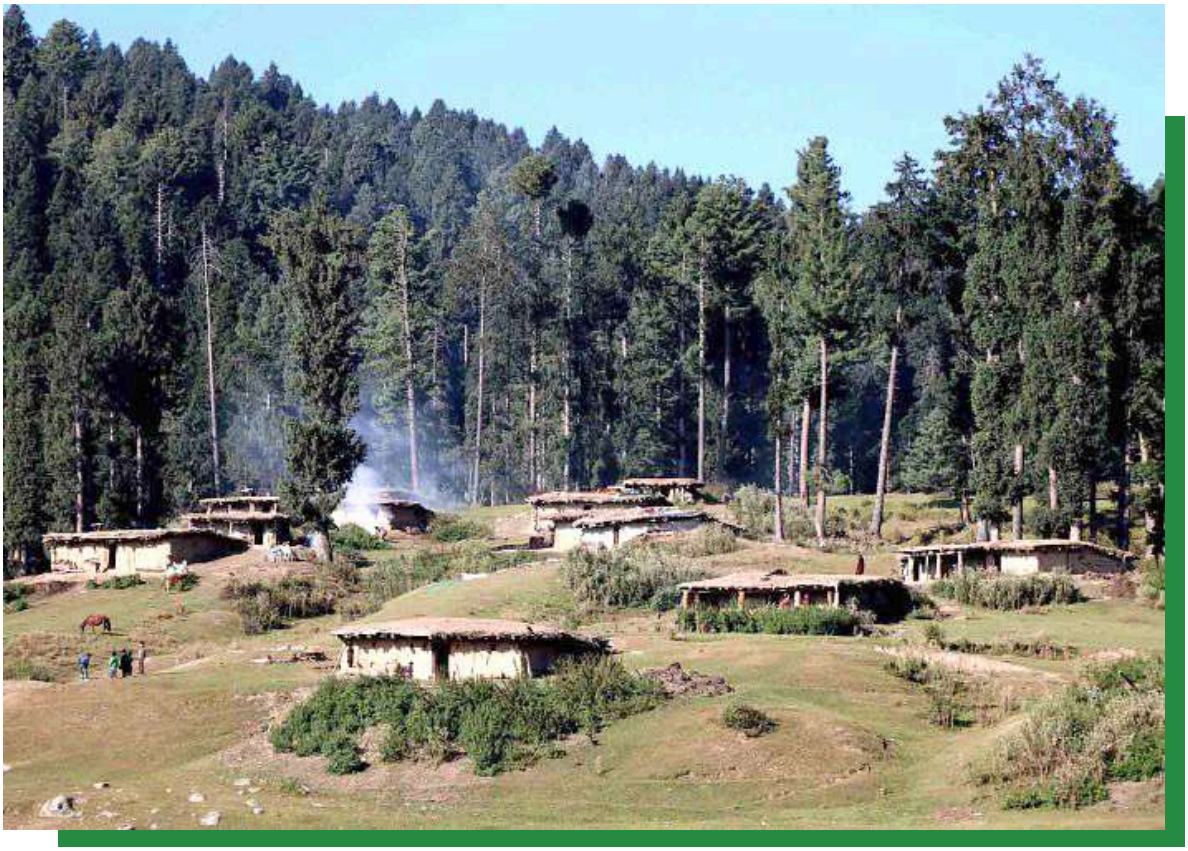
Table 9: Status of Claim under Forest Rights Act, 2006

Claims	Individual	Community	Total
Claim Received	32,207	10,224	42,431
Claim Distributed	315	4190	4505
Claim Rejected	-	-	33,187

The size of commercial activities of the forest department in Jammu and Kashmir reveals the importance of this sector in local livelihood. Thousands of families are involved in commercial activities related to forestry in the UT. Apart from commercialization, forests are also very integral to the local subsistence.

The UT of Kashmir is the only federal government in the western Himalaya, which showed interest in distributing forest land and its resources as per the Forest Rights Act, 2006. After converting Jammu and Kashmir into a Union Territory, the union government extended the Forest Rights Act to the UT. Within a period of two years, it awarded 4,505 titles to local forest dwellers. Out of this 4,190 titles were distributed as community forest rights. Only 315 titles were awarded to individuals.

However, the administration had rejected 33,187 claims out of a total 42,431 claims received in different districts. While the number of claims distributed by the UT administration looks very little, it is the highest number of titles distributed by any federal government in the Western Himalayan region.



Source: Image

3.3 Jameen: State of land in J&K

Jammu and Kashmir is divided into two major regions Jammu and Kashmir. Both of these regions of the UT have significant differences in terms of ecological diversity and agro-ecological characteristics. Jammu is a larger region which comprises 62% of the total geographical area of the UT and Kashmir accounts for 38% of the total geographical area. The Jammu division is divided into two sub agro ecological zones namely low altitude subtropical zone and mid to high altitude intermediate zone. The low altitude subtropical zone lies between 300m to 1350 m above sea level and covers the area of Kathua, Udhampur, Poonch and Rajouri district of the division. Paddy, Maize, Oat and Wheat are common crops in this zone along with cow, buffalo and sheep as common livestock. The other agro ecological zone of the Jammu region is mid to high altitude intermediate zone. This zone lies between 800m to 1500m above sea level and covers areas of Doda, Poonch,Rajouri, Udhampur and Kathua district of Jammu division. In addition to wheat and maize, this zone is also good for cultivation of barley and oilseeds. Cow and Buffalo are common livestock in this zone.

Table 10: Agro Ecological Zones of J&K

Agro Ecological Zone	Region	Area
Low altitude subtropical zone	Jammu	Jammu district and lower parts of Kathua, Udhampur, Poonch and Rajouri districts. Maximum rainfall is received during July-September. The mean height above sea level ranges from less than 300 m to nearly 1350 m.
Mid to high altitude intermediate zone	Jammu	It encompasses all the areas above outer hills, including the districts of Doda, Poonch, parts of Rajouri, Udhampur and Kathua. The zone varies in elevation from 800 to 1500 m masl in mid altitude and upto 4000 m masl in higher altitude.
Mid to high altitude temperate zone	Kashmir	The plain valleys have an altitude of 1560 m masl, which rises to 1950 m in low altitude Karewas in mid belts, 2400 – 3000 m in the upper belts and to 4200 m in snow bound areas. The soils of Kashmir valley are alluvial 4 in nature with irrigated area of about 62 percent.

https://www.jkapd.nic.in/pdf/agendaa.pdf

The entire Kashmir division is part of the Mid to high altitude temperate zone lying between 1560m to 4200m above sea level. This region has plain areas good for cultivation of paddy along with maize, oilseeds, temperate fruits, almond and saffron. As high as 62% of cultivable land in Kashmir has irrigation facilities that support massive paddy cultivation in the region. A substantial portion of the Kashmir region is snowbound with no vegetation.

Jammu and Kashmir has not changed in terms of its land use pattern in the last 2-3 decades. In 2022-23 the net sown area of Jammu and Kashmir was 733 thousand hectare, which accounts for 31% of the total reported area (2364 thousand hectare). The net sown area in 1998-99 was also 30% of the then total reported area (2381 thousand hectare). The land under two or more crops has also not changed in the UT. The data reveals that the total cropped area has marginally increased from 1061 thousand hectare in 1998-99 to 1133 thousand hectare in 2022-23.

Table 11: Classification of Land of J&K (000 Hectare)

Year	Land Not available for Cultivation			Other Uncultivated Land Excluding Fallow Land	Total Fallow Land	Net Area Sown	Cropped Area
	Area under Non Agricultural Use	Barren and Unculturable Land	Total				
1998-99	286.8	261.5	548.4	326.8	102.6	715.2	1061.8
2018-19	261.1	308.2	569.2	328.7	157.3	713.1	1123.8
2022-23	214.5	301.6	516.2	333.4	135.5	733.2	1133.4

https://data.desagri.gov.in/weblus/classification-of-area-report-web

Unlike Himachal and Uttarakhand, two major states in the Western Indian Himalaya, the land use in Jammu and Kashmir remains more or less same in the last 2-3 decades. In the other two states, data reveals that the net sown area has been gradually decreasing. Moreover, in those states the fallow land is increasing. However, the data reveals a completely different picture of Jammu and Kashmir, where agriculture has not declined.

The NSSO report found that there are 12.55 lakh families in the UT dependent on agriculture. However, like in other Himalayan states, the land holding is very small. Nearly 55% agricultural households of the UT have land below 0.f4 hectare. Marginal farmers having land in between 0.4 to 1 hectare, accounts for nearly 36% of the total households in the UT. Eight percent of households are small farmers and just 1% households have land above 2 hectares. Data shows that there is no household in the entire state that has land above 4 hectares.

Source: Image

Table 12: Distribution of Operational Holdings in J&K 2018-19

Size of holding in ha	No of Agricultural households	As % of total	No of Non-Agricultural households	No of All rural households	Income in Rs per month (2018-19) per household
<0.01 (landless)	00	0%	123,495	123,188	00
0.01 -0.4 (sub-marginal)	688,124	54.8%	308,305	995625	18,844
0.41-1.0 (marginal)	450,796	35.9%	0	450563	18,750
1.01-2.0 (small)	104,223	8.3%	0	104625	19,944
2.0-4.0 (medium)	12,557	1%	0	13500	17,005
> 4.0 (large)	00	0%	0	0	33,573
Total	12,55,700	100%	431,800	1687,500	

Source: (NSS Report no 587, Land p. A-90-93, pdf p 270, Income at p. A-886, pdf p 1064)

Of the total rural households in the state, there are around 26% households who are not dependent on agriculture. Of this more than 18% households possess land from 0.01 to 0.40 hectare. Of total as many as 7.2% households are landless and all other households are in the category of marginal, small and medium farm holding households. The income from farm across farming categorization is similar. All households irrespective of their land holding earns between Rs. 17,000 to Rs. 19,900 in a month.

Table 13: Area under principal crops in J&K (in thousand hectares)

Year	Millets	Pulses	Food Grains	Fruits	Vegetable
2004-05	360	31	889	1217	843
2009-10	357	30	936	1534	1374
2014-15	335	24	957	1779	1395
2019-20	294	17	836	2541	1337
2022-23	301	18	878	2721	1996

https://www.rbi.org.in/Scripts/AnnualPublications.aspx?head=Handbook%20of%20Statistics%20on%20Indian%20States

As discussed above the land use pattern in Jammu and Kashmir has not changed in the last two to three decades. However, there are visible changes in agricultural production in the state. The Jammu region has more agricultural land which has been producing wheat as the main crop.

On the other hand Kashmir valley has comparatively less agricultural land and it produces paddy as main crop. As given in the table above, we observe that the area under millet production has decreased from 360 thousand hectare in 2004-05 to 301 thousand hectare in 2022-23.

The reduction in area under pulses and food grains has also decreased in the last two decades like millets. However, the area under fruit and vegetable production has increased substantially from 2004-05 to 2022-23. The area under fruit production has increased by more than 100% from 1217 thousand hectare to 2721 thousand hectare. The area under vegetable production has also increased in these two decades by more than 100%.

The use of chemical fertilizer in Jammu and Kashmir is relatively less compared to its use in Uttarakhand. However, compared to Himachal Pradesh, use of chemical fertilizers in the UT is very high. The positive side of UT is that its chemical fertilizer consumption is not increasing as it is observed in Himachal Pradesh and Uttarakhand. Currently, the total fertilizer consumption of the UT is 120 kg per hectare.

Table 14: Fertilizer Consumption per Unit of Gross Cropped Area in J&K

Year	Nitrogenous (N) (kg/ha)	Phosphatic (P) (kg/ha)	Potassic (K) (kg/ha)	Total (NPK) (kg/ha)
2012-13	75.8	24.1	9.75	109.68
2019-20	50.8	16.8	11.1	78.84
2021-22	85.4	21.6	13.0	120.07

Agricultural Statistics India- At a Glance: https://desagri.gov.in/

Other challenges the soil of Jammu and Kashmir is facing is land degradation and desertification. As per Land degradation and desertification atlas prepared by Space Application Centre in 2016 more and 35% of undivided Jammu and Kashmir was under degradation and desertification. The area under degradation has increased from 33.92% in 2003 to 35.8% in 2026. In parts of current Jammu and Kashmir UT major reasons of land degradation are loss of vegetation and water erosion.

Source: Image

3.4 Jalvayu Parivartan - Climate change in J&K

The Union Territory of Jammu and Kashmir is divided into two major topographies namely Jammu and Kashmir. Within these two topographies, a range of landforms such as valleys, plains, rivers, lakes, mountain ranges and high altitude peaks makes the entire UT highly climate diverse. In general the year may be divided into four seasons. The winter season is from December to February followed by the pre-monsoon season from March to May. Monsoon season is from June to September and the period between October and November is post monsoon season.

The UT has two climatic zones corresponding to its topographical division. Kashmir Valley is temperate and Jammu region has subtropical climatic zone. Jammu region is a combination of plains, valleys, hills and mountains. Mountains and hills in this region are part of Pir Panjal and Shivalik ranges. Kashmir valley is situated between Pir Panjal and western end of the great Himalaya ranges. The Himalayan range stops monsoon winds from southeast and south and cold winds from central Asia.

Source: Image

The topography and variety of land form leads to high variation in temperature of the UT. It ranges from soaring heat in summer especially in the region of Jammu to very cold in winter and permanently snow covered mountain ranges in Kashmir valley. In Jammu region, the southern part is hottest in the state, but as we move upwards towards the north and eastern part of Jammu division, due to Shivalik range, the temperature goes down. The mean temperature of Jammu division is around 13 degree centigrade which ranges from 19 degree centigrade in south Jammu to 10 degrees in northern and eastern Jammu division.

Kashmir Valley is colder compared to Jammu division. The mean temperature of the Kashmir division is 5 degree centigrade, which ranges from 6 degrees centigrade in valleys to 1 degree centigrade around high altitude mountains. Winter is very cold, when the mean temperature is about -5 degree centigrade. The temperature increases steadily from March to July.

Jammu and Kashmir receives more than 100 cm precipitation in a year. However it is highly erratic and disproportionately distributed between Jammu and Kashmir divisions. The Jammu division receives more rain compared to Kashmir valley.

The average annual rainfall in Jammu division is more than 200 CM. The Jammu region receives 68% rain in the south east monsoon season. However, the Kashmir valley receives its highest precipitation (40%) during pre-monsoon season.[35] In total, UT has nearly 60 rainy days in a year. Number of rainy days in district like Katra, Gulmarg and Pahalgam is more than 100 days.[36]

Drought is also very common in Jammu and Kashmir. Districts like Samba, Srinagar, Jammu, Ganderbal, Anantnag and Baramulla have a history of occurrence of drought more often. The Baramulla district has faced more severe droughts since 1951.

In these years, in five different years, it observed more than 50% rain deficit. Excessive rain in the UT is also frequent. In the last 6 decades districts like Baramulla, Kathua, Kishtwar, Kulgam, Samba have had a history of excessive rain.

Climate change has started drastically affecting the natural, social and economic wealth of the Union territory. According to the Climate Change Action Plan of the UT, out of the total 7,997 glaciers in the UT, the majority of them are degrading at a very high pace.

Moreover, the report claims that the snow fall has decreased to just 0.6m from 3 meter 40 years ago.[37] Other visible impacts of climate change are related to erratic weather, decreasing snowfall adversely affecting production of apples and rain fed agriculture.

[35] https://diragrijmu.nic.in/CSS%20GUIDELINES/FINAL_CLIMATE%20OF%20JAMMU%20AND%20KASHMIR_e%20book.pdf

[36] https://jkplanning.gov.in/pdf/Digest%20of%20Statistics%202021-22.pdf

[37] https://moef.gov.in/uploads/2017/08/Jammu-Kashmir.pdf

4 Status of the natural environment in Himachal Pradesh

Source: Image

4.1 State of water resources in Himachal Pradesh

Himachal Pradesh is endowed with five major river networks namely Sutluj, Beas, Ravi, Chenab and Yamuna. Sutluj has the largest catchment in the state followed by Baes and Chenab. 90% of river catchment in the state is part of the Indus river basin.[38]

However, the Yamuna River which shares nearly 10% of the total catchment in the state is part of Ganga river basin. This complex network of rivers and their tributaries is a significant source of water in the state.

The state also has a huge deposit of snow in the form of glaciers and permanent snowfields. The seven major river catchments of the state have 800 glaciers spread in 3,124 sq km area. Moreover, 2,679 permanent snowfields spread in a 1,775 sq km area feed these river basins.

[38] T E R I, 2015. Green Growth and Water in Himachal Pradesh. New Delhi: https://www.teriin.org/projects/green/pdf/HP-Water.pdf

The Chenab river basin has the highest number of glaciers (457) and Satluj River has the highest number of permanent snowfields (857).[39] This huge snow deposit in the higher altitudes of the state feeds a number of perennial rivers and hundreds of springs in the state.

Major Water Statistics of Himachal Pradesh

Number of major river catchments	Number	04
No of Glaciers	Number	800
Number of Permanent snowfields	Number	2,679
Number of Surface water sources	Number	20,223
Number of Traditional water sources	Number	10,512
Number of villages with springs	Number	2,597
Ground water recharge worth area	Sq. Km.	3,468
Annual Groundwater recharge	BCM	1.11
Number of groundwater sources	Number	8,186

Source: Compiled from various government sources

Perennial spring, lakes and other traditional water sources also contribute significantly in providing water to local communities for various usages. According to a survey conducted in 1991-93, there are 33,350 water sources meeting water demands in Rural Himachal Pradesh. The survey has also enumerated 8,186 ground water sources in the state.[40] More than half of these water resources (20,223) are surface water sources. Yet another study commissioned by NITI Aayog in 2017 found that 2,597 villages of the state have springs.[41] The first ever census of water bodies released in 2023 by the Ministry of Jal Shakti has revealed that Himachal Pradesh has 88,017 different kinds of water bodies such as ponds, tanks, lakes, reservoirs etc.[42]

[39] HP State Centre for Climate Change, Directory of Water Resources in Himachal Pradesh, https://hpccc.hp.gov.in/SCCC%20Reports/Water%20Sources%20in%20Himachal%20Pradesh.pdf

[40] Himachal Pradesh Development Report, 2002, Department of Planning, http://164.100.161.239/plans/stateplan/sdr_hp/sdr_hpch2.pdf

[41] NITI Aayog, 2017, Inventory and Revival of Springs in Himalayas for Water https://dst.gov.in/sites/default/files/NITI-Aayog-report-Springs-29Dec2017-FINAL.pdf

[42] Ministry of Jal Shakti, 2023, First Water Bodis Census, Vol. 1 https://cdnbbsr.s3waas.gov.in/s3a70dc40477bc2adceef4d2c90f47eb82/uploads/2023/04/2023040672.pdf

Census of Water Bodies- Himachal Pradesh

Type of Water Body	Number
Pond	3,247
Tanks	56,583
Lakes	106
Reservoirs	249
Water Conservation structures	893
Other	26,939
Total	88,017

Source: Water Body Census, 2023

Groundwater is important to meet water demand in valleys and lower altitudes. According to the assessment of the Central Ground Water board, Himachal Pradesh recharges 1.11 BCM per year and it has potential to extract 1.01 BCM groundwater per year. The report further observed that all its monitored areas are in the safe category and the cumulative water draft of the state is 34.95%. Groundwater is used majorly in districts like Kangra, Sirmour, Mandi, Solan and Una. In total 0.35 BCM groundwater was extracted in the last assessment year for irrigation, industrial and domestic usages. Irrigation is the highest consumer of groundwater (0.18 BCM) followed by domestic use (0.12BCM) and Industrial (0.05 BCM).[43]

Source: Image

[43] CGWB, 2023, Dynamic Groundwater Resources of India, 2023, GoI, https://cgwa-noc.gov.in/LandingPage/LatestUpdate/NCDGWR2023.pdf

4.1.1 Water Challenges

Himachal Pradesh seems to have high availability of water from a variety of sources ranging from ground water to glaciers. However, various studies have found that all types of water sources are facing challenges leading to shortage of water, drying of landscape and extreme weather conditions such as drought and flooding. Moreover, the demand for water has grown exponentially in the last couple of decades.

The Human Development Report of the State published in 2002 estimated that the total water requirement of the state will increase from 454.5 Million Litre per Day (MLD) in 1999 to 726 MLD in 2021.[44]

The Energy and Resource Institute (TERI) in an estimate projected that the water demand of the state will go up to 1,000 MLD in 2030.[45] On the one hand water sources are facing existential crisis, on the other hand water demand is increasing exponentially in the state. Major supply side challenges faced by the state are as follows:

Receding of Glaciers:
A study conducted by scientists of IIT Hamirpur in 2022 found that glacial area in Himachal Pradesh is decreasing at the rate of 67.84 sq km per annum. The study calculated that the total glacial area has decreased from 4,020 sq km in 1994 to 2,198 sq km in 2021.[46]

Drying up of Water Sources:
Drying up of water sources such as ponds, tanks and spring is a serious issue in the state. A report of NITI Aayog published in 2017 observed that nearly 60% of springs have dried in the Indian Himalayan Region. The Census of Water Bodies released by the Ministry of Jal Shakti in 2023 observed that 12,146 out of 88,017 water bodies are not in use in the state. Of these nearly 8,000 water bodies are not in use because either they are dried or destroyed.

Pressure on Underground Aquifers:
While the ground water is not a very significant source of water right now, dependency on it is expected to increase in future due to shortage of surface water. The latest report of CGWB reveals that nearly half of wells monitored by it observe a decrease in water level.

Degradation of River Catchments:
With continuous deterioration of quality of forest, landslides and flooding the catchment areas of various rivers have degraded. Moreover, river pollution has also increased in recent times. According to a report of the Central Pollution Control Board, nine rivers of the state namely Ashini, Khad, Bald, Giri, Markanda, Pabbar, Ratta, Shikari Khad, Sirsa and Sukhana are critically polluted with respect to BOD criteria.[47]

---

[44] Govt. H.P. Human Development Report, 2002, https://planning.hp.gov.in/plg_Reports/HPHDR-02.pdf

[45] TERI, 2015. Green Growth and Water in Himachal Pradesh. New Delhi: The Energy and Resources Institute. 14 pp. https://www.teriin.org/projects/green/pdf/HP-Water.pdf

[46] Sharma et al, 2022, Glacier retreat in Himachal from 1994 to 2021 using deep learning, Remote Sensing Application- Society and Environemnt, Vol. 28 https://www.sciencedirect.com/science/article/abs/pii/S2352938522001781

[47] CBCB, 2022, Polluted River Stretches for Restoration of Water Qualities, GoI, https://cpcb.nic.in/openpdffile.php?id=UmVwb3J0RmlsZXMvMTQ5NF8xNjcxNzc3ODg2X21lZGlhcGhvdG8xODc0Ni5wZGY=

4.2 State of forests in Himachal Pradesh

Source: Image

Forests in Himachal Pradesh have been the backbone of local subsistence and a significant source of state revenue. It is highly diverse which ranges from dry scrub forests at lower altitude to alpine pasture at higher altitude. The Forest Survey of India has recorded 38 different forest types in this small Himalayan State. As the altitude increases the density of forest cover also increases in the state up to 3000 meter.

More than 58 percent of dense forest of the state is located between 2000 to 3000 meter and more than 60% of open forest is located between altitudes of 500 to 2000 meter. According to statistics of Himachal Pradesh government Himalayan Moist Temperate forest is largest forest category in the state, which includes tree species such as Cedrus Deodara, Quercus leucotrichophora, Quercus dilatata, Quercus semecarpifolia, Rhododendron arboretum, Pinus wallichiana, Abies Pindrow and Picea smithiana.[48] Details of forest types in the state are given in the following table.

[48] Himachal Pradesh State Forest Department, https://hpforest.gov.in/the-forest-detail-2 (25 Aug 2024)

Forest Type as per ISFR 2021	Area (sq km)
Tropical Moist Deciduous	208.63
Northern Tropical Dry Mixed Deciduous	2,848.42
Subtropical Pine	2,841.11
Himalayan Moist Temperate	7,079.16
Himalayan Dry Temperate	502.51
Sub Alpine Forests	661.47
Moist Alpine Scrub	58.05
Dry Alpine Scrub	335.7
Grasslands	
Himalayan Temperate Pastures	1,004.58
Alpine Pasture	3,271.73

The Himalayan Moist Temperate forests are also known as oak forest which has high importance to support local subsistence along with alpine pasture land. The oak forest provides resources like fuel, fodder and water and alpine pasture land support sheep rearing in this state.

Source: Image

4.2.1 Forests, Actual Forests and Missing Forests

37,948 sq km out of the total geographical area of 55,673 sq km of the state is recorded as forest under various central, state and local laws. In other wards little more than 68% of the total geographical area of the state is recorded as forests. Moreover, nearly one third area of the state is always under snow cover. Details of forests according to their management are given in the following table.

Forests according to Management	Area (in sq km)
Reserved Forests	1,898
Protected Forests	33,130
Unclassed Forests	2,005

Source: State Forest Department, H.P.

Himachal has a huge network of national parks and wildlife sanctuaries to manage its forest. The state has 5 national parks, 26 wildlife sanctuaries and 4 conservation reserves. The largest national park of the state is Great Himalayan National Park (905 sq km) and largest wildlife sanctuary located in Lahaul Spiti is Kibber WLS (2220 sq. km.).

While the legally recorded forest of the state is more than 68% of its total geographical area, the actual forest is very less compared to its recorded forest. The latest India State of Forest Report (2021) observes that out of a total 37,033 recorded forest the actual forest is mere 10,644 sq km. The ISFR does not give account of as large as 26,389 sq. km (71%) forest land of the state.

According to the ISFR-2021 the total forest cover of the Himachal Pradesh is 15,443 sq km out of which a significant forest area of 4,799 sq km is outside of the recorded forest. This forest outside the recorded forest includes forest owned by individual and private agencies. The forest outside of recorded forest constitutes 31% of the actual forest in the state. Details of the forest cover are given in the following table.

Forest Status	Area in sq km
Total Geographical Area of HP	55,673
Total Recorded Forest	37,033
Actual Forest Cover in Recorded Forests	10,644
Actual Forest cover in Forest outside Recorded Forests	4,799
Un Accounted Forests (missing forests)	26,398

Source: ISFR, 2021

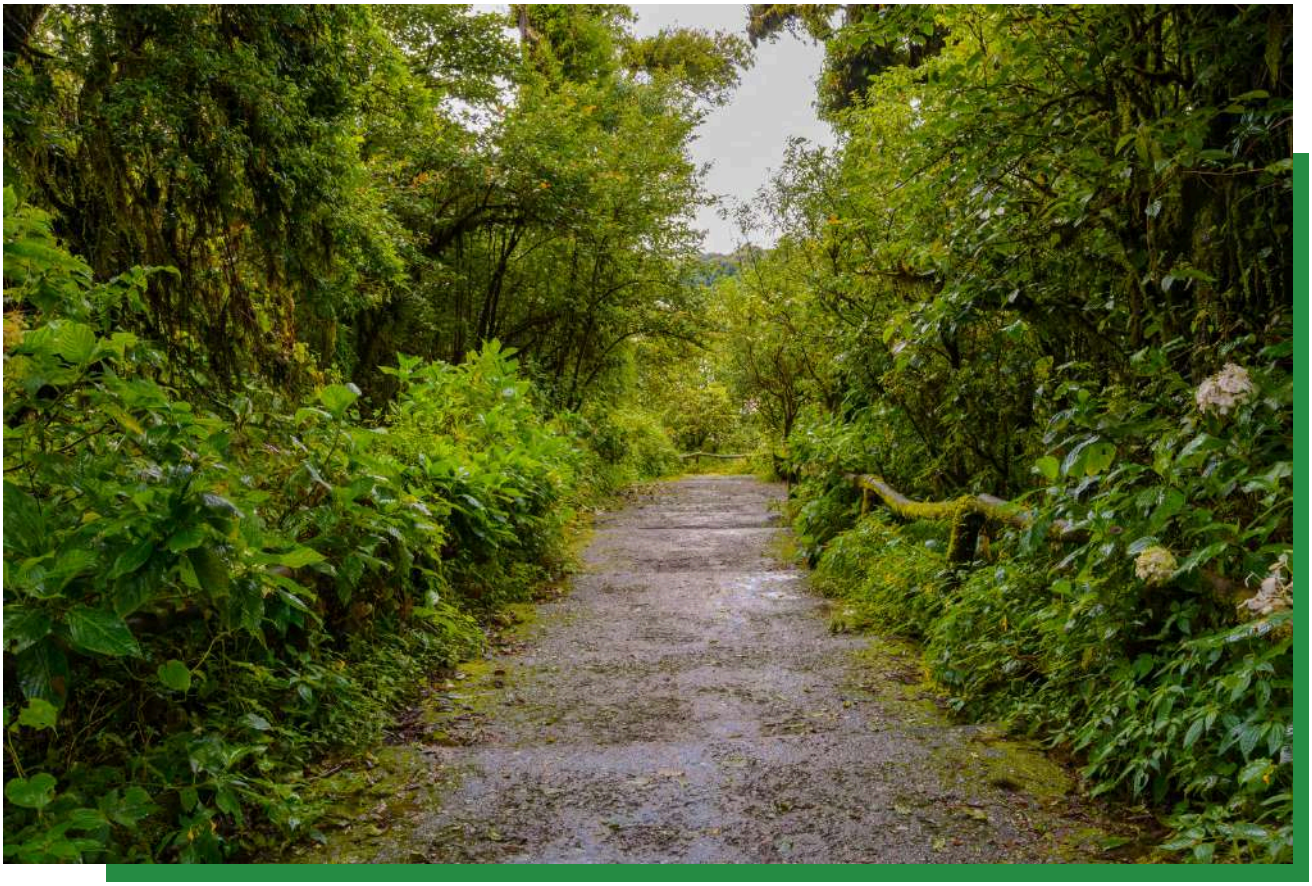
Himachal Pradesh being a crucial Himalayan state in the Western Himalayan region has no forest cover on its 71% of recorded forest land. It can be understood that a large area is snow covered and not feasible for any vegetation. Yet, a significant area of the recorded forest has no tree cover. Unfortunately, no agency including the state forest department has details of this tree-less forest land.

Quality of Forest in HP

Year	Total Forests	Dense Forest (Canopy Density more than 40%)	Open Forest (Canopy density between 10 to 40%)
1991	11,780	8,911	2,869
2001	14,360	10,429	3,931
2011	14,679	9,605	5,074
2021	15,443	10,263	5,180

Compiled from ISFR

Apart from the issue of missing forest, the state is struggling with deterioration of its quality of forests. In the last three decades the total forest cover of the state has increased by 31% from 11,780 sq km to 15,443 sq km. However the increase in dense forest is merely 15% during this period. In fact, the data shows that the dense forest in 2021 has decreased compared to 2001 by 166 sq km. The ISFR data also reveals that from 2011 to 2021 the state lost 61 sq km of dense forest with canopy density more than 70%.



Source: Image

4.3 State of land in Himachal Pradesh

Source: Image

The geography of Himachal Pradesh is divided into four agro ecological zones and nine sub zones. The Sub Humid Mid Hill agro ecological zone is the smallest and Dry Temperate High Hill zone is the largest agro ecological zone of the state. Soil in low hills and dry temperate high hills are neutral and low to medium in Organic Carbon (OC), Cation Exchange Capacity (CEC) and Water Holding Capacity (WHC). Mid hill soil is moderately acidic and high in OC, CEC and WHC.[49] The variation of agro ecological conditions available in the state diversifies its agricultural practices from production of basic grains such as wheat & rice to apples, kiwis, vegetables and flowers.

Agro Ecological Zones of Himachal Pradesh

Agro Ecological Zone	Area (% of Total Area	Soil Type
Sub Tropical Sub Montane and Low Hills	18.5	Sandy Loams and Loamy Sand
Sub Humid Mid Hills	8.4	Sand Loam- Clay, Silt Loam-Loam
Wet Temperate High Hill	16.5	Mainly Loamy Shallow- acidic
Dry Temperate High Hill	56.6	Sandy Loams Sends and Pebbles

https://agriculture.hp.gov.in/en/agro-climatic-zone/

Nearly 68 per cent of total geographical area of Himachal Pradesh is recorded as forest land out of which the actual forest cover is 26% of the total area. Nearly one third (32.8%) of the landmass of the state is open and permanent grazing land.[50] The size of agricultural land is about 10 percent of the total geographical area of the state. In the last two decades insignificant changes were observed in the land use pattern of the state.

[49] Himachal Pradesh State Forest Department, https://hpforest.gov.in/the-forest-detail-2 (25 Aug 2024)

[50] Himachal Pradesh, 2008, Annual Season and Crop Report – 2007-08, Govt pf Himachal Pradesh, https://himachal.nic.in/WriteReadData/l892s/13_l892s/1695123930.pdf

Classification of Land of Himachal Pradesh (,000 Hectare)

Year	Land Not available for Cultivation			Other Uncultivated Land Excluding Fallow Land	Total Fallow Land	Net Area Sown	Cropped Area
	Area under Non Agricultural Uses	Barren and Un culturable Land	Total				
1998-99	238.5	909.7	1,148.3	1,671.1	84.5	549.4	970.1
2008-09	467.8	653.9	1,121.7	1,706.1	79.1	539.4	946.1
2018-19	358.3	774.4	1,132.8	1,692.4	83.9	542.3	914.0

https://data.desagri.gov.in/

While the land use pattern of the state is static, the 10% land that is used for agriculture has observed significant changes in the last three decades. The land which was primarily used for food grains such as Wheat, Maize, Rice and Pulses is gradually moving in horticultural productions such as fruits and vegetables. In this period the sharpest decline was recorded in land area used for production of Wheat, Maize and Pulses. The vegetable production area has doubled from 45 thousand hectares in 2000-01 to 92 hectares in 2021-22.

Area under principal crops in Himachal Pradesh (in thousand hectares)

Year	Wheat	Maize	Rice	Pulses	Total Food Grains	Fruits	Vegetables
1993-94	375	305	88	42	855	182	-
2000-01	363	298	82	31	815	217	45
2005-06	385	295	79	07	777	187	46
2010-11	357	296	77	34	795	211	65
2017-18	319	281	72	19	725	231	89
2021-22	320	263	66	15	711	235	92

https://iasri.icar.gov.in/

4.3.1 Soil challenges in Himachal Pradesh

Both natural and anthropogenic interventions have contributed to degradation of soil in Himachal Pradesh. The soil in the state is majorly facing two challenges namely soil erosion and loss of natural soil nutrient due to excessive use of fertilizers. These two threats are briefly described in the following section.

Use of Chemical Fertilizers

In the financial year 2021-22, Himachal Pradesh consumed 56,000 tonnes[51] of chemical fertilizers and 454 metric tonnes of chemical pesticides.[52] The consumption of bio fertilizer in the state was just 5 metric tonnes. The table below shows that in the last three decades the per hectare consumption of chemical fertilizer has doubled from 30.08kg/ha in 1993-94 to 64.68 kg/ha in 2020-21. The exponential growth was observed in use of Phosphatic and Potassic chemicals in these three decades.

Fertilizer Consumption per Unit of Gross Cropped Area in HP

Year	Nitrogenous (N) (kg/ha)	Phosphatic (P) (kg/ha)	Potassic (K) (kg/ha)	Total (NPK) (kg/ha)
1993-94	25.79	02.55	01.74	30.08
1998-99	30.4	05.38	04.33	39.75
2003-04	32.35	09.11	07.53	48.5
2008-09	37.48	11.31	11.84	60.63
2018-19	41.04	10.69	10.06	61.79
2020-21	41.20	12.28	11.20	64.68

https://desagri.gov.in/

Soil Erosion

Soil erosion is yet another problem Himachal Pradesh is facing due to a number of reasons such as sharp slops, continuous degradation of forests, large non vegetative area, increase in extreme weather conditions such as long dry spells and flash floods. A study carried out in 2014 had estimated that 54% landmass of Himachal Pradesh is prone to soil erosion. Out of this 98% is due to surface runoff.[53] Furthermore, the Land Desertification and Land Degradation Atlas of India reported that as high as 43.11 per cent of the state is under degradation and desertification.[54]

[51] Ministry of Agriculture and Farmer Welfare, Agricultural Statistics at a Glance, 2022, GoI, https://desagri.gov.in/wp-content/uploads/2023/05/Agricultural-Statistics-at-a-Glance-2022.pdf

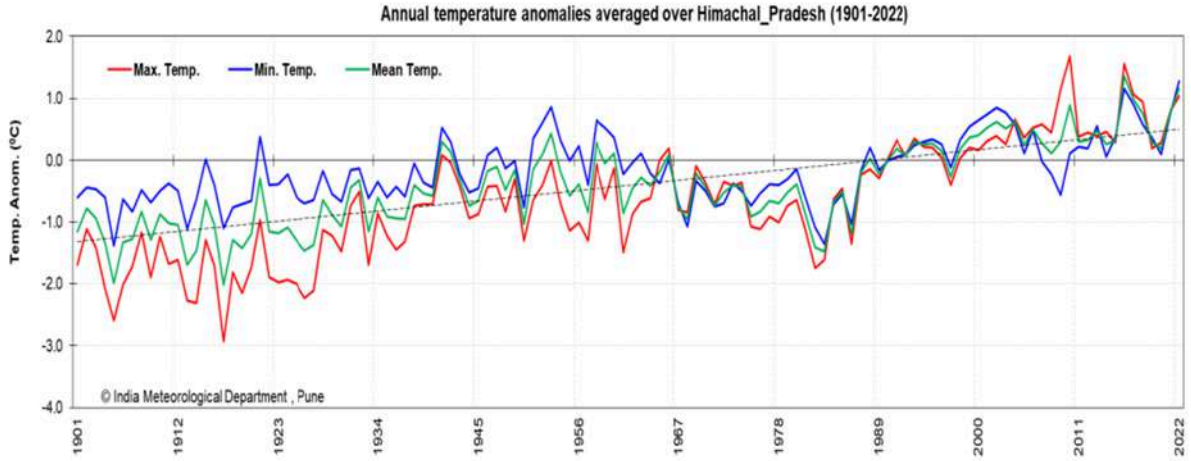
[52] Lok Sabha unstarred question no. 1069 answered on 13th December, 2022, https://sansad.in/getFile/loksabhaquestions/annex/1710/AU1069.pdf?source=pqals

[53] Prashanth M, Kumar A, Dhar S, Verma O, Rai SK and Kouser B (2023) Land use/land cover change and its implication on soil erosion in an ecologically sensitive Himachal Himalayan watershed, Northern India. Front. For. Glob. Change 6:1124677. doi: 10.3389/ffgc.2023.1124677, https://www.frontiersin.org/journals/forests-and-global-change/articles/10.3389/ffgc.2023.1124677/full

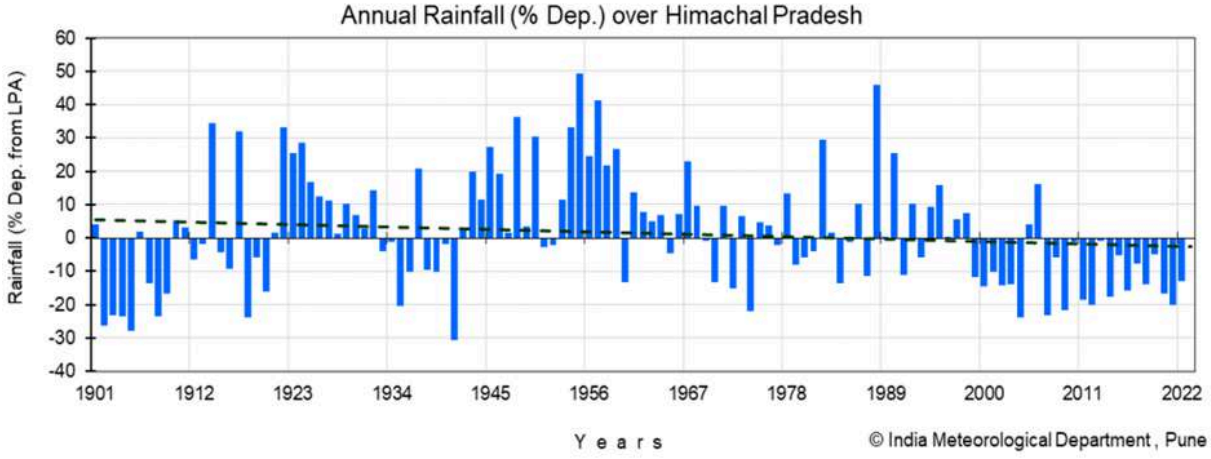
[54] Space Application Centre, Govt of India, 2021, Desertification and Land Degradation Atlas of India, https://vedas.sac.gov.in/static/atlas/dsm/DLD_Atlas_SAC_2021.pdf

4.4 State of climate in Himachal Pradesh

Within the Western Himalayan Region the unique climate of Himachal Pradesh diversifies and distinguishes its landscape and climatic conditions. This uniqueness of the state has been shaping its rich culture, economy and ecology from time immemorial. The change in global temperature and local anthropogenic pressures have adversely affected its climate and thereby increased vulnerability of natural resources of the state.



A compilation of temperature over Himachal Pradesh from 1901 to 2022 by IMD reveals that the annual mean temperature during the period significantly increased at the rate of 1.5 degree centigrade per 100 years. The maximum temperature also increased at the rate of 2.18 degree centigrade per 100 years during the period.



Himachal Pradesh receives its 59% rainfall during south-west Monsoon (June- September) and 19% during winter (Jan-Feb). The IMD data reveals that in both seasons Himachal Pradesh gradually moved from average excess rain in the early 1900s to rain deficient in the last 2-3 decades.[55] Both the rainfall and the temperature of the Himachal Pradesh has significantly changed in the last 100 years and more importantly the rate of change has gradually increased in the last 2-3 decades. This change in climate has further changed the quality and quantity of other natural resources in the state. Some climate led changes in natural resources are explained in the following section.

[55] India Meteorological Department, 2022, Statement on Climate for the State of Himachal Pradesh, https://mausam.imd.gov.in/shimla/mcdata/cli_hp.pdf

4.4.1 Impact of climate change on natural wealth of Himachal Pradesh

Glaciers

The entire Himalayan mountain range is more vulnerable to global warming compared to other mountain ranges in the world. An assessment of the ICIMOD in 2019 revealed that the temperature of Hindu Kush Himalayas are rising faster compared to the global average.[56] The IPCCC report had also found that the warming has occurred in the Himalayan mountain range that has changed the snowline, glaciers and precipitation in the Hindu Kush Himalayas.[57] Himachal Pradesh is one of the important states in the western Himalayan region that has global responsibility to protect the Himalaya. A recent study by scientists of IIT Hamirpur found that the total glacial area of Himachal Pradesh has decreased from 4020 sq km in 1994 to 2198 sq km in 2021.[58] Apart from snowlines and glaciers the impact of global warming is now visible on other natural resources such as degradation of forests, land and drying of water sources.

Forest Degradation

Successive FSI report on India's State of Forest Reports reveals that the very dense forests are gradually declining despite the fact that total forest cover is increasing in the state. Moreover, the latest ISFR report of 2021 observes that the entire forest cover of the state will experience an increase in temperature more than 1.5 degree centigrade and more than 20% rain deficient/excess by 2030. If the situation persists the report further estimates that by 2085 the nearly 93% of the state's forest will experience an increase in temperature by more than 5.1 degree centigrade and more than 38% rainfall departure.[59] These climatic changes are sufficient to completely change the ecosystem and local biodiversity.

Desertification and Land Degradation

Desertification and land degradation is very high in Himachal Pradesh compared to other Himalayan States. According to the Desertification and Land Degradation Atlas 43.11% of the total geographical area of the state is under degradation and desertification. The land under degradation in the state has increased from 38.46% in 2003-05 to 43.11% in 2018-19. Major causes of land degradation in Himachal Pradesh are vegetation degradation (32.27%), Frost Shattering (5.97%) and Water Erosion (4.83%).

[56] ICIMOD, 2019, The Hindu Kush Himalaya Assessment, https://doi.org/10.1007/978-3-319-92288-1

[57] International Panel on Climate Change (IPCC) https://www.ipcc.ch/report/ar6/wg1/downloads/factsheets/IPCC_AR6_WGI_Regional_Fact_Sheet_Mountains.pdf

[58] Sharma et al, 2022, Glacier retreat in Himachal from 1994 to 2021 using deep learning, Remote Sensing Application- Society and Environment, Vol. 28, https://www.sciencedirect.com/science/article/abs/pii/S2352938522001781

[59] FSI, 2023, India Sate of Forest Report, Govt of India, https://fsi.nic.in/isfr-2021/chapter-11.pdf

5 Status of natural environment in Uttarakhand

Source: Image

Uttarakhand is an important state in the western Himalaya that has enormous natural wealth in the form of water, forest and land. These natural capitals are crucial for the sustainability of the Himalaya and life and livelihoods of its people. The total geographical area of the state is 55,483 sq km, out of which more than 68% (i-e 38,000 sq km.) area is under forest cover. Of the total landmass of the state, 14% area is under agriculture, most of which is concentrated in tarai and bhabhar region of Uttarakhand. The state is also very rich in water resources, which receives about 48,352 MCM water annually through precipitation. Moreover, it has a network of more than 213 rivers and 14,000 glaciers.

The ecological services provided by the enormous natural wealth located in the state directly benefits more than 1 billion people of the state and many more in the Gangetic plain. All of these natural capitals are under crisis due to excessive anthropogenic pressure and climate change. This chapter very briefly highlights the state of various natural resources of the state and articulates major challenges faced by them.

5.1 Jal- State of water resources in Uttarakhand

Uttarakhand has huge networks of rivers, large number of glaciers, vast area under snow cover and long rainy seasons both during monsoon and winter making it a water surplus state. The annual precipitation provides about 48,352 MCM water to the state, other sources such as glaciers, snow, water inflow from other countries and groundwater aquifers further increases the water availability in the state.

According to an NMCG survey there are five major river basins namely Alaknanda, Bhagirathi, Sharda, Ramganga and Yamuna. These major river basins cover entire geography of the state with the network of 213 small and medium size perennial rivers and streams.[60]

The average annual rainfall in Uttarakhand is 1700 mm, however it varies from district to district. According to a report of NGWB, average rainy days in summer and winters are 120 and 60 respectively. The south west monsoon adequately showers the state including heavy rainfall in mountains. Due to steep slopes, the runoff is very high in mountainous districts of the state. However, good quality oak forests in the mountains are crucial in slowing down runoff, soil erosion and recharging local springs and water sources.

Major Water Statistics of Uttarakhand

	Number of major river catchments	Number	04
	Number of Rivers	Number	213
Watersheds		Number	8
Sub-watersheds		Number	116
Micro-watersheds		Number	1110
Average annual Rainfall		MM	1700
Precipitation (including Snowfall): (MCM)		MCM	48351.82
No of Glaciers		Number	14000 (5.3% of TGA)
Number of glacial lakes		Number	1353
Number of Permanent snowfields		Per cent	10% of TGA

Source: compiled from different Govt sources

All rivers in the state are perennial, fed by glaciers. However, a large amount of water sourced by these rivers is from underground seepage accumulated by rich forest diversity in the state. The geohydrology of the state is largely divided in two categories namely Gangetic Alluvial Plain and the Himalayan Mountain Belt.

The gangetic alluvial plain is in the south most portion of the state which is the part of Indo-Gangetic Foreland basin. The large part of the state geography is part of the Himalayan Mountain Belt, which is further sub-categorized in four zones.

[60] National Mission for Clean Ganga: Uttarakhand River Atlas, August 2021: https://iwis.cganga.org/wp-content/uploads/2022/11/UK-River-Atlas-Report_Lowres.pdf

The south most sub-zone adjacent to the Gangetic alluvial plain is called Sub-Himalaya or Outer Himalaya which is at the elevation of 250 to 800 m above mean sea level. Doon valley is part of the outer Himalaya. Moving northwards the second zone is Lesser Himalaya that covers areas such as Almora, Baijnath and Askot. Central Himalaya and Tethys Himalaya are top two geo hydrological zones of Uttarakhand.[61]

Source: Image

5.1.1 Water challenges in Uttarakhand

The abundance of water resources in the state was re-planned about two decades ago to utilize it for local social and economic development. This plan was executed under the traditional development model that believes in generating wealth through mega projects. Many hydro power projects were initiated in the last two and half decades in the state to tap the hydro power generation potential of its hundreds of rivers. Uttarakhand government has estimated that its rivers have potential to generate 24,551 Mega Watt electricity per year. Apart from already functional hydro power projects, 87 more projects are in different stages of construction in the state. This over emphasis on hydro power projects has grossly undermined aquatic biodiversity, river life of rivers and social & economic dependence of locals on rivers and other water resources. Effectively, the hydro power generation has overshadowed all other social, economic and environmental usage of water in the state.

Apart from hydro power generation, water demand for agriculture and domestic use is significant. However both these sectors are facing challenges to meet existing demand. Nearly 5.4 lakh hectare agriculture land has potential for irrigation in the state which constitutes about 34% of the total land under agriculture in Uttarakhand. However, the irrigation department of Uttarakhand has developed irrigation capacity for only 4.48 lakh hectare, despite having enough water in the state. Similarly, in rural areas, state government is able to supply only 529 MLD as against demand of 663 MLD of drinking water.[62] Similar gaps also exist in demand and supply for drinking water in urban areas.

[61] Central Ground Water Board- Ground Water Year Book (2020-21), Uttarakhand: https://www.cgwb.gov.in/old_website/Regions/UR/Reports/Ground%20Water%20Year%20Book%202020-21%20Uttarakhand.pdf

[61] Irrigation Research Institute, Roorkee, State Specific Action Plan for Water Sector, 2018, Uttarakhad: https://nwm.gov.in/sites/default/files/Report_Draft-SSAP_Uttarakhand.pdf

Water streams and local water sources such as Naula, Dhara and Gadhera are important sources of water for domestic purposes and livestock use. These water sources supply more than half of total rural water demand. In mountain districts these sources are very high. In some districts like Chamoli, Rudraprayag, Pithoragarh and Uttarkashi these water resources supplies 100% of water required for domestic use.[63] However, these water streams and sources are gradually drying-up due to deforestation, changing characteristics of the local ecosystem and habitation extension. The Central Ground Water Board has also observed that water level in streams monitored by it are immensely fluctuating.[64]

Climate Change is yet another major factor affecting the water resource of the state. Various studies have observed that glaciers are receding at a very high rate, the tree line is moving upward changing the ecosystem of Himalayan alpine and permanently snow covered area. With increase in temperature, incidents such as Glacial Lake Outburst Floods (GLOFs) are very common.[65] The Kedarnath flood in 2012 and Vinshnupryag flood in 2021 are two recent devastating GLOFs the state witnessed.

Uttarakhand, despite being a water rich state, has a very uneven distribution of water for various uses. The overemphasis of the state on hydro power generation has grossly undermined sectors such as drinking water, irrigation, river fishing and other recreational activities. Our water infrastructures are not capable of meeting water demand for irrigation and domestic use. Over and above, all major water sources in the state such as rivers, glaciers and streams are threatened by climate change and unregulated development.

Source: Image

[63] Irrigation Research Institute, Roorkee, State Specific Action Plan for Water Sector, 2018, Uttarakhad: https://nwm.gov.in/sites/default/files/Report_Draft-SSAP_Uttarakhand.pdf

[64] Central Ground Water Board- Ground Water Year Book (2020-21), Uttarakhand: https://www.cgwb.gov.in/old_website/Regions/UR/Reports/Ground%20Water%20Year%20Book%202020-21%20Uttarakhand.pdf

[65] Laurent Benjamin, Receding Glaciers Threaten Uttarakhand Residents' Electricity and Homes, Earth Refugee, April 08, 2021: https://earthrefuge.org/receding-glaciers-threaten-uttarakhand-residents-electricity-and-homes/

5.2 Jangal- State of forests in Uttarakhand

Forests in Uttarakhand are integral part of subsistence living, moreover, from the early twentieth century the then British government started developing it as a key revenue source for the government. The colonial government developed a profit making business around forest resources such as timber, wood for railway track and resins.

To promote this forest based business and industry, the then government promoted plantation of economically beneficial tree species such as chir pine, teak, sheesham and eucalyptus. These economic activities continued even after independence in 1947. However, more recently more activities have been added to broaden forest based revenue of the state government. These activities include collection and trade of herbs and likens. Moreover, the government has earned a lot by diverting forest land for non forest purposes after commencement of the Forest Conservation Act, 1980.

The commercialization of forest land and its products have grossly changed the local ecosystem and characteristics of forests. Forests at the elevation from 700 msl and above are in two broad categories namely Subtropical Pine Forests (mixed forests) and Himalayan Moist Temperate Forests (oak forests) these two categories of forest are backbone of mountain life and livelihood as they provide fuel, fodder, grazing, water and other MFP to villagers. These forests account for nearly 39% of the total forest area. The chir pine found in the Tropical Dry Deciduous Forest which was promoted and planted initially by the British government and continued after independence accounts for more than 15% of the total forest land.

5.2.1 Drastic changes in ecosystem of forests

Chir pine has proved to be a dominating species in the mountains and created existential threats to local oak and mixed forests in Uttarakhand. Gandhian activists late Smt. Mira Mahen in 1952 raised the issue of invasive characteristics of chir pine and wrote to the then Prime Minister Mr. Jawahar Lal Nehru. She argued that the promotion of chir pine has not only deteriorated the local ecosystem but also led to social fragmentation.[66] These trends are continuing as a recent study observed that from 1991 to 2001 in the region of Almora and Nainital 18.2% dense oak forest converted into chir forest. Similarly, 7.4% dense oak forest degraded to chir forest from 2001 to 2017 in the same region.[67]

[66] Guha Ramachandra, 2006, ‘How much should a person consume? Thinking through the environment’, Parmanent Black.

[67] Das Arundhati, Tarun Menon, J. Ratnam, R. Thadani, G. Rajashekar, R. Fararoda and G Shahabuddin, 2021, ’Expansion of pine into mid-elevation Himalayan oak forests: Patterns and drivers in a multiple use landscape, Forest Ecology and Management 497(2021)

Species wise forest classification in Uttarakhand

Species	Area	% to TFA
Sal, Teak, Sissoo, Eucalyptus	375585.89	14.51
Oak	383088.12	14.8
Mixed	614748.59	23.77
Chir Pine	394383.84	15.25
Other (Deodar, Blue Pine, Fir, Spruce, Sypress)	132762.13	5.44
Waste Land/ Empty land	685749.43	26.52
Total	2586318	100.29

Uttarakhand Forest Statistics (2014-15) , GoUK

The changing characteristic of forests in Uttarakhand is a serious concern as it has disrupted the subsistence living in all mountain districts of Uttarakhand. Moreover, chir forest has also changed the regulation of ecosystem services such as water. Chir forests are dryer compared to oak forests. Expansion of chir forest is making the region dryer and contributing in drying of mountain water streams. These forests are more prone to forest fires in the state.

5.2.2 Mis-governance of forests and its resources

The change in forest ecosystems and their characteristics is very much dependent on forest governance. In Uttarakhand the state forest department has administrative control over only 64% of the total forest area. A substantial area under forest i-e 19% is under the control of Van Panchayats. These Van Panchayats are community based institutions responsible for protection and conservation of forests and equitable distribution of forest resources. The incentive of these Van Panchayats is in oak and mixed forest which provides fuel, fodder and grazing to local communities.

Forest Administration in Uttarakhand

Administrative Control	Area (in sq. km.)
Forest under administration of the State Forest Department	24,418.67
Forest under administration of Van Panchayats	7,210.19
Forests under administration of the State Revenue Department	4,768.7
Forests under other agencies	157.51
Non classified forests	1,444.51
Total	37,999.58

Uttarakhand Forest Statistics (2014-15) , GoUK

According to forest statistics published by the state government both mixed and oak forest are in much better condition compared to chir pine forest in the state. More than 72% of these two category forests are either very dense or moderately dense. On the other hand Chir pine forest which is largely governed by the state forest department and where communities have no incentives has less than 60% area either in dense and moderately dense forests.

5.2.3 Unaccounted Forests

According to ISFR the total forest land in the state is 38,000 sq km which accounts for 68.48% of the total landmass of Uttarakhand. However, as per the same survey report the recorded forest in the state is only 16,785 sq km. The forest or green cover outside recorded forest is 7,520 sq km. Of the total recorded forest in Uttarakhand, the Forest Survey of India has no data for 21,215 sq km (55.8%).

Source: Image

S.no.	Forest Status	Area (in sq km)
1	Total Geographical Area of Uttarakhand	55,483
2	Total Recorded Forest	38,000
3	Actual Forest Cover in Recorded Forests	16,785
4	Actual Forest cover in Forest outside Recorded Forests	7,520
5	Un Accounted Forests (missing forests) (2-3)	21,215

Source: ISFR, 2021

A lot of this forest land is empty and waste land such as snow covered areas, glaciers, mountains, water bodies and pasture land. According to the state forest department the total waste/empty forest land is 6,857 sq km.[68] Yet a very large forest land is still unaccounted for in records of the state forest department and Forest Survey of India. In absence of data, its vegetation and wildlife a large portion of the forest land still remain unplanned.

5.2.4 Degradation of forests

The state of forest survey reports published by the Forest Survey of India has been keeping records of Uttarakhand forest from 2001 after formation of the state in 2000. The data shows that the total forest area including forest outside recorded forest has marginally increased by 1.5% from 2001 to 2021. However, the quality of forest has degraded significantly in these two decades.

In these two decades, the state has lost 1200 sq km dense and moderately dense forests. Probably most of these forests degraded to open forest with canopy density less than 40%, the forest land in this category having increased by 1567 sq km during the period.

Quality of Forest in Uttarakhand

Year	Total Forests	**Dense Forest** (Canopy Density more than 40%)	**Open Forest** (Canopy density between 10 to 40%)
(area in sq km)			
2001	23,938	19,023	4,915
2011	24,496	18,929	5,567
2021	24,304	17,823	6,482

Compiled from various ISFR

Uttarakhand government as a trustee of its rich forest cover has been advocating for financial incentives from the government of India. However, its forests are facing two major challenges. One, the density of its forests is continuously deteriorating; two, the ecological characteristics of its mountain forests are changing due to the invasive nature of pine trees and climate change. In the last two decades, despite heavily regulated forests, a significant landmass has converted from dense forest to open forests.

On the other hand continuous upward movement of pine forest is replacing mixed and oak forests in the mountain district. The invasive nature of the pine tree and decreased forest governance role of local communities has led this change unchecked. These challenges together have further intensified problems relating to soil erosion, surface runoff, shortage of fuel & fodders, forest fires, drying of water streams, upward movement of tree line occupying alpine rangelands and wildlife habitat. To address these challenges, we need quality data; however, the government has no data for its more than 55% forest land.

[68] Govt. Of Uttarakhand- Uttarakhand Forest Statistics (2014-15), Forest Department, Uttarakhand: http://www.uafdc.in/acts&rules/forest_statistical_2014-15.pdf

5.3 Jameen: Sate of land in Uttarakhand

Nearly 70% of the total geographical area of the state is under forests and about 29% of the state is culturable and cultivable land. However the net area under agriculture is about 14% of the total geographical area of the state. On this small land size nearly 70% of the population is dependent for their livelihoods.

The land distribution is uneven in the state that gives ownership of maximum agricultural land to very few owners. Nearly 70% of the land owners in the state hold land less than 1 hectare. These 70% farmers share only 27% of the total agricultural land in the state. However 22% of the total agricultural land is possessed by just 3% land owners in the state.[69]

The very small land holding and fragmented land holding makes agriculture an expensive enterprise especially in hilly districts of Uttarakhand. The labour intensity in hilly agriculture is much higher compared to agriculture in bhabar and tarai regions of the state. Moreover, decreasing productivity due to loss of soil nutrient, climate change and destruction by wild animals such as monkeys and beer makes agriculture even more vulnerable in the state. According to statistics of the State Migration Commission in 2019, the major reasons for distress migration in Uttarakhand are livelihoods (50%), poor education and health (15%) and loss in agriculture (10%).

Classification of Land of Uttarakhand (,000 Hectare)

Year	Land Not available for Cultivation			Other Uncultivated Land Excluding Fallow Land	Total Fallow Land	Net Area Sown	Cropped Area	Area Sown more than once
	Area under Non Agricultural Uses	Barren and Un culturable Land	Total					
2000-01	152.2	310.244	462.4	866.7	107.4	769.9	1222.3	452.3
2010-11	217.6	224.764	442.4	894.4	127.7	723.1	1169.6	446.5
2020-21	188.3	249.278	437.6	940.5	191.0	620.6	996.8	376.1

Compiled from various Agricultural Statistics at a Glance Report: https://desagri.gov.in/

Marginal farmers which accounts to about 70% of the total land owners are increasingly finding it difficult to continue agriculture in the state. Data related to land use in the first two decades further confirm this statement. The fallow land has almost doubled from 1.7 ha in 2000-01 to 191 ha in 2020-21. Consequently, the net sown area and total cropped area has also decreased significantly in their period. Farmer's ability to draw more than one crop has also decreased significantly in these two decades.

[69] Govt. Of Uttarakhand, Uttarakhand State Perspective and Strategic Plan (2009-27), Watershed Management Directorate, Dehradun: http://wmduk.gov.in/Perspective_Plan_2009-2027.pdf

5.3.1 Land utilization and agricultural production

Source: Image

Wheat and Rice have taken over a variety of millets as the main crop of Uttarakhand over the decades. More than 60% agricultural land in the state is under food grains such as wheat and rice. A sizable land is under vegetable cultivation. However, compared to its neighbouring states Himachal Pradesh and Jammu & Kashmir, land under horticulture in Uttarakhand is much less.

Area under principal crops in Uttarakhand (in thousand hectares)

Year	Millets	Pulses	Food Grains	Fruits	Vegetable
2004-05	293	45	1038	201	72
2009-10	271	64	1009	193	82
2014-15	222	67	897	205	100
2019-20	182	60	805	181	99
2022-23	158	63	757	181	100

https://www.rbi.org.in/Scripts/AnnualPublications.aspx?head=Handbook%20of%20Statistics%20on%20Indian%20States

Other than horticulture, the area under every crop has decreased in the last two decades in Uttarakhand. Area under millet cultivation has observed sharpest decline of about 46%, which has decreased from 293 thousand hectare in 2004-05 to 158 thousand hectare in 2022-23. Area under food grains has also decreased from 10.38 lakh hectare to 7.57 lakh hectare (27%).

The land for agriculture in Uttarakhand is very limited. Moreover, the land distribution is skewed in favour of large farmers, who are just 3% of the total farmer population in the state. The impact of climate change, decreasing soil nutrient, attack of wildlife, fragmented land holding and insignificant average land holding are some reasons which have made farming an expensive, labour intensive and loss making livelihoods.

5.4 State of soil in Uttarakhand

Uttarakhand is divided into four different agro climatic zones formed with different types of soil and therefore create a range of geological and hydrological formation across the state. The first agro-climatic zone, which comprises areas of Tarai, Bhabat and parts of Champawat, Dehradun and Nainital district is formed of alluvial soil. These regions are favourable for cultivation of rice, wheat, sugarcane, mango, litchi and guava.

The second agro climatic zone is at the altitude between 1000 to 1500 msl and is formed of sandy loam soil. This zone is also called mid hill south zone and is favourable for cultivation of rice, wheat and finger millets. This zone is north of the Tarai and Bhabar region of Uttarakhand and comprises parts of Dehradun, Champawat, Nainital, Almora and Tehri district of the state.

Soil in the remaining two agro climatic zones of the state is red to dark and black clay. This climatic zone is at the altitude of 1500 msl and above. All hilly districts of the state have these two agro-climatic zones. These two zones are favourable for cultivation of many local millets Amaranth and finger millet and fruits like apple and pears.

Agro-climatic zone of Uttarakhand

Zone	Farming situation	Soil	Districts	Principal farm produces and Livestock
Zone A up to 1000 M	Tarai irrigated	Alluvial	U.S. Nagar, Haridwar	Rice, wheat, sugarcane, lentil, chickpea, rapeseed mustard, mango, Litchi, guava, peach and plums. Livestock: Buffalo and cattle
	BhabarIrrigated	Alluvial mixed with boulders and shingles	Nainital, Dehradun and Pauri Garhwal	Rice, wheat, sugarcane, rapeseed mustard, potato, lentil, mango, guava and litchi. Livestock: Buffalo and cattle
	Irrigated lower hills (600-1000M)	Alluvial sandy soil	Champawat, Pauri Garhwal, Dehradun, Nainital, Tehri Garhwal	Rice, Wheat, onion, chilly, peas, potato, radish, cauliflower, pulses, oilseeds, soybean, mango, guava, plums and peaches.Livestock: Buffalo and cattle
	Rain-fed lower hills (600-1000M)	Residual sandy loam	Champawat, Nainital, Pauri Garhwal, Dehradun, Tehri Garhwal, Bageshwar	finger millet, Maize, rice, wheat, pulses, mango, guava, plums and peaches.Livestock: Buffalo, cattle and goat
Zone B1000-1500M	Mid hills south aspect (1000-1500 M)	Sandy loam	Champawat, Nainital, Almora, Dehradun, Tehri Garhwal, Bageshwar	Rice, finger millet, wheat, potato, tomato, peas, cole crops, pulses, peach and plums.Livestock: Cattle, sheep & goat
Zone C1500-2400M	High hills(1500-2400 M)	Red to dark	Pithoragarh, Almora, Chamoli, Bageshwar	Amaranth, finger millet, French-beans, Cole crops, potato, peas, peaches, plums, pear, apple and stone fruits.Livestock: Cattle, sheep and goat
Zone D>2400 M	Very High hills	Red to dark Black clay	Pithoragarh, Chamoli and Uttarkashi	Amaranth, buckwheat, peas, Cole crops, apple and potato.Livestock: Sheep & goat

State Horticulture Mission, Uttarakhand: https://shm.uk.gov.in/pages/display/6-state-profile

5.4.1 Soil nutrient and fertilizers

The decreasing soil nutrient in Uttarakhand is a big concern like in other parts of the country. It has further increased the cost of agricultural input such as fertilizers, pesticides and seeds. The tradition of local seed conservation has taken over the market leading to much unpredicted production. The use of chemical fertilizer has also increased drastically in the state in the last couple of decades. Per hectare use of chemical fertilizer in Uttarakhand is very high compared to other states in western Himalaya namely Himachal Pradesh and Jammu & Kashmir.

Fertilizer Consumption per Unit of Gross Cropped Area in Uttarakhand

Year	Nitrogenous (N) (kg/ha)	Phosphatic (P) (kg/ha)	Potassic (K) (kg/ha)	Total (NPK) (kg/ha)
2006-07	87.4	20.6	7.27	115.35
2009-10	115.4	29.6	10.26	155.3
2014-15	128.9	24.1	6.88	160.0
2019-20	123.8	30.73	8.81	163.4

Compiled from various Agricultural Statistics at a Glance Report: https://desagri.gov.in/

Fertilizers and other market solutions for mountain agriculture have helped in production and per unit yield in the last couple of decades. The yield of food grains has increased from 622 kg /hectare in 2004-05 to 958 kg per hectare in 2022-23. Similarly, yield enhancement was observed in millets and pulses as well.[70] Despite the growth in yield, many people have deserted their fields and abandoned agriculture due to many reasons discussed above including decreasing soil nutrients and increasing input cost.

The Government of Uttarakhand has pushed for organic production and natural farming through various schemes, projects and legislation. In 2019 the state government enacted legislation to regulate and promote organic farming and production. In 2023-24, Uttarakhand had 51,628 hectare land under organic certification. In this year, the state's organic production was 44,745MT.[71] Compared to other states in the western Himalaya, Uttarakhand has moved ahead in terms of recognizing the crisis of soil nutrient and took steps to reclaim its soil.

[70] RBI, Handbook of Statistics on Indian States (2022-23) , Reserve Bank of India; https://www.rbi.org.in/Scripts/AnnualPublications.aspx?head=Handbook%20of%20Statistics%20on%20Indian%20States

[71] Agricultural and Processed Food Products Export Development Authority (APEDA), Government of India: https://apeda.gov.in/apedawebsite/organic/data.htm

5.5 Jalvayu- State of climate in Uttarakhand

The temperature in Uttarakhand varies significantly from place to place due to sudden changes in elevation and diversity in locations, slopes and topography. The temperature in the state starts to rise from March and peaks in May and June.

Mean Maximum and Minimum Temperature in Summer and Winter

	Summer		Winter	
Location	Mean max	Mean min	Mean max	Mean min
Southern Uttarakhand and Valleys	340C-380 C	200 C-240 C	200 C	60 C
Places >2000 m altitude	230 C-240 C	150 C	100 C-120 C	10C-30C

Source: Compiled from India Meteorological Department, 2014, Climate of Uttarakhand
https://www.imdpune.gov.in/library/public/Climate%20of%20Uttarakhand.pdf

Southern part of the state namely Bhabar and Tarai region are hotter compared to mid and high Himalayan regions. The summer mean maximum temperature of southern Uttarakhand and valleys is equivalent to summer mean maximum temperature of areas at the elevation above 2000 meter.

According to the state plan for climate change the temperature has been increasing in western Himalaya. According to the plan document, the net increase in regional temperature is in the range of 1.70 C to 2.20 C in 2030 with respect to 1970.[72]

The annual average rainfall in Uttarakhand is about 1330 mm, however it varies from district to district. Almora receives minimum rainfall with an annual average of 966 mm and with annual rainfall average of 1775 mm Pithoragarh district receives maximum rain in the state. The precipitation is in the form of rainfall and snow. However, snowfall is limited to high altitude regions from December to February every month. Annual average rainy days in Uttarakhand are 63, which are highly concentrated in months of June, July, August and September. Rainy days in winters are also significant in the state (16%).[73]

The state plan for climate change has reported that the average rainfall is on the increase. According to their estimate the net increase in rainfall in 2030 will be 60mm to 206mm with respect to average annual rainfall in 1970. It further provides that the monsoon rainfall will increase by 12mm and winter rainfall will increase by 5 mm in 2030. Moreover, some areas of Uttarakhand will even see net rainfall increase of 50% with respect to average rainfall of 1970.[74]

[72] Government of Uttarakhand- Uttarakhand Action Plan on Climate Change, 2014: https://forest.uk.gov.in/uploads/climate_change_information/1616764235.pdf

[73] India Meteorological Department, 2014, Climate of Uttarakhand: https://www.imdpune.gov.in/library/public/Climate%20of%20Uttarakhand.pdf

[74] Government of Uttarakhand- Uttarakhand Action Plan on Climate Change, 2014: https://forest.uk.gov.in/uploads/climate_change_information/1616764235.pdf

5.5.1 Impacts of climate change on natural wealth of Uttarakhand

Receding Glaciers: Uttarakhand has nearly 900 glaciers supplying water to hundreds of its perennial rivers and streams. Various studies shows that these glaciers are melting at alarming rate due to climate change and increase in global temperature.[75] According to the state plan for climate change Gangotari glacier is retreating at the rate of 19m per year. Other important glaciers such as Pindari, Milam, Dokriani, Chhanguch, Thelu and Raktavama are also retreating at very high speed. Chhaguch glacier is retreating at the rate of 85 m/ year.[76]

Increasing Incidents of GLOF: Glacial Lake Outburst Flood (GLOF) is increasingly becoming a major cause of disaster in the state. The Kedarnath flood in 2013 and Dhauli Ganga flood in February 2021 are two recent examples of devastating GLOFs. Both of these disasters were massive and took the lives of hundreds of people. Studies shows than due to climate change and increase in temperature in Himalaya, many glacial lakes are expanding which increases possibilities of their outburst.[77]

Land Degradation and Desertification: According to the Desertification and Land Degradation Atlas of India, 6.48 lakh hectare land of Uttarakhand is under desertification and land degradation. This landmass is 12.12% of the total geographical area of Uttarakhand.[78] Degradation of vegetation is the most prominent factor responsible for land degradation and desertification in the state. According to the atlas, this factor is responsible for degradation of 11.37% of total geographical area in Uttarakhand. Of this, 2.7% degraded land is part of forests and 8.6% landmass is part of land with scrub.

Endangered Ecosystem: Successive FSI report on India's State of Forest Reports reveals that the very dense forests are gradually declining despite the fact that total forest cover is increasing in the state. Moreover, the latest ISFR report of 2021 observes that the entire forest cover of the state will experience an increase in temperature more than 1.5 degree centigrade and more than 20% rain deficient/excess by 2030. If the situation persists the report further estimates that by 2085 the nearly 99.6% of the state's forest will experience an increase in temperature by more than 5.1 degree centigrade and more than 38% rainfall departure.[79] These climatic changes are sufficient to completely change the ecosystem and local biodiversity.

[75] Aksheev Thakur, Uttarakhand glaciers melting at larming pace, may trigger water scarcity, The Tribune, Oct 25, 2024: https://www.tribuneindia.com/news/uttarakhand/uttarakhand-glaciers-melting-at-alarming-pace-may-trigger-water-scarcity/

[76] Government of Uttarakhand- Uttarakhand Action Plan on Climate Change, 2014: https://forest.uk.gov.in/uploads/climate_change_information/1616764235.pdf

[77] Indian Institute of Remote Sensing (IIRS), RS for GLOF/LLOF Hazards: https://ndma.gov.in/sites/default/files/PDF/Sikkim_Conclave/Session%205/IIRS%20GLOF_Mapping_Modeling_2022_SDMA.pdf

[78] ISRO, Space Application Centre, Desertification and Land Degradation Atlas of India, 2016: https://www.sac.gov.in/SACSITE/Desertification_Atlas_2016_SAC_ISRO.pdf

[79] FSI, 2023, India Sate of Forest Report, Govt of India, https://fsi.nic.in/isfr-2021/chapter-11.pdf

6 A Call to Action

It is evident that the economic growth in all Himalayan states and UTs in the last two and half decades has not led to improving social, economic and ecological well being. Moreover, the increasing unemployment/under-employment, rapidly depleting natural wealth and increasing social unrest, leads one to question its sustainability. Based on this observation, a radically new strategy for addressing these is required.

The Business as Usual (BAU) strategies put macroeconomic GDP growth first, then worry about human development and well-being, and finally pay some residual attention to environmental aspects. We assert that the triad of employment crises requires us to adopt a radically different developmental strategy, which reverses the normal economic priorities. We need to put nature first, then human beings and then GDP growth.

We call this growth strategy Nature-regenerating, Enabling human, social and institutional development and Well-th (well-being not just income) enhancing, which makes the acronym NEW. As against the current strategy, which is exploitative of both nature and human beings, the new strategy nurtures both nature and human beings.

Nature Regeneration

Invest in regenerating nature and conserving the environment: jal, jangal, jameen and jalvayu (land, forests, water and the climate) need to be regenerated, for reviving the agriculture and allied sectors. New green activities such as generation of renewable energy, recycling of waste, and climate-change adaptive construction and services, eco-tourism, etc. will have to be taken up in a big way. These will lead to the setting up of many nature-care enterprises. Nature regeneration interventions required in the western Himalayan regions are as follows

Sectors	Interventions
Surface and Ground water conservation	River rejuvenation - treatment of river basin other than forest area
	Restoration of defunct water bodies
	Restoration of damaged water bodies
	Monitoring and Research on Glaciers and Expansion of Glacial Lakes
	Contour Trench
	New Check Dams
	New Percolation Tanks
	Chal-Khal (traditional water sources) revival using women's self-help groups and MGNREGA funds
	Springshed Restoration
Regeneration of Forest Commons	Regreening of Open/scrub forest land through agro-forestry and planted forestsby Eco-Task Force type of formations comprised of local people
	Restoring Moderately Dense forest forests - mainly through assisted natural regeneration
	Forest fire Control Measures in Fire prone forestsand formation of local Forest Fire Protection Committees
Land and Soil	Treatment of land affected by water erosionusing MGNREGA funds
	Restoration of soil nutrients in single cropped land
	Restoration of soil nutrients in multiple cropped land

The message is clear: both the natural and social environments are at a serious level of deterioration and require urgent action for regeneration/revival.

There are five levels at which action will have to be taken:

1. Individuals by themselves; as citizens, as activists, as thinkers and influencers
2. Individuals by joining local community Social Groups; and by individuals joining organised NGOs/Civil Society Institutions
3. Gram Panchayats/Zilla Parishads/Town Wards / Municipalities
4. State and Central Government departments and specialised agencies
5. International Cooperation at the Regional and Global level

We give below some suggestions for action at each of these levels, broadly covering environmental, social, and economic aspects.

6.1 Individual Actions

Every individual will have to become mindful of their ecological footprint, in terms of Greenhouse Gas (GHG) emissions contributing to global warming and in other ways in which we damage the environment – whether by excessive use of fossil fuel energy, for heating or transportation, or by polluting the environment with untreated effluents and solid waste. While it may appear that the contribution of each individual is miniscule and cannot make a difference to large trends like global warming, we must recognise that the effect of our individual actions gets multiplied by the population of the village/district/state or country. So at the level of India, each ton of carbon emissions saved by an individual over a year will add up to 1.5 billion tons of carbon dioxide emission reduction.

There are two ways in which individuals can impact the environment – first by cutting their own emissions and second by persuading others to do so. For example if the individual is a rice farmer, she should adopt techniques such as system of rice intensification (SRI) which, involves cultivating rice with as much organic manure as possible, starting with young seedlings planted singly at wider spacing in a square pattern; and with intermittent irrigation that keeps the soil moist but not inundated, and frequent inter cultivation with a weeder that actively aerates the soil.

Another environmental action that the farmers of Western Himalayas can take is to ensure that no land is left fallow or unused in their small farms. As per land use data, as much as 23% of cultivable land is at present not cultivated. Using water harvesting structures and polyhouses can obviate some of the causes for keeping land unused.

Individuals living near forests should ensure that forest fires do not get started due to rash actions, which would be an important contribution. Not only do these fires damage the forest where the fire burns, but the ashes get deposited over the glaciers and cause those to melt much faster due to greater heat absorption.

6.2 Social Groups, NGOs and Civil Society Institutions

Individuals can be more effective by joining environmental action groups / NGOs to undertake clean ups of solid waste, tree plantation and spreading awareness. These groups can also be used to influence organised public systems such as panchayats and municipalities to do more for conserving the environment such as banning leaf fall burning, composing food and organic waste, recycling plastic and other solid waste, treating sewage with minimum methane emissions, prohibiting dumping of solid waste and sewage in rivers, establishing green belts, renovating water bodies for water harvesting and recharging groundwater. Polluting industries should be taken to task and citizens should report them.

By and large, developmental efforts have been government led and supply/scheme driven. As a result, these have not been very effective. A different kind of social mobilization is needed when the goal is developmental rather than welfare delivery. Demand side has to be strengthened by bringing people into different interest or specific-function groups. Among these, Women's Self-Help Groups (SHGs) and specific-function groups such as Climate Change Action Committees, Forest Protection Committees, Watershed Management Committees and School Management Committees can be formed/strengthened in rural areas. In urban areas, Resident Welfare Associations, Town Market Committees and Hospital Management Committees can be formed/strengthened as the building blocks of citizen participation.

While Uttarakhand has had a vibrant tradition of civil society institutions, this is less so in the other three states. In any case, most of those institutions are now very short of resources. They need to develop revenue models for their work. For example, taking advantage of the fact that crores of people from all over India for pilgrimage, and lakhs visit the cool climate and scenic beauty, Paryavaran Bodh Kendras (Environmental Awareness Centres) can be established every 20-30 kms along the pilgrimage and tourist routes to educate people about the environmental crises facing us and what can be done about it at the individual and collective level.

It can amplify the message of Mission LiFE, which means 'Lifestyle For Environment'.[80] This can help build a mass movement towards an environmentally conscious lifestyle. Revenue can be generated from these Kendras through small visitor fees, sale of souvenirs and serving local cuisine as well as cuisine from various parts of the country. This revenue can be used by Civil Society Institutions to carry out various other social and environmental activities.

Source: Image

6.3 Gram Panchayats/Zilla Parishads/Municipalities

Public representative bodies such as Gram Panchayats and Zilla Parishads need to do more for conserving the environment. Under the 11th Schedule of the 73rd Amendment to the Constitution, PRIs have been assigned the function of taking care of the basic natural resources of the village – jal, jangal, jameen – or water, forest and land. They also get funds under the Integrated Watershed Management Program and the MGNREG Program to undertake projects to conserve or regenerate these natural resources, which are critical for the livelihoods of the rural population and indirectly even for the urban population as many of these resources (or their absence) affects urban populations too.

As part of the Panchayat Development Plans (PDP),[81] each panchayat should make a comprehensive five year plan for regenerating their water, forest and land resources in their jurisdiction and they must be required to submit a report on the progress made.

Likewise, under the 12th Schedule of the 74rd Amendment to the Constitution, Urban local bodies or Municipalities have been assigned the function of taking care of land use planning, water supply, sanitation, solid waste management and public health. They must thus prohibit dumping of solid waste, sewage and untreated industrial effluent in rivers and ban leaf fall burning. They must encourage composing food and organic waste, recycling plastic and other solid waste, treating sewage, establishing green belts, renovating water bodies for water harvesting and recharging groundwater.

They receive funds for these activities under the Swacch Bharat Mission and have been empowered to impose fines and take other civic action to prevent environmental damage. Each ULB should be required to come up with a five year City Development Plan,[82] as was done under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) in 2009-10, for the land and water resources and infrastructure development for public services in their jurisdiction and they must be required to submit a report on the progress made.

Source: Image

[80] https://www.niti.gov.in/sites/default/files/2022-11/Mission_LiFE_Brochure.pdf

[81] People's Plan Campaign https://gpdp.nic.in/

[82] City Development Plan Toolkit. https://localbodies.up.nic.in/Toolkit/CDP.pdf

6.4 State and Central Governments

Since the 1972 United Nations Conference on the Human Environment in Stockholm, a lot of progress has been made in environmental knowledge, legislation, regulation and preventive and promotional programs. Yet the fact of the matter is that the overall environmental situation has deteriorated since then. This may be due to the rising population, multiplied by rising per capita consumption levels and one could ask counter-factually what the situation would be if even the extant environmental knowledge, legislation and regulation was not there.

Be that as it may, additional efforts will have to be made, and urgently to tackle the environmental crisis, both of global warming triggered climate change as also pollution and degradation caused by human and industrial activity.

The biggest issue is to develop a value for the long-term, inter-generational and “across all species” view of what is good, to replace the dominant short-term, "après moi le déluge", anthropocentric view. This requires more than knowledge – at least more than scientific and economic knowledge – it requires a different world view which values the natural over the man-made, spiritual over material progress and communitarian over individual prosperity.

It requires the kind of thinking that Gandhi did in the Hind Swaraj in 1909, EF Schumacher did in Small is Beautiful – Economic as if People Mattered” in 1973 and what Gro Harlem Brundtland did in 1987 in the report “Our Common Future - From One Earth to One World.

The Central Government would have to significantly shift its policies from maintaining status quo as far as possible to championing change, as it has done in some aspects such as adoption of renewable energy. The fact that over 46% of India’s energy generation capacity is now from renewable sources, though in terms of actual generation it is still only 22% is a good example. By dragging its feet over transition from coal, the Indian government wants to be on both sides of the fence.

By adopting 2070 as the date when India will become net zero in GHG emissions, when in 2024, the Earth has breached the 1.5 Celsius mark for global warming, India lost its moral standing while arguing for more funds for mitigation and adaptation at the COP29 at Baku recently for example.

No amount of preaching adoption of an environmentally conscious lifestyle under the Mission LiFE cuts no ice in front of the fact that India is now the third largest emitter of GHGs. While we should continue to fight for climate justice, we cannot continue to add to the problems. It is our common future after all.

The state governments have an important role to play both as key implementers of these programs as well as closer to the ground monitors of the environmental situation. For this they have to get off the view that higher GSDP growth rate is an unmitigated virtue. They must assess every growth proposal for what it does to the environment and what it does for jobs.

The Environmental Impact Assessment reports should not be seen as mere formalities that have to be gone through to expedite “development”, not should environmental activists be dubbed as anti-development.

In addition the state pollution control boards need to be better equipped and empowered to monitor and if necessary penalise polluters. Investments in municipal and panchayat capacity in solid waste management and sewage and drainage, must be made.

6.5 International Cooperation – Regional and Global

Many of the problems of India's hill states are beyond their control and require not just support from the Central Government, but in some cases, most notably climate change, need international support. There are some issues such as water sharing of transnational rivers, which require regional cooperation.

Natural phenomena do not know humanly drawn boundaries. Climate change sweeps across national borders, just as cyclones and hailstorms, heat waves and earthquake tremors cross these without a visa. It becomes necessary therefore to seek international cooperation – in monitoring, research, in prevention and mitigation where possible, and in disaster relief when adverse events do happen.

The most evident case for regional cooperation is about sharing of waters which flow across countries. Tibet is regarded as the roof of the world, is the source of two major south west flowing rivers – Indus and Sutlej and three east/southeast flowing rivers – Yangtze, Brahmaputra and Mekong.

The Tibetan plateau frequently experiences earthquakes as it is located over the tectonic plates. Construction of major dams by China, such as the Three Gorges dam and recently approved what will be the "largest dam in the world" on the Brahmaputra close to the Indian border,[83] can disrupt the seismic balance of the fragile Himalayan range.

Source: Image

[83] https://www.thehindu.com/news/international/china-defends-plan-to-build-worlds-largest-dam-over-brahmaputra-river-in-tibet-says-will-not-affect-lower-reaches/article69034001

Similarly, in the Western Himalayas, Ladakh and J&K have rivers which originate in the Tibetan plateau and Uttarakhand has rivers entering from Nepal such as Kali and Sharda are major rivers in the Kumaon region flowing from Nepal. In these cases, India is the lower riparian state and thus must seek cooperation from China and Nepal. But in the case of the Teesta and the Ganga rivers, as also the Brahmaputra, which flow into Bangladesh, India is the upper riparian state and needs to negotiate water use with that country. The much talked of the Indus Water Treaty of 1960 between India and Pakistan was hailed as an example of international cooperation and accommodation, though it has been re-examined now on the ground that India yielded too much.

These issues will have to be resolved through regional cooperation. India, for example, can use the Shanghai Cooperation Organisation (SCO) as a forum where it can raise the issue of the appropriate treatment of the Tibetan Plateau on environmental grounds.[84]

Due to the impact of global warming, many of the glaciers, which are critical freshwater resources, are rapidly melting. According to the IPCC, "the Hindu Kush Himalaya could face the potential loss of more than two-thirds of Himalayan glaciers by the end of this century. The UN declared 2025 as the International Year of Glaciers' Preservation an international conference is going to be held on the topic in Tajikistan starting 29 May 2025.

As the conference announcement says.[85] "The ultimate objective is to ensure that individuals reliant on glaciers and snow, as well as those directly impacted by the Earth's cryospheric processes, receive hydrological, meteorological, and climate services specifically tailored to their needs. These services should acknowledge the vital role of mountain regions as the cradle of the cryosphere and the primary source of global freshwater and ecosystem services for the entire world. "The Government of India must send a strong delegation comprising scientific, administrative and political leaders to learn from the international deliberations on this topic.

Source: Image

[84] The SCO is an intergovernmental organization founded in 1996 by China, Kazakhstan, Kyrgyzstan, Russia, Tajikistan, and Uzbekistan to encourage regional cooperation. India was granted observer status in 2005 and became a full member in 2017. In 2022,India served as the President of the SCO.

[85] International Conference on Glaciers' Preservation, 2025
https://sdgs.un.org/partnerships/international-conference-glaciers-preservation-2025

RAJIV GANDHI
INSTITUTE FOR CONTEMPORARY STUDIES

Rajiv Gandhi Institute for Contemporary Studies

Jawahar Bhawan,
Dr Rajendra Prasad Road,
New Delhi 110 001
India

Please visit us at:

www.rgics.org

https://www.facebook.com/rgics/

https://www.youtube.com/user/RGICSIndia