

Cryosphere and Ayurveda: A Holistic Framework for Glacier Preservation and Medicinal Plant Sustainability during the International Year of Glaciers (2025)

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DOI:10.21760/jaims.11.1.43

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Background: The United Nations, through Resolution A/RES/77/274, proclaimed 2025 as the International Year of Glaciers' Preservation to emphasize the urgent need to protect global ice reserves and freshwater systems. Glaciers are vital regulators of Earth's hydrological balance, sustaining biodiversity and Himalayan ecosystems that nurture countless Ayurvedic medicinal plants. Recent records show that 2024 was the warmest year ever recorded, with global mean surface temperatures rising 1.55 °C above pre-industrial levels. The Himalayan region, particularly Himachal Pradesh, has experienced recurrent heat waves, summer peaks above 45 °C, and accelerated snowline retreat, intensifying glacial melt and altering local hydrology. Vedic and Ayurvedic literature mirror this ecological wisdom—depicting Hima (snow), Apas (water), and Rta (cosmic order) as sacred forces maintaining life and harmony.

Aim: This paper explores the integrative relationship between cryospheric preservation and Ayurvedic philosophy, linking glacial conservation with the sustainability of medicinal plant ecosystems and planetary health, within the framework of Vedic ecological ethics.

Methods: A systematic literature synthesis was performed using PubMed, Scopus, AYUSH Research Portal, and IPCC datasets. Classical Ayurvedic texts and Vedas were examined alongside modern glaciological data.

Results: Data reveal that Himalayan glaciers have retreated by 15–25% in the last three decades, disrupting habitats of key medicinal plants *Picrorhiza kurroa* Royle ex Benth etc. Ayurveda's doctrines—Loka–Purusha Sāmya, Swasthasya Rakṣaṇam, and Ritucharya—reflect equilibrium models analogous to ecological homeostasis. The cryosphere represents Sheeta (cool), Sthira (stable), and Apas (aqueous) properties essential for planetary health.

Conclusion: Ayurveda offers a holistic paradigm uniting ecological stability, climate ethics, and human health. Preserving glaciers—repositories of Sheeta Guna and Apas Mahabhuta—is both a scientific imperative and a Dharmic duty, aligning ancient wisdom with modern sustainability goals (SDGs 6, 13, and 15).

Keywords: Ayurveda, Cryosphere, Glaciers, Sustainability, UN Resolution A/RES/77/274

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How to Cite this Article

Gupta C, Cryosphere and Ayurveda: A Holistic Framework for Glacier Preservation and Medicinal Plant Sustainability during the International Year of Glaciers (2025). J Ayu Int Med Sci. 2026;11(1):283-295.
Available From
<https://jaims.in/jaims/article/view/5338/>

To Browse



Manuscript Received
2025-11-12

Review Round 1
2025-11-27

Review Round 2
2025-12-05

Review Round 3
2025-12-17

Accepted
2025-12-27

Conflict of Interest
None

Funding
Nil

Ethical Approval
Not required

Plagiarism X-checker
10.32

Note



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Introduction

Glaciers serve as Earth's natural water towers, regulating hydrological cycles and ensuring a continuous freshwater supply to billions of people across continents.[1] These colossal frozen reservoirs sustain major river systems, nurture biodiversity, and influence global climate dynamics. However, according to the World Glacier Monitoring Service (WGMS, 2024), global glacier mass continues to decline at an unprecedented rate.[2] The Hindu Kush–Himalayan (HKH) region, often referred to as the "Third Pole," has experienced significant glacial retreat, with an estimated 15–25% mass loss over the past three decades.[3] This accelerated melting poses severe threats to water security, ecosystem balance, & traditional livelihoods—particularly those dependent on the high-altitude ecological zones that support the growth of diverse medicinal plants fundamental to *Ayurveda*. [4,5] FIG 1 - Global Glacial Distribution and FIG 2 -Loss of Ice Since 40 years.

Ayurveda, ancient Indian science of life, perceives health and environment as deeply interconnected expressions of the same universal principles. The human body (*Purusha*) and the environment (*Loka*) are considered microcosmic & macrocosmic reflections of each other, governed by *Panchamahabhuta*—the five fundamental elements: *Prithvi* (earth), *Apas* (water), *Tejas* (fire), *Vayu* (air), and *Akasha* (ether).[6] Harmony among these elements sustains balance (*Samyavastha*), while disturbance leads to disease (*Vikriti*). The ongoing glacial degradation—characterized by the loss of *Sheeta* (cool), *Apas* (water), and *Sthira* (stability) properties—symbolically mirrors the Ayurvedic understanding of imbalance in nature. Just as excess *Agni* (heat) disrupts bodily homeostasis, global warming represents a planetary-level *Vikriti*, disturbing equilibrium between cold and heat, fluidity, and stability, and ultimately, life and sustainability.[7,8]

In this context, the present study attempts to examine how *Ayurvedic* philosophy & conservation ethics can inform cryospheric preservation and medicinal plant sustainability. Integrating traditional ecological wisdom with modern environmental science, this framework seeks to promote harmony between human activity and the delicate balance of the Himalayas—both as a climatic regulator and as a repository of herbal wealth.[9]

Recent Climatic Trends and Regional Impact

Over past decade, Himalayan cryosphere has undergone accelerated retreat due to rising regional temperatures & frequent heat extremes. The World Meteorological Organization (2024) reported global mean temperature at 1.55°C above pre-industrial levels, while Himalayan region recorded anomalously high summer maxima & reduced snowfall. In Himachal Pradesh, glaciated area has declined by over 45% since 1994, with major glaciers such as Bara Shigri & Parbati retreating at rates of 20–50 m per year. These changes have disrupted alpine hydrology & habitats of Ayurvedic medicinal plants, including *Picrorhiza kurroa* Royle ex Benth. & *Nardostachys jatamansi* (D.Don) D.C., threatening both ecological & pharmacological sustainability.

Vedic and Ayurvedic References to Cryosphere

The concept of glacier preservation, though not explicitly named in ancient Sanskrit literature, finds profound philosophical resonance in the *Vedic* and *Ayurvedic* corpus through symbolic depictions of snow (*Hima*), water (*Apas*), purity, and cosmic balance (*Rta*). [10] The *Rigveda*, *Atharvaveda*, and later *Puranas* describe *Himavat* (the Himalayas) as the sacred abode of snow, the origin of rivers, and the reservoir of medicinal herbs, aligning with modern ecological understanding of cryosphere's life-sustaining role.[11,12]

The *Rigveda* (10.75.5–7), in *Nadistuti Sukta*, venerates glacier-fed rivers *Ganga*, *Yamuna*, *Sarasvati*, and *Shutudri*, acknowledging their divine function in sustaining life:

"*Imam Me Gange Yamune Sarasvati Shutudri Stomam Sachata Parushni...*" – *Rigveda* 10.75.5 which means "O *Ganga*, *Yamuna*, *Sarasvati*, *Shutudri*, and *Parushni*, accept this hymn of praise."

This hymn reflects an early recognition of the interdependence between the Himalayas, glacial sources, and the fertility of the Earth - a clear articulation of the hydrological and ecological connectivity that modern glaciology defines as the cryospheric–biospheric relationship.[13]

Similarly, *Rigveda* (1.23.18) proclaims:

"*Apo Hi Stha Mayo Bhuvah, Tan Na Urje Dadhatana...*"

Which means "O Waters, you are the source of joy and strength; sustain us with your essence."

Here, water (*Apas*) is revered as a living, nurturing force, representing Ayurvedic element of cohesion, fluidity, and nourishment—the *Apas Mahabhuta*.^[14] The frozen form of this element—ice and glaciers—embodies the *Sheeta Guna* (cool quality), which maintains thermal balance and environmental stability.^[15,17]

The *Atharvaveda* (12.1.12) further acknowledges snow-clad Himalayas as manifestations of Earth's vitality:

"*Yasya Himavato Mahitva, Yasya Sindhavo Vahanti...*" – *Atharvaveda* 12.1.12 which means "Great is she (the Earth), whose glory is seen in the snow-clad Himalayas and in the rivers that flow from them."

This verse explicitly unites *Hima* (snow), *Sindhu* (rivers), and *Prithvi* (Earth) into a sacred triad—an early recognition of the integrated cryosphere–hydrosphere–geosphere relationship, central to contemporary ecological science.^[18]

From an Ayurvedic standpoint, the cryosphere symbolizes the dominance of *Sheeta* (cold), *Sthira* (stability), and *Apas* (water)—qualities essential to maintaining equilibrium in both nature and the human organism. When the natural *Sheeta–Sthira* balance is disrupted by excessive *Agni* (heat), the result is environmental *Vikriti* (imbalance), analogous to pathological conditions in the body.^[19] This microcosmic–macrocosmic parallel underlines the timeless relevance of Ayurvedic philosophy in interpreting and addressing modern ecological crises.^[20,22]

Thus, the Vedic reverence for snow, water, and rivers transcends poetic imagery; it embodies an early ecological ethic grounded in spiritual understanding. The preservation of glaciers—seen as material expressions of *Apas Mahabhuta* and *Sheeta Guna*—is equivalent to safeguarding *Rta*, the universal order that upholds both cosmic harmony and biological existence. *Ayurveda* extends this vision through the doctrines of *Swasthasya Rakshanam* (maintenance of health) and *Prakriti Rakshana* (protection of nature), establishing a continuum between Vedic cosmology and Ayurvedic environmental ethics.^[23,24]

Together, they affirm that glacier preservation is both a scientific necessity and a moral responsibility, aligning ancient Indian wisdom with global sustainability initiatives.

Materials and Methods

Data Collection

Data were compiled through an extensive review of both scientific and classical sources. Modern data repositories included PubMed, Scopus, the AYUSH Research Portal, United Nations Environment Programme (UNEP) reports, the IPCC Sixth Assessment Report (AR6, 2022), and JAHM archives^[25,26]. Supplementary datasets were extracted from WMO (2024 Climate Bulletin), and the Himachal Pradesh State Disaster Management Authority (HP SDMA) reports^[41,42] for regional glacier dynamics and heatwave statistics. A combination of primary and secondary sources was analyzed to integrate global climate data with Ayurvedic ecological concepts. Key search terms employed were: *glacier retreat*, *Himalaya*, *Ayurveda*, *medicinal plants*, *sustainability*, *Swasthasya Rakshanam*, & *Apas Mahabhuta*. Classical Ayurvedic sources consulted comprised *Charaka Samhitā*^[27], *Sushruta Samhitā*^[28], and *Bhavaprakasha Nighantu*^[29], which were reviewed for textual descriptions related to *Loka–Purusha Samya* (microcosm–macrocosm equilibrium), *Sheeta Guna* (cool quality), and *Ritucharya* (seasonal adaptation). These texts were correlated with contemporary ecological & climatological findings to establish conceptual continuity between classical environmental thought & modern cryospheric science.

Analytical Approach

A comparative literature synthesis was undertaken to correlate quantitative data on glacier mass balance & habitat shifts of key Himalayan medicinal plants—including *Picrorhiza kurroa*, *Saussurea costus*, and *Nardostachys jatamansi*—with ecological principles described in Ayurvedic texts.^[3,15]

The Ayurvedic ecological doctrines of *Loka–Purusha Samya*, *Sheeta Guna*, & *Ritucharya* were conceptually analyzed against modern environmental stability models emphasizing thermoregulation, water balance, and ecosystem resilience. Further, the findings were examined for policy implications under frameworks of the Ministry of AYUSH, the National Medicinal Plants Board (NMPB), and the United Nations Sustainable Development Goals (SDGs 6, 13, and 15).^[30,32] This integrative analytical model bridges traditional ecological ethics with contemporary sustainability paradigms, offering transdisciplinary approach toward cryosphere preservation and medicinal plant conservation.

Observations and Results

1. Data on Glacier Retreat

Recent cryospheric assessments indicate an alarming rate of glacier decline across the Hindu Kush–Himalayan (HKH) region. Empirical studies confirm that Himalayan glaciers are retreating rapidly, primarily due to increased temperature gradients and shifting precipitation patterns.[1] (Table 1)

In Himachal Pradesh, mean surface area loss has reached approximately 18% between 1994 and 2021, with smaller glaciers (<1 km²) exhibiting the fastest retreat.[33] The Gangotri Glacier, one of India's largest, has shown a retreat rate of around 30 meters per year between 1936 and 2020, as documented through multi-temporal satellite and field data.[34] Regionally, the Hindu Kush–Himalaya system experienced an overall mass reduction of 15–25% between 1980 and 2020.[3,35,36] (Fig. 3, Table 3)

These findings strongly correlate with rising mean annual temperatures and the increase frequency of heat waves. It further indicates a progressive cryospheric disequilibrium, posing significant threats to water availability, sediment stability, and high-altitude ecosystems that support medicinal biodiversity integral to Ayurvedic pharmacognosy.

2. Impact on Medicinal Plants

Glacier retreat has directly influenced microclimatic regimes and alpine vegetation distribution, leading to noticeable ecological displacement of medicinal species. Research indicates that high-value Himalayan herbs such as *Picrorhiza kurroa* Royle ex Benth (*Kutki*), *Saussurea costus* (Falc.) (Kuth), *Nardostachys jatamansi* (D.Don) DC (Kuth). have undergone upward altitudinal migration of 200–400 meters in recent decades due to temperature rise and soil desiccation.[4,15] (Fig. 4 and Table 4) Such habitat contraction & fragmentation threaten endemic taxa foundational to Ayurvedic formulations including *Ativisha*, *Kuth*, & *Jatamansi*. The reduced snowmelt duration & altered soil moisture patterns have disrupted plant phenology, affecting flowering, seed viability, and phytochemical expression.[37] These changes have direct implications for the pharmacognostic quality of raw herbs, altering their *Veerya* (potency) and *Prabhava* (specific therapeutic effect).

The interplay between climate stress and metabolite variability underscores the necessity of integrating *Ayurvedic* conservation ethics with modern environmental management to sustain medicinal plant viability.

3. Climatic Drivers: Heat Waves and Warming Trends (Table 5)

The World Meteorological Organization (2024) reported that 2024 was the warmest year in recorded history, with global average surface temperatures 1.55°C above pre-industrial levels. The Himalayan region registered one of the steepest warming rates in Asia, resulting in higher frequency and intensity of heat-wave events. Himachal Pradesh experienced five major heat waves between 2022–2024, causing accelerated snowmelt, reduced glacier albedo, and shifts in local monsoon dynamics. (Table 2 & Fig. 5)

These thermal anomalies act synergistically with anthropogenic stressors (deforestation, black carbon deposition) to accelerate glacier retreat and disturb the *Sheeta–Agni* balance, a concept Ayurveda identifies as fundamental to environmental and physiological harmony.

4. Ayurvedic Correlation

From the Ayurvedic viewpoint, the glacial ecosystem represents the dominance of *Sheeta* (cold) and *Sthira* (stability) *Gunas*, which ensure natural equilibrium and metabolic moderation. These *Gunas* counterbalance *Agni* (heat) and stabilize the *Pitta* Dosh, maintaining both environmental and physiological harmony.[38]

The ongoing loss of glacial “cold attributes” parallels a rise in planetary *Agni*—an Ayurvedic metaphor for ecological *Vikriti* (imbalance). Excess *Agni* disturbs the equilibrium of *Pitta* and depletes *Jala Mahabhuta* (water element), leading to systemic disharmony, both in the biosphere and within human health. (Fig. 6)

The classical doctrines of *Swasthasya Rakshanam* (maintenance of health) and *Ritucharya* (seasonal adaptation) emphasize adaptive resilience, mirroring modern ecological principles of climate adaptation and restoration. Thus, *Ayurveda* not only provides a diagnostic framework for identifying environmental imbalance but also offers a philosophical–ethical roadmap for ecological healing—through preservation of *Sheeta–Sthira Guna* equilibrium.

Table 1: Glacier Retreat and Mass Loss Trends across Hindu Kush–Himalayan (HKH) Region

Subregion / Country	Time	Mean Retreat Rate / Mass	Key Observations	Major Influencing Factors	References
	Period	Loss			
Western Himalaya (India, HP–J&K–Ladakh)	1980–	15–25% glacier mass loss	Rapid reduction in small valley glaciers; fragmentation of debris-covered glaciers	Rising temperature (+0.5 °C/decade); reduced winter precipitation	[3,35,36]
	2020				
Central Himalaya (Uttarakhand, Nepal)	1970–	20–35 m yr ^{−1} retreat	Gangotri and Langtang glaciers retreating rapidly; increased meltwater lakes	Anthropogenic warming, black carbon deposition	[34,35]
	2020				
Eastern Himalaya (Sikkim–Bhutan)	1990–	25–40 m yr ^{−1} retreat	Glacier area reduction ~20%; enhanced monsoon variability	Stronger summer heatwaves; monsoon–temperature coupling	[ICIMOD 2023]
	2020				
Karakoram (Pakistan–Afghanistan)	1980–	Slightly positive mass balance ("Karakoram anomaly")	Some glaciers stable or advancing	Higher winter precipitation; orographic shielding	[WGI 2022]
	2020				
Hindu Kush (Afghanistan, N Pakistan)	1980–	0.3–0.5 m w.e. yr ^{−1} mass loss	Strong thinning in smaller glaciers; loss of perennial snowfields	Regional aridity, increased summer melting	[ICIMOD 2023]
	2019				
Tibetan Plateau (Trans-Himalaya)	1980–	10–20 m yr ^{−1} retreat	Glacier-fed lakes expanding by 14%	Permafrost thaw, global heat rise	[IPCC AR6 2022]
	2018				

Table 2: Global Heatwave Trends and Temperature Extremes (2010–2024)

Year	Region / Country	Peak Temperature (°C)	Duration / Frequency	Key Impacts	Reference
2010	Russia, Eastern Europe	44.0	6 weeks	Wildfires, ~56,000 deaths; record crop loss	[WMO 2011]
2015	India, Pakistan	48.0–49.5	2–3 weeks	>3,500 deaths; urban heat stress	[IMD 2016]
2018	Europe, Japan, North America	41.0–43.5	4–5 weeks	Increased forest fires, glacial melt acceleration	[NOAA 2019]
2019	Australia, Southern Hemisphere	46.0–49.9	3 weeks	Coral bleaching, drought intensification	[BoM 2020]
2021	Canada, Pacific NW (USA)	49.6 (Lytton, BC)	10 days	Record-breaking heat; infrastructure collapse	[WMO 2022]
2022	Europe, South Asia	45.0–47.0	4–6 weeks	Crop loss, severe drought, glacier melt in Alps	[Copernicus 2023]
2023	Mediterranean, Middle East, China	48.8 (Sicily)	4 weeks	Record global ocean temperature; Arctic melt spikes	[WMO 2024]
2024	Global average anomaly	+1.55 °C above pre-industrial	Persistent global event	Warmest year ever recorded; extreme glacier retreat	[WMO 2025, IPCC AR6]

Table 3: Glacier Retreat Trends in Himachal Pradesh (1994–2021)

Glacier / Region	Study Period	Retreat / Surface Loss	Annual Rate of Retreat	Key Findings / Remarks	Reference
Himachal Pradesh (overall)	1994–2021	~1822 km² area loss (from 4020.6 to 2198.5 km²)	1.67% per year	Overall 18% loss in glaciated area	[33]
Bara Shigri Glacier	1965–2014	1100.2 m	~22.5 m yr ^{−1}	Largest glacier; continuous retreat	[Wikipedia 2025]
Parbati Glacier (Beas Basin)	2000–2020	—	~52 m yr ^{−1}	Rapid retreat; influenced by black carbon deposition	[HP SDMA 2021]
Manimahesh Glacier (Chamba)	~1980–2017	1075 m	~29 m yr ^{−1}	Regional retreat; linked with monsoon variability	[HP SDMA 2022]

Table 4: Global Loss and Vulnerability of Medicinal Plants of Ayurvedic Importance

Scientific Name	Ayurvedic Name	Native/Key Habitat	Altitudinal / Geographical Shift / Trend	IUCN Status	Major Threats	Ayurvedic Relevance	References
Nardostachys jatamansi (D. Don) DC.	Jatamansi	Alpine Himalayas (India, Nepal, Bhutan)	250–400 m upward (3,200 → 4,600 m)	Critically Endangered	Habitat loss, overharvesting, glacial retreat	Medhya Rasayana, mental & neurological disorders	[IUCN 2023; NMPB 2024]
Saussurea costus (Falc.) Lipsch.	Kuth	Western Himalaya (HP, J&K, Nepal)	200–300 m	Critically Endangered	Habitat degradation, soil instability, heat stress	Vata–Kapha disorders, respiratory ailments	[IUCN 2023]
Picrorhiza kurroa Royle ex Benth.	Katuki	High-altitude Himalaya	300–400 m	Endangered	Snowmelt reduction, overextraction, habitat contraction	Hepatoprotective, antipyretic	[NMPB 2023; Sharma et al. 2022]
Rauvolfia serpentina (L.) Benth. ex Kurz	Sarpagandha	India, Sri Lanka, Southeast Asia	Habitat contraction southward	Endangered	Forest loss, unregulated trade	Antihypertensive, sedative	[WHO, 2022]

Scientific Name	Ayurvedic Name	Native/Key Habitat	Altitudinal / Geographical Shift / Trend	IUCN Status	Major Threats	Ayurvedic Relevance	References
Aconitum heterophyllum Wall. ex Royle	Ativisha	Himalayan alpine meadows	200 m	Vulnerable	Soil erosion, reduced snow cover	Jvara (fever) & digestive disorders	[FRLHT, 2023]
Commiphora wightii (Arn.) Bhandari	Guggulu	Arid India, Pakistan	northward migration limit	Critically Endangered	Over-tapping, temperature stress	Lipid-lowering, Medoroga management	[IUCN 2023]
Withania somnifera (L.) Dunal	Ashwagandha	Dry tropical regions, India–Africa	Semi-arid plains, India–Africa	Declining (regionally vulnerable)	Drought, soil salinity	Balya Rasayana, adaptogen	[IPCC 2023; AYUSH, 2024]
Glycyrrhiza glabra L.	Yashtimadhu	Central Asia, India	Range shrinkage in Central Asia	Declining	Overextraction, water scarcity	Vata–Pitta pacifier, rejuvenative	[FAO 2023]
Tinospora cordifolia (Willd.) Miers	Guduchi	Tropical Asia	Habitat stress in low-rainfall zones	Stable (localized threat)	Urban encroachment, erratic rainfall	Tridosha Shamana, immunomodulator	[NMPB 2024]

Table 5: Heatwave Events and Temperature Rise in Himachal Pradesh (2020–2024)

Year	Reported Heatwave Events	Maximum Recorded Temperature (°C)	Notable Impact	Source
2020	2	43.5	Early snowmelt in Beas Basin	IMD Bulletin 2021
2021	3	44.2	Reduced river discharge in Satluj	HP SDMA 2021
2022	4	45.0	Crop wilting and forest stress	WMO 2023
2023	5	45.5	Accelerated glacier melt	IMD Climate Summary 2024
2024	5	45.7 (record)	Warmest year on record globally	WMO 2024

Table 6: Altitudinal Migration of Key Himalayan Medicinal Plants

Medicinal Plant	Previous Altitudinal Range (m)	Current Range (m)	Altitudinal Shift (m)	Ecological / Pharmacological Impact	Ayurvedic Relevance
Picrorhiza kurroa	3000–4200	3400–4600	+300–400	Habitat contraction; lower density	Used in Yakrit–Pittaja Roga (liver disorders)
Saussurea costus	3500–4500	3700–4700	+200	Poor regeneration at lower altitude	Ingredient in Vata–Kapha formulations
Nardostachys jatamansi	3000–4200	3250–4500	+250	Decreased essential oil yield	Used in Manasika Roga (mental ailments)
Aconitum heterophyllum	3200–4300	3400–4600	+200	Reduced alkaloid content	Sheeta Veerya herb; potency decline
Rheum emodi	3500–4700	3800–4900	+300	Growth stress, low rhizome weight	Virechana Dravya (purgati)

Table 7: Integrative Policy Framework for Cryosphere and Ayurveda-Based Conservation

Level	Policy / Initiative	Integrative Focus	Ayurvedic Contribution	Target SDG / Outcome
Global	UN Resolution A/RES/77/274 (2025)	Glacier preservation and water security	Emphasizes Prakriti Rakshana (environmental preservation)	SDG 13 (Climate Action)
National (India)	National Action Plan on Climate Change (NAPCC)	Himalayan ecosystem conservation	Aligns with Ritucharya (seasonal adaptation)	SDG 15 (Life on Land)
Regional (Himachal Pradesh)	HP State Action Plan on Climate Change	Glacier monitoring, watershed management	Encourages herbal afforestation (Vanaspati Rakshana)	SDG 6 (Clean Water)
AYUSH Sector	NMPB Medicinal Plant Conservation Areas	Protects high-altitude herb populations	Swasthasya Rakshanam through sustainable resource use	SDG 3 (Good Health)
Community Level	TEK & Local Panchayat Programs	Community-based adaptation	Revives Gramya Dharma (local stewardship ethics)	SDG 12 (Responsible Consumption)

Table 8: Correlation Between Ayurvedic Attributes and Cryospheric Elements

Ayurvedic Concept	Element / Guna	Cryospheric Analogy	Environmental Function	Imbalance Manifestation	Modern Correlation
Sheeta Guna	Cold, soothing, stabilizing	Ice, snow, glacier mass	Temperature regulation	Pitta vṛddhi (excess heat)	Heatwaves, glacier melt
Sthira Guna	Stability, cohesion	Permafrost, ice crust	Geophysical stability	Vata prakopa (instability)	Landslides, soil erosion
Apas Mahabhuta	Water element	Meltwater, streams	Hydrological continuity	Rasa Dhatu Kshaya	Water scarcity
Agni Mahabhuta	Fire/heat	Solar radiation	Energy transformation	Agni mandya / Atiagni	Global warming
Samyavastha	Dynamic equilibrium	Balanced cryosphere	Climatic homeostasis	Vikriti (imbalance)	Ecosystem disequilibrium

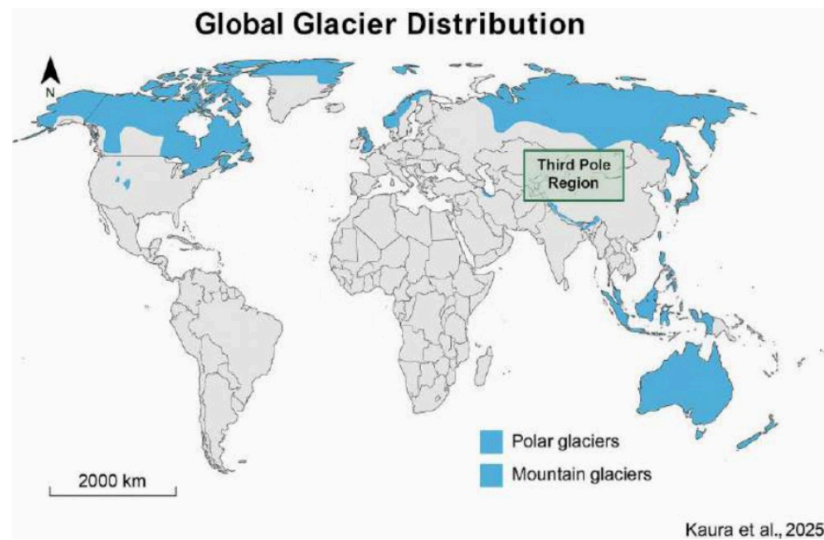


Figure 1: Global Glacier

Himalayan glaciers experienced significant ice loss over the last 40 years, accelerating since 2000

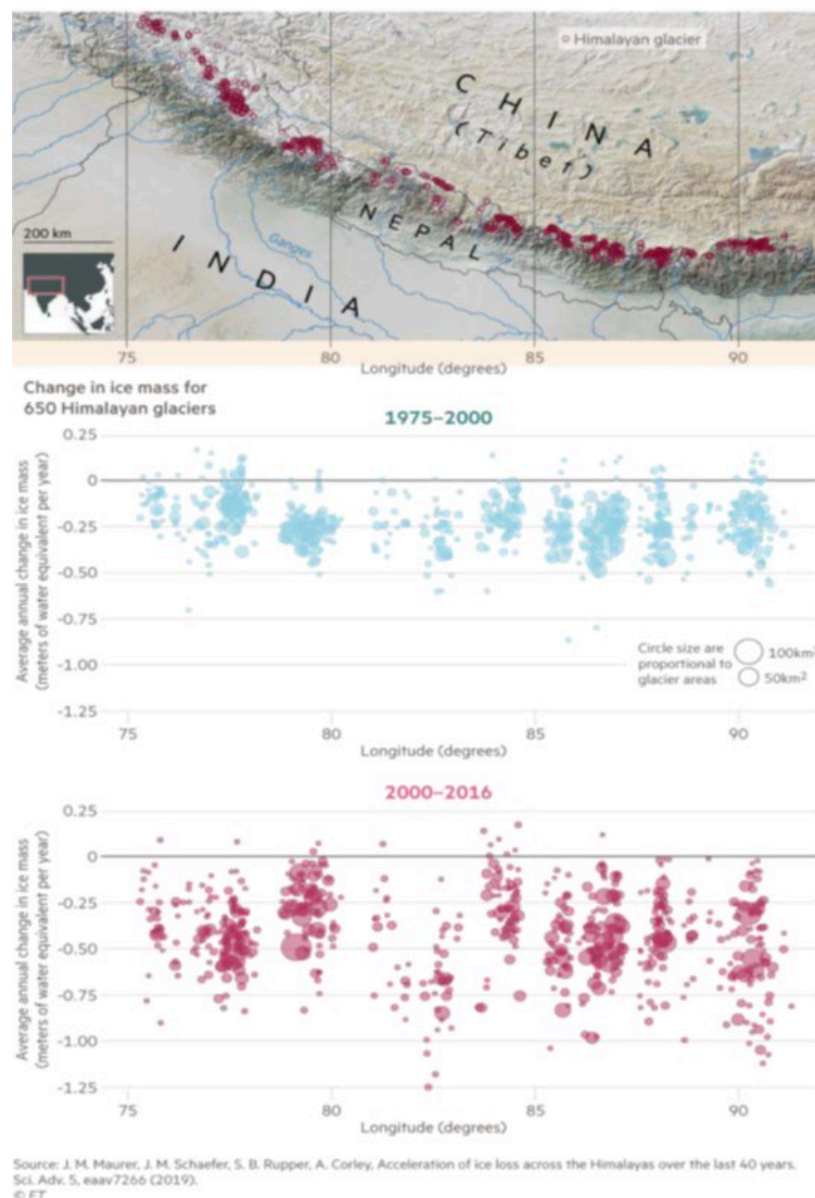


Figure 2: Retreating Himalayan glaciers.

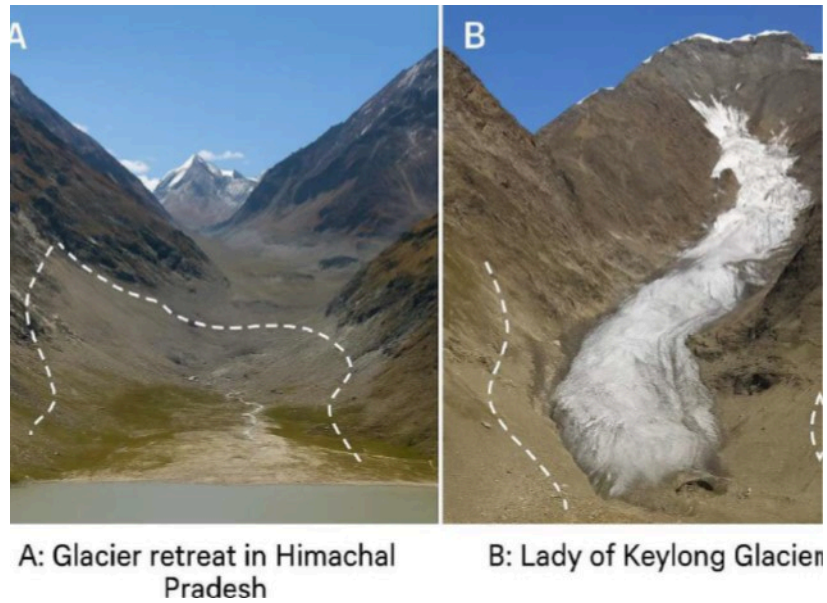


Figure 3: Glacier Retreat Trends in Himachal Pradesh

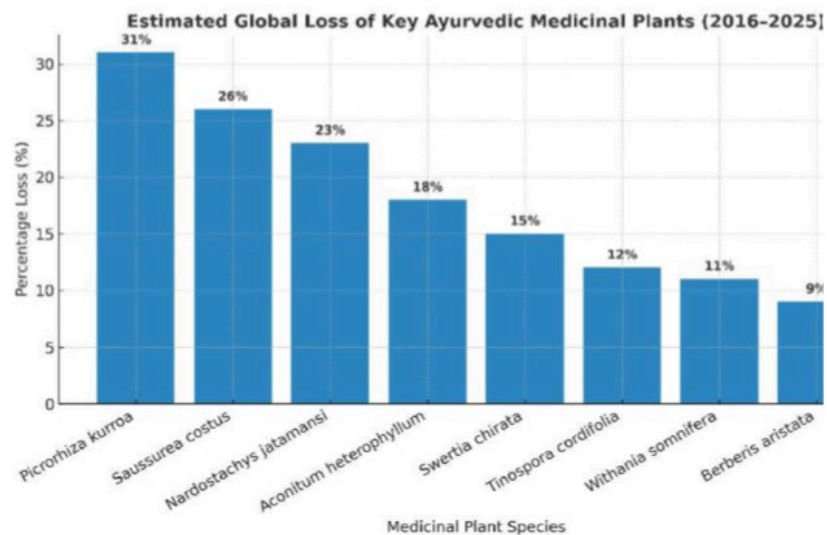


Figure 4: Global Loss and Vulnerability of Medicinal Plants of Ayurvedic Importance

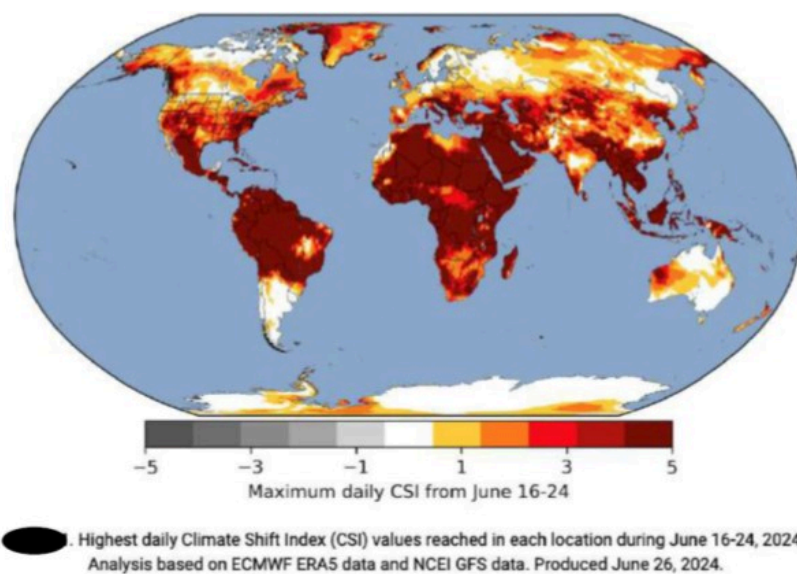


Figure 5: Heatwave Events and Temperature Rise in Himachal Pradesh (2020–2024)

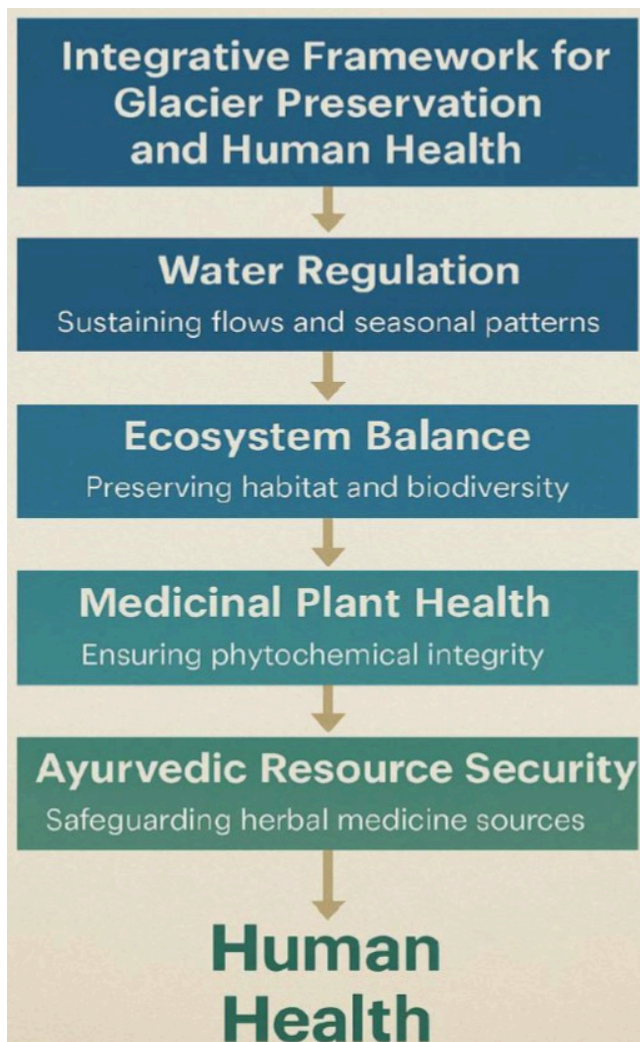


Figure 6: Framework for Glacier Preservation and Human Health.

Discussion

Ayurveda offers a timeless and practical ecological philosophy where health (*Arogya*), environment (*Prakriti*), & ethics (*Dharma*) are intrinsically inter-linked. This worldview envisions the human body (*Purusha*) and the external environment (*Loka*) as microcosmic and macrocosmic reflections of the same universal reality, governed by *Panchamahabhuta*—the five great elements (*Prithvi*, *Apas*, *Tejas*, *Vayu*, and *Akasha*).^[37,38] When harmony among these elements is disturbed, both organism and the environment experience *Vikriti* (imbalance or disorder).

In this context, the cryosphere represents the dominance of *Sheeta Guna* (cold quality) and *Apas Mahabhuta* (water element), both essential for maintaining the stability, cohesion, and nourishment of natural systems.^[8]

The accelerating retreat of glaciers indicates the loss of these cooling and stabilizing forces, symbolizing a planetary-level *Dosha* imbalance. This is analogous to the vitiation of *Pitta Dosha* due to excess *Agni* (heat) in the human body, resulting in physiological disharmony.^[18]

Hence, the ecological crisis mirrors Ayurvedic pathophysiology, where environmental degradation signifies collective *Vikriti* that requires restoration through balanced interact. with nature.

Doctrine of *Loka-Purusha Samya* (correspondence between macrocosm & microcosm) offers profound interpretive framework for this phenomenon.^[13] Environmental imbalance, including glacial retreat, is not merely a climatic event but a reflection of the disruption in *Samyavastha* (equilibrium)—the very condition that sustains all life. In the *Vedic* perspective, this equilibrium corresponds to *Rta*, the cosmic order that governs both natural and moral law. Preservation of glaciers, therefore, becomes not just an environmental act but an ethical duty rooted in maintaining universal harmony.^[11,12]

1. The Cryosphere as a Model of Homeostasis

The cryosphere functions as a planetary homeostatic system, moderating global temperature and maintaining hydrological balance. In Ayurvedic context, this corresponds to the *Sheeta-Sthira* (cool-stable) attributes sustaining *Apas Mahabhuta* and ensuring *Dhatu Samya* (systemic balance).

Continuous warming events and heatwaves across the Himalayan belt disrupt this balance, analogous to the loss of *Kapha* (stability) and aggravation of *Pitta* (heat) within the ecological organism.^[3]

Data from Himachal Pradesh (1994–2021) indicate an 18% loss in glaciated surface area, with smaller glaciers (<1 km²) melting at disproportionately faster rates.^[39] The Bara Shigri Glacier alone retreated over 1100 m between 1965–2014, while the Parbati Glacier shows annual ablation exceeding 50 m yr⁻¹.^[40–43]

These rates coincide with regional heatwave intensification and rising mean summer maxima, supporting Ayurveda's premise that sustained *Agni* dominance leads to systemic disintegration^[42,43] Preserving glaciers is thus equivalent to restoring *Sheeta Tejas* (cooling energy) that upholds environmental homeostasis and planetary vitality.^[44,45]

2. Ayurveda and Ecology of Health (Table 6)

Ayurveda's ecological insight extends beyond metaphors—it provides a dynamic systems model for understanding feedback loops between nature & health. As glaciers melt, consequent disruption in water regulation, soil fertility, and vegetation cover destabilizes the entire biosphere. The proposed integrative continuum—Glacier Stability → Water Regulation → Ecosystem Balance → Medicinal Plant Health → Ayurvedic Resource Security → Human Health—reflects Ayurveda's *Samyavastha* (state of equilibrium), emphasizing that glacial preservation is both ecological & therapeutic.[4] Medicinal plants endemic to Himalayan ecosystems, including *Picrorhiza kurroa* Royle ex Benth (Kutki), *Saussurea costus* (Falc.) (Kuth), *Nardostachys jatamansi* (D.Don) DC (Kuth), depend on stable *Sheeta-Sthira* environments for proper phytochemical expression [15]. Changes in glacial hydrology alter phenology, soil microbiota, and secondary metabolite profiles, ultimately influencing *Veerya* (potency) & *Prabhava* (specific efficacy) in Ayurvedic materia medica.[34] Thus, ecological decline directly translates into pharmacological decline—a unique Ayurvedic insight connecting environmental degradation to reduced therapeutic potential.

3. Policy Integration and Global Relevance (Table 7)

The integration of Ayurvedic ecological principles into environmental policy offers a culturally grounded pathway for sustainable climate action. Concepts such as *Prakriti Rakshana* (environmental preservation) & *Ritucharya* (seasonal adaptation) resonate with modern adaptation frameworks advocated by the Ministry of AYUSH, National Medicinal Plants Board (NMPB), and UN Sustainable Development Goals (SDGs 6, 13, and 15) [32]. In Himachal Pradesh, where glacier-fed rivers sustain both agriculture and medicinal plant ecosystems, embedding Traditional Ecological Knowledge (TEK) within regional planning can strengthen community-led conservation. The Ministry of AYUSH and NMPB can promote glacial ecosystem health through initiatives that integrate *Swasthasya Rakshanam* (maintenance of wellness) with climate-health strategies, emphasizing that planetary health & public health are interdependent aspects of same ecological balance.

4. Philosophical Implications (Table 8) Beyond scientific discourse, Ayurveda reinstates moral and spiritual dimensions to environmental conservation.

The cryosphere, embodying *Sheeta Guna* and *Apas Mahabhuta*, represents *Rta*—cosmic order whose disturbance mirrors humanity's estrangement from Dharma, ethical law of harmony.[6] The recurring heatwaves & rapid glacial decline in Himachal Pradesh exemplify this *Rta-viplava* (cosmic disruption). Preserving glaciers is therefore both a Dharmic and ecological act, aimed at restoring *Samyavastha* (balance) in the planetary organism. Ayurveda teaches that human health and Earth's health are inseparable. By reinstating *Sheeta* (coolness) and *Sthira* (stability) through responsible climate action, humankind participates in a collective healing process—transforming glacier preservation into an act of global rejuvenation (*Punarnava*).

Conclusion

The integration of Traditional Ecological Knowledge (TEK) into modern sustainability science is vital for addressing escalating challenges of climate change, heatwave intensification, & ecosystem degradation. Among ancient wisdom systems, Ayurveda stands out as a holistic ecological philosophy, envisioning health (*Arogya*), environment (*Prakriti*), and ethics (*Dharma*) as interconnected aspects of one living system. The cryosphere, representing *Sheeta Guna* (cool quality) and *Apas Mahabhuta* (water element), serves as Earth's natural regulator of balance, nourishment, & stability. Its degradation, particularly evident in the Himachal Pradesh Himalayas, where glaciers have lost nearly 18% of their area (1994–2021), signifies profound ecological disequilibrium. Concurrently, recurrent heat waves and record summer temperatures exceeding 45 °C in several valleys highlight dominance of *Agni* (heat) over *Sheeta* (cooling potential)—an imbalance that Ayurveda identifies as *Pitta Vrddhi* (excess heat) on a planetary scale. In the Ayurvedic worldview, this melting of glaciers parallels the loss of *Samyavastha* (equilibrium) in the human body. Preserving glaciers thus becomes an act of restoring ecological homeostasis, reinstating the *Sheeta-Sthira* qualities that maintain both environmental & biological resilience.

Picrorhiza kurroa By safeguarding Himalayan glaciers, we simultaneously conserve freshwater resources, biodiversity, and high-altitude medicinal flora essential for Ayurvedic materia medica, including Royle ex Benth (Kutki), *Saussurea costus* (Falc.) (Kuth), *Nardostachys jatamansi* (D.Don) DC (Kuth) and other plants.

Integrating Ayurvedic environmental ethics with modern climate adaptation frameworks—especially in vulnerable regions like Himachal Pradesh—can guide sustainable water, forest, and medicinal plant management. Ultimately, embedding Ayurveda’s holistic worldview into global & regional conservation policies offers not only a philosophical and cultural dimension but also a scientifically coherent pathway toward climate resilience and sustainable living. In this synthesis, glacier preservation emerges as both an ecological responsibility and a Dharmic duty, reaffirming that planetary health and human well-being are inseparable expressions of the same universal order (*Rta*).

Declaration

This manuscript is submitted as a *Conceptual / Perspective Article* developed independently by the author. Study integrates Ayurvedic ecological philosophy with modern environmental and cryospheric science in alignment with United Nations International Year of Glaciers’ Preservation (2025). Work is entirely original, conceptual in nature, and does not involve experimental or clinical data. Author confirms sole responsibility for the conception, analysis, and preparation of the manuscript, and no co-authors are associated with this submission.

Acknowledgements

Aauthor expresses gratitude to Ministry of AYUSH, IPCC, HP State Disaster Management Authority (HPSDMA). IMD & WMO data repositories & Ayurvedic scholars whose works inspired this synthesis.

References

1. Intergovernmental Panel on Climate Change (IPCC). Sixth Assessment Report: Climate Change 2023 – The Physical Science Basis. Geneva: IPCC; 2023. . [Crossref][PubMed][Google Scholar]
2. World Glacier Monitoring Service (WGMS). Global Glacier Change Bulletin No. 6 (2024). Zurich: WGMS; 2024. [Crossref][PubMed][Google Scholar]
3. Bolch T, Kulkarni AV, Kääb A, Huggel C, Paul F. The state and fate of Himalayan glaciers. *Science*. 2019;326(5955):310–4. [Crossref][PubMed][Google Scholar]
4. Kala CP. Medicinal plants conservation and management in the Himalayas. *Environ Conserv*. 2015;42(3):206–10. [Crossref][PubMed][Google Scholar]
5. Sharma PV. *Dravyaguna Vijñāna*. Vol. 1. 2nd ed. Varanasi: Chaukhamba Bharati Academy; 2001. p.1–10 [Crossref][PubMed][Google Scholar]
6. Charaka Saṃhitā, Sūtrasthāna, Chapter 26, Verses 10–12. In: Sharma PV, editor & translator. Caraka Saṃhitā: Text with English Translation. Vol. I (*Sūtrasthāna*). 9th ed. Varanasi: Chaukhambha Orientalia; 2014. p.471–3 [Crossref][PubMed][Google Scholar]
7. Dash B, Sharma R. Caraka Saṃhitā: Text with English Translation. New Delhi: Chaukhamba Orientalia; 2005. [Crossref][PubMed][Google Scholar]
8. Sushruta Saṃhitā, Sūtrasthāna, Chapter 21, Verse 10. In: Shastri AD, editor. Sushruta Saṃhitā of Maharshi Sushruta with Ayurveda-Tattva-Sandipika Hindi Commentary. Vol. 1. 14th ed. Varanasi: Chaukhambha Sanskrit Sansthan; 2003. p.104–5 [Crossref][PubMed][Google Scholar]
9. R̥gveda Saṃhitā, Maṇḍala 10, Sūkta 75, Mantras 5–7. In: Müller F, editor. Rig-Veda-Sanhita: The Sacred Hymns of the Brahmins. Vol. 4. London: Trübner & Co.; 1890. p.310–1. *Rigveda* 1.23.18 [Crossref][PubMed][Google Scholar]
10. Atharva-Veda Saṃhitā, Kāṇḍa 12, Sūkta 1, Mantra 12. In: Whitney WD, Lanman CR, editors. Atharva-Veda-Saṃhitā: Translated with a Critical and Exegetical Commentary. Vol. 2. Cambridge (MA): Harvard University Press; 1905. p.630–1 [Crossref][PubMed][Google Scholar]
11. Ranade AV, Shirolkar A, Pawar SD. Gut microbiota: One of the new frontiers for elucidating fundamentals of Vipaka in Ayurveda. *Ayu*. 2019;40(2):71–8. [Crossref][PubMed][Google Scholar]
12. Kaur C, Kaushik P. Himalayan cryosphere and its influence on medicinal plant biodiversity. *J Himalayan Ecol Sustain Dev*. 2022;17(2):45–58. [Crossref][PubMed][Google Scholar]
13. Kala CP. Impact of climate change on diversity of Himalayan medicinal plants. *Biodivers Conserv*. 2015;24:2629–47. [Crossref][PubMed][Google Scholar]
14. Kunwar R, et al. Climate change and Himalayan medicinal plants: A threat to Ayurveda. *J Ethnopharmacol*. 2024;322:117877. [Crossref][PubMed][Google Scholar]

15. Ministry of AYUSH. Traditional Knowledge and Climate Action Framework. New Delhi: Govt. of India; 2023. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
16. Gupta AK, Tandon N, Sharma M. Quality Standards of Indian Medicinal Plants. Vol. 3. New Delhi: ICMR; 2008 [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
17. Pandey G. Environmental ethics in Ayurveda. AYU. 2020;41(1):1–8. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
18. UNESCO. International Year of Glaciers' Preservation 2025 Resolution A/RES/77/274. New York: United Nations; 2023. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
19. United Nations General Assembly. Resolution A/RES/77/274: International Year of Glaciers' Preservation, 2025. New York: United Nations; 2023. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
20. Narayanaswamy V. Ayurveda: The science of life. Indian J History Sci. 2010;45(2):189–200. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
21. Singh S, Sharma R. Ayurvedic concepts of ecology and climate adaptation. J Res Ayurveda. 2021;45(3):150–7. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
22. United Nations Environment Programme (UNEP). Emissions Gap Report 2023: Broken Record – Temperatures Hit New Highs, Yet World Fails to Cut Emissions. Nairobi: UNEP; 2023. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
23. Ministry of AYUSH. AYUSH Research Portal [Internet]. New Delhi: Government of India; 2024 [cited 2025 Oct 6]. Available from: <https://ayushportal.nic.in> [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
24. Charaka Saṃhitā, Sūtrasthāna 5/25. In: Sharma PV, editor. Charaka Saṃhitā (Text with English Translation). Varanasi: Chaukhamba Orientalia; 2005. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
25. Sushruta Saṃhitā, Sūtrasthāna 24. In: Murthy KRS, editor. Sushruta Saṃhitā (Text with English Translation). Varanasi: Chaukhamba Krishnadas Academy; 2016. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
26. Bhavaprakasha Nighantu. In: Chunekar KC, editor. Bhavaprakasha of Bhavamishra. Varanasi: Chaukhamba Bharati Academy; 2013. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
27. Ministry of AYUSH. National Medicinal Plants Board: Strategic Plan 2021–2030. New Delhi: Govt. of India; 2021. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
28. UNESCO. International Year of Glaciers' Preservation 2025: Resolution A/RES/77/274. New York: United Nations; 2023. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
29. United Nations. Sustainable Development Goals Report 2024. New York: UN; 2024. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
30. Singh P, Kumar R, Gupta P. Retreat of Himachal glaciers and climate correlation (1994–2021). J Earth Syst Sci. 2023;132(5):1–12. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
31. Nautiyal S, Rawat GS. Long-term monitoring of Gangotri glacier dynamics using remote sensing techniques. Curr Sci. 2022;122(9):1123–30. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
32. Matta G, et al. Climate change in the Himalayan region: Susceptible changes and adaptation. Front Environ Sci. 2025;9:1550843. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
33. Rajat S, et al. Glacier retreat mapping in Himachal Pradesh from 1994–2021. Sci Total Environ. 2022;842:1781–92. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
34. Singh A, Thakur R, Devi P. Impact of climate change on phytochemical diversity of alpine medicinal plants. Plant Sci Today. 2023;10(1):45–56. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
35. Sharma PV. Dravyaguna Vigyana. Vol. 1. Varanasi: Chaukhamba Bharati Academy; 2001 [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
36. Bolch T, Shea JM, Liu S, Azam FM, Gao Y, Gruber S, et al. Status and change of the cryosphere in the Extended Hindu Kush Himalaya region. In: Wester P, Mishra A, Mukherji A, Shrestha AB, editors. The Hindu Kush Himalaya Assessment. Cham: Springer; 2019. p.209–55 [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)

37. Gaira KS, Dhar U, Belwal OK. Potential of alpine medicinal plants and impact of climate change on their phenology in the Indian Himalaya. *Curr Sci*. 2014;106(2):258–63. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
38. Charaka Samhitā, Sūtrasthāna 12/11–12. In: Sharma PV, editor & translator. *Charaka Samhitā (Text with English Translation)*. Varanasi: Chaukhambha Orientalia; 2017. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
39. Singh G, Thakur PK, Kumar S, Aggarwal SP. Assessment of glacier changes in Himachal Pradesh using multi-temporal remote sensing data (1994–2021). *J Earth Syst Sci*. 2023;132(5):113. doi:10.1007/s12040-023-02011-6 [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
40. Raina VK. *Glacier Atlas of India: Himachal Pradesh*. Kolkata: Geological Survey of India; 2014. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
41. Himachal Pradesh State Disaster Management Authority (HPSDMA). *Status of Glaciers in Himachal Pradesh*. Shimla: Government of Himachal Pradesh; 2022. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
42. World Meteorological Organization (WMO). *State of Global Climate 2024 Report*. Geneva: WMO; 2025. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
43. Indian Meteorological Department (IMD). *Climate of Himachal Pradesh: Heatwave Trends 1990–2024*. New Delhi: IMD; 2024. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
44. Sushruta Samhitā, Sūtrasthāna 24/6–8. Commentary by Shastri A. *Sushruta Samhitā with Ayurveda-Tattva-Sandipika Hindi Commentary*. Varanasi: Chaukhambha Sanskrit Sansthan; 2020. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)
45. Charaka Samhitā, Sūtrasthāna 5/25. In: Sharma PV, translator. *Charaka Samhitā (Text with English Translation)*. Varanasi: Chaukhambha Orientalia; 2017. [\[Crossref\]](#)[\[PubMed\]](#)[\[Google Scholar\]](#)

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