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## Environmental Shifts and Dwindling Agricultural Sustainability: A Review of Lahaul-Spiti District

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## **Environmental Shifts and Dwindling Agricultural Sustainability: A Review of Lahaul-Spiti District**

**Diki Sherpa**

Over the past few years, an ongoing and pressing issue in the mountainous Lahaul-Spiti district has been the escalating problem of water shortages (*Times of India* 2017; Chakravorty 2019; Thakur 2021; Singh 2023). The situation is particularly dire in villages like Hikkim, Komic, Langza, Demul, Chicham and Kibber, where the lack of water sources and dependence on dwindling winter snow has made agriculture increasingly unviable (Manta 2017).

Studies attribute this situation to the combined effects of climate change and lack of strong winter weather systems, which have led to reduced snowfall and precipitation in the region with serious implications for agriculture, livelihoods and food security of the local population (Shashni and Sharma 2022; Kulkarni et al. 2009; Shekhar et al. 2010). Relying solely on seasonal water sources, especially those from melting snow and glaciers that feed irrigation channels called Kuhl, makes the district's agricultural system vulnerable to environmental changes. This dependency means that any shifts in weather patterns, snowfall, or glacier behaviour could significantly impact water availability. Through a review of existing materials, this essay delves into the ecological changes over time in the Himalayan Lahaul-Spiti district.

### **Brief Overview of Lahaul-Spiti District**

Lahaul-Spiti, situated in the North-Western part of Himachal Pradesh, is a region of unique geographical features and climatic conditions. As the largest district in the state, it covers a vast expanse of 13,693 square kilometres, representing nearly a quarter of Himachal Pradesh's total geographical area. Despite its expansive size, Lahaul-Spiti is the least populated district, primarily due to the challenging and inhospitable living conditions that characterise the region.

Geologically positioned in the Himalayas and the Tibetan Plateau, Lahaul-Spiti comprises two distinct mountain tracts - Lahaul and Spiti. These tracts have contrasting landscapes, with Spiti being notably more mountainous and barren than Lahaul. The Spiti region is often

referred to as a “mountain desert” owing to its meagre annual rainfall, averaging only 6.7 inches (DOA 2009). The climate in both Lahaul and Spiti is marked by sharp temperature fluctuations, high-speed winds, a high-altitude atmosphere, and low humidity. These climatic factors collectively impact the quality of soil in the districts and, in turn, the agriculture (DOA 2009).

The district is drained by three prominent rivers originating from glaciers. Chandra and Bhaga flow from Baralachha glacier, merging to form the Chandra-Bhaga (Chenab) river (Lahaul-Spiti District, Official Website). The Spiti River starts at Kunjam Pass, winding through the region before joining the Sutlej at Khab in Kinnaur. However, it has been observed that the economic impact of these rivers in the local area is rather limited (DOA 2009).

### **Main Drivers of Water Shortage**

**Declining Snowfall:** Negligible winter snowfall due to climate change creates water shortages in the region. The region depends on western disturbances for snowfall, but these weather patterns have become unpredictable due to changes in climate, leading to reduced and erratic snowfall. This changing climatic trend affects snow accumulation and melting, influencing water resources for irrigation and planting season timing. It was in 1993 that, for the first time, an accelerated snowmelt rate was observed from winter to spring, affecting the pattern of snowmelt feeding springs (Kripalani et al. 2003). The 1990s are attributed to be the warmest decade of the 20<sup>th</sup> century and are indicative of global warming’s persistent impact on snow patterns (Kripalani et al. 2003). The latest report on seasonal snow covers conducted by the Himachal Pradesh State Centre for Climate Change (SCCC) and the Geo-Sciences, Hydrology, Cryosphere Sciences and Applications Group (GHCAG), Ahmedabad, shows a further substantial reduction. More recently, snowfall measured in terms of the total monthly average area from October to April 2022-23 compared to 2021-22 showed an overall reduction of about 14.05 percent (Randhawa, Jain, Thakur et al 2023).

**Shrinking Glaciers and Drying Kuhls:** The Lahaul-Spiti district is home to 845 glaciers, some of which are among the largest in the region, covering up to 100 square kilometres. However, these glaciers have been experiencing rapid retreat due to declining snowfall and rising temperatures in the region (Mandal et al. 2014). A study estimated that the Lahaul-

Spiti Himalayan range lost 13 percent of its glaciers between 1999-2011 (Mandal et al. 2014). The retreat of these glaciers is leading to a decline in the flow of streams and channels, known as Kuhls, that provide year-round freshwater supply for irrigation and other uses in the region. This has serious agricultural implications. For instance, in Tandi Village, Spiti, reports indicate that in the summer of 2022, more than 50 percent of crops suffered due to insufficient water in the Kuhl (Gupta 2022).

Drying up of natural springs, another key source of water in the Indian Himalayan Region (IHR), is another challenge. NITI Aayog reports on Himalayan springs indicate that perennial springs have either dried up or become seasonal. According to the report, nearly 50 percent of the springs in the IHR are drying up, affecting thousands of villages that depend on natural spring water for domestic and livelihood needs like drinking water and irrigation. It was primarily caused by a combination of environmental factors, including changes in rainfall patterns, land cover, landslides, climate change, deforestation, infrastructure development, and groundwater withdrawal (Gupta 2017).

**Shift in Cropping Pattern:** Over the past 20 years, cropping patterns in the district have changed significantly. A shift from traditional and water-resilient crops like barley to more economically lucrative but water-intensive crops such as cauliflower, cabbage, and potato has added stress to the region's water resources (Shashni and Sharma 2022). For example, cauliflower cultivation expanded substantially, from 33 hectares in 2005-06 to 658 hectares in 2016-17, accounting for nearly 15 percent of the total cultivated area. At the same time, the land dedicated to barley, a relatively less water-using crop, decreased from 608 hectares to 400 hectares during the same period (Shashni and Sharma 2022).

### **Water Management in Lahaul-Spiti: A Temporal Perspective**

Contrary to the dwindling natural water supply in the district today, historical documentation presents a contrasting scenario. While water shortages have persisted as a chronic concern over time, their severity has markedly escalated in contemporary times. In the past, the sustenance of agriculture in the region owed much to the consistent replenishment of water resources facilitated by winter snowmelt, which reliably nourished the intricate network of spring water channels, or Kuhls.

Given its unique geographical setting, water management methods like the Kuhl irrigation system have become widespread. The Kuhl is a comprehensive water collection and dispersion system designed to harness water from glaciers and snowmelt for agricultural purposes (Baker 1996; Moudgil 2014). It operates by collecting water from local snow-fed streams and rivers into a tank during the night, allowing it to flow into the exit channel in the morning. By evening, the tank is nearly emptied, and the exit is closed, concluding the daily cycle (Baker 1996; Moudgil 2014). This intricate decentralised management system has historically ensured efficient use of water resources.

According to the 1899 District Gazetteer [i], in the district's agricultural cycle, the use of snowmelt was efficient. The gazetteer records, 'the rainfall being so slight is an unimportant factor in irrigation, in the agriculture of Lahaul. Cultivation is only possible with the aid of irrigation, but water is obtainable in abundance from the snow and glacier-fed torrents that fall into the Chandra, Bhaga and Chandra-Bhaga. Very little land is irrigated from the main rivers themselves, as they flow between steep high banks below the level of the culturable land, the fields lie either on the level plateau or the banks of the torrents, or in terraces on the hillside, wherever a channel can be brought from the nearest side stream without much difficulty and without danger of avalanches of falling rocks' (Gazetteer of Kangra District, Lahaul 1899).

Further, in stark contrast to the present challenges, 'there is generally no scarcity of water for irrigation and the harvests are more certain than elsewhere in the sub-division. The crops are exceedingly fine everywhere, and it is hard to detect in this respect any difference between one village and another' (Gazetteer of Kangra District, Lahaul 1899).

One aspect the above passage conveys is the overall sense of the necessity of effective irrigation practices to support agriculture in the region. However, it also emphasizes that irrigation is possible due to an adequate supply of water from snow and glacier-fed torrents, indicating a balance between necessity and resource availability. This balance, which supports agriculture in the region, has been disrupted in the present day, making it harder to sustain agricultural practices. The reliance on traditional water sources that once seemed

sufficient and effective is now proving risky, highlighting the need for innovative irrigation methods, water conservation, and sustainable practices to adapt to the changing conditions.

## **Conclusion**

The mountainous landscape significantly influences the environmental conditions and socio-economic characteristics of the Lahaul-Spiti district. The district is currently grappling with a growing water shortage, which has significant implications for agriculture, food security, and livelihoods. In contrast, the history of the social-economic system highlights sustainable water sources that were seemingly sufficient for sustaining agricultural practices. Sustainability has become dependent on several factors at present, including climate patterns, environmental practices, and human management. Maintaining traditional agricultural practices is crucial not just from an economic perspective. It has broader social and cultural implications, impacting local cultures that are deeply intertwined with farming traditions in the region. If the traditional agricultural practices disappear, there is a risk of losing the unique cultural heritage that has developed around them.

Urgent attention and proactive measures are crucial to ensure that water sources and local water management systems are preserved, enabling sustainable agriculture in the district. For this, conducting research and monitoring programs is essential to assess the impact of reduced snowfall, its effect on water availability, and its implication for livelihood in Lahaul-Spiti. Possibly, the NITI Aayog's involvement could be effective and lead to impactful outcomes due to its status as a government body. This approach will help inform policy decisions, adaptation strategies, and long-term planning to effectively address the challenges posed by climate change and water shortages. There is already a precedent for such research such as the NITI Aayog's initiative of 'the Sustainable Development of the Mountains in the Indian Himalayan Region' and its study on natural springs in the Indian Himalayan Region. The research highlighted the depletion of these springs due to various factors, including changes in land use, ecological degradation, and developmental activities (Gupta, 2017). It reveals the importance of understanding and managing these vital sources to ensure water security in the Himalayas. Similar studies should be undertaken to understand other traditional water sources and management systems in the region.

Additionally, engaging local communities in water conservation efforts, promoting sustainable farming practices, and learning from these traditional water management systems — the Kuhls — is important to provide education on water management. Empowering communities to adopt water-saving techniques and raising awareness about the importance of water conservation can contribute to mitigating the impact of reduced snowfall on water resources and agriculture.

Public policy dialogues are necessary to debate issues like global climate change mitigation, adaptation to local climate change impacts, and local production systems that shift out of locally adapted water use patterns to cater to urban markets. It is also important to retain the voice and agency of the district administration and state government to ensure sustainability and wellbeing.

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## End-Note

[i] District Gazetteers were valuable documents produced by the British Government for understanding and managing colonial India. It provides detailed information about the geography, population, administration, culture, and resources of the territories under British rule. These gazetteers served as comprehensive guides for administrators, policymakers, and others involved in the governance.

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