

# Understanding the Relationship between Global and Local Commons: A Study of Household Perceptions of Climate Change in Leh, India

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## Abstract

Ecologically fragile geographical areas most likely to be adversely impacted by climate changes, which can rightly be considered as global commons, are often inhabited by traditional communities dependent upon scarce natural resources for their livelihoods, which are often at subsistence or near subsistence levels. Hence, an understanding of these communities' perceptions and responses to climate change are essential to constructing effective sustainable development strategies that mitigate adverse impacts of climate change. With elevations ranging from 2700m to 7000m, and temperatures ranging from 30 °C to -40 °C, Leh is India's highest and one of its most arid, coldest and sparsely populated districts. We analyze the responses to a survey of 14703 households in the district of Leh, located in the Trans-Himalayan province of Ladakh, in Jammu and Kashmir State of India. We find that the perceptions of climate change are widespread and include observations of rise in temperature and heavy snow melt, less snow fall, heavy and untimely rainfall, biodiversity loss etc. These changes in climate in the region have severely affected the use and management of natural resources and hence the livelihoods of the local people.

**Keywords: climate change, perceptions, adaptations, indigenous knowledge, sustainable development, environment, Indian Himalayas, Ladakh**

## Introduction

The evidence of global warming is becoming abundantly clear with newly appearing reports on climate change. Sir Nicholas Stern's much publicized report on the economic impact of climate change – 'Economics and Climate Change'<sup>1</sup> – and the recent analytical report of the Intergovernmental Panel for Climate Change (IPCC)<sup>2</sup> offer elucidatory evidence of the climatic impacts associated with anthropogenically induced global carbon emissions. Several climatic analyses suggest that the geographical areas most likely to be adversely impacted by climatic changes are those that are already ecologically fragile, where inhabitant communities rely exclusively on scarce natural resources; such as mountain areas, edges of deserts, and small, low-lying, islands.<sup>3</sup> The reach and understanding of these reports on climate change, however, remain limited to the scientific and political communities that are engaged in devising strategies for climate change mitigation and adaptation.

Natural resource based communities, especially those that shall be among the first impacted by climatic variations because of global warming, are far removed from the ongoing scientific and political discussions. These overlooked communities are important

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<sup>1</sup> Stern, N (2006)

<sup>2</sup> IPCC (2007)

<sup>3</sup> *ibid*

stakeholders in the dialogue on the climate; without their clear understanding, participation, and equivocal agreement on climate change issues, no major action can be expected to be taken to effectively meet the climatic challenges we are likely to face – ecological degradation, demographic displacement, natural resource scarcity and resulting natural resource use conflicts.

Our analysis tries to provide an insight into the local perceptions of climate change in such an area of natural resource scarcity – focusing more importantly on its local understanding, as perceived through observed changes in local natural resource limits – and offers suggestions of how this understanding can become a useful platform for initiating community-driven actions for adaptation. It does not offer strategies for the inclusive process of dialogue on climate change, where communities need to be given the rightful importance of being integral stakeholders to the dialogue, but, rather, presents an understanding of the local comprehension of climate change, and discusses how this understanding may be useful to the arena of climate change mitigation and adaptation.

### **Scale/Location of the Study**

The study is geographically limited to the district of Leh, located in the Trans-Himalayan province of Ladakh, in Jammu and Kashmir State of India. With elevations ranging from 2700m to 7000m, and temperatures ranging from 30 °C to -40 °C, Leh is India's highest and one of its most arid, coldest and sparsely populated districts.<sup>4</sup> Geographically Leh district is sandwiched between two Himalayan ranges – Zaskar on its west and Ladakh on its east. Across the eastern range are the great highlands of Leh district – Chang Thang – which extend along the south of Ladakh and west, over the Indian-Chinese border, into Tibet. To the north of Leh district is the district of Kargil and beyond it is the Karokoram Range. The Indus River runs through Leh district from its south to its north, collecting the water of melting glaciers and straddling several high-lying villages along its banks. Geologically Leh district is divided into almost halves – a cold, arid desert with minimal precipitation in the northern half, and a high altitude grassland (Chang Thang) with perennial grasses in the southern half. Politically Leh is a tribal area governed autonomously by the locally elected and central-government supported Ladakh Autonomous Hill Development Council. Leh's predominantly agricultural and nomadic pastoral communities have sustained themselves through half a millennium, employing intricate and time-tested methods of managing their scarce natural resource base. This scarce resource base is replenished annually through mineral-rich streams originating in the rapidly declining glaciers of the Trans-Himalayan ranges, without which, sustenance in Leh would be extremely difficult. With diminishing glacial resources and increasing variations in climatic and ecological conditions, inducing impacts such as flashfloods and frequent locust attacks, Leh's communities are finding themselves more susceptible to changes in their traditional livelihoods and sustenance. While Leh's population growth has remained somewhat stable, as observed through decadal population enumerations, natural resource productivity has likely been adversely impacted by climatic changes, thus also necessitating the energy intensive import of food grains and consumptive resources from mainland India. This sustained and rather reinforcing process of energy intensive

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<sup>4</sup> Humbert-Droz and Sonam Dawa (ed) (2004)

import and diminishing local production may result in an inter-temporal decrease in local sustainability.

Leh district is divided into six revenue blocks: Leh, Kharu, Khalatse, Nyoma, Durbuk and Nubra. Leh block is the district's most urbanized block, with the district's highest concentration of population, literacy and availability of social services. It is also the administrative centre of the autonomous local government, and the hub for all socioeconomic activities associated with tourism, governance, and the Indian Armed Forces. Agricultural activities have gradually diminished in Leh over two decades, with agricultural lands being converted into residential and commercial areas. The other blocks of Leh district – Kharu, Khalatse, Nyoma, Durbuk and Nubra – are rural, with Kharu, Khalatse and Nubra being largely agricultural, while the inhabitants of Nyoma and Durbuk are largely pastoralists. Given Leh district's large area, and thus large distances, the spread of urbanization from Leh block to the other blocks has been slow or minimal, with government offices and schools being the main medium of connectivity between the centre at Leh and the outer blocks.

Our analysis, while done at the household level, has been aggregated at the block level for practical reasons.

### **Study Details**

The study relies primarily on the data collected through a comprehensive household survey conducted in Leh district between August 2006 and January 2007. Every household of Leh district was surveyed. In the survey questionnaire three questions relevant to the local perceptions of climate change were asked in the local language by trained Ladakhi surveyors. Each of these questions was explained in detail to the households, before their response was noted. These are: (1) compared to last one or two decades, do you notice any change in climate or environment / ecology in your region?, (2) if yes, indicate the types of climate or ecological change?, and (3) how have these climate or ecological changes affected your livelihood?

This study analyses the responses to these questions and discusses its findings.

### **The Analysis**

Table 1 presents the block-wise household responses to the first of the questions listed above. The responses show that over 80% of all households in Leh district perceive a climatic or local ecological change, at least within the last decade (1996-2006). The household responses from Leh block, the most urbanized area of Leh district, indicate that about 66% of the households perceive a climatic or ecological change, while in Kharu block, which is a predominantly agricultural area, about 96% of the households perceive such a change. It is observed that as the block becomes less agricultural or pastoral, fewer households in it perceive a climatic or environmental change. In Kharu, Khalatse and Nubra blocks, all with Ladakh's highest concentration of agriculturally dependent

households (see Table 1A), over 93% of all households on an average indicate a perception of climatic or ecological change. In Durbuk and Nyoma blocks, where inhabitants are primarily livestock herders (see Table 1A), an average of about 84% of the households indicate such environmental change. These findings indicate that the greater the dependence on, or need for managing, scarce natural resources, the more acute is the perception of ecological impacts in Ladakh. This also corroborates well with our anecdotal information, where pastoral and agricultural households have shared their observations on the increasing scarcity of water resources which are crucial for the renewal of perennial grasses for grazing in the highlands of Nyoma and Durbuk blocks, and for the optimum yield of crops grown in Leh district's short cropping season.

**Table 1. Household Perception of Climate Change: Compared to the last one or two decades, do you notice any change in the climate or environment in your region?**

Block Name	Total No. of Households	Percentage (%)		
		Yes	No	Don't Know
Leh	6299	65.87	32.75	1.38
Kharu	1341	96.77	2.70	0.53
Khalatse	2245	94.22	3.81	1.97
Nyoma	1176	85.86	8.34	5.80
Durbuk	725	88.10	11.76	0.14
Nubra	2917	90.71	8.23	1.06
<b>Leh District</b>	<b>14703</b>	<b>80.59</b>	<b>17.80</b>	<b>1.61</b>

Source: Gyurja Project - Ladakh Autonomous Hill Development Council Household Survey 2006

**Table 1A. Percentage Distribution of Household Responses for: Sectors of Employment for the Main Income Earner in the Household (More than one response is possible for a household) <sup>5</sup>**

Block Name	Percentage (%) Distribution of Responses for: Sectors of Employment for the Main Income Earner in the Household							
	Own Farm Activities	Livestock Rearing	Labourer	Employed (Salaried)	Tourism and other Business	Army	Traditional	Other
Leh	33.31	15.47	11.39	51.81	13.10	7.92	1.32	14.17
Kharu	65.53	29.55	28.27	27.21	5.97	12.40	1.59	14.97
Khalatse	64.81	34.64	23.78	32.41	7.49	9.95	2.51	12.64
Nyoma	49.44	52.20	28.99	22.95	3.88	1.90	1.64	8.71
Durbuk	48.53	41.82	36.50	21.68	4.34	5.17	0.98	9.93
Nubra	62.22	35.70	38.98	27.04	6.44	7.43	0.95	14.05
<b>Leh District</b>	<b>48.76</b>	<b>27.89</b>	<b>22.89</b>	<b>37.94</b>	<b>9.11</b>	<b>7.92</b>	<b>1.46</b>	<b>13.34</b>

Source: Gyurja Project - Ladakh Autonomous Hill Development Council Household Survey 2006

<sup>5</sup> 'Labourer' includes agricultural and non-agricultural labourer; 'Employed (salaried)' includes government service and private service; 'Tourism and other business' includes tourism, guest house and small business; 'Traditional' includes traditional medicine practitioner (Amchi), driver, servant and other

A more detailed analysis of household perceptions of the different types of climate changes is presented in Table 2; this table analyses response to the second question listed above. The most obvious observation of climatic change by households throughout Leh district is the change in precipitation patterns – heavy and untimely rain, and less snowfall – along with increasing ambient temperatures that are leading to quicker snow melt, and thus a shorter season of flowing streams.

Less snowfall results in a slower recharge of ground water and springs, and a quicker drying up of scarce water resources even if population and per capita consumption pressures remain stable. As has been discussed before, flowing water emanating from annually replenished glacial sources and springs is the only source of drinking water in Ladakh and the lifeline of Ladakhi agriculture, which is, on average, the main occupation of more than 58% of Leh district's citizens outside of Leh block. In more remote areas, agriculture and livestock rearing are not only the main occupation but also the main source of sustenance. An average of almost 48% of households in Kharu, Khalatse and Nubra blocks - mainly agricultural blocks - have observed the reduction in annual snow falls.

Tourism is also becoming an increasing source of annual government revenue and private income in Ladakh. Ladakh is popular globally for its breathtaking landscape, composed of majestic snow capped Himalayan peaks and scenic, culturally preserved, villages amidst pristine glacial valleys, which attract many tourists to the region each year. Climatic changes that are impacting this landscape are also likely to affect the tourism economy. The rise in ambient temperature and heavy snow melt in Ladakh, as observed by the households, can be confirmed by widely acknowledged anecdotal information that indicates that glaciers such as Siachen, Khardong and Stok in Ladakh – all well known for their strategic and scenic locations – have either receded or almost disappeared in about a decade (1996-2006).

Leh district receives about 20 mm rainfall in a year, which has risen nearly ten times in the past few years<sup>6</sup>. As is seen in the analysis in Table 2, over 73% of all households in Leh district have perceived similarly about the increasing intensity of rainfall, through their own observations of climatic changes. This heavy and untimely rain has, in recent years, caused great amount of damage to private and public property due to landslides and flash floods. The recent flash floods of August 2006 destroyed homes, bridges and roads, cutting off villages from sources of communication and assistance, and inundated fertile fields with rock and sand, rendering them unsuitable for further cultivation. Such climatic occurrences also significantly reduce the resilience of Ladakhi households to withstand other socioeconomic and ecological changes. Since most homes in Ladakh are made of mud bricks and wood, local anecdotal information reveals that the large majority of homes suffered partial to severe structural damage due to the intensity and duration of rainfall. As can be understood easily through field observations, traditional homes in Ladakh have been designed with much ecological and climatic wisdom - to withstand the forces of the elements and to last for the needs of several generations. However, the recent unpredictable climatic changes are proving to be unfaced challenges that require the adoption of energy intensive and little understood construction practices, imported from

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<sup>6</sup> Sethi, A (2007)

mainland India, that pose more harm than good to the fragile Ladakhi landscape. In addition such adoptions create a large economic burden on many families socioeconomically unaccustomed to devoting the large part of their lives towards collecting the required resources to build homes.

**Table 2. Block-wise Household Perception of the Different Types of Climate/Environmental Change**

Block Name	Percentage of All Households in Leh District Responding the Following Perceived Environmental Changes						
	Heavy and untimely rain	Frequent occurrences of floods and landslides	Rise in temperature and heavy snow melt	Loss of biodiversity	Occurrences of new diseases	Less snow fall	Other climatic or environmental problems
Leh	61.41	27.94	34.42	1.44	2.21	36.89	0.25
Kharu	87.75	33.96	45.60	2.93	2.70	49.14	0.23
Khalatse	87.13	35.92	47.76	3.50	5.87	50.67	0.18
Nyoma	74.98	21.42	44.95	2.63	7.02	38.37	4.04
Durbuk	76.06	15.86	38.24	2.97	5.95	31.02	3.82
Nubra	80.35	36.87	44.14	1.34	6.86	42.97	0.51
<b>Leh District</b>	<b>73.33</b>	<b>30.41</b>	<b>39.60</b>	<b>2.04</b>	<b>4.30</b>	<b>40.78</b>	<b>0.69</b>

Source: Gyurja Project - Ladakh Autonomous Hill Development Council Household Survey 2006

The third part of our analysis studies the perceived magnitude of the impacts of climatic changes, in people's lives and livelihoods. The analysis, presented in Table 3, shows that almost 72% of all households in Leh district feel that climatic changes have affected their livelihoods in some way. As observed earlier, this perception is stronger in agricultural and pastoral areas, than in urban areas. Notably, almost a quarter of all households in Kharu and Khalatse feel a serious impact on their livelihoods. Even within Leh, a largely urban block, the more rural, agricultural villages have reported being seriously affected by climatic or ecological changes. In Nang village of Leh block, for example, farmers have complained that they do not get enough water to irrigate their crops during the peak irrigation period time; as a result, the village incurs heavy crop losses each year.

According to several surveyed households, despite a well functioning *Churpon* system – an efficient and effective traditional water managing social institution that employs the use of equitable water distribution depending on the slope, the area to be irrigated, etc – their village faces severe water scarcity which is attributed to heavy runoff of water from faster snow melt. It is important to note that the run off water enters into the Indus River and flows downstream into lower lying regions. Ladakhis have traditionally not relied on the Indus for irrigation due to its low depth, the low quality of its water and the great difficulty in lifting water from its levels without the use of polluting, energy inefficient, mechanized pumps. The altitude and climate of Ladakh pose great mechanical challenges often not experienced in any permanently inhabited part of the world.

**Table 3. Household Perceptions of How Seriously Climate / Environmental Changes Have Affected their Livelihoods**

<b>Block Name</b>	<b>Very Seriously Affected</b>	<b>Seriously Affected</b>	<b>Slightly Affected</b>	<b>Not at all Affected</b>	<b>Cannot Say</b>
Leh	1.02	10.56	46.45	7.78	34.20
Kharu	3.28	23.56	58.76	10.22	4.18
Khaltse	2.81	24.99	60.67	5.26	6.28
Nyoma	0.17	6.04	72.19	4.59	17.01
Durbuk	0.28	4.00	71.59	10.07	14.07
Nubra	2.13	13.54	61.50	13.40	9.43
<b>Leh District</b>	<b>1.61</b>	<b>13.85</b>	<b>56.03</b>	<b>8.59</b>	<b>19.91</b>

Source: Gyurja Project - Ladakh Autonomous Hill Development Council Household Survey 2006

Heavy snow melt is also impacting the livestock economy of Leh district. Our interaction with nomadic pastoralists in Kharnak village in Nyoma block indicated to us that the disappearance of snow from the surrounding mountains has led to reduced grass yields important for grazing. As a result, the pastoralist groups now move more frequently from one place to other, in search of grazing lands, as compared to a decade earlier. This has further impacted the regenerative ability of the highlands. Thus, what used to be a traditional and lucrative occupation for many generations of livestock herders is being reduced to a source of increasing penury. According to the inhabitants of Kharnak village, while more than 60 families were involved in pastoral activities until only a few years ago, the number of such families has reduced by half. Pastoralist families have migrated from Nyoma and Durbuk blocks to Leh town, in search of better economic opportunities within the tourism economy and its allied sectors.

Another impact of climatic changes has been the increase in the frequency and intensity of pest attacks. The recent (2006) devastating invasion by locusts, both in magnitude and duration, in Nyoma and Durbuk blocks, is perceived by inhabitants of villages such as Anlay, Rongo, and Kuyul in these blocks as a consequence of the rise in temperatures in the region. It has been noted by the agricultural extension office and the Field Research Laboratory at Leh that the frequency of such pest attacks can be attributed to warmer temperatures which are conducive to the increase in the geographical range and the duration of infestation of such agricultural pests.<sup>7</sup>

### **Conclusion and Recommendations**

It is clear that most of Leh district's citizens have a clear perception of climatic or ecological changes in their region, even if they are not aware of the scientific basis of

<sup>7</sup> Anecdotal information, based on interactions with agricultural officers and ecological researchers stationed in Leh

climate change or global warming. It is also evident that people with a greater proximity to, and need for, managing natural resources in Leh district have a stronger, or more resolute, perception of such climatic changes.

Ladakhis, as we have noted earlier, have sustained themselves for at least half a millennium of documented history, on their region's scarce resource base, amidst a climatically challenging environment. They have developed ingenious ways of efficient natural resource management, through the accumulated wisdom of many generations of experience. However, recent social, economic and ecological changes are damaging this fabric of Ladakh's sustainability. While we do not address here the myriad social and economic reasons, we do partially analyse the impact of ecological changes on people's livelihoods. Loss of livelihood and biodiversity; increasing scarcity of lifeline resources such as clean drinking water; increasing migration from remote rural areas to urban Leh town; changes in primary occupations, construction practices, and socioeconomic living habits are only some of the complex interrelated impacts of climatic and ecological changes in Leh district. In our understanding, these environmental changes are the precursors to many socioeconomic impacts, and thus deserve greater attention than they presently receive.

Throughout Leh district, it is observed that the Ladakhis are keenly aware of, and are articulating, these observed environmental changes that are impacting their lives. Moreover they are taking individual and, at places, small concerted village scale efforts to adapt to these environmental challenges. The actions for mitigation and adaptation to climatic impacts require concerted efforts at much larger, more significant scales, such as we observe at the regional, national and international level, however, governments ultimately depend on the efforts of local communities to undertake these mitigative and adaptive actions. Leh district is somewhat representative of such communities that are already primed, through social-ecological interactions and ecological management wisdom, to detect the magnitude and scale of climatic impacts on their local environment; they are, in several ways, the first source of information and the first line of meaningful action on climate change. It is, thus, pertinent to involve such communities through their articulate representatives to inform and participate in the dialogue on the global environment. It is, after all, these natural resource dependent communities, with acute perceptions of social-ecological relationships, that stand to be most immediately and greatly affected by environmental changes though anthropogenically induced climatic changes.

It is hoped that our study throws some light on the ability to capture local perceptions, in ecologically fragile regions with marginalized populations, on the social, economic and ecological impacts of climatic changes. This understanding of local perceptions is intended to inform the debate on climate change, and more importantly, instigate public citizens, policy makers, organizations and researchers to make informed, concerted and strategic decisions for mitigation and adaptation. As such, the Ladakh Autonomous Hill Development Council is the one of the primary actors who stands to benefit from this analysis of the climatic perceptions of its citizens.

No sustainability study can be complete without a detailed analysis of the complex interrelated social, economic and ecological factors governing the scale of its study. Our



study too necessitates a more detailed understanding of these factors, including comparisons with historical data wherever possible, which we hope to present in more detail in our subsequent analyses.

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