

Climate Vulnerability and Resilience Assessment

of mountain Communities living in the Ladakh Region in India



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About the organisation

Groupe Énergies Renouvelables, Environnement et Solidarités (GERES) was set up following the first oil crisis in 1976 and has since been engaged in the quest for an ecologically responsible society. Much of GERES' efforts through its programmes and policy advocacy are focussed at promoting clean and efficient energy production and utilisation across the three continents that it is currently working in.

GERES has been operating in India since 1986 and has actively implemented projects in the cold desert regions within the states of Jammu and Kashmir and Himachal Pradesh on issues of environment, renewable energy, food security and sustainable rural livelihoods. In the recent past, GERES has carried out two big projects, one on promoting 'green houses' for winter vegetable cultivation and the other on promoting 'passive solar houses' for reducing energy vulnerability of poor rural communities living in the western and Trans Himalayas. In partnership with local organisations, GERES helped build over 500 green houses and more than 1000 passive solar houses. It received the Ashden Award in 2009 for the former project and was among 8 finalists for the World Habitat Award in 2011 for the later.

Acronyms and Abbreviations

CCU	Climate Change Unit (at GERES headquarters)
cm	centimeter
DIHAR	Defence Institute for High Altitude Research
DRR	Disaster Risk Reduction
FGD	Focussed Group Discussion
GERES	Groupe Énergies Renouvelables, Environnement et Solidarités
GHG	Greenhouse Gases
GLOF	Glacial Lake Outburst Flood
ICIMOD	International Centre for Integrated Mountain Development
IPCC	Intergovernmental Panel on Climate Change
LEDeG	Ladakh Ecological Development Group
LEHO	Ladakh Environment and Health Organisation
LNP	Leh Nutrition Project
LREDA	Ladakh Renewable Energy Development Agency
MASL	Meters above Sea Level
NAPCC	National Action Plan on Climate Change
NGO	Non Governmental Organisation
PDS	Public Distribution System
SAPCC	State Action Plan on Climate Change
SKUAST	Sher-e-Kashmir University for Agriculture Science and Technology
SLC	Snow Leopard Conservancy Trust Indian
WWF	World Wide Fund for Nature

1. Introduction

Climate Change and Mountain Communities

There is overwhelming scientific evidence that climate change is happening and the earth is showing a trend of warming up due to acceleration of the Greenhouse phenomenon. There is also consensus that the causes are largely anthropogenic. The life sustaining role of the biosphere is at serious risk because of an unrestrained use of natural resources and emission of Greenhouse Gases (GHGs) by humans, largely in the process of achieving economic growth. Mountains are established to be among the most sensitive regions/ecosystems to climate change. Some of the most visible indicators of climate change come from the mountains, such as the accelerated retreat of glaciers that have been observed in the recent decades. Even though the trend is not consistent, most available data and local people's accounts point to a recession of glaciers from most parts of the Himalayas. This increase in glacial melt, scientists believe (and as has been abundantly witnessed across the world in the last few years), will result in increased flooding and avalanches across the Himalayas in the coming two to three decades which would then be followed by substantial decrease in the water flow in most rivers. This could result in severe environmental and economic implications for the people of the region.

The sensitive position of mountain areas has also been clearly highlighted by the Intergovernmental Panel on Climate Change (IPCC) in its Fourth Assessment Report on Climate Change, 2007. According to ICIMOD, mountains provide freshwater to half of the world's population and are home to half of all global biodiversity hotspots. Besides, *"Mountain communities in the developing world are often marginalised from political influence and economic opportunities and generally face high levels of poverty. Mountain ecosystems and mountain people are exposed to multiple drivers of change including globalisation, economic policies, and increasing pressure on land and mountain resources resulting from economic growth and changes in population and lifestyle. Climate change is expected to place additional stress on these already challenged ecosystems and livelihoods."*¹

Key Concepts²

Climate Change

Any change in climate over time, whether due to natural variability or as a result of human activity.

¹ Macchi, M; Gurung, AM; Hoermann, B; Choudhary, D (2011) *Climate variability and change in the Himalayas: Community perceptions and responses*. Kathmandu: ICIMOD

² Taken from CARE International (2009) *Climate Vulnerability and Capacity Analysis Handbook*

Vulnerability to climate change

The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Adaptive capacity

The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Resilience

The ability of a community to resist, absorb, and recover from the effects of hazards in a timely and efficient manner, preserving or restoring its essential basic structures, functions and identity.

Study objectives

The Himalayas in general and the Tibetan Plateau (of which Ladakh forms a part) in particular are generally counted among global 'hotspots' for climate change (for a given level of global change, the regional climate of a hotspot will change more than other places), yet there is little documented studies of the vulnerabilities faced by village communities of Ladakh region and their capacities to deal with them. The study aims to improve understanding of how climate change, as also socio-economic changes, are affecting the lives and livelihoods of rural mountain communities inhabiting remote villages in this fragile cold desert region and how these communities are coping with and adapting to these changes. The ultimate goal would be to help in strengthening current and devising future adaptation initiatives.

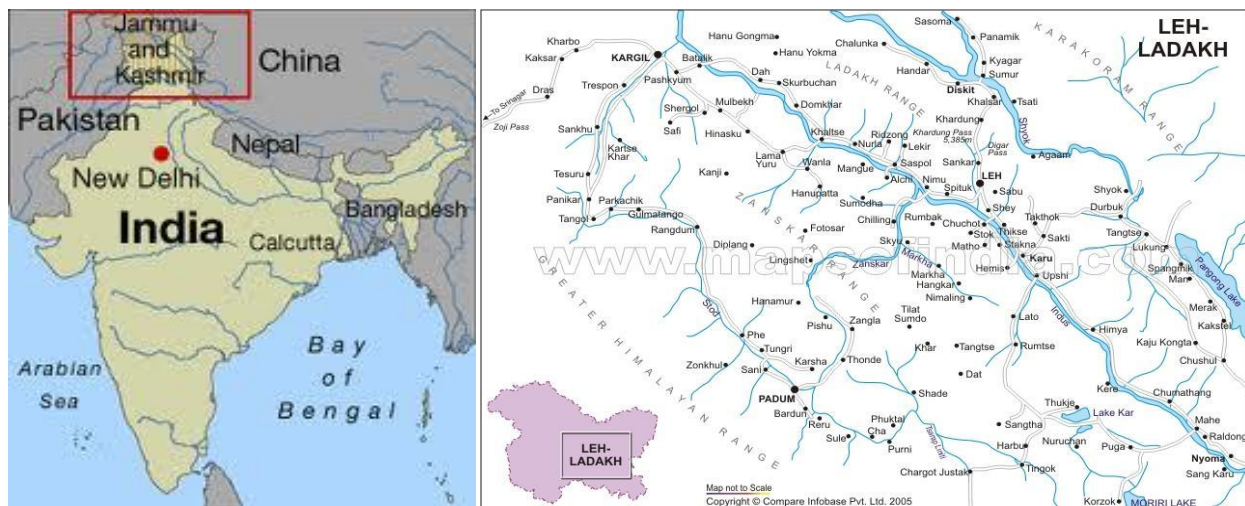
The key objectives of the study were:

- to get a first-hand account from the people on how they perceive changes in the environment around them
- to identify the impacts of these changes on their lives and livelihoods
- to assess the communities' vulnerabilities arising from climate change and their current coping and adaptation mechanisms
- to help in devising future adaptation strategies to enhance resilience of local communities

2. Description of study area

Geography

Ladakh is situated north of the greater Himalayan mountain ranges and south of the Karakoram ranges with the Zaskar and Ladakh ranges running parallel from the south-east to north-west. It lies between $75^{\circ} 15' E$ to $80^{\circ} 15' E$ and $32^{\circ} 15' N$ to $36^{\circ} 00' N$. The region constitutes the western part of the Tibetan Plateau and forms the main cold desert region in India. Politically, Ladakh forms one of the three geographically and culturally distinct regions in the Indian state of Jammu and Kashmir, bordering China/Tibet to the East and Pakistan to the North. Ladakh makes for over 60% of the state in terms of area and a mere 2% in terms of population. At around three persons per square kilometer, it is likely the most sparsely populated region in an otherwise densely populated country.



Climate

There are significant variations in climate within the region. Much of the Nubra, Sham and Suru valleys, for example, are at lower elevations of 8,000 to 10,000 feet above sea level and experience a shorter and less harsh winter. These villages are typically able to get two crops in the relatively longer summers. The Changthang region, vast plains forming eastern Ladakh, on the other hand, where villages are located between 13,000 to 15,000 feet above sea level, experience 7-8 months of winter with temperatures dropping down to $-45^{\circ}C$. The people here are largely pastoralists and are able to practice limited or no farming. Majority of the villages in the region, however, are located at 10,000 to 12,000 feet and experience winter temperatures of $-15^{\circ}C$ to $-30^{\circ}C$.

The region falls in the rain shadow area with very little of the monsoon clouds getting past the mighty Himalayan peaks. Annual precipitation ranges between a mere 10 to 20 cm, much of which is received in

the form of snow. True of a desert ecosystem, temperature variations are extreme, ranging between summer highs of 30 °C and winter lows of -30 °C. However, peak annual variations nearing 100 degrees Celsius have also been recorded from the region. **The region thus has the distinction of being one of the highest, coldest and driest inhabited places on earth, all at the same time.**

People and livelihoods

Over 90% of the people inhabiting the region belong to various Scheduled Tribes (indigenous communities) classified by the Govt. of India and are largely of Tibetan descent. Buddhists and Muslims make up for around 47% each of the total population of the region, with the Buddhists largely concentrated in Leh district and the Muslims in Kargil district. Christians, who are largely Buddhist converts, and Hindus and Sikhs, largely migrant traders from the Punjab region who settled here a few generations back, constitute small minorities in both districts. Majority of the communities speak dialects of the Tibetan language and cultural practices are also largely influenced by Tibetan Buddhism.

Subsistence agriculture remains the main source of livelihood in much of the region even though unproductive soil and harsh climatic conditions mean the growing season in the region is very short and the yields from a single annual crop are very low. Water resources are minimal with glacier-fed streams providing the only source of irrigation. Animal husbandry also forms an important source of subsistence and livelihood for most communities. The choice of livestock is constrained by the altitude while economic considerations remain an important criterion. While cashmere producing goats are the most preferred by pastoral communities, lower lying agricultural villages have seen a surge in demand for high breed jersey cows. Horses, Donkeys, Yaks, *Dzos* (hybrids of Yaks and Cows), Sheep and local cows are the other animals people keep for meat, milk, wool as well as for carrying loads.

The dominant cereal crops in the region are wheat and barley. Of late, cash crops such as apples, apricots, potatoes, peas and other vegetables have also become a very significant contributor to the family income, especially in the lower parts of the region. Pastoralist and agro-pastoralist communities also make up significant groups in the region. In the last two decades, employment with the state governments as well as the Indian army has emerged as significant alternatives to farming, and one much preferred by the educated youth. A significant number of the uneducated youth as well as the elderly add to their farm incomes by working as seasonal casual labour in the private sector as well as the military/para-military. Tourism is another sector that is fast emerging as a significant and attractive source of employment in the region and one that is encouraging a lot of migration to the urban centres, especially to Leh town. The census report of 2011 puts the decadal growth of urban population in Leh district at a whopping 120.7%, while it is -5.3% for rural Leh³. The local government believes that the census data is skewed because of the inclusion of the large number of defence personnel based in Leh town to the local population. But nobody refutes the point that urban migration in Leh district is indeed very high.

³ <http://www.census2011.co.in/census/district/621-leh.html>

3. Methodology

Through the Climate Vulnerability and Resilience Assessment (CVRA), the study attempts to understand how climate as well as socio economic changes are impacting the lives and livelihoods of marginalized and vulnerable mountain communities, what constitutes their vulnerabilities, how they are coping with and adapting to these changes and what/who are helping them in this process of adaptation. The study design and tools have been adapted from ICIMOD (Macchi, Framework for Community Based Climate Vulnerability and Capacity Assessment in Mountain Areas, 2011) and CARE (Climate Vulnerability and Capacity Analysis Handbook, 2009) to a large extent.

Even though with limited results, secondary research on documented impact studies and weather data in the region were conducted. Interviews with key stakeholder, both governmental and non-governmental agencies active in the region, were also conducted to assess their reading of the situation and involvement with climate change adaptation support.

The main tool for information gathering were sampled household surveys and focused group discussions in three villages, two in Leh district and one in Kargil district. The villages have been selected to represent different altitudes within the region as also differences in the major sources of livelihoods and distance from urban centers. Sato-Kargyam represents a high altitude pastoral community while Shakar represents a somewhat lower lying farming community and Sabu represents a mid-altitude, close to the city and somewhat affluent community with a large number of govt. and private sector employees.

Village	Altitude (approximate, MASL)	Distance to urban centre (Kms)	No. of HHs	Population	No. of households surveyed
Sabu	3500	7	258 ⁴	12214 ⁴	29
Sato-Kargyam	4500	147	1094 ⁴	5624 ⁴	12
Shakar	3000	83	260 ⁵	25003 ⁵	29

The field studies were conducted in the summer of 2012 with support from GERES' local partner organizations working in these villages on a joint project on passive solar housing and hence sharing good rapport with the communities. Within each village, a detailed questionnaire was administered to a sample of at least 10% of the households. The households selected were random, with the local field staff making sure that households from different economic and social classes as well as hamlets located upstream and downstream got representation. Focused Group Discussions were also conducted, mainly

⁴ District wide Micro Level Planning (MLP) report, TATA-LAHDC 'Gyurja' Project

⁵ Approximate figures given by the village Sarpanch (headman)

with elderly members, and across gender where possible. Semi structured interviews were also conducted with key informants or knowledgeable people within the communities. For the sake of uniformity, in most cases the respondents were asked for their perception of changes in comparison to how things were around 20 years back. Even though the focus was on seeking and documenting impacts related to climate change, it was felt that people's accounts had a mix of changes resulting from climate variability as well as changes related to social, economic and political processes. It was also felt that responses largely hinged on the people's memories, often not as sharp and often stronger for recent events and missing the patterns over years and decades.



Talking climate with a small group of elderly men at a road side tea stall in Shakar

The following questions largely guided the direction and scope of the study

- How do different individuals and social groups living in fragile and vulnerable mountain ecosystems perceive and interpret climatic changes?
- What are the major impacts of these changes on the lives and livelihoods of these communities? How the impacts are felt differently across the fairly diverse occupations practiced by these people.
- Are the people also exposed to hazards and disasters resulting from climate change?
- What are the underlying causes of vulnerability in these communities?
- How do mountain communities respond to these perceived changes? Are these responses adequate and what would they wish different?
- Are there any differences across age or social groups (men and women, different castes and so forth) in terms of their perception of change and its implications, and with regard to their vulnerabilities, adaptive strategies, strengths, and needs?

- What are the main strengths of mountain communities in coping with, and adapting to these changes?
- What actions (technological, institutional, policy) are necessary to reduce the vulnerability and enhance the resilience of these mountain communities?
- Do the communities perceive any opportunities emerging from climate change?
- How far are the govt. and other agencies studying the impact of climate change on these communities and which institutional mechanisms and policy areas are facilitating or hindering the capacity of these people to adapt?



Group Discussion with a pastoralist community at the community hall in Kherapulu hamlet in Kargyam

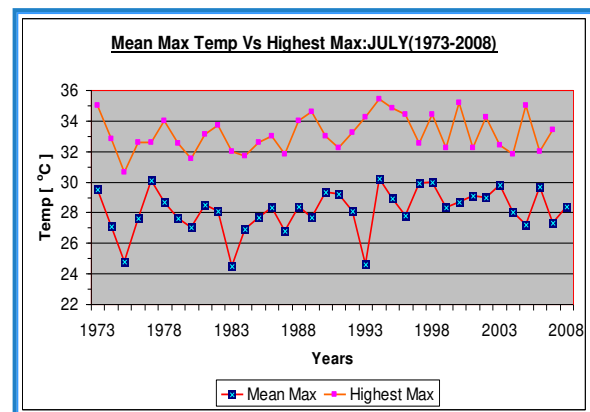
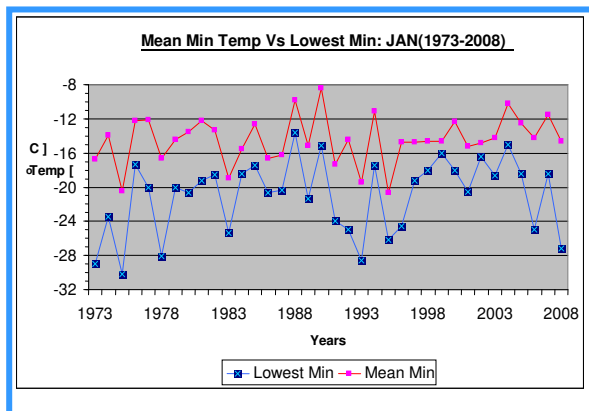
4. Climatic trends in the study area

Records on climate variability and trends

Much in line with reports from studies on other remote mountain communities in the Himalayas; it was difficult to come by reliable long term weather data for Ladakh. The only source from where any temperature and precipitation data was available from the early 1970s onwards was the Indian Air Force unit based at the defense airport in Leh quoted in a previous GERES study by Angmo and Philipp-Heininger (Impacts of Climate Change on local livelihoods in the cold deserts of the Western Indian Himalayan region of Ladakh and Lahaul & Spiti, 2009). The credibility of the data, however, is questioned by many since the data has been manually recorded and is subject to human error and negligence. Similar data for the last few decades is also recorded by the All India Radio station, Leh and the Defense Institute for High Altitude Research (DIHAR) but the same skepticism extends to those data as well, including from people within the organisations. Use of automated weather stations is a very recent development in the region.

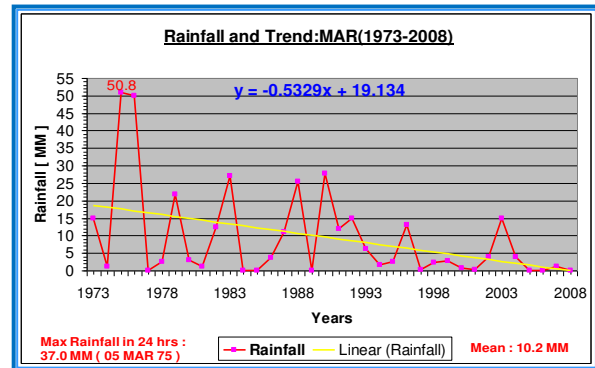
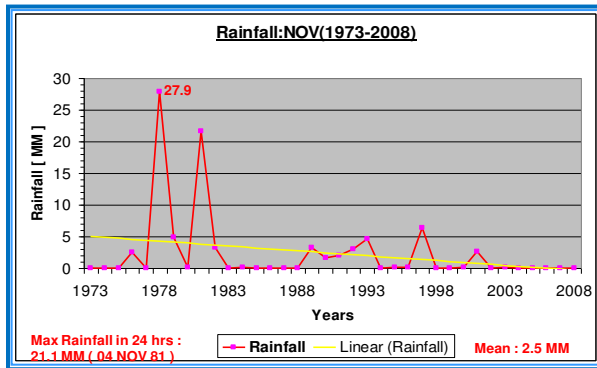
The 2009 GERES study uses the weather data from the Air Force station to show that a 0.5°C increase is observed in Leh town for the summer months over the previous 35 years. Data for the winter months shows a much higher increased of close to 1°C . When we compare this with reported global temperature increase of $.76^{\circ}\text{C}$ since 1850, we get a very scary picture of the pace of climate change in the region vis-à-vis rest of the planet. The raw data could not be availed but the monthly data trends for the coldest and hottest months for the years 1973 to 2008 produced by the study are given below to get a sense.

Graphics 1 and 2: Winter and Summer temperature trends (1973-2008)



Similarly, as could be seen from the following graphs, precipitation data shows a clear declining trend for the winter months of November to March, when around two-thirds of the annual precipitation is received in the form of snow. The other seven months that account for a third of the annual precipitation, mostly in the form of rains do not show any significant change.

Graphics 3 and 4: November and March precipitation trends (1973-2008)



People's perception of climate variability and trends

In the high altitude cold desert region of Ladakh, snow melt from the glaciers, brought down by the numerous streams feeding the few rivers flowing through the region, are the only source of water, both for drinking and irrigation. Falling in the rain shadow of the Himalayas that do not receive the monsoon showers on which much of India depends, and being one of the driest inhabited places in India, rain water is of limited utility to the farming communities here. The only people whose lives are significantly touched by the rains are the pastoral nomads of the Changthang region for whom light showers around spring and early summer are very crucial for a healthy re-growth of the vast pastures on which their animals graze. Now they just don't get that kind of rains any more, and when it does rain, it generally pours, leading to floods or flood like situations. People of Sabu also report similar changing trends and the erraticity of rainfalls. Most importantly, people across the region are very concerned with the extreme forms that the rains have often taken in the recent years, with cloud bursts and flash floods seemingly establishing a pattern of regular occurrence in the region and wreaking havoc on people's lives.

Every single interviewee in the sampled villages were unanimous in their observation that the glaciers have receded significantly over the last few decades. A sense of uncertainty over the future could be sensed in most people who have observed with alarm the fast rate at which the glaciers were depleting in front of their eyes. Almost every interviewee also reported that the amount of snowfall had drastically reduced in the last two or three decades. With the acceptance of stray years in between, both the summer and winter temperatures had also reportedly increased in the last two decades. The summers were expanding and the winters shrinking. People also felt that, except in cases of heavy lashing of

"Throughout my childhood and youth, the village would be white throughout much of the winters. We would be walking through ankle deep snow if not higher. The past 10-15 years, I have longed to see snow in the winters. It snows just a couple of times and then it melts before you've even seen it properly."

Rinchen Tondup, 62, Sabu

rains often taking the form of floods, the amount of rainfall had reduced over the years and the rainfall patterns have become more erratic than ever before. Given that people were responding from their memories and since memories of the recent years are typically much sharper than those of 15 or 20 years back, many seemed influenced by a few of the recent years that brought heavy snow and rain along blurs the pattern of reducing precipitation and increased temperature over the years.

The GERES 2009 study also conducted interviews in the field with elderly people across sampled villages in the region to assess people's perception of climate variability. The results are much in line with the trends indicated by the data they quote, even though the extent of the perceived changes could not be quantified unlike in the case of the data. This three year old study found that 85% of sampled people feel that summer temperatures have gone up in the recent past while even a higher 92% feel the winters are much warmer than before. Around 70% feel that the amount of rainfall has gone down compared to the past while 87% believe it snowed much more in the past.



A small group of women sharing their perceptions of change

5. Vulnerability to climate variability and change

Impacts of climate change on natural resources

Communities living in this high altitude desert do not have access to a wide range of natural resource base as communities living in the plains do. Local communities have survived, and some would say even thrived, but in any case lived happily despite the harsh environment, thanks largely to the art of making judicious use of the few resources they have access to. Subsistent farming communities would use every inch of available cultivable land and every drop of snow melt water to grow enough food in the single cropping season to last for the whole year. Farming was almost a communal practice with neighbours and relatives helping each other through the sowing and harvesting. Pastoralist communities would draw and follow extensive and intricate migration plans, every village dividing itself into a large no. of small groups, following different migratory routes for the whole year, shifting base every few weeks or months depending on the availability of pastures, climbing difficult and icy heights with their herd and making sure pretty much every blade of grass available was eaten. Vegetables grown in the summers would be also be dried and saved for the winters. Potatoes and tuberous vegetables would be preserved in simple dug up cellars. Animals would be killed and eaten more in the winters since the meat would not spoil in the sub zero temperatures and could be kept for a very long time. There were long standing barter relationships between villages of farming and pastoral communities, exchanging meat and wool with wheat and barley.

These economic and social relationships of interdependence between and within village communities suddenly weakened through the 1970s and 80s after the region's physical and economic isolation were reduced as a result of the government building motor-able roads connecting the region with the Indian main land (driven largely by strategic military considerations though) and removing restrictions on outsiders visiting the region. Climate change did not play any role in the weakening of social capital amongst these communities. But another change, of receding glaciers, increasing temperatures, thinning snowfall and erratic rainfalls, that also started to manifest through the 1970s and 80s and that became more obvious through the following two decades had everything to do with global climate change. The limited natural resources people were critically dependent on, snowfall to the farmers and rainfall to the pastoralists, were short in supply and could not be relied upon any more.

People in Sato village report that light rainfall between the months of April and July could earlier be relied upon across much of the pastoralist Changthang sub-region. The continuous gentle drizzle early in the summer is exactly what the vast pastures need for a healthy growth of grass through the summers till late autumn for the goats, sheep, yaks to feed upon and gain enough health and fat to survive through the lean winters of light grazing. But since over a decade now the rainfall patterns have become very erratic. The pattern has shifted from gentle rains for 2-3 months to heavy rains for a much shorter period, which does not help in growing the pastures as much. Similarly, the people of Shakar also report that the rainfall pattern has become very erratic in the last decade or two. They used to receive good

amount of rains in the months of June and July helping in the lush growth of grass on the small mountains all around the village. Till a decade or two back, when people actually kept a large number of animals, they did not need to grow any fodder on their farms with the grasses harvested from the mountains along with the hay from the wheat and barley stalks sufficing their need. Now, when people have largely stopped keeping sheep and goats and typically have just a cow or two to feed, they need to grow their own fodder since very little grass grows in the wild now.



Terrace farms with wheat and barley crops



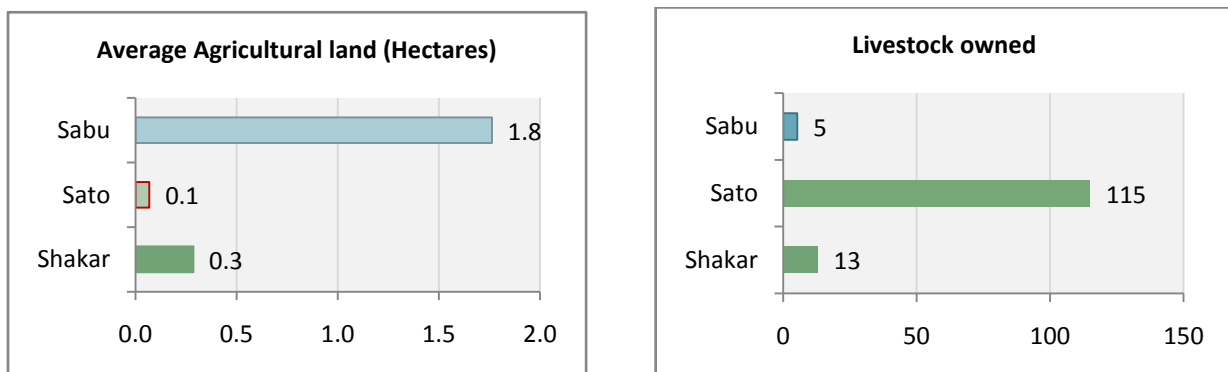
Pashmina goats making good of whatever the pastures have left to offer

Impacts of climate change on livelihoods

The combined effect of lesser snowfall and shorter-warmer winters has been the lesser accumulation of snow on the glaciers and their resultant shrinking. One of the direct consequences of this change on the farmers has been that they no longer get sufficient snow melt in the early summer when they need it for the pre sowing irrigation of the fields. The glaciers have shrunk and moved up and hence their melting has also moved farther into the summer. People often have to push the sowing ahead or leave some land fallow. Snow melt during the summers have also reduced across most of the region. Even though the growing population and the need to build more houses for the newly created families mean that the total land available for cultivation is going down, people are still not getting enough water to irrigate their fields through the summer months. Water disputes not known to communities earlier are becoming common across many villages and neighbours are experiencing strained relations over water. While it is also probable that a shift in people's preference to grow cash crops over cereals and a big focus on growing trees translate into a higher consumption of water than earlier, it still doesn't take away from the fact that the streams and rivers aren't simply carrying any more the amount of water they used to, because their source, the glaciers, are drying up.

Sabu village is very close to the main urban centre in the region and is known for their fine quality of potatoes. The farm soil is supposedly very good and produces not only higher quality potatoes but also yields significantly higher yields compared to other villages in the region. Large numbers of farmers in the village have made a shift from growing cereal crops to growing potatoes and a variety of summer vegetables. The village has a large number of natural springs on which they are heavily dependent for irrigating their fields. A healthy supply of water from these springs is dependent on the health of the aquifers in the catchment area of the village which in turn are fed by the winter snow and the summer rains, both of which have fallen short in supply over the last two decades. In a good year, it snows well and there is more than enough water for everyone's crops, vegetables and plantations. But a bad year means substantial water woes and a lot of adjusting around the available water. This means that all the crops, and especially the potatoes and other vegetables, which brings a very significant share of the family income for majority of farmers in the village, do not get adequate water and their yields suffer.

Figure 1 and 2 Average Agricultural land and Average livestock per household



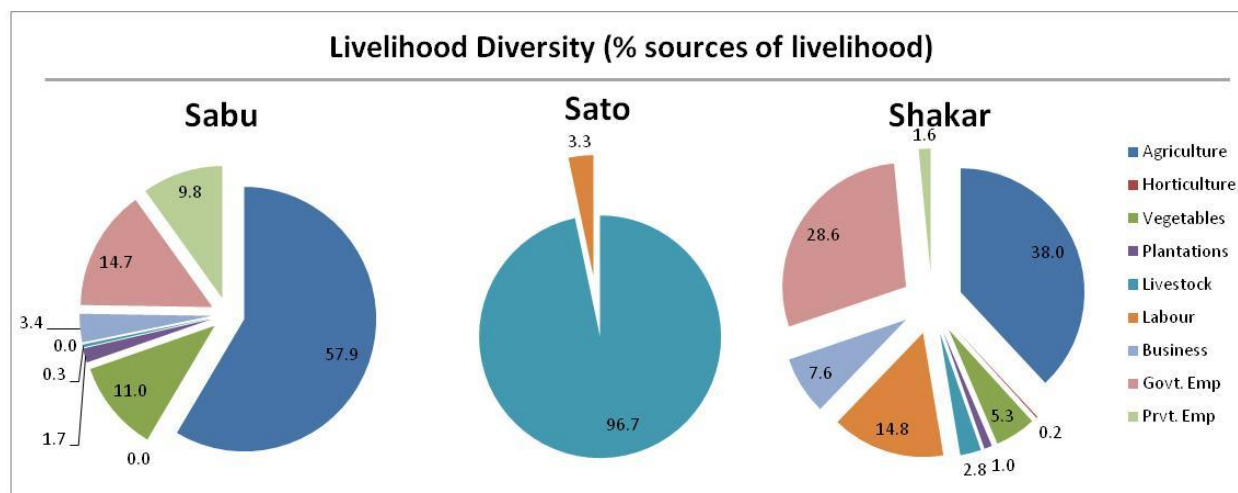
In Shakar village, animal husbandry was practiced in a significant way along with farming till around two decades back. Most families raised a herd of 30-40 sheep and goats for their meat and wool and a few *dzos* and donkeys for work on the farm besides a few local breeds of cows for milk. Besides, all of these animals also provided a very important resource for the farmer, dung, and large quantities of them, for critical use as natural fertilisers and for use as fuel. While many in the village argue that people have given up on keeping large number of animals because it is a lot of work these days to do so when the men are more and more going for paid work, children are going to schools and women are overburdened with the house and farm work, others feel that the loss of lush pastures around the village to the poor rains has also contributed to the decision on doing away with keeping much animals. Fewer animals thus mean that the farms don't get fertilised well any more, and thus creating a dependence on chemical fertilisers that, as they have experienced from long usage, make the soil hard, reducing its productivity and the crop yield. The incidences of pest have also gone up because of the use of chemical fertilisers and the higher temperatures.

Even though the people maintain that they use only a small amount of chemical fertilisers, household data reveals that the average consumption is much higher than the national average. In comparison to a national average of 145 kgs. of chemical fertilisers used per hectare of irrigated wheat⁶, the average usage was 182 kgs. for Sabu village and 302 kgs. for Shakar village (taken together for both wheat and barley). The government, in its quest for agricultural self sufficiency is making fertilisers available to people on subsidised rates, thus inadvertently encouraging or at least facilitating a shift from use of organic manure to chemical fertilisers. The people, however, complain that the fertilisers, as well as the crop seeds, often don't reach them on time or in sufficient quantities.

The worst affected however are the pastoralist communities of Changthang who almost entirely live off their livestock, who in turn live off the pastures whose health is going from bad to worse because of the dwindling and erratic rains. Poor health of the pastures since the last decade or two is what worries the people of Sato the most, who are finding it extremely difficult to graze their animals off the pastures these days. This has meant much more work for them as they now have to travel much higher and farther with their animals in search of food. Less snow has added to their problems since many of the higher mountains with good pastures where they would camp for days of good grazing are practically off limits now since the water streams in most of those places have dried up. With a single climate dependent source of income, low levels of education among children owing to a nomadic life style and little scope of diversifying their incomes, the pastoralist communities appear the most vulnerable to the impacts of the changing climate.

⁶ Fertilizer Use by Crop (2005), Food and Agriculture Organization of the United Nations, <http://www.fao.org/docrep/009/a0257e/A0257E05.htm>

Figure 2 Livelihoods diversity in sampled villages



[Note: In the graphs above on livelihood diversity, agriculture represents only cereal crops while vegetable cultivation, horticulture, tree plantations and animal husbandry have been taken as separated categories. While agriculture typically is seen as broadly inclusive of these other sub categories, it was segregated because the impacts of climate change on each of these sub categories could be quite different from the others. These categorisations were also done to reflect how different communities were reliant on a different mix of these sub categories within agriculture. But for the segregation, pastoral nomads who do not practice any settled agriculture would also be categorised as farmers.]

Impacts of climate change on natural disasters

Even though heavy rainfall and snowfall, often resulting in floods and avalanches, are not exactly new for the people of the region, the regularity and intensity of these catastrophes and the sheer magnitude of the resulting devastations does not find any parallels in the recorded history of the region. No losses of life seem to have been reported in the region from any natural disasters other than from landslides and avalanches. But all of this has changed now and from all one could see this change appears to be driven largely if not wholly by climate change.

Floods have occurred in the region once every few decades, but in the previous century these have largely been localized events with limited damage to houses, farms and animals. People of Shakar village mention that the worst natural disaster from folklore is of heavy snowfall over a hundred years ago in the month of May when it was too warm to hold the snow for long and the quick melting of snow washed away farm lands and eroded soil from the mountains. No loss of life or livestock is recorded from then. Both Shakar and Sabu villages report that they would periodically receive heavier than normal rainfalls but the damages were generally restricted to the streams and water channels, and occasionally to the fields and standing crops. The elderly in both these villages also remember that over thirty years back much of the region faced drought or drought like situations for three consecutive years and the gov. brought in emergency food supplies from outside. For the pastoralists of Sato on the other hand, disaster generally visit them in the form of heavy snowfall in the winters, causing casualty of their

livestock, especially the young and weak who are unable to dig deep for grass from under the thick blanket of snow and die of starvation.

Natural disasters with very serious consequences are however becoming a regular occurrence of late. The winter of 1998-99 was a particularly cold one and it also snowed heavily in most parts of the region, and particularly so in the pastoralist villages of Changthang. It snowed non-stop for days covering the entire pastures in a few feet high snow. While the Yaks and Horses could dig out some grass from under the thick snow, most sheep and goats could not and before the snow over the passes could be cleared and rescue teams could reach with fodder and feed, most people had lost over half of their entire livestock, while many really unlucky ones lost close to all.

In 2006 many villages in the region as well as the town of Leh received heavy rainfall resulting in the loss of over a dozen lives. Dozens of houses were also washed away and many more suffered extensive damage. A few villages reported cloudbursts while some others came in the grip of Glacial Lake Outburst Floods (GLOF). Lot of farm land and water channels were also washed away in many villages. The epicentre of the disaster was close to Leh town. Even though it was the biggest natural disaster people had ever seen in the region, it unfortunately turned out to be just a precursor to what was coming their way in just a few more years. Exactly four years later, cloudbursts and flash floods on the 6th and 7th of August 2010 shook up the entire region and engulfed around half of the villages in Leh district and around a quarter in Kargil district. The epicentre was again close to Leh town with the villages of Choglamsar, Sabu and Phyang as well as the town itself bearing the biggest brunt. Close to 250 people were officially declared dead while unofficial figures claiming around twice as much died in the ill fated floods. While Sato village and most of the Changthang region escaped any significant consequences from the floods of 2006 and 2010, both Shakar and Sabu villages were not that fortunate. Sabu was one of the worst hit in both these floods. In the floods of 2010, 14 people from the village lost their lives. Communities living in near perfect harmony with their environment had never thought that they would ever witness such fury of nature. The 2010 floods particularly left deep scars on the people's memories that many feel would be difficult to erase for a long time. In the wake of the floods, the Deputy Commissioner's office constituted a team to prepare Disaster Risk Reduction (DRR) plans to avert such occurrences or at least minimise their impact.



Villages close to Leh town inundated by the floods, Aug. 2010. Photo: Information Department, LAHDC Leh

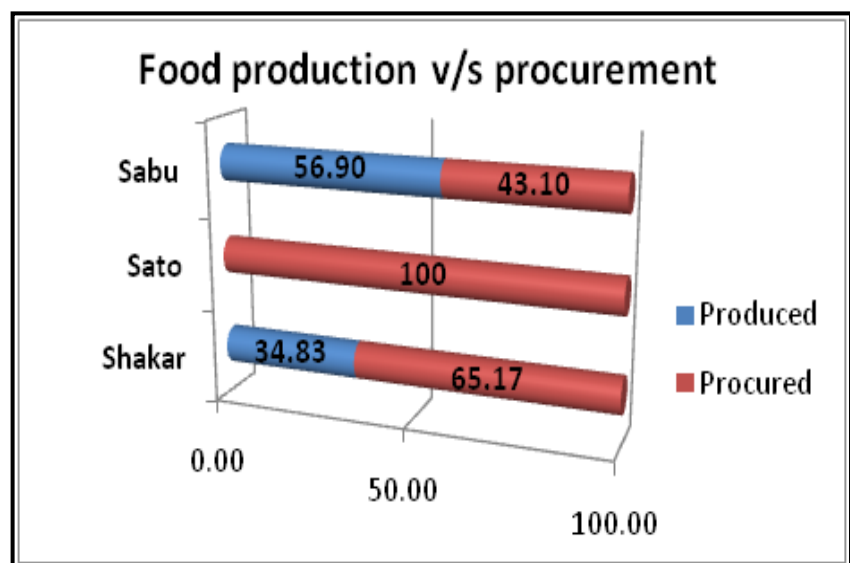
Changes in overall wellbeing through the years

Majority of the elderly people interviewed for the study, across the villages, remember the past with a sense of nostalgia. Everyone is quick to acknowledge and appreciate the positive changes that has come with opening up of the region and the ensuing 'modernisation' such as access to better health care and education, the network of roads, telecommunication, job opportunities and the plethora of goods and material comforts unknown to them a generation back. But they also miss the times that were simpler, people who were kinder, relationships that were personal, work that was more communal and overall a life that was happier despite the fact that it was much harsher and materially poorer. They often find it a difficult question to weigh in on all the pros and cons of the changes of the last few decades to tell whether life is better or worse now. People in the middle ages who have lived that harsh life as children or young adults and then got exposed to a more modern era are however very unequivocal about their preference for the later. They appreciate the fact that they have been able to move on from a life of subsistent agro-pastoralists living in very harsh conditions without enough to eat or access to any of the fruits of modernisation.

"People were poor, innocent and happy. The interdependence amongst the family and neighbours has given way to individualism and materialism. Despite more money and comforts, people aren't really as happy and content these days"
Mohammed Hussain, 75, Shakar

With the new access to hard cash through jobs and wage labour and to a market with large varieties of food items and particularly subsidised wheat flour and rice through the government's Public Distribution System (PDS), people started to find it cheaper or at least easier to buy food than to grow their own. The cheaply available food procured from the Indian plains also had the effect of changing the people's food preferences from locally grown and appropriate food to those eaten in the Indian plains, like white rice and flat bread made of refined wheat flour. People are generally quick to ascribe the growing health issues, particularly of arthritis, cold and respiratory diseases as also an increasing number of cancers partly to this change in food habits. But people often find it difficult to resist the taste as well as convenience in cooking of these new food items, despite the realisation that it is not as healthy as the diverse local cuisine from yester years that now stands largely forsaken.

Figure 3 Food production v/s procurement (Leh District)

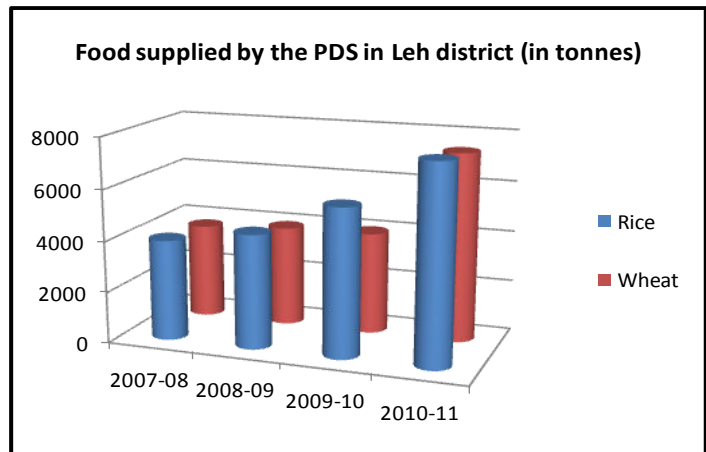


Besides changing local food habits, the government's subsidised food programme raises an issue that does not have any parallels from rural India, that people find it cheaper to buy food than to grow their own. For a region that remains cut off by surface transport from rest of the world for over half a year, and who's remaining open for the other half of the year, so that essential supplies could get into the region, remains contingent on maintaining peace with a less than friendly neighbouring nation that has strategic posts within firing range of the national highway (and could cut this essential lifeline as they did during the Kargil war a decade ago), giving up on growing its own food and becoming totally reliant on buying food from distant markets raises critical issues of food security.

*“Rice is cheaper to buy, tastier to eat, easier to cook as well as easier to digest.”
From an FGD with women in Shakar*

The people's account of an increasing trend of buying their food from the PDS as well as the government statistics of a 97% increase in the supply of rice and wheat over just the last three years calls for a debate on whether the government's policy could be doing more harm than good for the region. This is a concern that is also strongly voiced by the Chairman of the LAHDC Leh in an interview to a national news channel this summer. Since this policy falls within the purview of the union government, the local government can only take up the concern with them.

Figure 4 Amounts supplied by PDS (Leh District)



For communities practising subsistence agriculture and pastoralism that exchanged goods and services through barter relationships and had limited contact outside of the region, integration with the outside world and the formal economy brought lots of opportunities. People got jobs in the public and private sectors, scope for setting up businesses and trade expanded, and even the farmers and pastoralists found access to newer markets and could explore the potential of a more diversified product line. While the farmers diversified into growing cash crops such as a large variety of vegetables, fruits, alfa-alfa and poplar trees, the pastoralists started keeping more pashmina goats to cater to the growing demand for raw pashmina from which the fine cashmere shawls are made.

The explosion of possibilities outside the farm, typically seized by young men, did however mean the gradual feminisation and gerontisation⁷ of agriculture. Most of the young men from the village have either found jobs in the district or block headquarters; joined the army and got posted on the borders or outside the region; are working as seasonal casual labourers in the urban centres or keep moving across

⁷ Had to resort to 'inventing' a word, to express, in lines with feminization, how agriculture is being increasingly left to the old people to practice. Taken from the Greek 'geron' meaning old people.

the region; or picking up seasonal work in the tourism sector with the mushrooming of hotels, restaurants and travel agencies, based largely out of Leh town. The teenagers and younger adults are largely studying either in the urban centres within the region or increasingly outside the region in big Indian cities. The responsibilities of looking after the farms, animals, orchards and plantations as well as the children are increasingly falling on the shoulders of either the women or the elderly parents. The jubilation and festival like celebrations around the sowing and harvest times could rarely be seen anymore. With the young men working outside the village and hardly enough people around, labourers from outside are increasingly being employed during the harvest time. Since ploughing with a pair of *Dzos* (cross of Yaks and Cows) is an art the outsiders are yet to master, sowing still remains a family affair and people often come home on leave to take part in it.



Staring into a bleak future? An elderly lady outside her house in Sato

Differences in vulnerability between different social groups within the community

Compared to mainland India, social hierarchies and inequities are very low in India. Even though caste differentiation does exist amongst Buddhist communities and in some minor way amongst the Muslims, the scope and ramifications are nowhere close to the practices common in the mainland. Among

Muslims, caste comes into play only at the time of marital alliances while amongst Buddhists it also extends to not eating from the hands of lower castes and status based seating on social occasions such as marriages. But unlike the mainland, caste based segregation of settlements are not practiced in Ladakhi villages. People belonging to the lower castes are a very small percentage of the total population in the region and they were traditionally confined to certain vocations of 'lower purity' such as blacksmiths and musicians but with the spread of education amongst these communities as well they have largely broken out of these shackles to get into 'mainstream' vocations.

Unlike mainland India, there aren't social groups within the villages who are dependent, or more dependent than other groups, on the access to certain natural resources for practicing their vocations. All the farmers are equally dependent on glacier melt water and the pastoralists on the pastures, and have equal access to these resources irrespective of their caste. So, vulnerabilities arising out of the change in resource availability attributable to climate change did not really come out as affecting different social groups differently. No social groups seem to be facing any apparent barriers in diversifying their livelihood base by moving into employment or business opportunities outside of their traditional vocations either.

Rather than social groups, vulnerabilities arising out of climate change are more or less pronounced across occupational groups, cutting across social and economic hierarchies within those occupations. Families totally dependent on farming, and marginal farmers within them, seem to be more vulnerable than farmers who also have a member or two working as casual labourers or running a petty business, who in turn are more vulnerable than a farming family with an educated member with a secure government job. The most vulnerable of all to climate change and its manifestation through erratic rains and snow, however, seem to be the large number of pastoral communities whose only source of income is based on the highly climate-volatile livestock rearing. As mentioned earlier, these communities can face a sudden wipe out or near thereof, of their entire productive assets following an extreme snowfall, or a lesser dramatic, gradual loss of their productive base, the pastures, in the wake of decreased and erratic rainfall. And for those who are at the wrong end of the vulnerability scale, being rich is also of little consequence unless one periodically saves or hedges their investment. A rich pastoral nomad who reinvests his earnings into growing his herd, for example, is no less vulnerable to climate induced calamities than a poor one.

6. Existing capacities and Institutional support to cope with and adapt to climate change

Climate change impacts have hit different communities in different ways at different times and they have responded with coping mechanisms and adaptation strategies where ever they could. Many amongst the pastoral communities, for example, disheartened by the loss of very large numbers of their sheep and goats during winters when they receive sustained and heavy snow have now started increasing the share of yaks in their herd. Yaks are a very sturdy animal able to survive through some of the harshest conditions as they are able to dig deep into the snow and find themselves some grass to feed on. Yaks also have a good local market, especially in the winters, for meat. While Pashmina goats are the equivalent of high risk-high return shares, to draw a parlance from the business world, Yaks are low risk-medium return shares and very useful in hedging the risk of the risky investments in a bad winter. Another strategy, taken at the community level, is the decision not to pluck any shrubs from the pastures. The nomadic and semi nomadic communities would earlier collect whatever shrubs they could find on the pasture land while grazing the animals, by plucking them off their roots, for use as firewood. The communities have now decided to go for other sources of cooking and heating and conserve the shrubs for the animals to eat during a bad winter.

With the help from NGOs and the government, some villages are also experimenting with setting up of fodder banks to tide over a bad patch of winter before help could be sought or reach them and avoid the mass casualties of their smaller animals after a heavy snow. Responding to the current degradation of the pastures that are failing to provide enough for their animals, many families have started to cultivate a small patch of fodder or barley. These may not reap in the short summer at such heights but they would still be left with something to feed their animals. People are also increasingly resorting to buying fodder from other villages but they also worry about the financial sustainability of this strategy as the income from livestock are dwindling in the face of many risks while the cost of fodder continues to be very high.

The farming communities are also coping and adapting to the challenges in their own ways. A wide variety of vegetables are now being cultivated, especially in villages close to urban markets. Many of these are transplanted from nurseries late in the spring when the glaciers have started to melt and there is water in the streams. People have also taken to plantations in a big way since there is a huge demand, especially for poplar beams, in the growing construction sector. People with even a small patch of non cultivable land are increasingly planting trees since the investments are minimal, the returns, despite a long maturity period of around 15 years, are high and the trees, once they take firm roots, are more likely to survive through a summer following a winter without much snow. Villages lying in the lower belts are also focussing their attention on growing fruit trees, especially apricots that find a ready market locally.

Artificial glaciers, a technique of storing the autumn water in the form of ice over large stretches in a shadowy valley higher up from the village but lower than the natural glaciers such that it melts earlier than the natural glaciers now do and provide water for the critical pre sowing irrigation. The fields don't need to be irrigated for a month from then, by which time the natural glaciers would hopefully melt and feed the streams. Villagers, with help from the government have also started building water ponds in the village that would store the stream water through the nights and make them available for use during the days. This helps in avoiding disputes over the limited water in the day and also does away with the people have to keep awake through the nights for their water turns.

People in Shakar also mention that during summers of extreme water stress, which could generally be foreseen before beginning of the sowing season by the amount of snow received in the winter, the village community would collectively decide on abandoning their farm lands up in the valleys and use the limited water for cultivating only the fields down in the village.

“By 2025, Ladakh will emerge as the country’s best model of hill area development in a challenging environment, with its sustainability embedded in ecological protection, cultural heritage and human development”

Vision Statement, ‘Ladakh Vision 2025’ document, LAHDC Leh

Our current dependence on tourism and the army for our livelihoods and on the PDS for our basic food requirements are the three strongest impediments in achieving the goal of sustainable development for the region as the foundations on which these three are based are very shaky. Strengthening our agriculture based livelihoods and making it more appealing to the youth is the most important way in which this situation could be corrected.

Rigzin Spalbar (Chairman, LAHDC Leh), speaking on ‘To the Point’, Rajya Sabha TV, 24th June 2012

Institutional Analysis

The government departments as well as research agencies working around environmental issues or natural resources based livelihoods that were interviewed for the study neither have a clear mandate to work on climate change issues nor are they actively involved in conducting any research to get a grip of the impact on the people. This could probably be understood as a trickle down of the state government's less than pragmatic acknowledgement of the seriousness of the issue. Jammu and Kashmir, despite being categorised as a sensitive state from the climate change point of view, is among the few Indian states that are yet to prepare a State Action Plan on Climate Change (SAPCC) to implement the National Action Plan on Climate Change (NAPCC) as well as to get the specific concerns of the state to be addressed in the national plan. None of the Non Governmental Organisations (NGOs) seem to be involved in any research programmes on understanding the impact of climate change on the local communities either. WWF had done a study on the impact of Climate Change to wetlands in the region but the study does not look at the impact on the local communities.

However, both NGOs as well as government departments are carrying out initiatives in the field that are directly or indirectly helping communities cope with or adapt to climate change impacts. LNP and the Rural Development Department have built Artificial Glaciers in many villages with financial support from the Watershed Development scheme of the central government. The Watershed scheme and the Desert Development Agency have also helped many departments and NGOs in building water storage ponds in water starved villages so that the water flowing in the streams through the nights could also be saved for irrigating the fields the next morning. Similarly, DIHAR and SKUAST are conducting research on improved and hardy varieties of crops, vegetables and fruits while the Animal and Sheep husbandry department are working on improving the livestock breeds in the local conditions and running various schemes to help people raising various livestock. The Sheep husbandry department has set up centres in pastoral villages and provide them feed and fodder during difficult winters besides providing periodic animal care and medicine. NGOs like LEDeG, LNP and LEHO, largely in partnership with GERES, have also helped communities by giving technical, financial and in cases marketing support for additional farm based livelihoods by developing and implementing projects on green houses, food processing, traditional handicrafts etc.

Given the eccentricity of the weather and the frequency and magnitude of natural disasters of late, the government as well as non-governmental agencies seem very concerned about what looks like a gradually unfolding climate crisis. After the floods in 2010, the Deputy Commissioner's office constituted a team to prepare a disaster management plan for the district that details out the operative institutional mechanisms and standard operating procedures in case of a disaster and talks about strategies for preventing and responding to likely natural disasters in the future. NGOs are also talking about gearing themselves up to help village communities face the challenges thrown up by a changing climate.

7. Opportunities emerging from climate change

While the lower precipitation and receding glaciers are causing a lot of hardships to the farming and pastoral communities, in cases even threatening their base livelihoods; the warmer summers, milder winters, moister air and a longer cropping season, which are also largely consequences of climate change, are throwing open some windows of opportunities as well. Alongside the glaciers thinning and moving up the mountains, the snowline, tree line and pretty much all the crops and fruits are also breaking the ceiling altitudes they could grow up to. So now, villages that were too high and too cold to grow poplar and willow trees a generation back proudly boast of lush plantations. The same goes for apple and apricot trees.

Many villages that were traditionally barley growing because they were too high for the wheat crop to mature in the short summer are now successfully growing wheat alongside barley. An exponential expansion has taken place in the last decade or so as far as the variety of vegetables that are now grown in the region are concerned. Communities whose basket of opportunities were limited to less than a dozen odd vegetables are now experimenting with and choosing from over 50 different types of vegetables. The DIHAR has grown over 80 varieties in their farms and are still experimenting with more. Fruit varieties have also moved beyond the traditional apricots and apples to include plum, peaches and even the exotic strawberries. A large number of exotic apple varieties earlier grown only in Kashmir at heights of 6,000 feet are now grown in Leh town that stands close to 12,000 feet above sea level.

While a lot of these new found choices are also thanks to new research and development, improved technology, availability of better seeds and technical knowhow as well as the willingness of many progressive farmers who were ready to experiment with the new, changes in the atmospheric features brought in by climate change provide for the right condition that makes these changes possible in the first place.

8. Recommendations for enhancing their capacity and resilience for future adaptation

Given that very little research has been done on the issue in the region, there is a clear need to carry out detailed studies into better understanding the impacts of climate change on various aspects of human life and in particular the impact on livelihoods of communities that are based on the continued availability of certain natural resources or environmental conditions, so that appropriate adaptation programmes could be devised accordingly. The research findings could also be used to inform the state policies and action plans on climate change, whenever they take shape.

The local governments also need to think in terms of engaging with climate change challenges at a broader policy level. The PDS procurements from outside the region and their subsidised supply within the region, for instance, is actually de-incentivising farming within the region. If the local governments could persuade the central government to pass on the subsidy that they currently incur in procuring wheat flour from Indian plains and transporting it all the way up to Ladakh instead to offering higher procurement prices for wheat to the local farmers, it would not only strengthen the livelihood security of farmers reeling under the impact of climate change but even serve to give a fresh lease of life to the farming sector in the region that is in great distress and waning out, raising serious questions of food security for the region. Similarly, the government also needs to rethink the policy of extending heavy subsidies to chemical fertilisers at the cost of promoting sustainable agriculture practices. The vast defence establishment that is currently procuring all the vegetables and poultry from outside the region, often incurring heavy costs in flying them in from the plains, also need to be convinced to buy locally and help the local economy, and at the same time drop their own costs.

There is also an urgent need to initiate adaptation pilots to engage with some of the impending issues to find ways of minimising the climate change impacts and vulnerabilities of local communities. Some projects currently carried out both by governmental and non governmental agencies could probably be studied and replicated in similar contexts in the region, such as the building of artificial glaciers to tide over the scarcity of pre sowing irrigation before the natural glaciers start melting or the strengthening of livelihood diversity in the orchard belts of the region by training village groups in value addition of their produce by making jams and juices out of apricots and apples or adopting latest technologies in dehydrating vegetables to sell them at much higher prices in the local and outside markets than they would get by selling them unprocessed. One could also try out the possibility of tapping into the booming health food market in India by promoting a brand of organic cereals, fruits and vegetables.

The vulnerabilities of the pastoral communities on the other hand are more focussed around the depleting health of their pastures. Initiatives to develop the pastures in the form of building water canals through some key pasturelands have been tried out by the government but have failed to succeed for various reasons, such as canal breaching out at various points, drop of water level in the main stream feeding the water canal or even the destruction of pastures because of the uncontrolled

flow of water from the canals. The gentle showers of mild rains, falling frequently over a stretch of two to three months that the Changthang region used to get in the good times is what the pastures needed for a lush growth of the grass. Pilots could probably be launched in other methods of watering the pastures such as drip irrigation or sprinkler systems. In villages like Sato that has a reliable stream of water running by the village with vast pastures just above, it might be worth trying to lift that water as far up as possible, using renewable energy sources such as solar or wind and create a reservoir at one point, employing cheap methods such as lining up and linking discarded army barrels that are plenty in the region, and releasing it down in pipes through gradient flow with sprinklers at regular intervals. The sprinkled water might be the best substitute of mild showers that the pastures do best with. If a big pastureland is developed for every community with such methods, they could probably use this one pasture as a reserve and source of last resort for the lean periods when they have exhausted all the pastures around them.

Efforts also need to be strengthened at reaching out to these communities at times of calamities such as heavy snow following which the people suffer heavy losses of livestock. Since such efforts are often hindered by the closure of passes, following the snow fall, which connect these communities with the district headquarters that typically have the means to respond to such situations, the government needs to think in terms of establishing fodder banks within the communities and stocking the field veterinary centres with enough medicine and other supplies to cater to big calamities. For the long term, the government could also think on the lines of introducing some sort of a participatory livestock insurance policy with partial support from the government.

9. Conclusion

Looking back from the current times of climate change vulnerabilities, one could probably say that the process of social, political and economic 'de-marginalisation' of the region that began in the 1960s - following the war with China, when the government, realising the strategic importance of the region, built an airport at Leh and a motorable road that, at least seasonally, connected the region to rest of the country - has helped a large section of the subsistent farming communities living on the margins of development to seize new opportunities and be better prepared by the time climate change impacts became apparent and started hurting. The jobs in the public and defence sectors that flowed in, the service sector that took roots and grew after the region was opened up for tourists in the 1970s, the resultant growth of trade and commerce through the 1980s, the decentralisation of governance by establishing the autonomous development councils in the 1990s and their focus on developing infrastructure as well as human resources, all put together helped many families to diversify their sources of livelihood and build their capacities to face the challenges they would eventually face in eking out a living as agro-pastoralists in the post climate change world.

Not everyone, however, has been lucky to find secure jobs with the civil or defence establishments. Not everyone is lucky even to find work as seasonal casual contract labourers to substantiate their meagre incomes from other sources, unless may be they give up on their ancestral villages and traditional vocations of farming and pastoralism and migrate to the urban centres to work in the informal sector. These communities who are still dependent on the rains and snow to eke out a living as farmers and pastoralists and do not have the cushion of diverse sources of income are immensely under the heat and increasingly becoming vulnerable to the changing and erratic climate. These communities need a lot of help in terms of government policies as well as civil society support in coming to terms with these changes and adapting their lives and livelihoods around them.

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