



Climate change and changing livelihood in Leh and surrounding villages: A case study of Leh district

Chhering Tandup

¹Asstt. Professor in Faculty of Earth Sciences, Institute of Mountain Environment, Bhaderwah Campus, University of Jammu, E-mail: chheringgeo@gmail.com

Received: 30/09/2020 Revised: 20/12/2020 Accepted: 20/12/2020 Published:23/12/2020 CCLicense CC-BY-NC-SA 4.0	Abstract Ladakh have seen tremendous changes in livelihood for the past few decades. Primarily the Ladakh region is dominated by self subsistence based economy. Livelihoods perspectives have been central to rural development thinking and practice in the past decade. But where do such perspectives come from, what are their conceptual roots, and what influences have shaped the way they have emerged? This paper responds to these questions with an historical review of key moments in debates about rural livelihoods, identifying the tensions, ambiguities and challenges of such approaches. In particular, the paper highlights the problems arising from a simplistic application of synthetic frameworks which have come to dominate certain aspects of applied development discussion and practice over the past decade. Looking to the future the paper identifies a number of core challenges, centered on the need to inject a more thorough-going political analysis into the centre of livelihoods perspectives. Ladakh remains closed for rest of the world up to 1974. After the war of 1962 there was drastic change in the socio-economic landscape of Ladakh. This paper is based on the field observations and literature review. An extensive survey has been conducted the Leh city and surrounding selected villages. It has been observed that the most of the villages have seen changes in climate. In 1979 Ladakh has been opened for the rest of the world from tourism industry. Due to tourism industry there are changes in Landuse and landcover of Leh city and its surroundings. The 1962 India-China war had lead to establishment of Ladakh Scouts, which become the main sources of employment for the youth of Ladakh. Percentage of people who are still practicing their parental occupations are higher in Stok, Saboo, Choglamsar and Shay villages. Villagers have found changes in crops for the past 20 years. Keywords: Climate change Livelihood, tourism, agriculture, development
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INTRODUCTION

A complex archaeology of ideas and practices is revealed which demonstrates the hybrid nature of such concepts, bridging perspectives across different areas of rural development and practice. In arguing that livelihoods perspectives are important for integrating insights and interventions beyond disciplinary or sectoral boundaries.

Overwhelming scientific evidence has demonstrated that the earth is moving towards a point of no return. And change is law of nature. Changes have been also observed throughout the geographical history of the earth. Since the late 20th century, changes have been observed in the trends of some extreme weather and climatic events (Bandhyopadhyay, M.K. 1995). The impacts of climate change can be brought in terms of sensitivity and vulnerability. 'Sensitivity' is the degree to which a particular system or sector might be affected, positively or negatively, by climate change and climatic variability (Dev S. M. 2011).

For the purposes of this study, "climate change" is defined as "any change in climate over time because of both variation and change in nature or human activity" (IPCC 2001: 984), and "livelihoods" as "the means by which households obtain and maintain access to the resources necessary to ensure their immediate and long term survival. Rural livelihoods depend on natural resources and agricultural farming will be hard pressed to cope with the adverse effects of climate variability and change.

Climate change has demonstrated the key challenges that is threatening the sustainability of livelihood supporting resources through a brief overview of the current situation in (1) the agriculture sector, and (2) the natural resources sector (water, land cover/forests) in Leh valley (Kaddo J. R. 2017).

Rural Livelihood Issue in Leh valley

Climate change is a major challenge for agriculture, food security and rural livelihoods for rural people in Ladakh region of Jammu and Kashmir. Climate change can impact on agro ecosystem particularly in lower valleys irrigated by glacial water. Agriculture in Ladakh is based on 100% irrigation by snow and glacial water. It is supported by many facts and data that climate of Ladakh is changing very fast and ultimately it is affecting the rural livelihood. In an interview with Er.Sonam Morup, told that snowfall in Ladakh has drastically declined since last few decades because of global climate change. During our pilot survey in Nang village the surpanch and public told that due to increasing temperature it is possible to grow apple in Nang village, earlier it was not so. They have also mentioned that since last few years the water discharge has increased in lower valleys because of fast melting of glaciers.

Rural livelihood is extremely vulnerable to climate change. Higher temperature eventually reduces the yield of desirable crops while encouraging weed and pests proliferation. Present "Climate Change" leads to depletion of snowfields and glaciers, ultimately affecting water discharge at lower valley. Understanding nature of problems and the kinds of possible solutions held by diverse stakeholders (from govt. officials to Local farmers) exerts a significant impact on whether the proposed policy is feasible, adopted, equitable, or environmentally suitable.

Agriculture is the major source of livelihood in Ladakh region but several other region have substantial share of rural non-farm sector also. Rural-urban Migration is an important source of income. Income from remittance sent by migrants often help to increases the agricultural land by converting barren land into agricultural land, livestock, and human capital base of rural household members who stayed behind (Bhutiyani R. M. 2009).

Agriculture is the sector most vulnerable to climate change due to its high dependence on climate and weather and because people involved in agriculture tend to be poorer compared with urban residents. In Cold desert region agriculture sector is already facing many problems relating to sustainability. To these already daunting challenges, climate change adds further pressure on agriculture, adversely affecting the poor (Jamshidi O. 2018).

As the Ladakh, the cold desert, remains cut off from the main land for more than six months due to heavy snowfall and adverse weather, the supply of food and other items from outside is not sustainable, so the people of the region have to depend upon their own produce and agricultural production.

Study Area:

Natural physical Environment of Ladakh

Physical Environment of Ladakh one of the three province of Jammu and Kashmir State. It extends from 32°15' N to 36° N latitude and from 75°15' E to 80° 15' E longitudes. The mountain ranges form the most

important physiographic feature of Ladakh. The ranges, running nearly parallel to each other. The following are the important ranges of Ladakh:

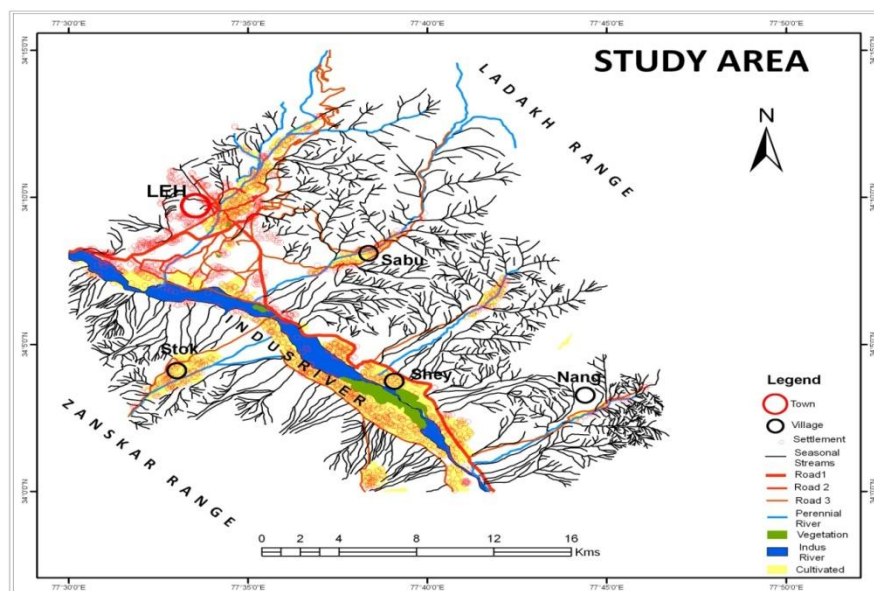
1. Northern Face of the Great Himalayan Range,
2. The Zaskar Range,
3. The Ladakh Range, and
4. Saltoro Ranges and Southern face of the Karakoram Ranges.

All these ranges provide barren, rocky surfaces largely devoid of soil and vegetation cover as well as of human settlement. Most of the mountains are covered with snow and major Himalayan glaciers are situated in these mountain ranges.

Because of the factors discussed above, nearly 68 percent of the total land lies above, 5,000 meters above the sea level and is virtually unfit for vegetative and human life. The land lying between 4,500 metres and 5,000 metres constituting approximately 5.58 percent of the total area, permits pastoral activity of rudimentary kind. Settled agriculture is confined to areas up to 4,500 meters in height. As a consequence of an extensive area being covered by uninhabitable mountains and barren plateaus, only 577.16 Sq. Km. or 0.6 percent of the total geographical area is inhabited.

Climate

Ladakh has a cold and arid climate. Winters are very severe because of high altitude. Mean monthly temperature does not exceed 24° C in Ladakh. July and August are the hottest months with mean temperature varying between 17.1°C and 23.7 ° C. January and February are the coldest months having mean monthly temperatures between -15°C to -17.1°C . The maximum mean temperature for Leh was recorded in July at 17.4°C, while the lowest temperature was registered during the month of January at -8.4°C. The annual average rainfall of Ladakh is 10 CM. The maximum of precipitation occurs in the form of snowfall during winter months. Severe winter and short summer is the main reason for short growing season in Ladakh.

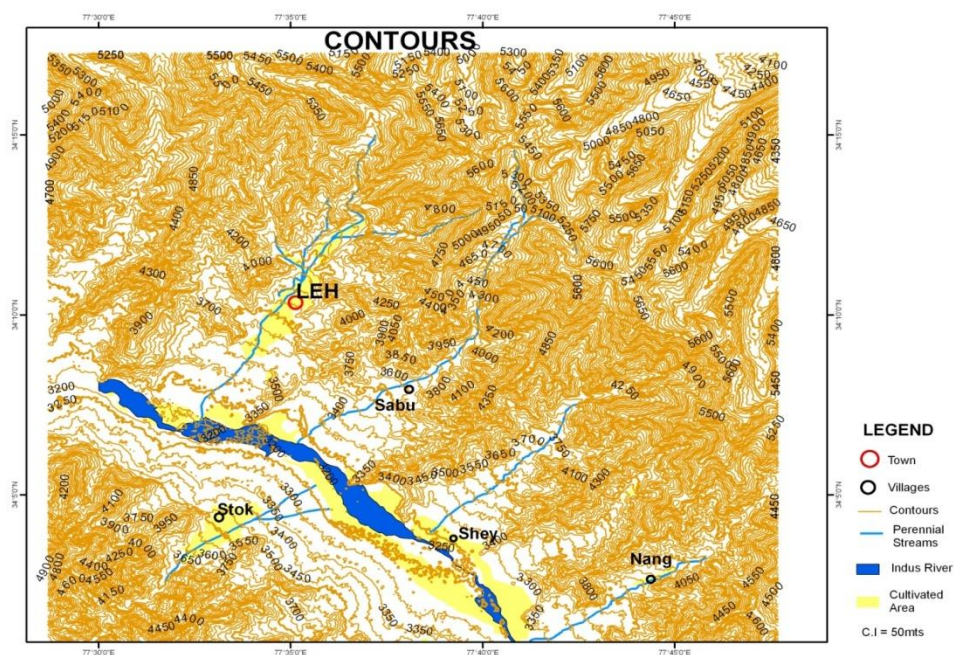


Map:1

The study took place in five villages of Leh district and one urban area of Leh. During the workshop we have conducted survey of five villages and one urban town namely Stock, Shey, Sabo, Choglamsar, Nang and Leh town respectively. The details of the villages are given below.

Stock village

Stock is about 18 km away from the Leh city on the southern direction falls under Chushot Block. There are around 300 households and total populations of 1471 including 706 male and 765 female. It is colder than the other nearby villages of Leh because it is located in higher altitude and near the famous StokKangri Glacier (6123m/20,088ft), which is very much popular among the mountaineering tourist. The village is completely dependent upon melt water of Stok glacier. Apart from this the main attraction for the tourist is Stok Palace, where the erstwhile royal family still live in this palace. The Royals shifted from Leh palace to Stok after the region was conquered by Dogra Army in 1834. The prime source of livelihoods of the villagers is agriculture and also some are involved in the service sector.



Map: 2

Shey village

Shey is the ancient capital of Ladakh located at 17km way from Leh on the east direction in Chushot Block. The village is mainly divided in to two parts as Shy Yokma and SheyGongma. This village is unique in the sense that one can find Buddhist, Muslim and Christian community. Shey is composed of around 398 households with the total population of 2238. The main attraction of Shey is the famous Shey Castle which was built around 400 years before. The Indus river is the prime source of irrigation But it was the capital of Ladakh in 10th century during the rule of first king of Ladakh Lha-chen Pal-giGon; still we have ruined castle and fort of that time. Another attraction of Shey is gilded statue of Buddha 8m/26ft high, which was commissioned by then King Deldan Namgyal (1642-94) in memory of his late father famous king Singe Namgyal. The villagers are primarily dependent upon the agriculture sector for their livelihoods.

Sabo village

Sabo is model village and it is located at eight km far from the district headquarter Leh falls in Leh Block in the east. Sabo is relatively a large village, spread out over an area of about 8km in length and two kilometers in the width. There are around 259 households with the total population of 1233 out of which 609 are male and 624 are female. The village is composed of both Buddhist and Muslim community. Sabo is mainly known for its fertile soil, even the name Sabo stands for 'sa-phud' means top quality soil. The soil is found to be good for the farming and cultivation. Cloud burst in 2010 adversely affected the village and it was badly devastated.

Nang village

Nang village in Leh block in the eastern part of Leh district at 30km far from the district headquarter. Nang is one among the most beautiful villages in Ladakh. The people of Nang are followers of Buddhism. There are around 74 households with a total population of 334 which include 156 male and 178 female. Like other villages of Ladakh government has provided basic services such as school, medical sub centre, ration store room and so on. The village got benefited by the introducing of artificial glacier as an adaptation strategy.

Choglamsar village

Choglamsar is seven km away from Leh on the bank of Indus River falls under Leh Block. It is one of the populated village in Ladakh which has around 1931 households with total population of 10754 of 6524 male and 4230 female. Most of the population is settled down in the recent times that were migrated from different villages of Ladakh. The largest Tibetan refugee camp in Ladakh is located in Choglamsar. Government has provided all basic infrastructure and services in the area. It came to lime light during the cloud burst in Ladakh in 2010 where it was heavily hit by the natural calamity.

Objectives:

The broader objective of this paper is to analyse the transformation of rural livelihood and perception about it by the local farmer community in Leh district under the cold arid climate and its subtle changes in the recent past in response to changing climate.

Methodology:

This research is based on both quantitative and qualitative design data. This paper is based on the analyses of empirical realities from the field. During ten days workshop on 'Climate change, cryosphere, habitat and changing livelihood pattern of Ladakh region' conducted 248 households survey in different villages of Leh district. The questions were asked on climate change, water resources, rural livelihood, demography and ecosystem etc. A resource mapping of the sample fields were observed during primary survey. The data on rural livelihood responded by farmer community of sample villages. GIS and SPSS software also used to analyse the data. Different maps and diagrams are also prepared using various cartographic techniques.

RESULT AND DISCUSSION:

Major factors for transformation of rural livelihood in Ladakh:

Ladakh remains isolated because of mountain ranges from the main land. Because of harsh climate and tuff terrain population of Ladakh is also thin. Still rural livelihood of Ladakh is mainly dominated by agriculture and primly for self-subsistence. A very few percent population is associated with tertiary services. There is almost no role of secondary activities in Ladakh. It is three decades ago the people of Ladakh are getting some advantages from tourism and army. Main factors of socio-economic changes in Ladakh are in four different phases;

Phase I-Before 1947 Period:

During this period there were only limited interactions with Central Asia, Kashmir, Baltistan, Tibet, and North Indian. The main motive behind these relations were only trades and Ladakh was considered to be a transit route. Traders used to exchange their goods here in Ladakh and returns to their respective land. The local people dependent only on agriculture for their survival. The limited interactions with outsider have a negligible impact on social fabric of Ladakh.

Phase II (1947-1962):

Ladakh became very important geostrategic location after independence. The interaction across the borders declined more so after 1949 when a cease-fire was declared and one tehsil of the Ladakh district, namely Skardu, fell under the control of Pakistan. Interaction between Ladakh and other parts of India however, grew. Still there were limited traders interactions with Tibet and Central Asia.

Phase III (1962-1974)

In this phase there was the turning point in the history of Ladakh. During this time there was a border dispute with China in 1962. Ladakh is the only geostrategic location of the country where international borders of China and Pakistan forms. During this phase India phase two wars with Pakistan in 1965 and 1971. Ladakh has become an very important strategic location after these two wars. This lead to movement of large contingent of Indian army in Ladakh and it has huge impact on the society and livelihood of Ladakh. Two roads project was also initiated from Manali to Leh and Srinagar to Leh keeping the strategic importance of the region. Srinagar-Leh Highway open for regular traffic movement in 1966. A few units of the Indian army and paramilitary forces were established or strengthened after 1962. Important among these include the Ladakh Scouts, The Indo-Tibet Border Force (ITBF) and The Indo Tibetan Border Police (ITBP). A large number of Ladakhi unemployed youths found their jobs in these units and became a big source of income for them. The army also added to the cash income of locals through the hiring of ponies and porters to transport supplies to remote border posts. The civil and armies are largely non Ladakhis generated demands for items like vegetables, milk and meat etc. So some land was converted for vegetables and fruits cultivation. This resulted in changes for agricultural land use.

Phase IV 1974-Till Date

The year of 1974 was considered golden year in the history of Ladakh. Ladakh was restricted area till 1974. All non – Ladakhis had to obtain permits to visit the region. It was very difficult task to obtain a permit from the government. It was only in 1973 that, after many efforts spread over more than a year one was able to visit Ladakh. Non-Indians were not permitted to enter the regions at all. However Ladakh was thrown open to tourists in 1974. Their numbers increased from 578 tourists in 1974 to 179491 tourists in 2011. A large number of hotels, restaurants and guest house opened up. The 1999 Kargil War again increased the geostrategic significance of Ladakh. Lot of infrastructural developmental work took place in Ladakh. The 2010 cloudburst was one of most dangerous natural disaster in Ladakh. In this disaster more than 800 people were died and there was huge loss of property. The increasing population pressure lead to settlement along the paleo channels in Ladakh. The policy makers have to rethink for planned development of the region.

Landuse and Landcover Changes in Leh and Surroundings

Since last few decades it has been observed that there is a huge changes in land use and land cover around Leh and its surroundings. This can be inferred through the pictures of same



Plate: 1, 1947

Plate: 2, 2013

Pictures: I Shows a Comparative Study of Landuse and landcover of Leh city and surroundings (1947 and 2013).

location taken in different time periods. It can be analysed through below given pictures that there is a drastic

reduce in agricultural land in upper Leh valley as well as below the Leh palace.

If we observe the pictures of 1947, there is maximum use of land for agricultural purposes and for social forestry it is almost negligible in both pictures. The number of willow and poplar tree is very few in case of 1947 pictures.

In the picture of July 2013, it can be observed that more barren land has been brought under social forestry, settlement and infrastructure developmental purposes. It can be clearly analysed that the social forestry has increased drastically as compare to the picture of 1947. There is drastic decline in agricultural land because of increasing commercial value of Leh and its surrounding areas. Opening of Ladakh for the rest of the world as a tourist destination the people of Ladakh has gotten a new avenue of earning livelihood. Tourism industry is continuously growing since last few years. Because of that more agricultural land is brought under commercialisation for building, hotels, guest house and other establishments. The greenery has gone drastically increased as compare to the picture of 1947.

Table 2: Number of Shops and Commercial Establishment

Year	Shops	Commercial Establishments	Hotels and Restaurants
1999-2K	2044	131	220
2000-01	2388	206	237
2001-02	2542	264	229
2002-03	2961	264	323
2003-04	3299	266	388
2004-05	3796	382	474
2005-06	3890	382	500
2006-07	4392	568	652
2007-08	4504	787	727
2008-09	4584	1199	767
2009-10	4598	1479	803

Sources: Department of Tourism

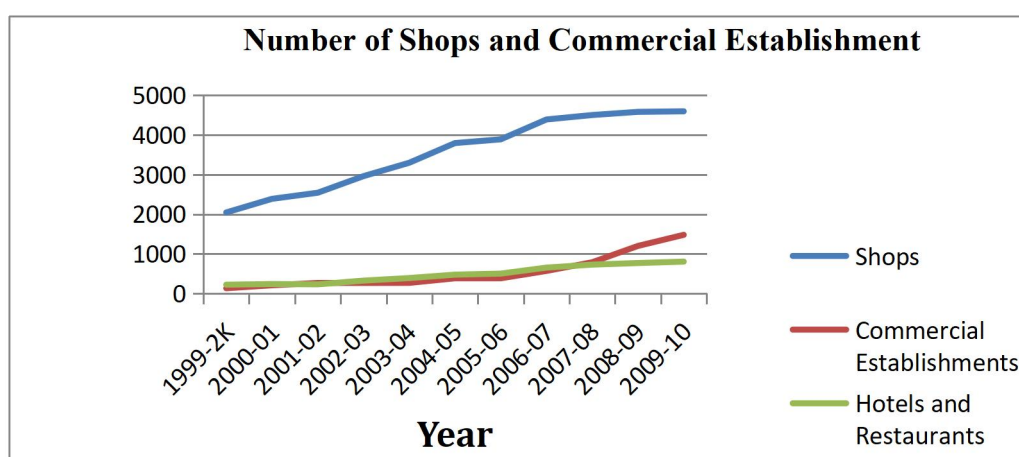


Diagram I: Shows the number of shops, commercial establishment, hotels and restaurants

It can be analysed from table number 2 and diagram I that number of shops, commercial establishment and hotels and restaurants has increased continuously from 1999-2K to 2009-10. In 1999-2K the total numbers of shops are 2044 while it has increased almost double with 4598 number. In case of commercial establishment the total number in 1999-2K was 131 which have increased upto 1479 in 2009-10. In 2007-08 the total number of commercial establishment were 787 which increased upto 1199 number. This is a huge increase in the number of commercial establishment in a year. The same table also reveals that the total number of hostels and restaurants were 803 in 2009-10 as compare to 220 in 1999-2K in Leh district. From above table and diagram it can be concluded the percentage increase in the number of commercial establishment is very high. Availableonlineat: <https://jazindia.com>

It is because of increase opportunity in tourism industry since last few years.

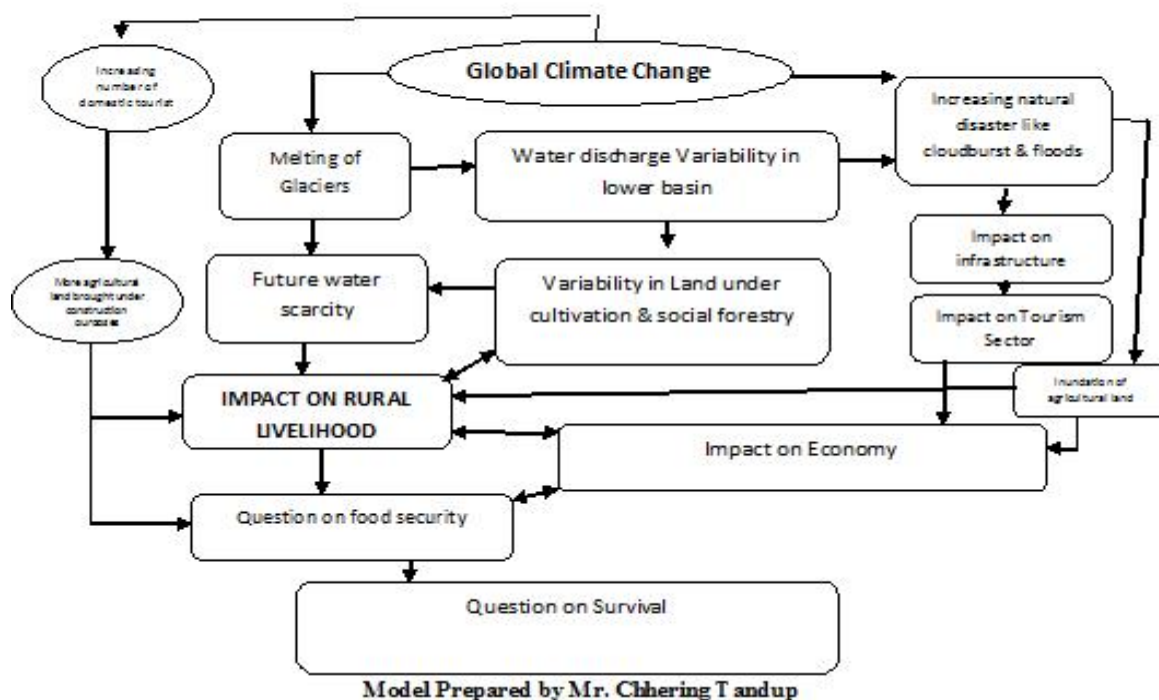
Global Climate Change and Rural Livelihood of Cold Desert Region Ladakh

Cold desert of Ladakh has a fragile ecosystem where a change in any of its component can drastically affect overall ecosystem. This linkage between global warming, melting glaciers and snowfield and extreme climatic events has a great impact on agriculture, economy and ultimately on rural livelihood, food security and survival, as shown in model no. I.

Majority of the population of Ladakh region depends upon agriculture for their livelihood. The agriculture in Ladakh totally depends upon irrigation. The culture of social forestry has been increased significantly because of escalating commercial value of timber since last few decades. The common trees in Ladakh are willow and poplar, all these plants required more water to sustain.

The continuously increasing global temperature is reason for fast depletion of glaciers as well as snowfield which ultimately cause to water discharge variability in lower basin. Variability in water discharge in lower valleys leads to landuse and landover variability. There is no doubt that fast melting glaciers is not a good sign for future it will escort water scarcity in future.

Fig. no.1 Global Climate Change and Impact on Rural Livelihood in Cold Desert Region Ladakh



The increasing temperature in plain areas Punjab, Haryana, Bihar, Uttar Pradesh, Jammu, Delhi, Madhya Pradesh etc. During pick summer season results the increase in domestic tourist in Ladakh region. In Leh the number of domestic tourist is continuously increasing for last few years because of that the agricultural land is being used for commercial establishments. This is the reason that the agricultural land is declining particularly in Leh and its surrounding areas.

Global climate change is also associated with increasing extreme climatic events like cloudburst (06, August, 2010) and floods which results in soil erosion, adversely affecting the agricultural land, infrastructure and tourism industry. Agricultural land in some area got inundated or washed away because of continuously occurring of floods in Ladakh since last few years. This is also affecting the economy as well as rural livelihood.

At last it can be concluded that all these phenomena of global climate change, melting glaciers, water scarcity in future, extreme climatic events, floods and inundation of agricultural land will raise the question on rural livelihood, food security and survival. This ten day workshop shall come up with a tangible outcome based on ground facts and reality. And it will make a base for further research on the climate change and its impact on rural livelihood and it will be useful for policy formulation to different stakeholders.

Engagement of workers in Different Sectors:

Table 3 Shows number of workers engaged in different sectors

Sr. No	Category	No. of Workers							
		1971		1981		2001		2011	
		Number	% age	Number	% age	Number	% age	Number	% age
	Cultivator	14305	65.48	17415	58.49	22041	37.92	20869	28
	Agriculture Labour	805	3.68	2191	7.36	2488	4.28	1645	2
	Manufacturing & processing other than Household Industry	102	0.47	451	1.51	NA	NA	1020	1.36
	Construction	564	2.58	546	1.83	NA	NA	NA	NA
	Trade and Commerce	297	1.28	305	1.03	NA	NA	NA	NA

Sources: LAHDC, Leh handbook Census 2012

From the above table it can be inferred that percentage of cultivator is continuously declining having 65.48% in 1971, 58.49 % in 1981 and 37.92% in 2001 and 28 % in 2011 . In other case agriculture labour in Leh district has been minor increased with 3.68 in 1971, 7.36 in 1981, 4.28 in 2001 and 2% in 2011. Here we can observed a very interesting fact that percentage of labour has declined from 7.36 in 1981 to 4.28 in 2001. In case of manufacturing and processing other than Household Industry has been observed continuously increasing having 0.47 % in 1971, 1.51 % in 1981 and 1.36 % in 2011. It can also be analysed from the above table that the percentage of workforce in construction is 2.58 in 1971 which observed little decline with 1.83 percent in 1981. Lastly in trade and commerce 1.28 percent of workforce is engaged in 1971 as compare to 1.03 percent in 1981. There is minor increase in this sector during last decade.

It can be concluded from the above mentioned table that the percentage of work force in cultivator has declined and in the manufacturing and processing other than household industry has increased almost three times.

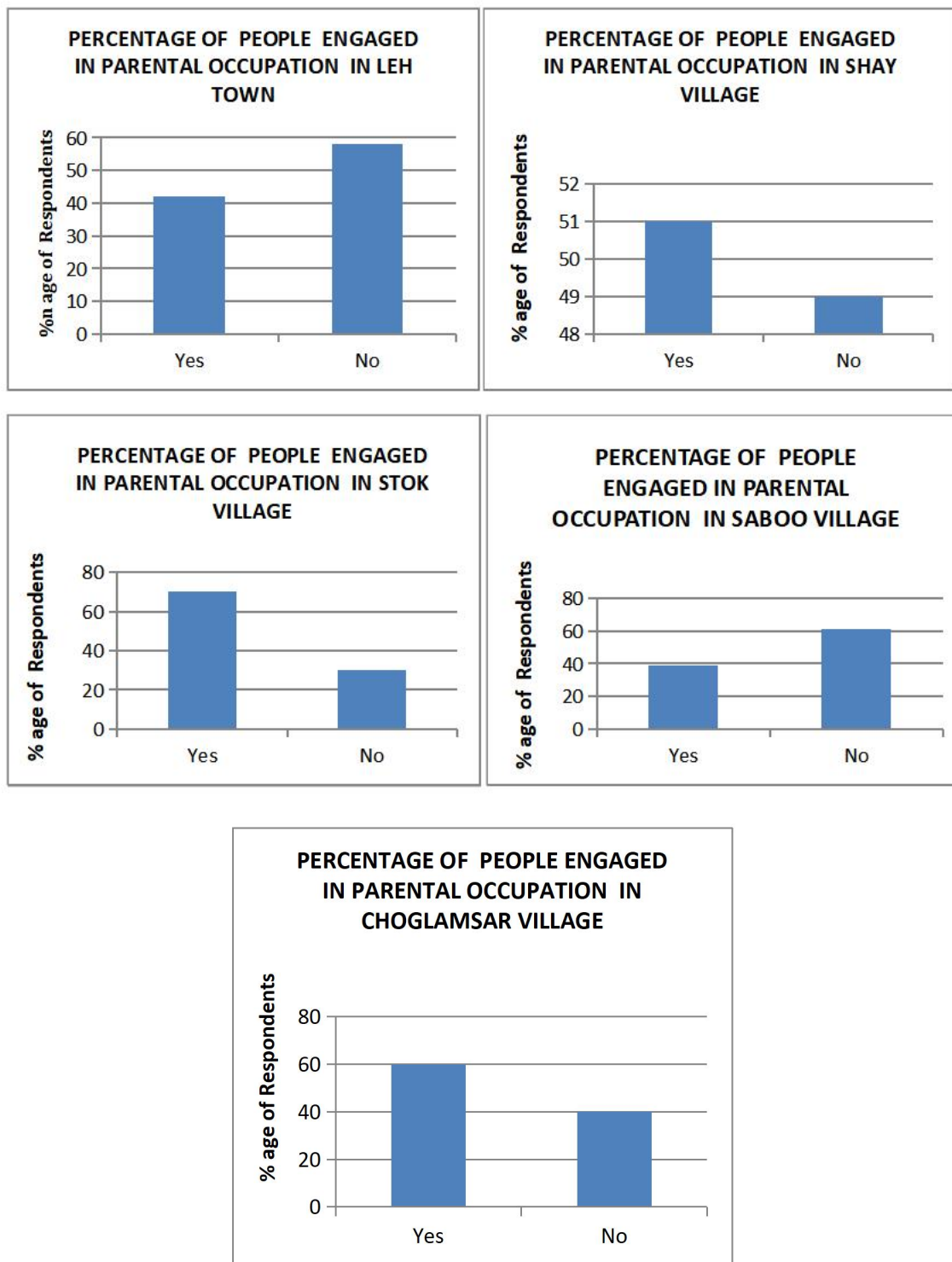


Diagram 2 shows the percentage of people engaged in parental occupations in different villages.

The maximum questions are close ended. It is found that respondent from Leh towns and its surrounding areas are not carrying their parental occupation which is primarily agriculture and associated activities. We have around 108 families who responded in different locations in Leh and its surroundings. Among these families 58 % respondents replied that they are not carrying their parental occupations. Its mean families opted for different occupations. There are 48 respondents who are still carrying their parental occupations which is 41.67 percent of the total respondents. The people in Leh town are involved in services sector. They are main stakeholders in tourism related activities. The prime agricultural land is being used for construction of hotels, restaurants, guest house and other commercial establishment. These are the prime reasons for not opting parental occupations by the respondents. This is clearly reflecting in landuse land cover analysis. The areas like Ganglass, Chubi, Sanakr, Zangstey, Stalam, Maneysteling, Kharyok, Skampare, Skalzangling and Stara are the prime destinations for the establishment of hotels and guest house because of vicinity from Leh

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city.

It can also inferred from the data that villages like Saboo have also not practicing parental occupations. Among 38 respondents only 15 (39.47%) are practicing parental occupation and 23 (60.53 %) respondents are not practicing the parental occupation. The main reason behind it is because a tourism village and very close to Leh town. It is also a model village adopted by our Ex. President of India, Dr. A.P.J. Kalam Azad.

In other villages Shay 25 (51.02 %) respondents practicing the same way of livelihood which opted by their parents and 24 (48.98 %) respondents are not practicing their parental occupations. In Stok village 37 (69.80 %) are practicing the agricultural associated activities and only 16 (30.19) respondents opted for different occupations as compare to their parents. In Choglamsar village people are associated with their parental occupation i.e. 11 (58 %) of respondents, while only 8 (42 %) not accepted the parents occupations.

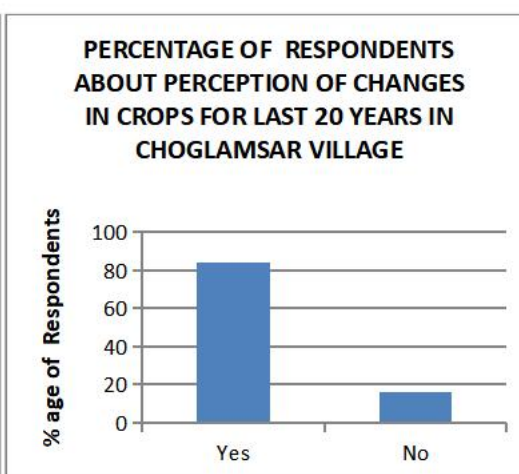
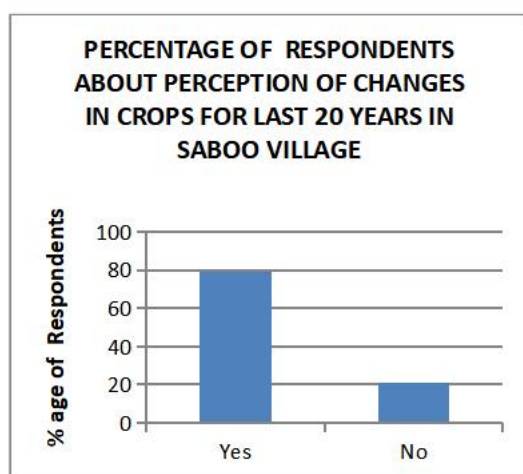
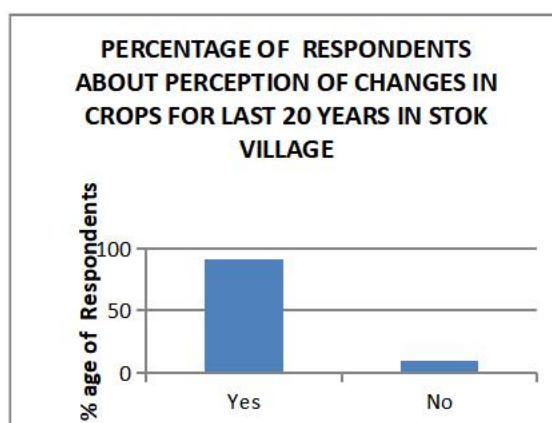
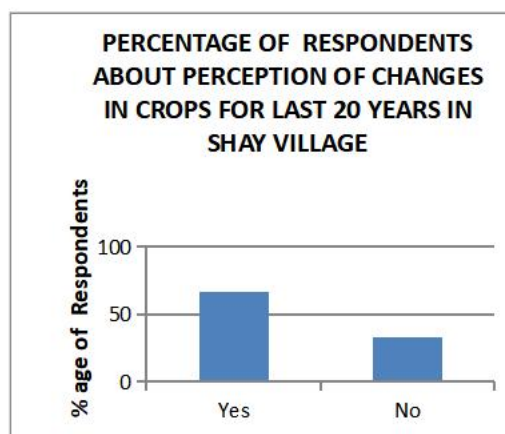
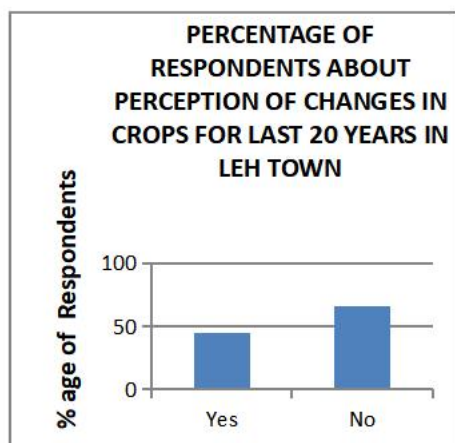


Diagram 3 shows the percentage of people perception in changes in crops for the last 20 years in different villages.

Diagram 3 shows the percentage of respondents about perception of changes in crops for the last 20 years in different villages. It can be analysed from the diagram that the Leh town percentage of people are less to observed changes in crops for the past 20 years. In Shay village percentage of respondents are 80 % whom have observed changes in the crops for the past 20 years. In the Stok village 90% respondents have observed changes in the crops for the past 20 years. In Saboo and Choglamsar villages 70 % and 80 % respectively respondents have seen changes in the crops for the past 20 years.

Tree plantation has become a very significant source of income in Ladakh for past few years. We also generate some data on tree plantation in selected sample villages and respondents. Again there is interesting facts that respondents from Leh and its surroundings are not associated with the tree plantation. Only 40 (37 %) respondents are associated with tree plantation and rest 68 (63 %) are not associated with tree plantation activities. In case of Stok village percentage of respondents are very low who are associated with tree plantation. At the same time all other sample villages the percentage are very high for those family who are involved in tree plantation. For example Shay 36 (74 %), Saboo 24 (64 %), Choglamsar 15 (79%) respondents are associated with tree plantation activities.

Army also play an important role to determine the livelihood in Ladakh. Questions are also asked to the respondents about their association with the army. It is found that almost in every villages few percent of respondents are associated with army. For example in Leh 29 (27 %), Stok 25 (48 %), Shay 18 (37 %), Saboo 19 (50 %) and Choglamsar 04 (21 %) respondents are associated with army directly or indirectly. But the maximum of respondents are not associated with the army. Army provide many opportunities to run the livelihood in Ladakh. Many Ladakhi youths got opportunity to join army in Ladakh Scouts. Villagers also supply vegetables, milk and meat to the army. Army have also infrastructure development programmes in which local contractors got opportunity to work with them.

It can be concluded that in region like Ladakh the percentage share to primary activities is continuously declining. Leh and its surrounding areas inhabitants are not carrying their parental occupations. They are opting for services economic activities. Still in rural areas agriculture is dominant sources of livelihood. Scope for businesses and other economic opportunities are limited in rural areas. The economy of Ladakh has gone changes in four different stages. The climate changes has severe impact on livelihood of Ladakh region. In rural areas agriculture is prime sector of economy. In Leh city and surroundings people are engaged in tertiary services. Data shows that percentage of agriculture labour and cultivators are continuously declining in Leh district.

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