# Impacts of Climate Change in Ladakh

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## Brief Overview about GERES

- **GERES**, *Groupe Energies Renouvelables, Environnement et Solidarités.* A French not-for-profit Organisation created in 1976.
- **20-year** experience working for the benefit of local and social development around the Mediterranean and in Southern countries
- Fields of Action: **Environmental conservation, Climate change mitigation and adaptation, Reducing energy vulnerability and Improving livelihood of the poor.**
- **A worldwide team (10 countries)** involved in implementing engineering solutions for development (in partnership with local stakeholders and communities) and in providing specific technical expertise (technology transfer).

# GERES India: LIGHT(2005-2009)

- **2005-2009 Project 'LIGHT' – Ashden Awards**

  ***'Learning of Income Generation in Himalaya Together'***

  - **600 Improved Greenhouses** have been built in Western Himalayas (based on local materials).
  - Very effective in peak winter
  - Farmers increased **their income by 20-30%**.
  - Villagers eat green vegetables throughout the winter
  - 80 local resource persons have been trained in construction supervision and agricultural guidance.
  - **0.8 ton of CO2 emissions** reduced per year per greenhouse.
  - Other activities: Solar poultry farms, solar Lambing sheds, fruit processing, wool transformation and Microhydro power units.

# Passive Solar Housing(2008:2012)

***Passive Solar Housing :*** *Improving the livelihoods of rural populations living in the most remote areas of the western Himalayas by improving unhealthy winter conditions, alleviating energy vulnerability, enabling the development of income generation in the newly improved habitat and setting up a sustainable network for dissemination*

- **300 domestic houses and community buildings** have already integrated energy efficiency.
- Minimum average temperature in a PSH never goes below 5°C (when the external temperature is below -20°C).
- Fuel wood consumption is **reduced by 67%** in energy efficient houses. 1,083 kg of fuel (biomass) are yearly saved for each PSH.
- **20.8 tons of CO2 emissions** would be reduced per house over 10 years.
- Implemented by five local NGOs in Ladakh and Lahaul & Spiti.

One main component of PSH is climate change.

# COP 15

- The next **UN Conference Of the Parties (COP15)** will be taking place in Copenhagen next December. Parties will decide on the post Kyoto framework and how to share responsibility of the Climate Change bill between the North and South countries.
- **GERES**, with a wide experience in both Climate Change and development is one of the best representatives **to support and push forward the debate on climate solidarity**. With GERES presence at COP15, successful case studies will be show cased as best examples of a possible climate solidarity framework.
- GERES will organise 3 side events among which one focus on:
- ***"Impacts of Climate Change and Adaptative Strategies for the Population in the Cold Desert Mountains of Asia"***

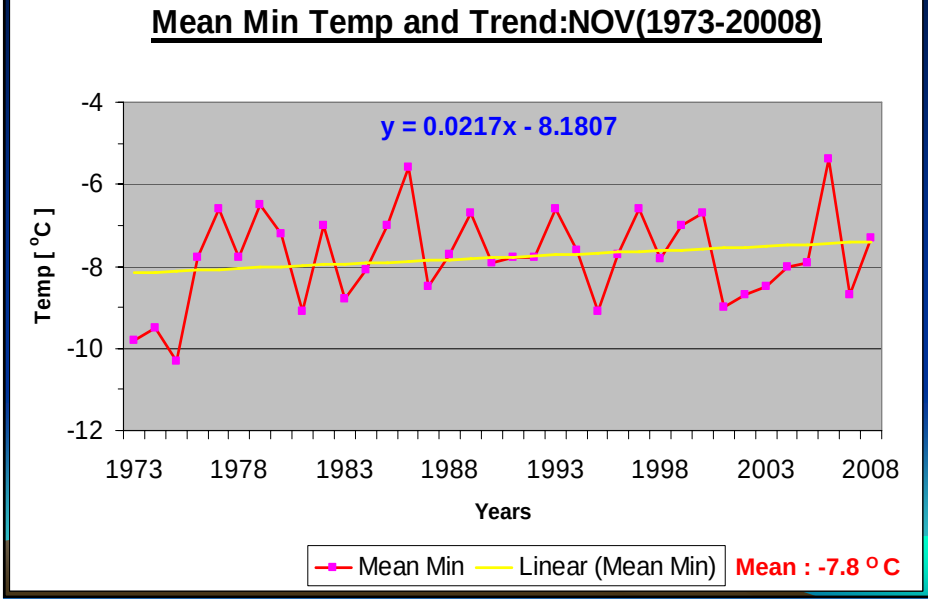
# Objectives

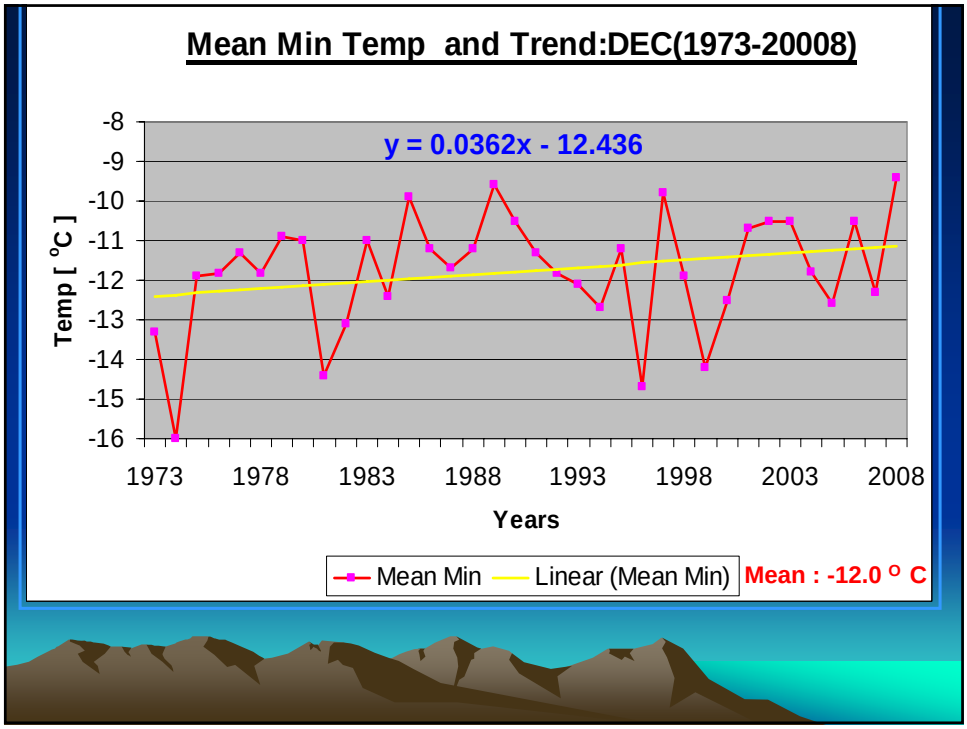
- **Analyzing the impacts of climate change on local environment and livelihood of rural population**
- **Elaborating adaptation options and mechanisms to enable communities to cope with the effects of climate change**
- **Raising awareness on climate change issues and on adaptation possibilities**

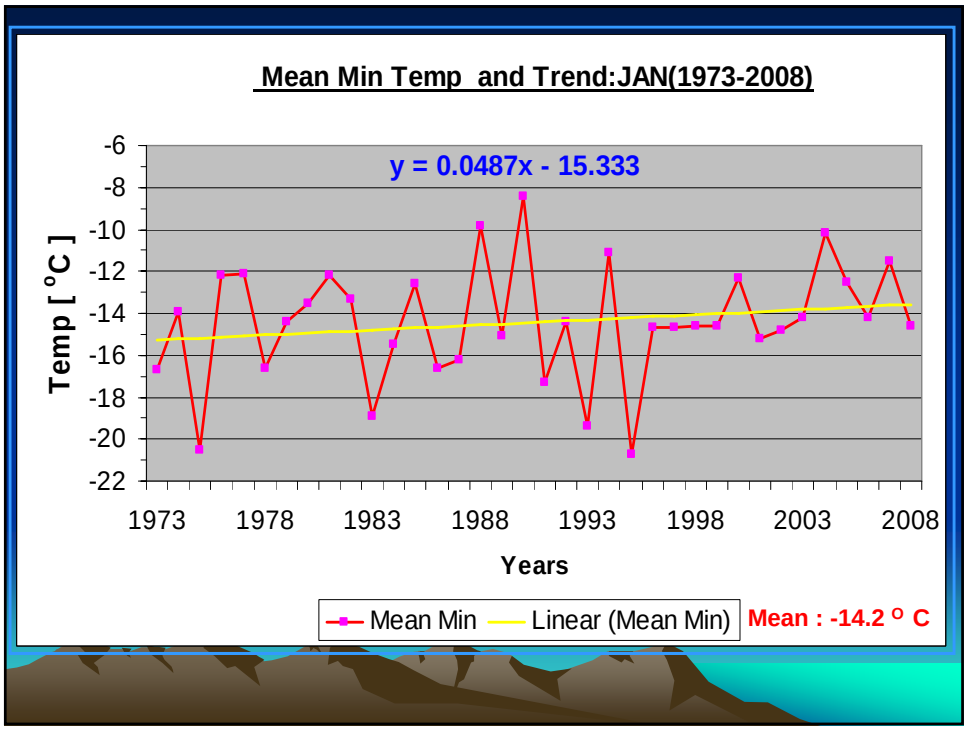
# Methodology

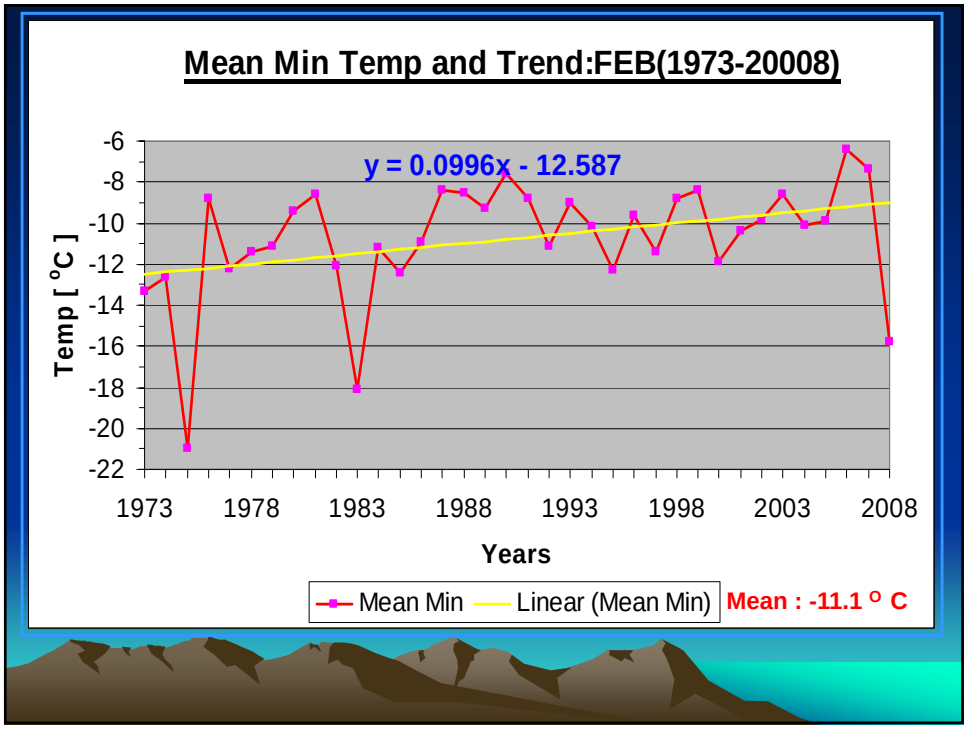
- An amalgam of three approaches was used for assessing the impacts of Climate change :
  - Analysis of meteorological data from 1973 to 2008 at Leh (Temperature and Precipitation)
  - Impact interviews with villagers and prominent persons (especially aged people) in eight representative villages
  - Baseline survey about Temperature and Precipitation Changes among 211 villagers older than 35 years

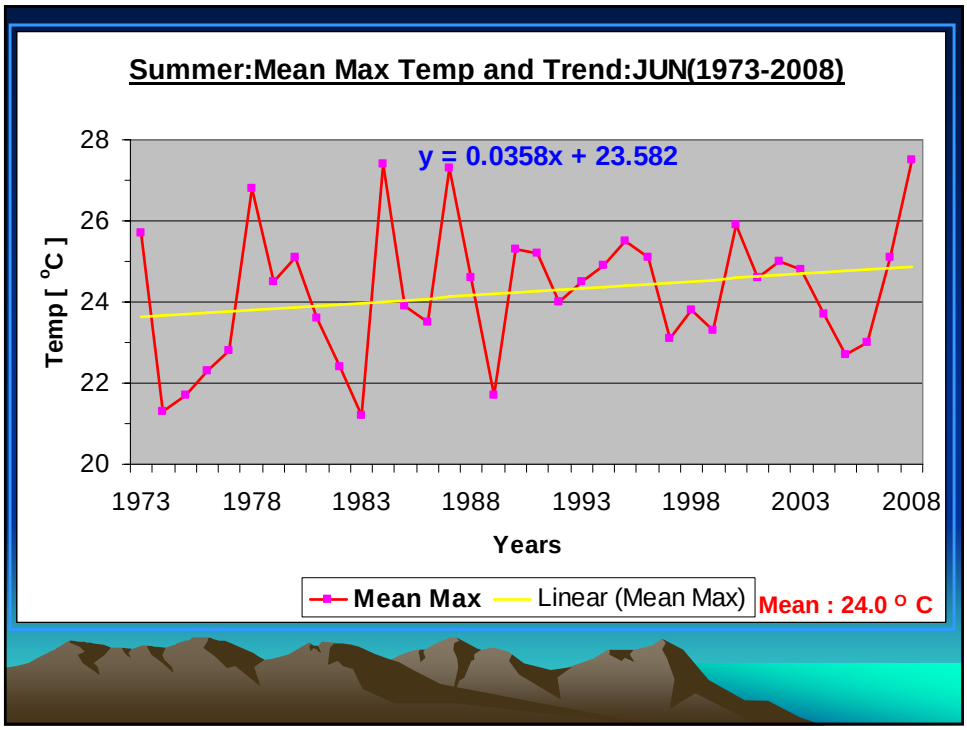
## WINTER SEASON NOV-FEB

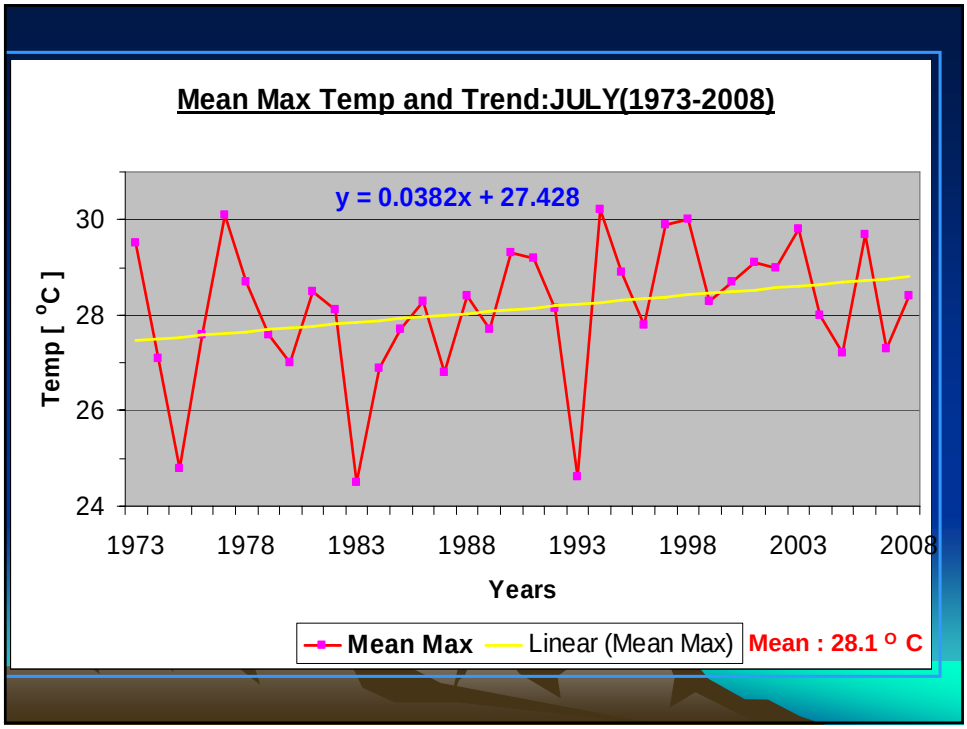


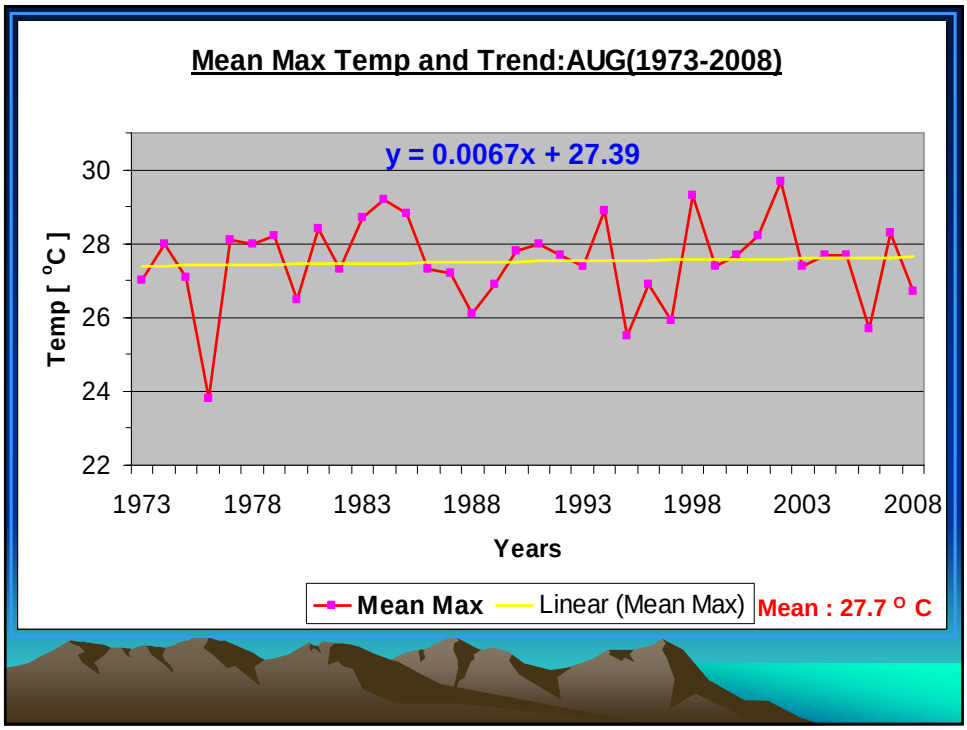

Mean Min Temp and Trend:DEC(1973-20008)
y = 0.0362x - 12.436
Temp [ °C ]
-8
-9
-10
-11
-12
-13
-14
-15
-16
1973
1978
1983
1988
1993
1998
2003
2008
Years
Mean Min
Linear (Mean Min)
Mean : -12.0 ° C

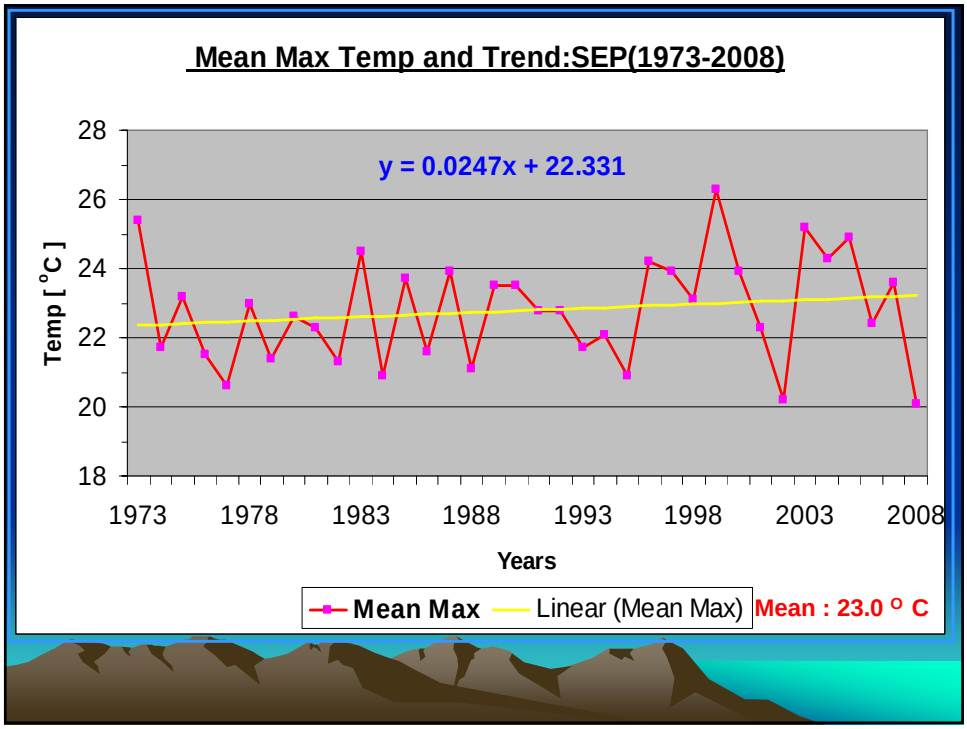

Mean Min Temp and Trend:JAN(1973-2008)
y = 0.0487x - 15.333
Temp [ °C ]
-6
-8
-10
-12
-14
-16
-18
-20
-22
1973
1978
1983
1988
1993
1998
2003
2008
Years
Mean Min
Linear (Mean Min)
Mean : -14.2 ° C


Mean Min Temp and Trend:FEB(1973-20008)
y = 0.0996x - 12.587
Temp [ °C ]
-6
-8
-10
-12
-14
-16
-18
-20
-22
1973
1978
1983
1988
1993
1998
2003
2008
Years
Mean Min
Linear (Mean Min)
Mean : -11.1 ° C


Summer:Mean Max Temp and Trend:JUN(1973-2008)
y = 0.0358x + 23.582
Temp [ °C ]
28
26
24
22
20
1973
1978
1983
1988
1993
1998
2003
2008
Years
Mean Max
Linear (Mean Max)
Mean : 24.0 ° C


Mean Max Temp and Trend:JULY(1973-2008)
y = 0.0382x + 27.428
Temp [ °C ]
30
28
26
24
1973
1978
1983
1988
1993
1998
2003
2008
Years
Mean Max
Linear (Mean Max)
Mean : 28.1 ° C

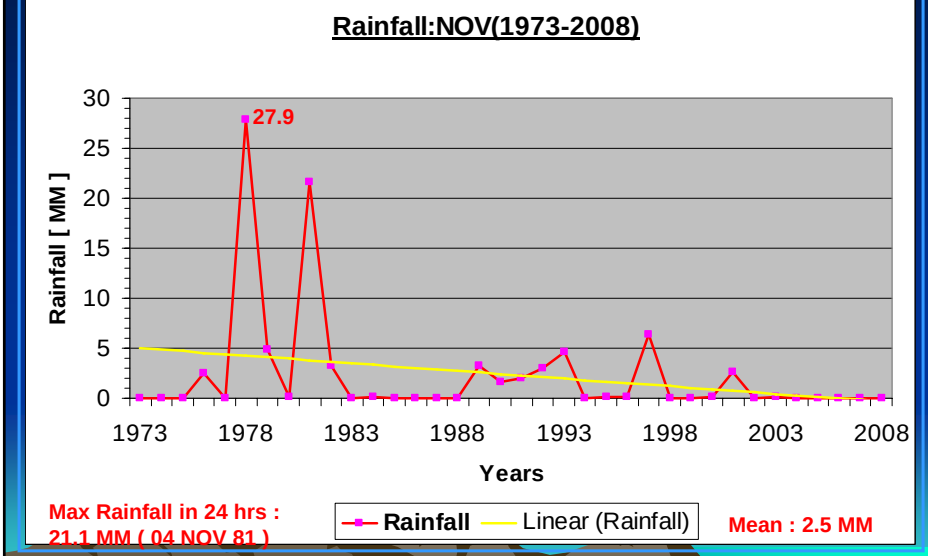

Mean Max Temp and Trend:AUG(1973-2008)
y = 0.0067x + 27.39
Temp [ °C ]
30
28
26
24
22
1973
1978
1983
1988
1993
1998
2003
2008
Years
Mean Max
Linear (Mean Max)
Mean : 27.7 ° C

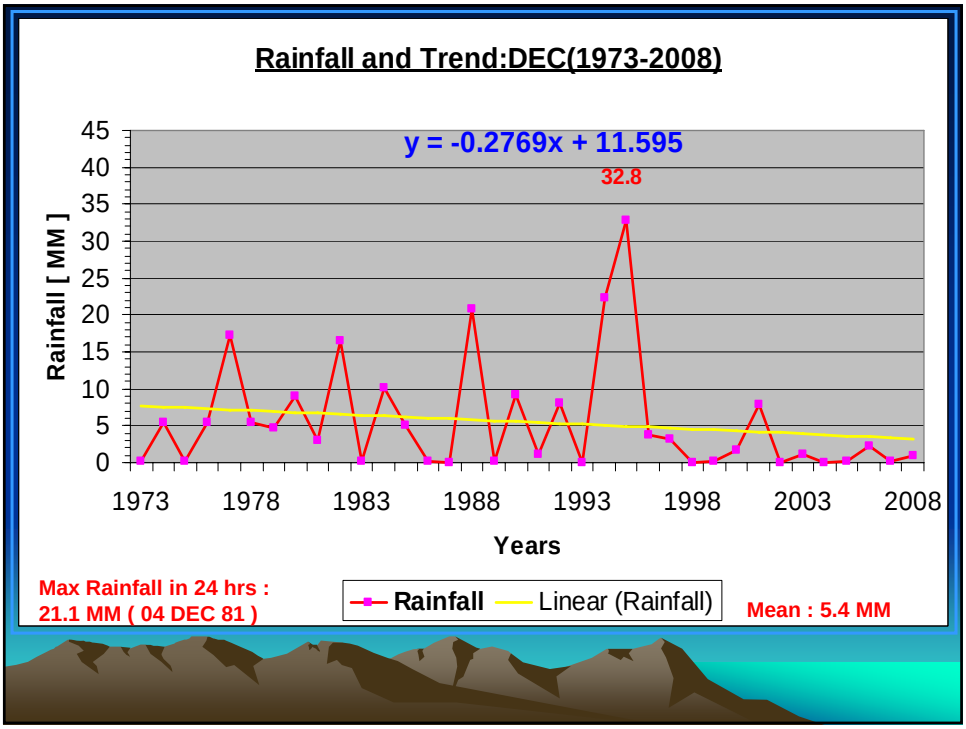


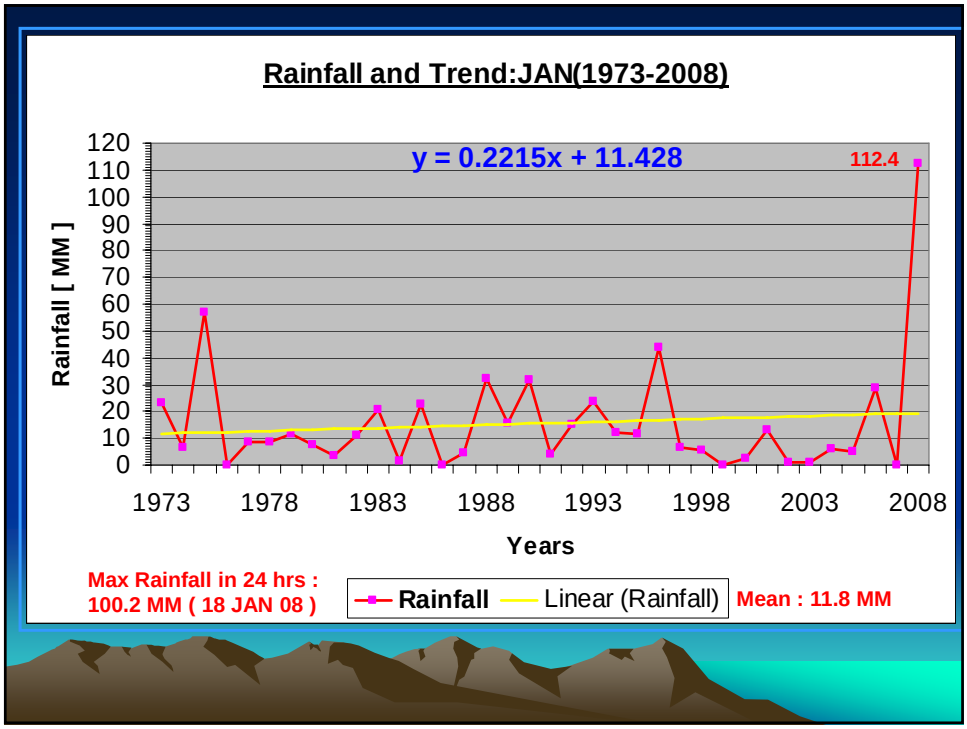

# Inferences

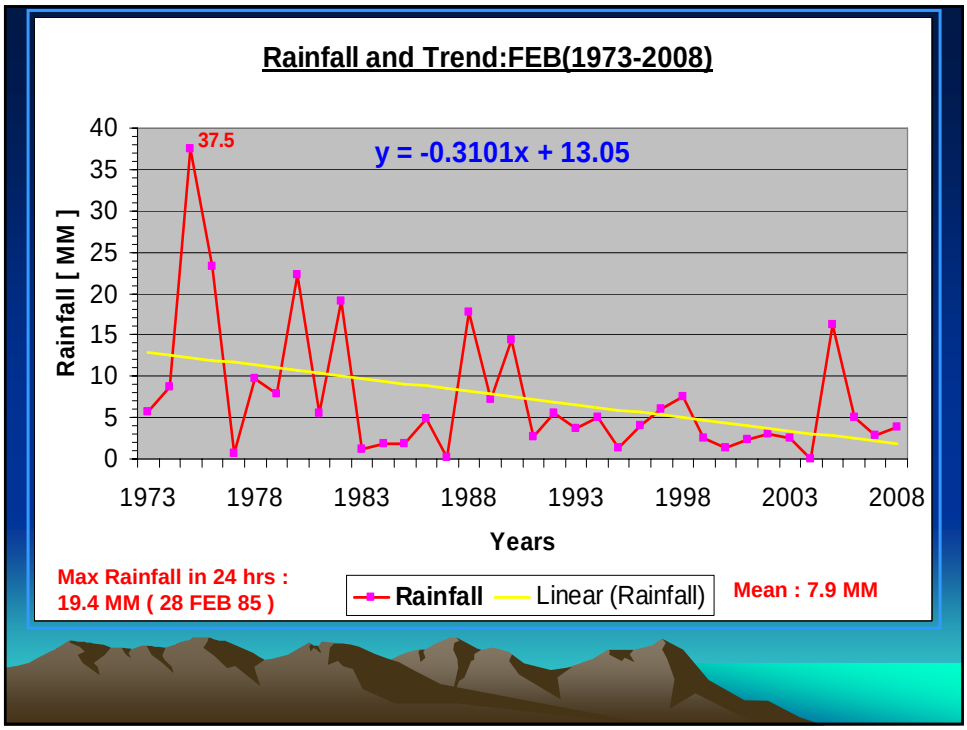
- Trend analysis clearly indicates that there is rising trend of min temp at Leh and the rise is of the order of nearly 1° C for all the winter months.
- The Max temp for summer months shows rising trend of nearly 0.5°C in last 35 years.
- Though, the rising trend is more sharp in min temp of winter months.

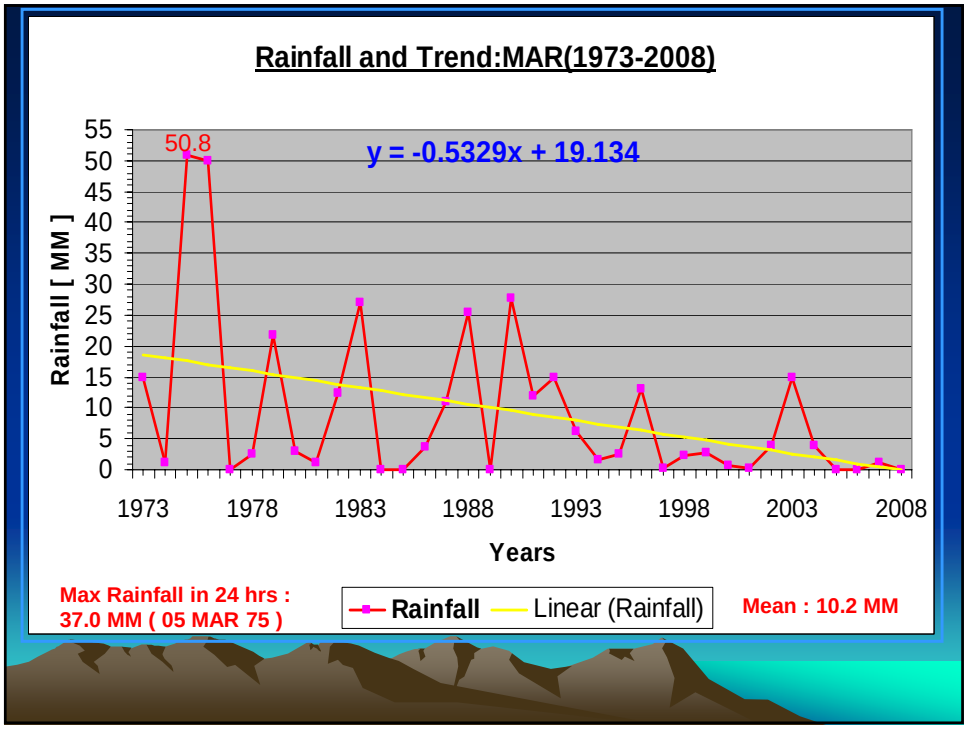
## SNOWFALL: NOV- MAR(1973-2008)

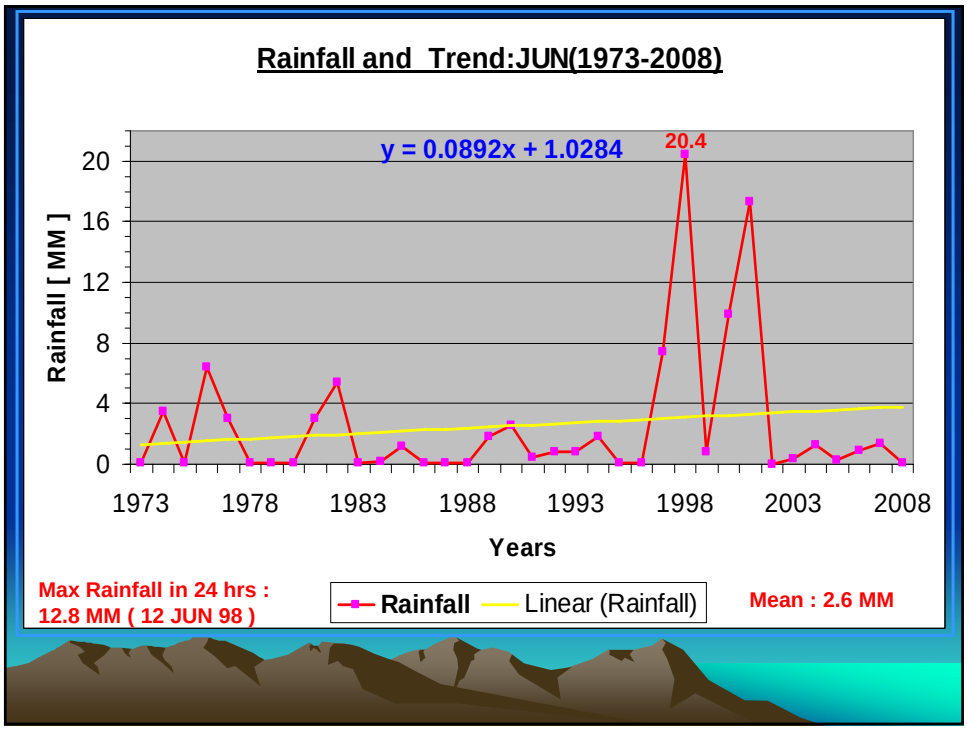


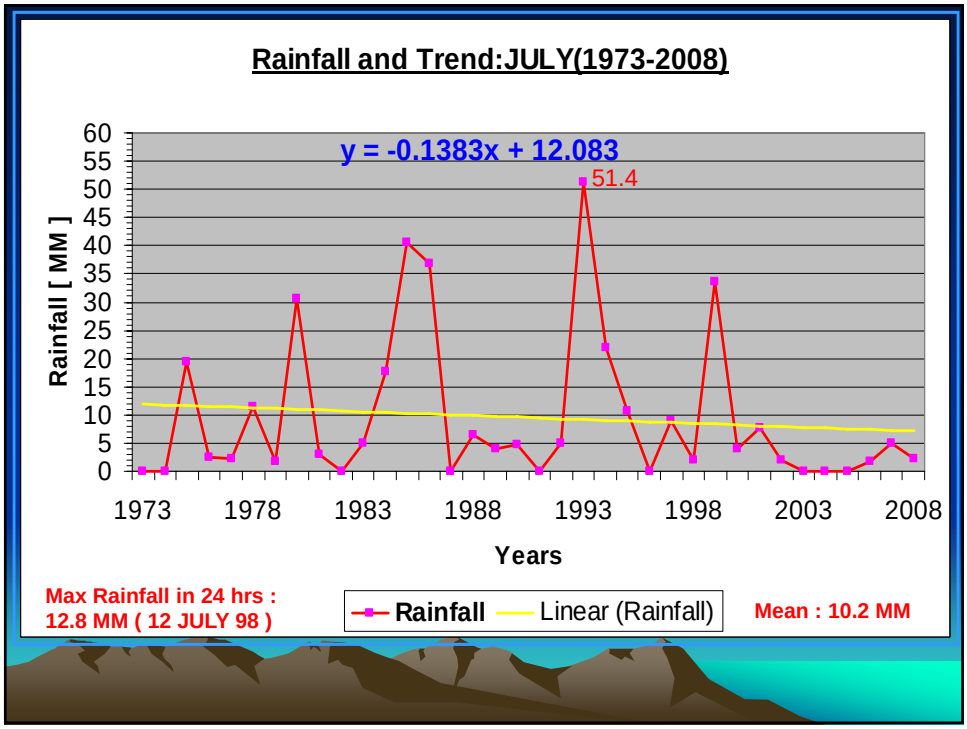



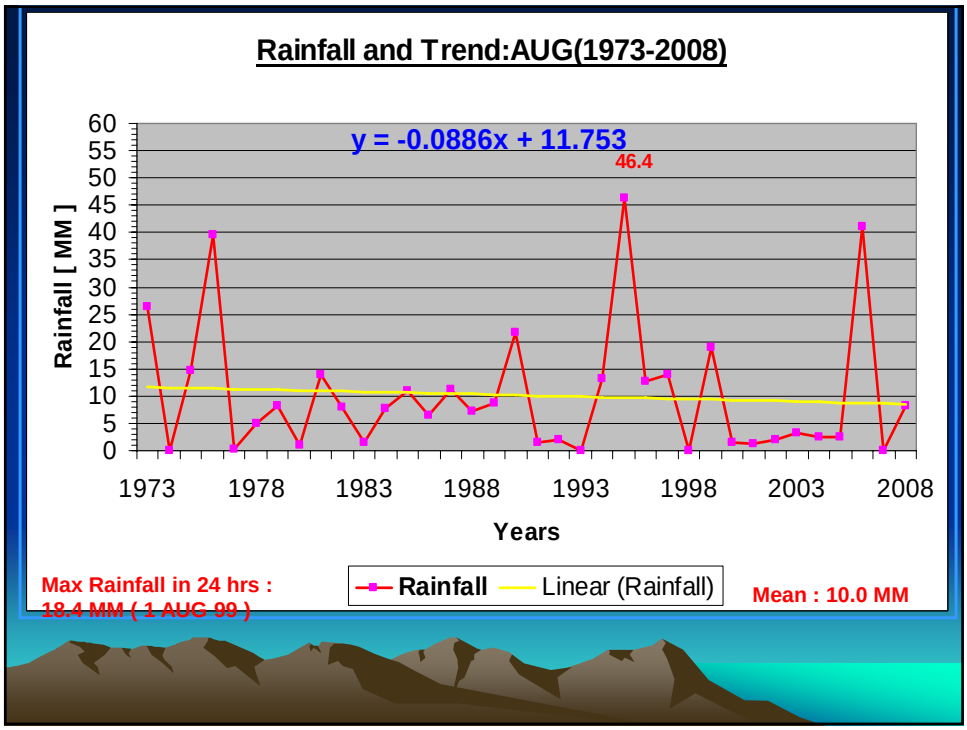

Rainfall and Trend:JAN(1973-2008)
y = 0.2215x + 11.428
112.4
Rainfall [ MM ]
120
110
100
90
80
70
60
50
40
30
20
10
0
1973
1978
1983
1988
1993
1998
2003
2008
Years
Max Rainfall in 24 hrs :
100.2 MM ( 18 JAN 08 )
Rainfall
Linear (Rainfall)
Mean : 11.8 MM


Rainfall and Trend:FEB(1973-2008)
37.5
y = -0.3101x + 13.05
Rainfall [ MM ]
40
35
30
25
20
15
10
5
0
1973
1978
1983
1988
1993
1998
2003
2008
Years
Max Rainfall in 24 hrs :
19.4 MM ( 28 FEB 85 )
Rainfall
Linear (Rainfall)
Mean : 7.9 MM


Rainfall and Trend:MAR(1973-2008)
y = -0.5329x + 19.134
50.8
Rainfall [ MM ]
55
50
45
40
35
30
25
20
15
10
5
0
1973
1978
1983
1988
1993
1998
2003
2008
Years
Max Rainfall in 24 hrs :
37.0 MM ( 05 MAR 75 )
Rainfall
Linear (Rainfall)
Mean : 10.2 MM


Rainfall and Trend:JUN(1973-2008)
y = 0.0892x + 1.0284
20.4
Rainfall [ MM ]
20
16
12
8
4
0
1973
1978
1983
1988
1993
1998
2003
2008
Years
Max Rainfall in 24 hrs :
12.8 MM ( 12 JUN 98 )
Rainfall
Linear (Rainfall)
Mean : 2.6 MM


Rainfall and Trend:JULY(1973-2008)
y = -0.1383x + 12.083
51.4
Rainfall [ MM ]
Years
Max Rainfall in 24 hrs :
12.8 MM ( 12 JULY 98 )
Rainfall
Linear (Rainfall)
Mean : 10.2 MM


Rainfall and Trend:AUG(1973-2008)
y = -0.0886x + 11.753
46.4
Rainfall [ MM ]
Years
Max Rainfall in 24 hrs :
18.4 MM ( 1 AUG 99 )
Rainfall
Linear (Rainfall)
Mean : 10.0 MM

## Precipitation: Inferences

- Trend analysis of precipitation suggests:
- There is clear declining trend in precipitation amount from Nov to March ( reduction in snow fall).
- This is the season for 70% occurrence of precipitation over Ladakh and mostly in the form of snow.
- Jan trend is rising due to one extreme event of snowfall during Jan 2008.
- During summer season, no significant change noticed in precipitation amount as it accounts for 30% of annual precipitation and in the form of rain.

## Impacts Interviews

The impact assessment study was carried out with village elder men and experts from the field of agriculture, horticulture etc. in the form of informal interviews.

- Leh: Tagmachik, Dhomkar, Leh
- Kargil: Matayan, Pandrass, Zanskar

# Perceived impacts in Leh

Bio indicators of Climate change

- Glacier retreat in almost every part of Ladakh like Khardong-la, Stok Kangri, etc.
- Presence of pests (coddling moth) on apple & apricots in almost every part of Ladakh which earlier was found only on Apple and lower villages like Dha-Hanu.
- Water discharge of the Indus river is becoming less which may have implications on the hydro generation in future
- Agricultural fields in many villages (Tagmachik, Alchi, Gia) have been left fallow due to unavailability of irrigation water.
- Increased incidence of disasters like floods in 2004, 2005 in almost every part of Ladakh

- Shift in apple belt from lower Sham(9000 ft.) to Rong area(12,000 ft).
- Change in flowering of apricots and apples . (earlier end April: now mid April)
- Change in Harvest season ( earlier : Oct 1-2week Now: sept 4$^{th}$ week)

# Perceived impacts in Kargil

Bio indicators :

- Water shortage in Kargil and surrounding villages like Achkmal, Pandrass, Matayan due to less snowfall . (Pandrass, 2000 no cultivation)
- Water shortage in Shun Shadey, Kumic in Zanskar ( relocation)
- Chadar Trek is becoming shorter by almost two months (Earlier: Dec - March, Now: Jan to end Feb)

- Cultivation of wheat possible in Zanskar (Aksho, Ating) due to warmer conditions since the last ten years .
- Shift in sowing and harvesting of barley by almost a month.

Sowing : Earlier – Beginning June and now in may beginning

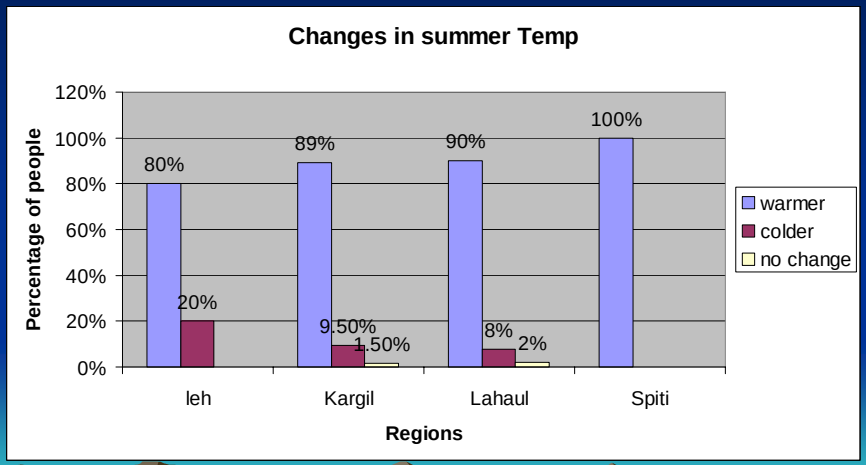
Harvest: Earlier - in end Aug and now in end Sept

# Baseline survey

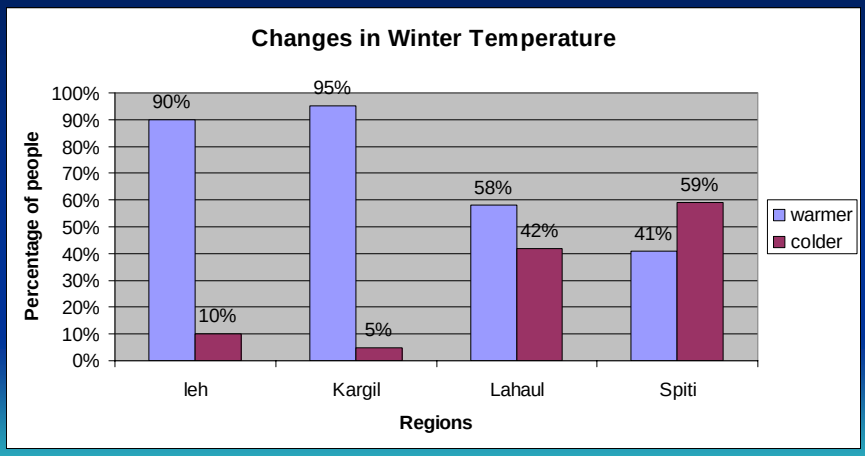
**An awareness baseline survey regarding climatic changes was conducted in:**

- **20 villages in four regions (Leh, Kargil,)**
- **Total 211 people above 35 years have been interviewed.**

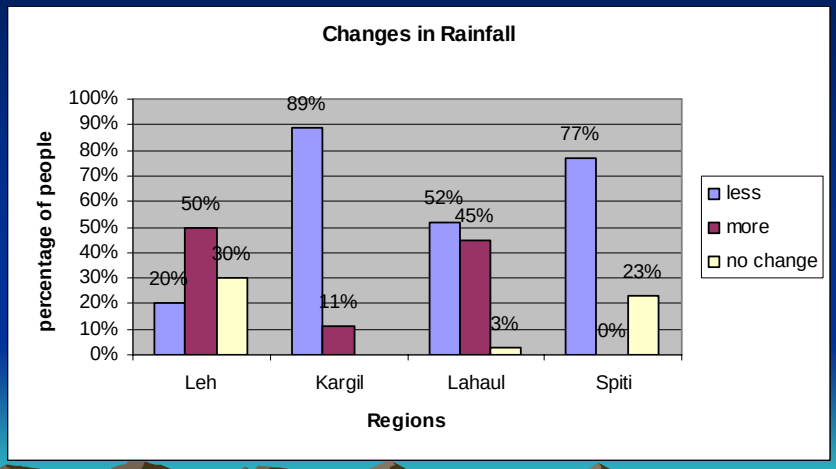
# Findings of Baseline Survey



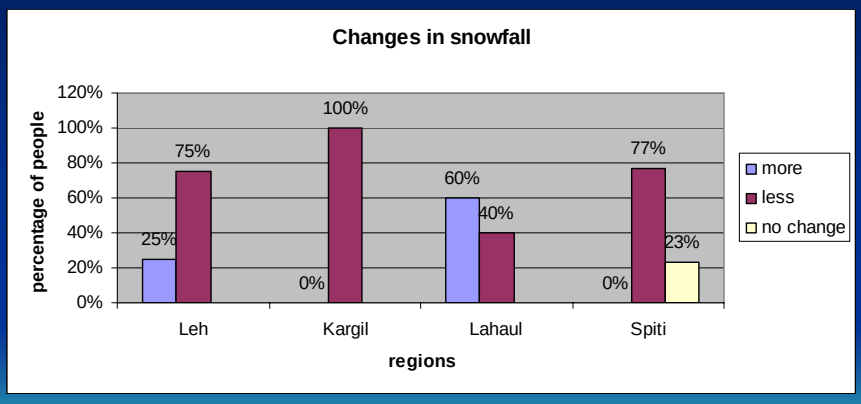
# Changes in winter temperature




# Changes in Rainfall



# Changes in snowfall

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