Mountains of Uttarakhand

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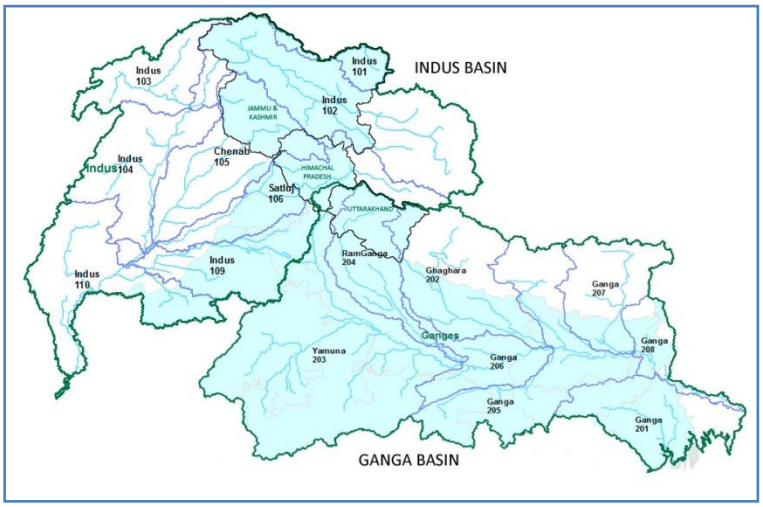
R. Sreedhar, Neeraj Doshi (Transcription-Tape no DV239 6:41- Boxes are adaptations of slide presentation)



R.Sreedhar - We looked at the North-Western Himalayas that is the Ganga basin and parts of the Indus basin. The idea was to look at the whole region and look at vulnerability at different altitudes because in the Himalayas the altitude variation is high. This is the general region that we are talking about. The focus is on states of Uttarakhand, Himachal and Jammu and Kashmir. This picture shows the entire Ganga basin and the Indus basin.

Vulnerability: when we talk in the Himalayas - one is events which is geological induced. As you know Himalayas is extremely earth quake prone because these are young mountain formations. These are visible and we have had a sequence of earthquakes in 91 and 98 and even currently, what the records shows swarms of micro-earthquakes. You have something equivalent to about 500 micro-earthquakes taking place across the Himalayas.

Then second kind of vulnerability is the kind of events that are triggered by the State's development of physical infrastructure, whether they are roads that are being built, whether they are power projects. There are closed about 100 power projects that are coming up in each of the states. The Entire Himalayas now under the spell what has called the 50,000 MW of National Programme of generating Hydropower. You have got huge number of hydropower projects.

Then the vulnerability as we understand from the climate perspective which are outcomes of a larger phenomena, which is not visible, for which the source of impact are not local.

Vulnerability

- By events which are geologically induced (earthquakes, young formations etc.) but are visible
- By events triggered by State's development of physical infrastructure with least understanding of physiographic nature
- By events which are an outcome of larger weather phenomenon and which are not visible or for which the source of impact cannot be easily pointed at, like temperature rise, increased or decreased rainfall

If we take High Altitude Environment Components, the high altitude areas which are beyond 10,000 ft high and into the Tibetian plateau, you will find major glaciers, glacial fed river systems. There is a high density of forest and low density of population and virtually the normal belt of the state have restricted peoples movements through a number of National

High Altitude Environmental Components

- Glaciers & Glacial Fed River Systems
- High Density Forests & low Density Population
- Protected Areas (NDBR, Valley of Flowers), Alpine Shrubs and Meadows

Vulnerable are communities in the Glacial Margins as well as those with livelihood based on restricted resources (because of National Parks)

Parks and Sanctuaries. .
The vulnerability communities are those who are in the margin of these glaciers and those who are restricted all these kind of projects. So if can see from the east to the west you have the Asgot Musk deer Sanctuary, we have Nandadevi biosphere reserve and Sanctuary, The Govind Pashu Vihar and now the Gangothri National Park, then you have the great Himalayan National park. So you have the entire belt where people are restricted so their livelihoods are restricted while they are having other kind of vulnerabilities.

Then the mid attitude which are 4000 to 10,000 ft where lots of areas are coming in the rainshadow areas. And in these rainshadow areas the vulnerability is much higher because of the fluctuation of the rainfall. So what we find is the value agriculture and the horticulture potential in most of these most of the areas are affected. That is why we hear about apples moving about 3500-4000 ft. now going up to 7000-8000 ft. So now the northern district like Kinaur, Chamauli even Lahual spiti have now begun to grow apples which were not earlier apple growing areas. Then there is more urbanization and physical development in all the areas especially in the Uttarakhand after the new state formation. There is a lot more infusion of small urban towns getting built and access ways, more access being built. So you find that that is also causing intense development in these areas. Again here the farming communities are most vulnerable, and also the grazers and also particularly nomadic areas because they come for a very short period. And during that short period if whatever resources they need to access is not available at these altitude then whole cycle of grazing gets immensely disturbed. (13:18)

Mid Altitude Environmental Components
- Rainshadow Areas & Hydro Projects
- Valley Agriculture & Horticulture Potential
- More Urbanisation and Physical Development
- Intense Development Activity

Vulnerable are farming communities, graziers especially nomads

Then low attitude which is on foothills of the Shivaliks and in the Shivaliks, the maximum urbanization has happened for instance, 63 of the so called urban centers in the Uttarakhand happen to be in the lower hills only. Similarly in Himachal, we have the whole Baddi Barotiwala Nalagarh stretch which has been highly industrialized now and also some of the cement and mining activities that are going on in these areas. Here the problem is both the farming communities and the general population is affected by huge amount of pollutions that has been caused not only by some of the mining activities in places like Himachal but the new industrial activities has been started in Uttarakhand. After the formation of the state a lot of concessions were given to industry, so a lot for industries migrated into Uttrakhand.

Low Altitude Environment Components
- Agriculture dominates Land Use
- Urbanisation Continues (63 Urban Centres in Uttarakhand)
- Protected Areas, Industrialisation and Poor forests
- Bhabar – Terai Region

Vulnerable are farming communities but the risk is for larger population is due to additional pollution

So what are the kind of vulnerability parameters. As I said geological transformations are natural but they are stressed further due to these developmental activities. Currently most of the landslides, as you may have recently read in the case of Sikkim where it was the power project, the tunneling for the power project, caused even more deaths and damages during the earth quake. So, where there are natural phenomena the activities being done by the state, are only accentuating them. Then we still have what can be called carbon neutral settlements which are at higher altitudes where the state is still not able to reach. There are settlements which do not have even fertilizer. So there are certain carbon

neutral c settlement, but they are few and in the interiors.

There are small farmers with marginal land holdings less than one hectare as many as 6.28,000 farmers (The population of these states are not very large. Uttarakhand still doesn't have population of one crore. It is about 88,00,000. Same is the case of Himachal). So small farm land are dominant. The input costs are already high.

The abrupt temperature variance - what is happening is that extreme events are taking place so the temperature variance disturbs the sowing and harvesting cycle and whatever measures that were available to them in terms of protective irrigation for raising their nurseries have all been destroyed. So, now they are dependant on the rain, and any disturbance is disturbing their sowing and harvesting cycle.

Vulnerability Parameters

- Geological Transformational changes natural, stressed further due to developmental activities.
- Carbon neutral settlements few, in interiors
- Small farmlands (MARGINAL LAND HOLDINGS LESS THAN 1 HECTARES = 6,28,000), inputs cost high (material, labour)
- Abrupt Temperature Variance disturbing sowing-harvesting cycles
- Western Disturbance prolonging – erratic rainfall, humidity, moisture conditions!
- Monocultures – reduces both floral and fauna diversity. Outcome of Forest Diversion for large projects. 626 sq. km in UKD; >150 sq. km in HP?
- Climate too risky for cash crops / horticulture crops (mid to big farmers). Cereal crops – small & marginal farmers

Then the "western disturbances" as they call it, that is when the monsoon winds goes beyond the Pir Panjal range, then we have got erratic rainfall, humidity and moisture conditions. For instance, the year of 2008 some of the plain areas did not see sunshine for more than 120 days,. So you have got humidity and fog like conditions that is also prolonging. Then the others: the monoculture destroys the forest diversity. This is also an outcome of the large amount of forest diversion that is taking place mainly for the purposed of hydel power generation. Then for cash crops and horticulture crops since the investments are is very large, the risk related to variations in weather for any farmer is also higher.

What we are finding is.. there is historical evidence of rainfall which are lesser than normal. In different altitude classes, we are finding that there are several periods about 50% of the time where the rainfall has been low and the 43% of the time it has been in excess. Only about 10% of the years you find that there has been normal rainfall. Either there is less than normal rainfall or excess of the rainfall.

In some of the excess rainfall has led to cloud bursts.

HISTORICAL EVIDENCE: LESSER NORMALS!

District wise Comparison of Annual Normal Rainfall with Frequency of Annual Rainfall in District

Districts	Average Annual Rainfall Normals (mm)	No. of Years of Data	Percentage of Cases (years as in Col.III) occurring w.r.t. Rainfall Normals		
			Normal	Excess	Low
Col. I	*Col. II*	*Col. III*	***Col. IV***	*Col. V*	*Col. VI*
Bilaspur (300-900m)	1256.7	37	**18.92**	40.54	40.54
Hamirpur (300-900)	1462.6	32	**15.63**	40.63	43.75
Una (300-600m)	1209	31	**12.90**	58.06	29.03
Mandi (900-1800m)	1564.6	45	**13.33**	42.22	44.44
Chamba (1800-4500m)	1355.1	35	**5.71**	37.14	57.14
Kangra (600-900m)	1852.3	39	**5.13**	30.77	64.10
Sirmour (300-900m)	1688.7	46	**8.70**	47.83	43.48

Shaded portions only depict clubbing of altitude classes to compare (these all are adjoining districts with large valley formations) as these are adjoining regions and lie over more or less in the same longitude**!** Variance seen across the agro climatic regions

Here, we tried to put together in different altitude zones in different districts what are the kind of factors, what are the kind of events that have occurred in recent past. And then what we find is in many cases there are some factors which are industries, reservoirs, hydro projects or industrial estates, or limestone mining and cement plants which are causing local problems. These are some factors that are affecting local weather phenomena and some which have led to cloud burst in this area. You will find virtually in many of the high altitude areas there has been cloud burst and in 2003 we had big event in Chambal where we lost 60 lives in just the cloud burst and in June this year also there was another cloud burst in Chambal. Fortunately we didn't lose many people in that event.

Districts in Himalayan Regions in order of their Altitude Variations or Ranges					
State	Districts	Altitude Range (m) Low – High	Predominant Altitudinal Profile in District	Some Key Factors	Some Events of Cloudburst
UKD	Udham Singh Nagar	150 – 300m	150 - 300m	Distilleries and Other industries	
HP	Una	300 – 900m	300 – 600m	Industries	
UKD	Haridwar	150 – 1350m	150 – 600m	Industries (IEE), Stone Crushing	
HP	Hamirpur	300 – 1350m	300 – 900		
HP	Sirmour	300 – 1800m	Shivalik & Mussourie Range – 300 – 600m & 1350 – 1800m	Mining in 2 blocks, Industrial belt in Paonta	Rajgarh Tehsil (06.08), Sadhauara bridge (08.07), Pain Kuffar Village (Rajgarh – 09.08)
HP	Bilaspur	300 – 1800m	300-900m	Cement Plants, Bhakhra's Govind Sagar Reservoir, River Bed Mining	
UKD	Champawat	150 – 3000m	900 – 1800m		
UKD	Nainital	150 – 3000m	300 – 600m , 600 – 900m	Lower parts like Dhaula Kuan etc. industrial belts, Urban Centre	
JK	Jammu	150 – 3000m	150 -300m, 300 – 600m, 900 – 1350m		
HP	Solan	300 – 3000m	300 – 600 & 1350 – 1800	Mining & cement, Industries, Urban Centre, River Bed Mining, Industrial Hubs (Kala Amb, Baddi)	
UKD	Dehradun	300 – 3000m	900 – 1800m	Industrial estate, Urban Centre	
UKD	Pauri Garhwal	300 – 3000m	900 – 1350m & 600 – 900m		
JK	Kathua	600 – 3000m	300- 600m, 600 – 900m		
JK	Rajauri	600 – 3000m	600 – 900m		

HP	Mandi	600 – 3000m	900 – 1800	Cement, Industrialisation on pick	Manjhainalah near Athamille area (08.11), Dhundi area (07.11), Pandoh (08.11)
UKD	Almora	600 – 3000m	900 – 1800		
JK	Pulwama	1350 – 3000m	1350 – 1800m, 1800 – 3000m		
JK	Udhampur	300 – 6000m	900 – 1350m		
UKD	Pitthoragarh	600 – 6000m	> 4500m, 900 – 1350m & 1800 – 3000m	Mining, HEPs	Munsiyari (2010),
UKD	Bageshwar	900 – 6000m	1800 – 3000	Mining, HEPs	
UKD	Chamoli	900 – 6000m	4500 – 6000, 3000 – 4500 & 1350 – 1800m	Mining, HEPs	Badrinath (2004)
JK	Doda	900 – 6000m	1800 – 3000m		Assar-Baggar (06.11)
UKD	Rudraprayag	900 – 6000m	1350 – 3000m, 3000 – 4500m		
UKD	Uttarkashi	900 – 6000m	4500 – 6000m, 3000 – 4500m, 1350 – 1800m	HEPs	
JK	Anantnag	1350 – 6000m	1800 – 3000m, 4500 – 6000m		
HP	Shimla	1350 – 6000m	1350 – 1800m, 1800 – 3000m		Chirgaon in Rohru & Wangtu-Neugal Seri in Kinnaur side | Cloud burst in Rohal mountain range (1997) killing over 120 persons
JK	Baramulla	1350 – 6000m	1350 – 1800m		
JK	Budgam	1350 – 6000m	1800 – 3000m		
JK	Kupwara	1350 – 6000m	1350 – 1800m followed by 1800 – 3000m		
JK	Kargil	1800 – 6000m	4500 – 6000m, 1800 – 3000m		
HP	Kangra	300 – 7500m	600 – 900		
UKD	Chamba	600 – 7500m	1800 – 4500		Udaipur (06.11) Rohtang Tunnel; Claimed 60 lives in same area in 2003
HP	Kinnaur	1350 – 7500m	1350 – 3000m, 3000 – 6000m	HEPs	Sangla Valley (08.07), Kaamru Nala and Barang Nala in Sangla
HP	Kullu	1350 – 7500m	1350 – 1800	HEPs	Gursa Tehsil (2003), Upper Manali (07.11; 8 & 22), Tharman Village (08.10)
HP	Lahaul & Spiti	3000 – 7500m	Lahut Valley, Sarchu Peak (5741m), Chenab Sub Basin, Mulkila (6417m)		

JK	Leh & Ladakh	3000 – 6000 & > 6000m	3000 – 4500m, 4500 – 6000m		Leh (08.10)

Then of course a lot of you have heard about what happened in Leh.

There is also lot of evidence about glacial retreat. We are finding that out of the 2600 odd glaciers that have been mapped, about 76 of them have been retreating. You find two thirds of the glaciers are actually retreating, and there is only 7% which are advancing. There are certain valleys where relatively the weather, the climate pattern has changed that.. but there is overall warming due to which retreat is happening especially in stretches where the hydro projects are there. Now has happened in the past decade, more than the old large reservoir projects which we have heard of like Teri, Bakhra, Poong or Chamera,--- most of the hydro projects what they call as "Run-of-the-river" projects. There is a small barrage from where the water is diverted and you use the gradient only with the result that a large part, for instance Sutlej, today virtually runs in tunnels, because there is a cascade of projects. So there is a project. The water is diverted. It goes into a tunnel, then it comes out, then again there is barrage.Then again it goes into tunnel. So all the people who are dependent on the stream, and all the people on the rivulets which came into the stream, are affected by this. And in these places it is very difficult to distinguish what the larger climate phenomena impacts and what the local phenomena does, because the local phenomena overwhelms the larger phenomena.

Glacier Retreat

	No. of glaciers Monitoried	Retreat	Advance	No Change
Fluctuations in different basins based on SoI maps and satellite images	2630	2047	435	148
		77.83%	16.53%	5.62%
Fluctuations based on Satellite images	2190	1673	158	359
		76.39%	7.21%	16.39%

- **Spiti Basin** – Interpretation of glaciers in this basin indicate that there is rapid retreat after 2001 and this is the highest among all basins!
- **Alaknanda & Bhagirathi Basin** - Glacier retreat for this basin after 1990 is much rapid whereas glaciers in Bhagirathi basin which is adjacent to Alaknanda basin has shown slow retreat after 1990.
- **Bhaga & Chandra Basin** - Bhaga basin is located in similar climatic conditions as Chandra basin but glaciers of Bhaga basin show higher rate of retreat as glaciers here are debris free. Another reason is the small size of glaciers indicating smaller depth

Then the either side on the streams there is significant impacts.

Vulnerabilities and Impacts on Land Based Production Systems in the Himalayas				
Crop	**Popular Belts / Eco Regions**	**Scale**	**Fragility**	**Remarks / Quotes**
Apple	Grown in Mid to high hill climates.	**Apple farming extends to over 1 lakh hectare and forms almost 45 – 50% of the land under fruits.** 83% of 592 million tonnes apple of total fruits.	During July 2009, over 30 per cent crops at heights between 4000' to 5500' were damaged due to hailstorm.	As per government, almost **900 crores worth of crop is lost over the last three years**. Kothgarh-Thanedar is one of the prominent apple growing belts in District Shimla which is severely impacted this year. Cherry, pear and peach are also affected.
Apple	Fruit belts in Shimla, Kullu, Chamba Kinnaur, Sirmour and Mandi districts	Dry season in the valley is progressing has created a disturbance in the sowing and growth of different crops and will also severely affect the fruit crops if the trend continues	The period when chilling temperatures are required for the crop, Kullu region observed dry cold wave.	*There is still no evaluation on the estimation of 1^0C increase in temperature in Himalayas as to what additional resources will be compromised like water, crop area, forest fires etc.*
Replacement for Apple		**From Apples to growing the more exotic nectarine. Nectarine can grow at low altitudes.**	*This suggests a kind of adaptation measure by planting the exotic species from USA?*	With the expansion of other horticulture crops like cherry, kiwi, apricots, strawberry, olive, almonds and plums is targeted to replace vulnerable crops like apple which is by far the major contributor of horticultural produce (>80%)
Replacement for Apple	High reaches of Shimla, Kullu, Mandi, Chamba, Kinnaur and Lahaul and Spiti are ideal for cherry cultivation Cherry (flowering March-April)	**As per horticulture department estimates, at least *10,000 farmers*, most of them with small land holdings, grow cherries over an area of *374 hectares*.** The areas are more prone to weather uncertainties like erratic rainfall, hailstorms and even long dry cold spells.	Requires less caring but fetches proportional price.	Himachal Pradesh produced **453 tonnes of cherry in 2008-09, though it was higher in 2007-08 - 698** tonnes
Kiwi	Shimla, Kullu, Chamba Kinnaur, and Mandi districts	Four different varieties of Kiwi fruit being cultivated in the hilly state (Hayward, Monty, Bruno, Allison)	Subsidies given 22,000/hectare & export to megacities in India	
Oranges		Due to the change in weather, we are facing a lot of problems from the last eight to ten years. It's not raining on time because of which the plants are getting dried. The orange cultivation in this area is almost finished," said Ramesh Pathania, an orange grower	**Orange is grown in over *25,000* hectares of land in the State. Out of this, 80 percent cultivation is done in Kangra valley.**	

Strawberries	Sirmour in the temperate zone accounts for 90% of the estimated production in the state of Himachal Pradesh.	Prominent belt along Poanta – Dhaula Kuan but it is also grown in lower/mid hills of Kullu, Kangra, Una and Shimla.		High value crops are taking a leap forward and most of them find markets outside the state.

Then if we look at land based production systems, for instance apple cultivation, (a lot of it has been talked about) what we are finding is , there are different things that are causing the fragility of the system, which later leads to becoming more and more vulnerable. For instance, in 2009 over 30 % of the crops at the height between 4000 and 5500ft were damaged due hailstorms. The Himachal government claims about 900 crores worth of fruits crops has been lost over the last three years. Then quick chilling was there. The period when the chilling temperature are required by the crop, the kulu region went into dry wave. That is why we have mentioned about need for quick chilling varieties.

Then, what is the replacement. So there have been replacements that are exotic. What we are finding is nectarine, which is similar to an apple, it is an American species that is being brought in here in order to ensure that they continue with their horticultural activities.

In higher reaches, most of then grow cherries and longer dry spells disturbs these cherry cultivators. is Then we find Kiwi. This is a exotic fruit that has been introduced. But Kiwi still doesn't have a market, and the only market for that is in the mega cities, so you are bringing in an exotic species because of climate vulnerability , you are subsidize the farmer in order to sell it in Delhi. So, you are increasing the food miles by bringing in a crop which is not be used at all in the local area.

Other thing what we are finding is some of the citrus fruits have now taken over in areas where apple was there. There are different varieties of oranges : kino, malta. 25:32

Crop	Popular Belts / Eco Regions	Scale	Fragility	Remarks / Quotes
Off Season Vegetables	Shimla, Solan, Sirmour, Kullu, Una and Kangra (off-season vegetables - cabbage, cauliflower, peas, tomato etc.).	Solan belt is popularly known as the area of Red Gold because of its tomato production	**Off-season vegetable production, which was nearly 34-35 thousand tons earlier, has now increased to 1/3rd**	Farmers are increasingly looking forward to off season vegetables as these fetch high prices when the production period is over elsewhere. (see below)
Vegetables		The drought like situation in Kandaghat area of Himachal Pradesh has damaged a major area of vegetable crops.Over 60 percent of the crops have been damaged, delaying the transplantation in the area.	tomato, capsicum, brinjal and cauliflower and our economy depends on these vegetables	However, there has been an increase in vegetable cultivation area from 25,000 hectares to 50,000 hectares in the state during the last few years.
Wheat and Cereal Crops	This temperate mid zone occupies approximately 32% of geographical area and 37% of cultivated area (Himachal Pradesh) and ranges from 650 m – 1800 m which means 5-6 Himalayan Districts *(refer table above).* This belt is also good for cash crops like off season vegetable, ginger and high quality seeds.	As per National Wheat Research Centre's analysis a long dry spell affected the wheat crop in the lower hills. Now, heavy rain accompanied with hailstorm and high velocity winds is flattening the ripe wheat crop.'	Yield of the wheat this year is expected to fall 20-30 percent due to hostile weather at the time of harvesting. About 81 percent of the total cultivated area in the state is rainfed. Rice, wheat and maize are the important cereal crops	The uncertain weather patterns have kept the farmers guessing and there is no adaptative measure as this is a rainfed area and bringing in other crops would mean more investments and also know how. Ginger is grown in Kadukhal (district tehri), *Ginger production in HP rose to 21,267 tonner in 2010-11 which is an increase of over 6000 tonner from the previous year*
Forest Fires	As reported in 2009, the meteorological office (HP) stated that the mean maximum and mininimum was 1 – 4 ^{0}C above average.	**In 2009 alone, over 650 incidents of forest fires were reported from Shimla, Solan, Sirmaur, Bilaspur, Mandi, Kangra, Hamirpur, Una and Mandi districts whereas the number was 572 in 2008**. Fires could break out due to the long dry spell and unprecedented hot weather. It is estimated that around 7900 hectares of forest land has been destroyed due to unprecedented fires.	In a report by Council for Science, Technology and Environment, there are 447 reported species in Himachal (out of 1228 reported species in India). Similarly, 77 species of mammels (snow leopard to Himalayan Tahr) are found here. The storehouse of biodiversity also supports 3,120 species of flowering plants, including 187 species of medicinal plants	Looking this from the backdrop of biodiversity, which is quite rich in this Himalayan State, the results coupled with this factor (forest fires) may also displace or force migration to other regions. E:g Himachal is home to 36% of country's bird species.

Now the other thing we found was off season vegetable production has grown. Where horticulture crops could not grow, people have moved into growing vegetables. You will find about , 30% increase in the off season vegetables, like winter vegetables for the plains, off season vegetables are what are

not available in the plans in that season can be grown in the hills.

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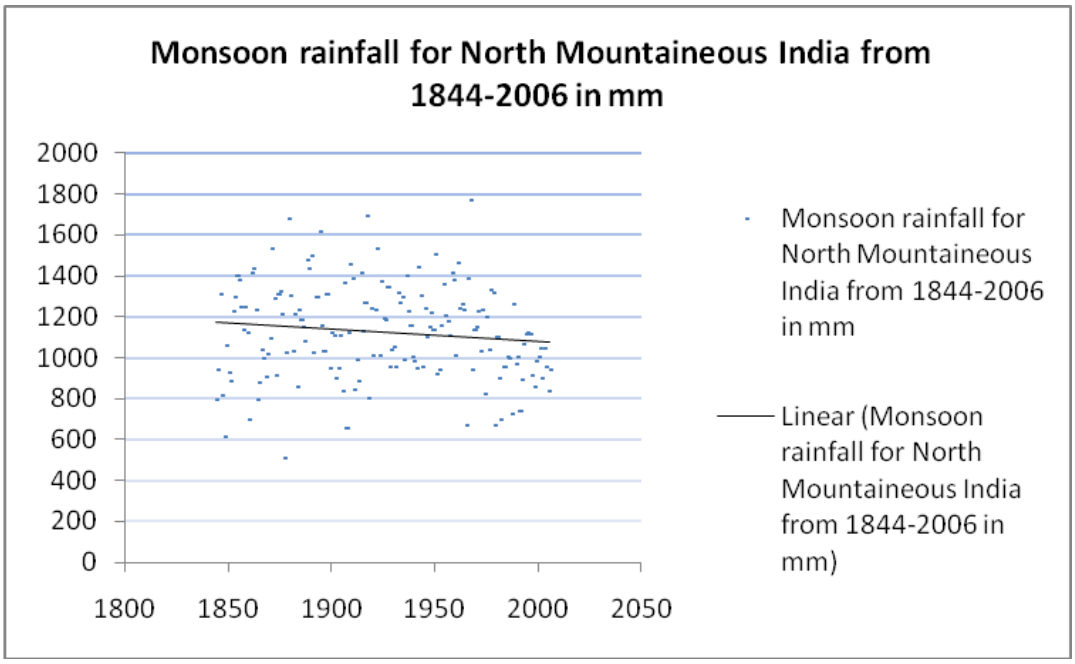
Earlier in Kandaghat in Solan district area which used to be an apple growing, now depends largely on growing tomato capsicum , brinjal, cauliflower etc.

The wheat crop and cereal crop production is dropping.

Then there are a large no of forest fires. So once gain whether it is due to a rise in temperature, or the heat island effect because of the large construction activity going on surrounding these dams and other projects. What we have found is there were 650 incidents of forest fires in 2009 alone and this number of forest fires have not been seen in the past.

Though we say there is variation in monsoon rainfall, local people also realized that there is increase in erratic precipitation. When you talk to people, if you ask what is their perceptionof rainfall over a long period, almost 90% People believe that that it is becoming more and more erratic.



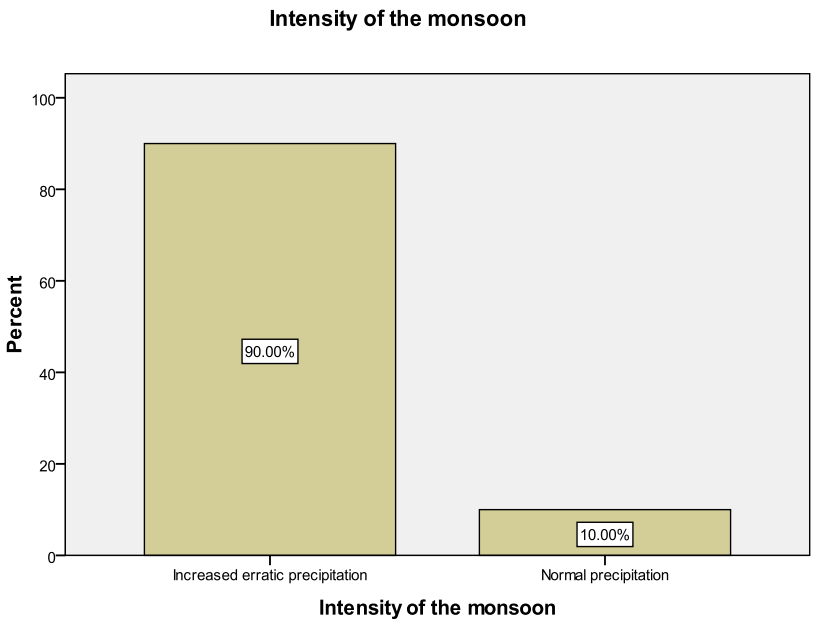
MONSOON HAVOC

	2011	2010
Lives lost	30	62
Houses damaged	1,903	6,656
Cost of loss (Rs crore)	334	1,793
Roads damaged (km)	NA	17,682
Bridges damaged	NA	45

Also you will see that the amount of damage it has caused just in 2010 & 2011: in 2010 we had 6000 houses damaged. We had 62 lives lost, about 17000 km of roads that were lost. What we are finding is that the monsoon period where there are period of erratic and intense rainfall, has increase the havoc it has been causing.

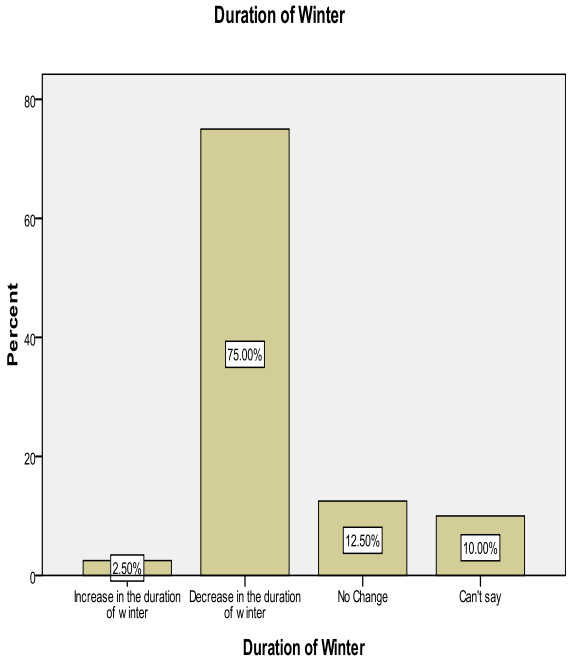
The other thing is people feel that the kind of fluctuations that they are seeing, which is - there used to be some cycle. In the past three decades also every two three years there might be a variation, some change in the weather. But now it is happening more frequently.

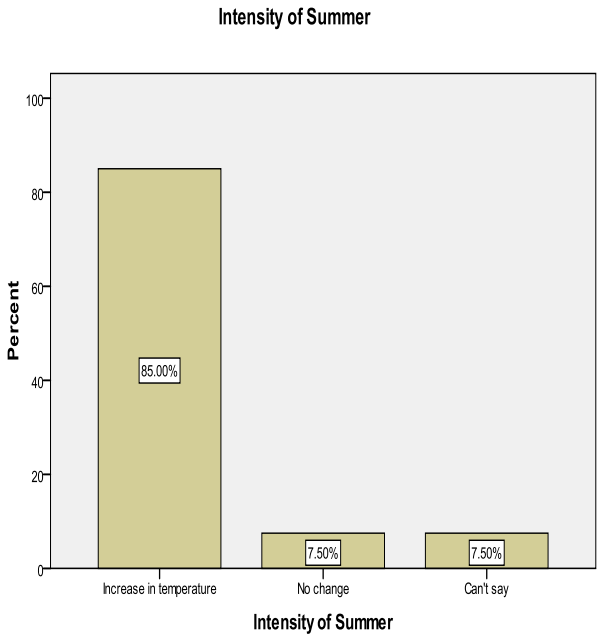
A lot of the elders feel that it was more spread even and gradual and prolonged. This also enabled better snowfall. Now it does not trigger snowfall. So they find that in areas where we used to have constant snowfall there is now rain, so many of the glacial margins when snowfall is not happening and rain starts pouring, the glacier melt even faster and retreat faster



Neeraj:- When we were researching the first thing we ask was do you see snow, because , it is the biggest and most obvious indicator that climate is changing. We talked to older people. We talked to women since they would go collecting firewood and we would talk to kids. The kids wouldn't know, because we are talking about change over two decades.. But the older people know: There would be up to two feet of snow and now there is no snow, and even if there is snow it snow on the hilltops. So, there is this obvious change that they feel though they dont know whether it is climate change or whatever. They mention that they no longer have similar seasons.

THE TWO MAIN SEASONS

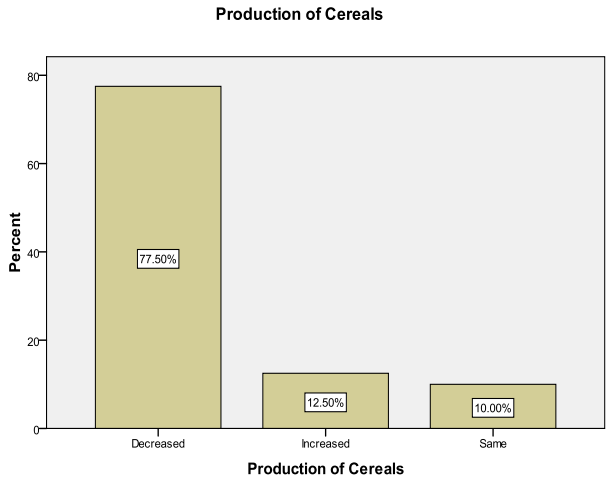




The General perception is that seasonal fluctuations were not frequent as they have been over a shorter period of 2-3 years duration recurrence.

Few of the older people in villages mentioned that if the rainfall is more gradual and prolonged, it causes good snow. As in the recent times the rain has become less gradual and more short and intense, it does not trigger snowfall.

R. Sreedhar:- Lot of people say that the production of cereals have dropped down. One reason that is that there are increasing instances of pest attack. That is what they say. So, obviously there is a longer warmer period. Also it has been seen that , there has been reduction in the biodiversity, because of the change in the agriculture.



Increasing instances of pest attacks and survival as the warmer periods prolong.

Mid Hills which forms productive agricultural belt has seen reduction in productivity. People say, getting back to the traditional system of multiple cropping may have to be followed as risks are higher now with single crops.

Neeraj :- There has been invasion of species like raja-grass and lantana which has taken over the biodiversity. Because of this they have less cattle now because they cannot find local fodder. Women have a hard time finding firewood because of Lantana because it has taken over the entire resource base.

R.Sreedar:- How can we reduce this vulnerability? One is we need better crop insurance systems, because every year you are actually running into a risk, especially when you are cultivating horticulture crops. , How to cover marginal lands, because many of the crop insurances does not cover smaller farmers. How do we bring them into that?

Reducing Vulnerabilities

- **Crop insurance** :
  - How the current models be reframed both economically and geographically?
  - And to cover marginal lands which have large dependents?
- **Early warning systems** : both scientific and traditional
- **Flash flood prevention**: community-based flash flood risk management plan
- **Managing water resources**:
  - Hill acquifers
  - Micro watershed strengthening

There are no early warning systems. For instance: if we have near time whether predictions, for instance cloud burst. If we know a little earlier that there is likelihood of intense rainfall, then there is possibility of protecting people, at least protecting lives. But what is happening is we have weather information is over long period. It doesn't tell about near time weather phenomena. And how we can we integrate traditional knowledge. There have been traditional methods of knowing like If we see this bird it will rain and things like that. How do we capture both of them and bring out some early warning systems to people.

Along with cloud burst and intense rainfall, we have flash floods. , How do we map flash flood prone streams and to what extent they will be at risk for a given quantum of rainfall or water. Those kinds of models for different watersheds may be required. Then, how to deal with hill aquifers. How to manage largely with the water resources, because many of the mainstreams and the streams have been taken away by power projects. When I say a hundred projects they are on the main rivers. But there are like 600 projects in Himachal Pradesh, which are so called micro-hydel projects. But micro hydel in the context of Himachal is projects which are less than 25 mega watts. So when you have 20 MW projects,

10 MW projects, even smaller streams on which people were dependent, there are also now taken away.

That is why we need strengthening and enhancing observational and monitoring mechanisms because even the central water commission which is supposed to be knowing about much water is to be there doesn't have regular mechanism for such monitoring. Only in the new National Action Plan, they have put up money for monitoring rivers, monitoring even meteorological data more intensely across the Himalayas.

INCREASING RESILIENCE

- Strengthening and enhancing observational and monitoring mechanisms at micro watershed levels.
  - This will enhance early warning capabilities
  - May give tips for longevity to livelihood's sustenance
- **Seed management**
  - Traditional varieties with agro climate suitability now
- **Crop diversification & alternate livelihoods**
  - Diet, food security and in addition enhancing household based alternate production systems

ADAPTIVE CAPACITY

Taking into account reducing vulnerabilities and increasing resilience; backing communities with information

- To plan adequately towards their food security
- To plan adequately towards livestock needs and alter uses
- To underline key indicators as to take lead for this planning in advance
- To engage in easily convertible activities which may not be land based but (based on agri-waste) as a branch of

We also need to look at seed management, because some of the traditional varieties are now being sought once again because they are studier, they can withstand these kinds of fluctuation,. So how do we look at seed management. Then also crop diversification and alternate livelihoods for people.

Apart from Information, the other issues is, how to deal with food security issues. How to look at livestock needs, because as Neeraj pointed out, one of the biggest damage is now being caused by weed infestation in huigh part of the Himalayas.. In uttarakand ,we have made some calculations that for every cattle that the household keeps, at least three to five hectares of forest are required to order to sustain it. We eed to have a very serious focus on livestock development and management in the Himalayas. Then , activities that can be lead to other agro-related livelihoods, that also needs to be promoted.

Thanks