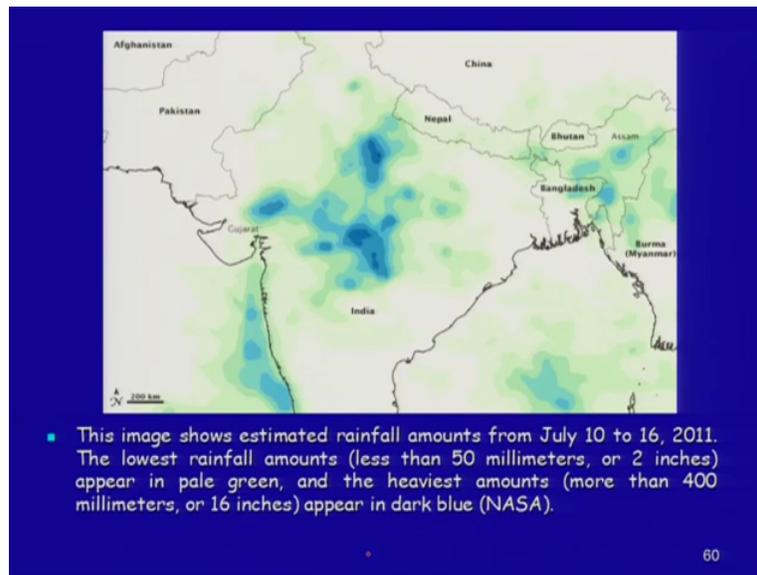


Earth Sciences for Civil Engineering Part-2
Professor Javed N Malik
Department of Earth Sciences, Indian Institute of Technology Kanpur
Introduction to Geological Hazards and Environmental Impact (Part-3)
Module 1
Lecture No 3

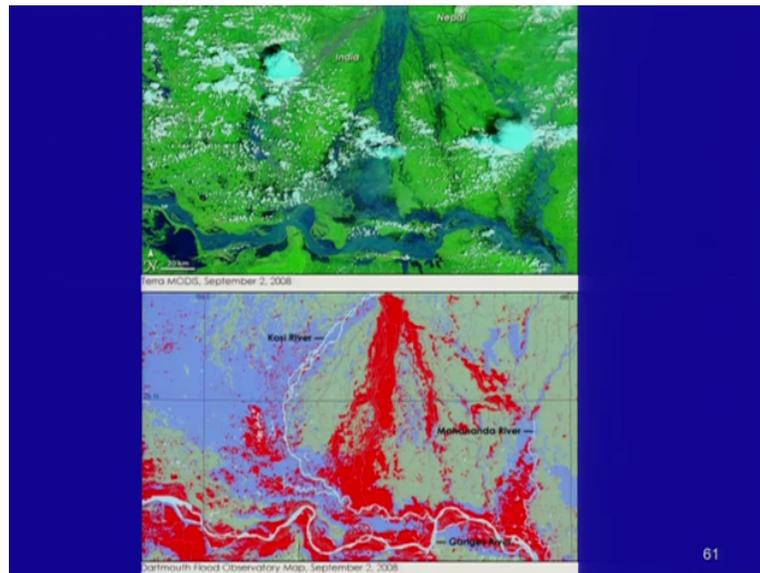
Hello everybody and welcome back.

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So as I was talking about that few of the the events that is natural hazards can be predicted well in advance okay because we have the the information from the satellite data so we have predict that how much rainfall will occur in that particular area and accordingly we can estimate that how much amount of water is going to come into the a reservoir either it is a dam or an area okay. Based on that, we can judge that how much are we will get inundated.

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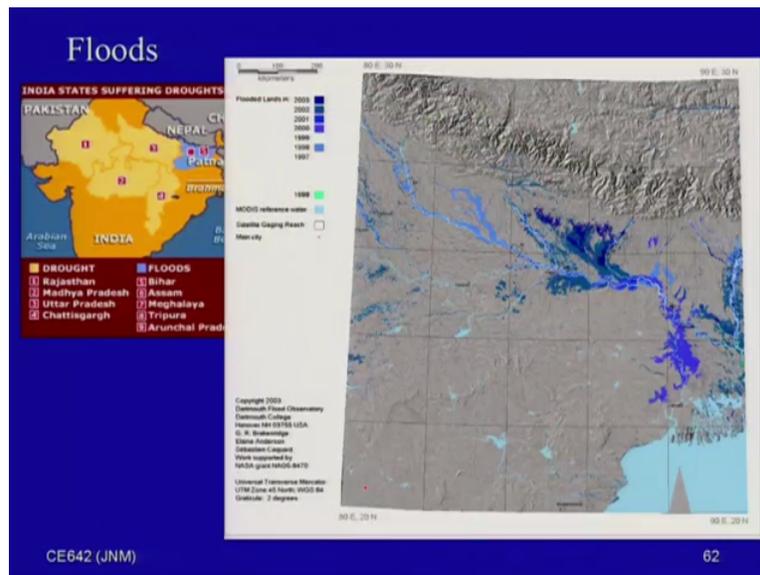


The one of the example from the Indo Gangetic Plain and which took place in 2008 okay. Now again there is a very important geomorphic feature here or we can say the physiographic changes which are taking place between the the hilly track and the plain areas so at the so so streams which are coming from the hilly terrain and flowing onto the onto the Indo Gangetic plain will usually have multiple channels okay like they will have multiple channels.

May be I can draw it on the the upper part so that it is clear so this this is the the earlier channel or the original channel of Kosi river but it has multiple channels which are over here but through that, the river doesn't flow usually okay so the actual path of the channel was before 2004 and 2008, it it flowed in this direction here so this was the original path but it took this one because of the extreme flooding event so it took this is what we call the Palaeochannel.

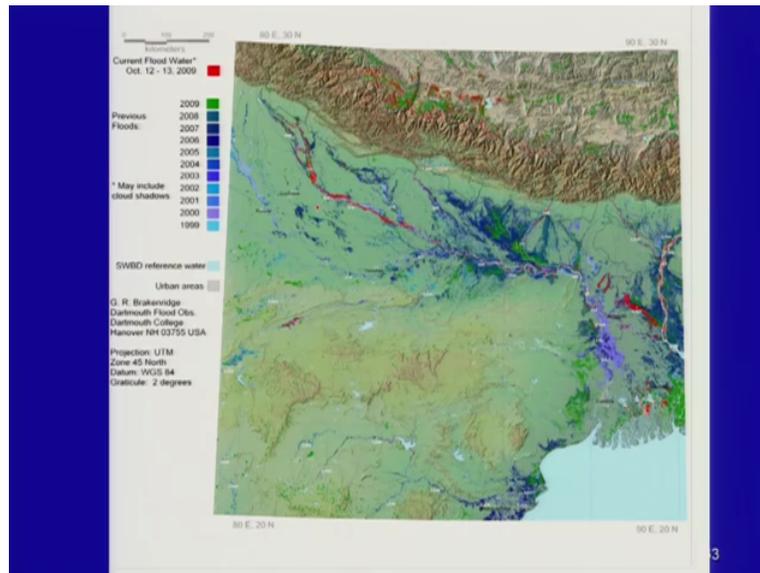
So this was the the palaeochannel, ancient channel through which it flowed, it took up that that path okay so and flowed up through that so this is for sure because based on the the its history if you go back into like 10, 20 to 30 years or 50 years, it has flowed through several paths okay so at present, it is here but during the peak flood, it may take this route or it may this one so this happened in 2008 and it affected many people from from this region.

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So if you carefully look at the the satellite data, one can easily judge how much area is going to be inundated so you have the records so of the past years okay so if you are having good records, good amount of number of records then you can predict the future flood events and all that so here this is again the Kosi river and you have different colored marks here that is showing the inundated areas and this information has been collected by the satellite observatory okay, Dartmouth Flood Observatory. And the data which has been shown here, this is of 2003 which marks the inundated area and then you have further up to 1988.

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So you have the information of many years okay so the data point is more and hence you can also generate the flood zonation map for this area okay and this is showing what we were talking about 2008 okay. This one is 2008 here, this one and this area is getting affected every year okay which has been shown by this one so you have an understanding that how much area is going to be affected in future okay and accordingly you can have the the town planning from this region so this is one of the advantage of such events okay which we can easily plan and safeguard the people from this area.

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This was in 2013 in Kedarnath because of the sudden pouring of huge amount of water that is what we call the cloud burst. Okay, now some of the teams they have they studied the sediment records from this region and they their study studies revealed that this was not the only event which occurred in 2013 because the deposits which are available in the sedimentary succession can tell you that how many events of similar kind occurred in the past also. That can also help you in choosing your area for construction and all that okay so this was not the only event which took place in 2013. Similar events took place in past also okay.

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So this was the scenario of what we call the debris deposit so we have large boulders which came in along the the landslip okay.

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And floods in Uttarkashi okay in during that period, we had, this is this shows that how poor understanding we have to put our houses or settlements along the riverbanks okay.

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And this is one of the the best example okay so if you have a river channel, mostly if I I will I will just draw the cross section here so we will have this is our riverbed here and then we are coming up and then we are having another one so the steps here, this is one step here, there is another step here okay on the either side, these steps are nothing but what we call is the terraces.

And here we have another one so we have if I I put here, the cross section is like, it goes like this and then it goes up okay so we have 2 terraces so usually what happens is that we all love to build our houses on on very flat area okay and these flat areas along the river channels or the river valleys are available in from amongst the old floodplains or terraces okay and the similarly most of the houses were been constructed along this terraces so this is higher of course, people will say that okay fine it is quite high from the riverbed but the problems which were been faced during this flood was the under scouring of the terrace material and that resulted into the collapsing of or of most of the houses in this region okay.

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So if you see some close-ups, this is what happened okay so you you had peak floods and most of the houses were sitting right into the waters okay and this was because of the the lack of understanding that what will happen if this river is having peak flood in future okay so if you carefully see this one here, there an erosion here and this house definitely must have gone off okay during the flood events.

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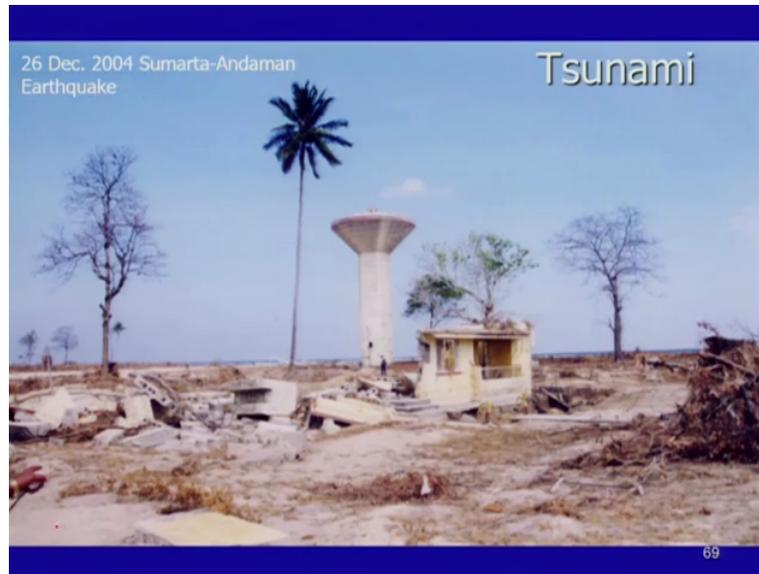




So far the information, if you take the the statue of Shiv, the height of the statue of almost like 15 feet or more okay and so and during the flood okay, this was the condition okay so one should take into consideration what happened in 2013 Uttarkashi and should consider this in developing the flood hazards maps okay.

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There is another hazard which is extremely catastrophic Tsunami and this is a photograph from 2004 Sumatra Andaman event where you can see that most of the the houses along the the coast okay were been completely wiped off so they constructed because they never had an idea that this area will have the flooding or will be affected by any such Tsunamis okay and the height of the waves which was been experienced here was up to a 7 to 8 meters.

They were quite deadly so if you have an understanding that these areas or the areas along the coastal zones will be affected by Tsunamis and will have the wave heights up to 8 to 9 meters and prone up to couple of kilometers then accordingly you can plan here settlements there.

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There is another example from that area. Lot many houses were been completely toppled off because of the extreme Tsunami waves.

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Some areas got subsided. This is from Port Blair area which experience subsidence by almost like 1 meter.

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This is from the Great Nicobar or Campbell Bay where the low laying areas which were sitting close to the coast faced inundation and they are facing inundation today also because the area subsided by almost 3 meters in this area okay.

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This is what happened in 2011. Tohoku earthquake but not many people got killed because they understood the event and they were aware of that but some areas still resulted into devastation because they never expected such a large Tsunami in that particular region okay.

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This was the pattern of damage. It's the experience. Huge vessels from the oceans were been drifted on onto the land.

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Tsunamis around the world

- 684 Kii Channel Earthquake, Japan
- 1096/1099 Quakes, Japan
- 1700 - Vancouver Island, Canada
- 1703 - Kanto Quake, Japan
- 1755 - Lisbon, Portugal
- 1771 - Yaeyama Islands, Okinawa, Japan
- 1792 - Tsunami in Kyūshū, Japan
- 1854 - Ansei Nankai Quakes in South Coast of Japan
- 1868 - Hawaiian Islands local tsunami generated by earthquake
- 1883 - Krakatoa explosive eruption
- 1896 - Sanriku coast, Japan
- 1917 - Halifax Explosion and tsunami
- 1923 - The Great Kanto Earthquake, Japan
- 1929 - Newfoundland tsunami
- 1933 - Sanriku coast, Japan
- 1944 - Tonankai Earthquake, Japan
- 1946 - Nankai Earthquake, Japan
- 1946 - Pacific tsunami
- 1958 - Lituya Bay megatsunami
- 1960 - Chilean tsunami
- 1963 - Vajont Dam Megatsunami
- 1964 - Niigata Earthquake
- 1964 - Good Friday tsunami
- 1976 - Moro Gulf tsunami
- 1979 - Tumaco tsunami
- 1983 - Sea of Japan tsunami
- 1993 - Okushiri, Hokkaido tsunami
- 1998 - Papua New Guinea
- 2004 - Indian Ocean tsunami
- 2006 - South of Java Island tsunami
- 2006 - Kuril Islands tsunami
- 2007 - Solomon Islands tsunami
- 2007 - Niigata earthquake
- 2011 - Tohoku earthquake

76

So these are couple of Tsunamis and devastating or deadly Tsunamis which occurred along the coast line in world and this is what we have like 2004 we are having from the Indian ocean and then we are having this one is from 2011. These were the quite damaging one.

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How to provide safe environment to our people ?

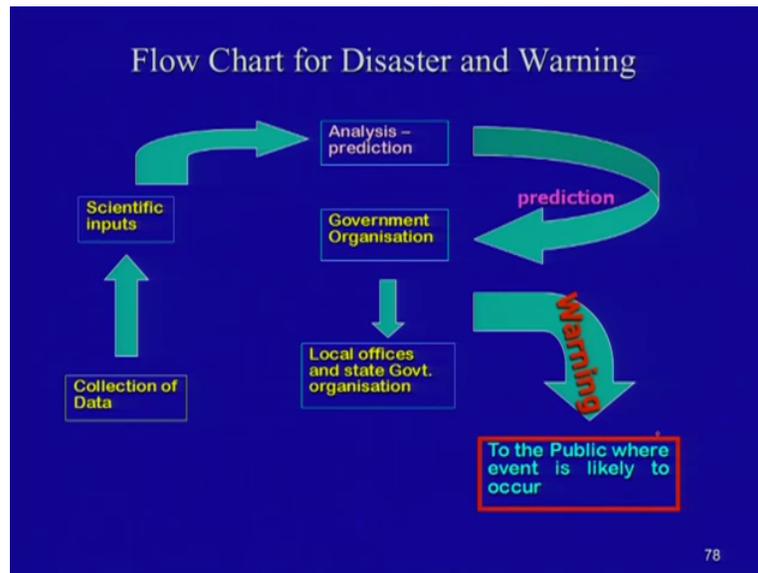
- Disaster prediction and warning
- By identifying the *location*
- By determining the *probability of its occurrence*
- Proper identification and understanding of *Precursory events*
- *Forecasting* of the event
- *Warning* measures

77

So how to provide safe environment to our people, as I told that if we predict and warn the people okay then we can reduce the or we can minimize the hazard part okay. Okay so by

identifying the location, by determining the probability of its occurrence, proper identification and understanding of precursory events, forecasting the events and then issuing the warning okay so if you do this then you will be able to minimize okay.

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So if you take the flow chart, we have to collect more data so in terms of what we were talking about, the floods and all that so we have more number of data points there and then we can and we understand that phenomena very precisely so one can do that so after having the scientific inputs okay and then analysis and prediction, we should pass on that information to the government organization and then local offices and we can issue the warnings there okay to public where the event is likely to occur so what, if you recall back what we have discussed so we have talked about the Vardah cyclone where the warnings were been issued.

We understood where it started and how it moved, where it went, that also we knew and then we talked about the location of fault, if we understand then accordingly we can plan the structure and then we were talking about the floods so if you have more number of data point likewise what we observed, if the floods, in the Indo Gangetic plain along Kosi river so we can have the understanding that how much area is going to get inundated and if you are having peak flood and also based on the sediment records, one can identify the type of events which will occur in that particular area that which what we were talking about of Kedarnath event okay.

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Benefits and disadvantages



Palm trees along the San Andreas Fault, USA

- Flooding causing damage to human settlement – erodes lot of material from mountains and deposit it in the lower reaches along the river floodplains – adds nutrients to form fertile soil
- Landslides – in hilly areas result into formation of dam along the river courses – provide valuable resource in form of storage of water
- Volcanic eruption – create good agricultural and grazing land and aqua life
- Faults – can cause blocking of ground water example shown above of SAF.

79

Now benefits and disadvantages. Of course the flooding causes damage to human settlement, erode lot of material from the mountainous areas, deposit it in the lower regions along the river floodplains okay and add a lot of nutrients to form fertile soil okay. This is what we have in the Ingo Gangetic Plains. A lot of erosion is taking place in the mountainous areas and we are getting lot of fertile land but at the same time okay we also have the landslide in the hilly areas resulting into the formation of dams okay so erosion will also result into the the landslides and landslides can result into the formation of natural dams okay along the river coasts okay.

Of course provides valuable resource in form of storage of water but when it burst okay or breach, it will result into the local flooding in the areas okay. Volcanic eruptions again they are very good in terms of the the nutrients which are coming up because they can give us a very good agricultural fields, good soil and good aqua, life in the region.

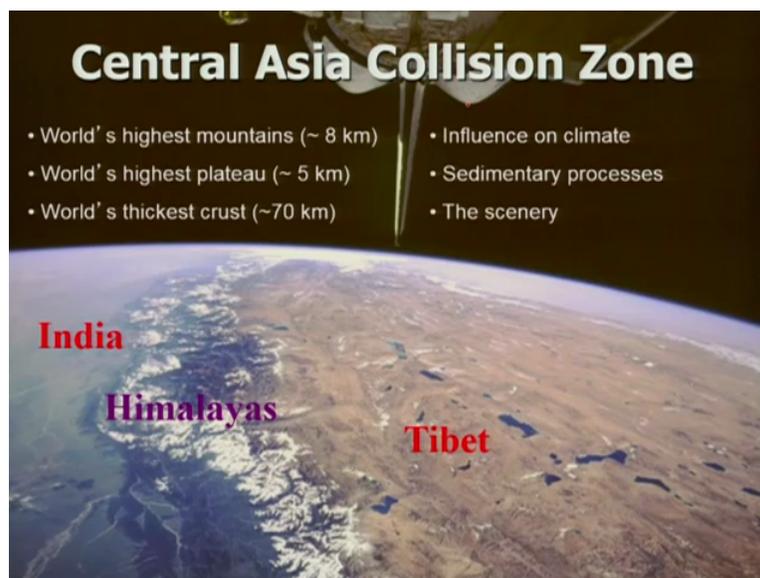
This is because after the eruption is is stopped okay and then of course the faults okay causes the blockage of ground water and the best example is given above from the San Andreas fault system okay so this is almost like dried area where you are having the the growth of palm tress okay and this growth of palm trees is along the outline where it has blocked and provided a water pool for the the plants and all that so one can have advantages as well as disadvantages from such events okay.

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Now coming to the Himalayan part if you take, of course, we are having a very wide spread Indo Gangetic plains and then we are having sub Himalayas, we are having Tibets and all that. Of course the rise of Himalaya provided us the the different or we can say the monsoon at least okay and then the ocean of this higher Himalayas or lesser Himalayas or some Himalayas provided a very fertile land that is what we call the Indo Gangetic plain and we are of course this is because of the mighty rivers which got developed here.

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So advantage if we take about the Himalayas and the Tibetan okay it also we can say that they are world's highest mountain, world's highest Plato that is the Tibet. You are having world's thickest crust okay, influence on climate, sedimentary processes and of course along with that we are having the scenic from this region, so the hazards what we are looking at are having advantages and disadvantages and this is one of the the very important example, the best example we have of the formation of Himalayas okay.

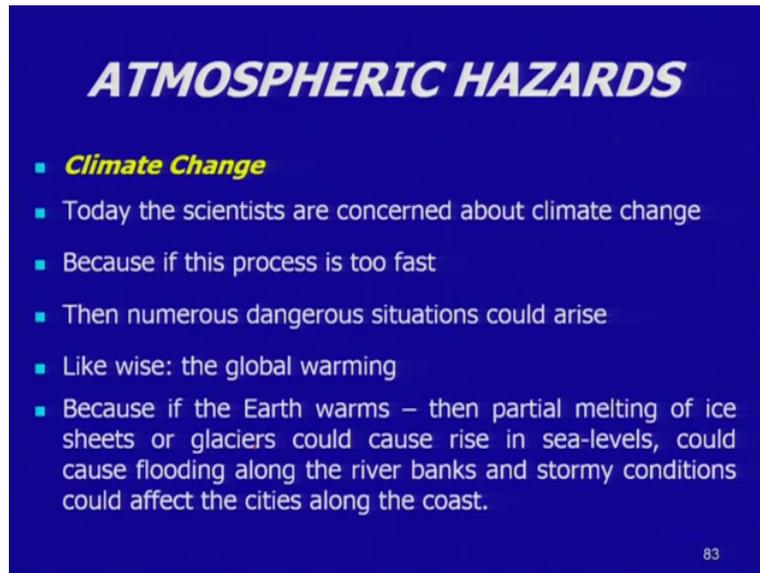
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- Earthquakes are related to mountain building processes:
 - Mountains provide us beautiful scenic areas – which attracts tourists and people love to visit to admire the beauty
 - Mountain chains like Himalaya has given lot to Indian sub-continent
 - – it controls rainfall
 - – rivers emerging from Himalaya have provided us extensive flood plains full of fertile soil (Indo-Gangetic Plain)
 - – used extensively for farming
 - – It has provided wealth of mineral deposits and other resources.
 - However the adverse effect
 - – the earthquakes in this region are deadly with large magnitude
 - – prone to landslides
 - – floods every year in some part in Indo-Gangetic Plain areas.
- 82

Now earthquakes and related to mountain building processes, mountains provide us beautiful scenic areas which attracts tourists and people love to visit to admire the beauty. Mountain chains like Himalaya has given lot to Indian subcontinent okay, it controls rainfall, rivers emerging from Himalaya okay have provided an extensive floodplains full of fertile soil that is what we are having in the Indo Gangetic plains okay.

Used extensively for farming, it has provided wealth of minerals, mineral deposits and other resources okay however the adverse effects are that the earthquakes in this region are deadly and with large magnitude, prone to landslides okay flood every year in some part of Indo Gangetic plain areas okay so we have advantages, disadvantages in this matter okay.

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ATMOSPHERIC HAZARDS

- **Climate Change**
- Today the scientists are concerned about climate change
- Because if this process is too fast
- Then numerous dangerous situations could arise
- Like wise: the global warming
- Because if the Earth warms – then partial melting of ice sheets or glaciers could cause rise in sea-levels, could cause flooding along the river banks and stormy conditions could affect the cities along the coast.

83

Along with that, if we talk about the atmospheric hazards, we are facing what we call the climate change. Today the scientists are concerned about the climate very much because if this process is too fast okay then numerous dangerous situations could arise okay. On it's like wise the global warming will take place and because if the earth warms then partial melting of ice sheets or glaciers, it causes rise in sea levels okay and could cause flooding along the riverbank and stormy conditions could affect the cities along the coast and that is what we are experiencing. We are having extreme events every year.

So I will stop here and we will continue with the new topic in the next lecture. Thank you so much.