Natural Hazards
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Lecture – 05
Introduction to Natural Hazards (Cyclones & Earthquakes Part II)

Welcome back. So, in the previous lecture, we talked a little bit about earthquakes and we were discussing one of very recent example. Of course, it was in 2016, but was important in terms of the ruptured pattern and all that of Kaikoura, New Zealand earthquake 7.8 magnitude, where the rupture was been experienced and which was been mapped on the surface or on land as well as in ocean. Now, further if you look at the other part this is one of the best example that how earthquakes can be devastating and disastrous, like this was one example from Japan Kobe earthquake of 1995.

And, another hazard which is always associated with subduction zone earthquakes where you have earthquake occurring in ocean then you will have an associated hazard which is posed and that is tsunami. And, then we have briefly talked about cyclones; we will see some examples of slow failures mainly the landslides. So, landslide is again and could be in very devastating and we never stop putting our houses and selecting these the locations close to the hill slopes.

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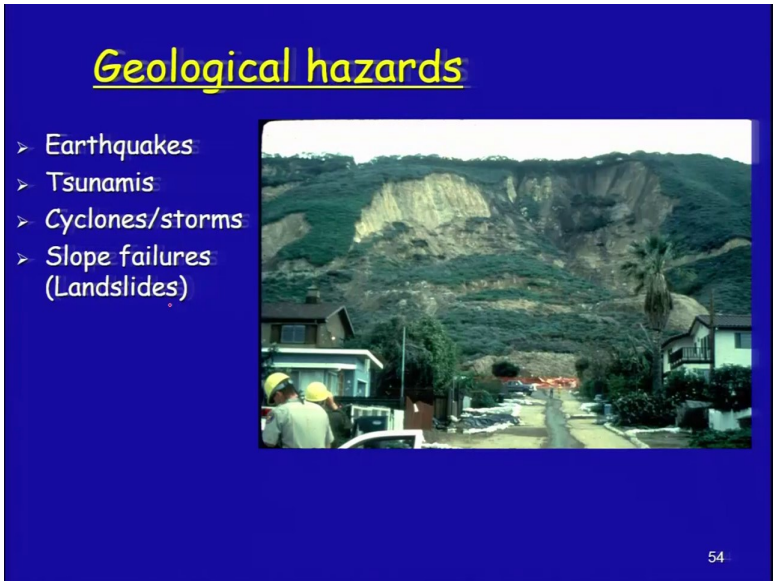

And, most of the time if we the slope or you can say the material sitting on the slope is loses its shear strength will result into a major slept, or maybe you can say the mass moment landslides.

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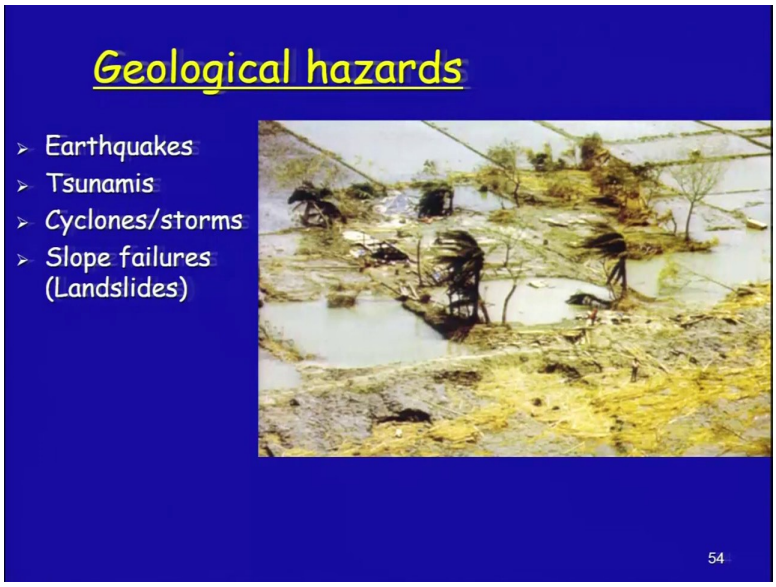

Then, we have cyclones. This is from Odisha in 1990's which was again in a very severe storm. Then we have another hazard which we are going to talk about in detail are floods.

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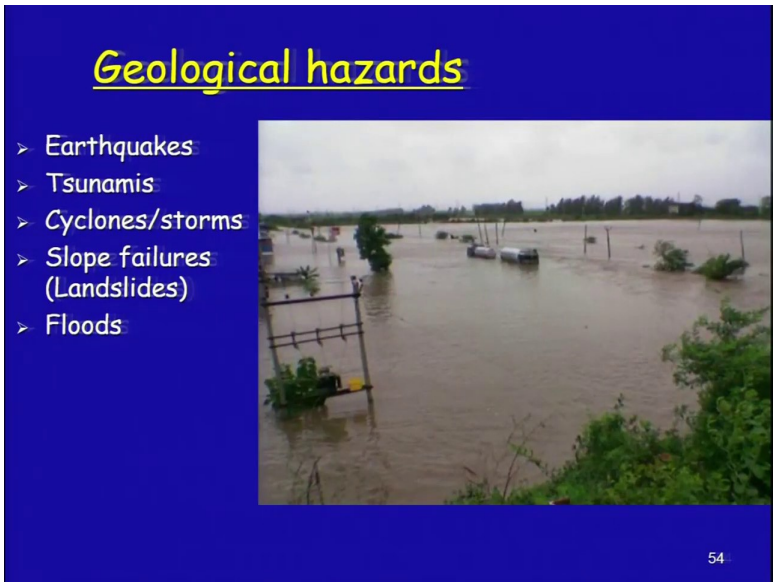

This is an example from Surat, 2006 and here we will also talk about whether the most of the floods which are experienced are manmade where, there is an influence of humans or it is purely related to the seasonal variations or maybe we can say heavy rainfall.

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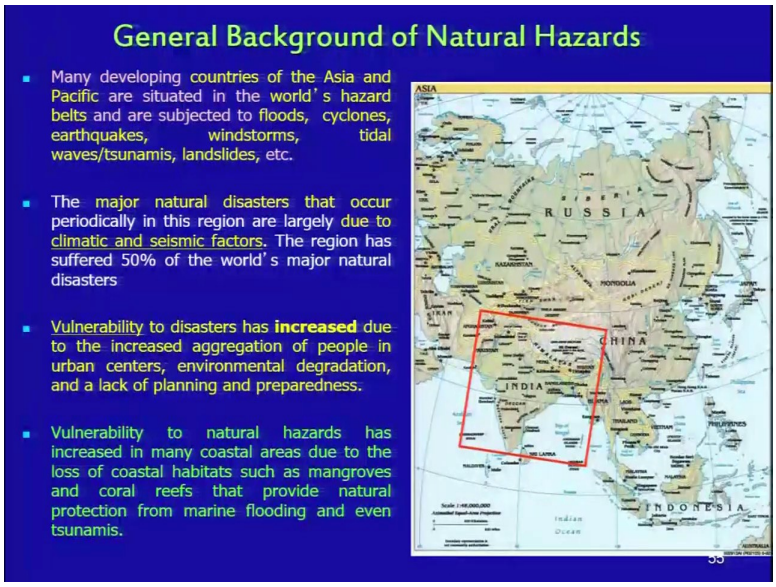

Now, general background of natural hazard if you take, so, we have mostly the region or the areas which are under the developing countries in Asia and Pacific. Most of these countries are subjected to floods, cyclones, earthquakes, wind storms, tidal waves or we can say tsunamis, high energy waves and landslides. So, many countries which falls within the periphery or in the areas of Asia and Pacific are subjected to most of the hazards, are the experience this is hazards.

The major natural hazards that occur periodically in this region are largely due to climate or we can say seismic factors. The regions have suffered almost like 50 percent of the world's major natural disaster in this particular region. Vulnerability to disaster has increased there was very important point, and it says that this is because of the increase in population. Even if we like consider the case of the India or Indian subcontinent we know very well that the population is going exponentially and we lack in proper planning and preparedness.

We understand that we are progressing well and developing the infrastructure, but still the question remains that in urban planning whether we have taken into consideration that what type of hazards we are going to face. Nevertheless, there are many states who

have already taken this task on priority and they have developed their own disaster management cells. Even the ministry of earth sciences and other ministries have taken this call and they are pretty serious about that what will be the scenario of the area and they have considered in terms of the on the hazard assessment and the vulnerability and they have come up with multi hazard atlas.

So, this is another like important part which we need to take into consideration that either we are we have done proper planning or not and whether we are prepared to face such disaster. I would like to add here one important another important point is that we cannot stop this hazard or cannot say that we are foolproof from facing this any particular hazard, but one thing is pretty sure that we will be able to minimize the damage we will be able to minimize the loss of life as well as the property.

So, vulnerability to national hazard has increased in many coastal radiance is due to loss of coastal habitats. Now, when we start talking about the coastal habitats either this is this decline in particularly if you take in terms of the mangroves and the coral reefs could be related to the pollution or the polluted toxic elements poured into the ocean as well as into the river. So, it will definitely affect the nearby areas or we can say the system in which we live, ok. We were talking about some the earth as a whole as an system. So, if you influence one system the effect is going to be to the another one.

So, in that sense to some extent the human intervention has affected the coastal areas where we see the decline in the mangroves and this was experienced in 2004 tsunami earthquake the areas which had thick mangrove forests were less affected by the tsunamis. So, sometime the coral reefs as well as the mangroves provides natural protection from marine flooding and even tsunamis.

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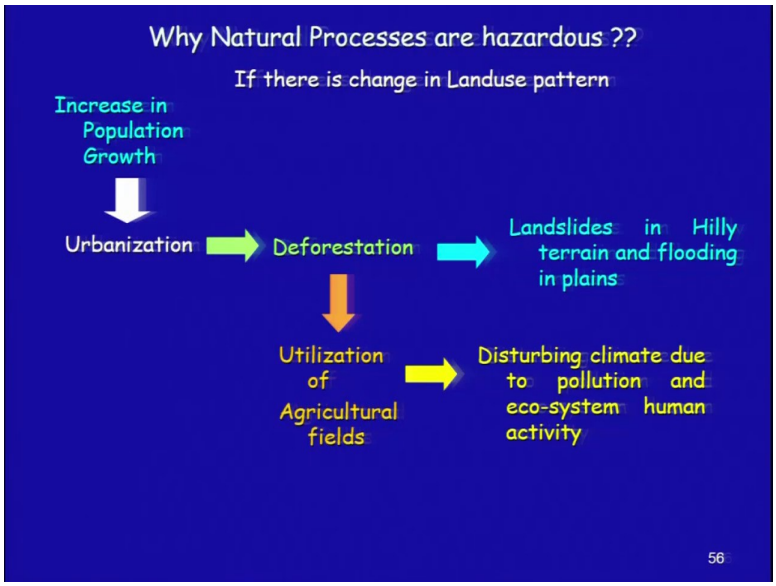

Now, why natural processes are hazardous? If there is change in land use pattern, it will be more hazardous. Reason again is that we are putting more and more people or the increase in population will force us to go and occupy the locations probably we are unaware of that these locations are prone to either landslides or floods, but we need area to settle down. So, increase in population growth will definitely result into this.

So, what does happen is increase in population growth, urbanization we are talking about, deforestation; so, we if we do not we do not have the land if the land is not available then we keep occupying the areas which where forests in the past. So, we cut the trees, we occupy those areas, we also do and we while occupying that area of course, we will come up with more construction and all that we reduce the recharge of that particular region that is from the rainfall and all that.

So, landslides in hilly terrains and flooding in plains; this is another most commonly observed or experienced hazard in every monsoon season in most of the areas which are prone to such hazards. Deforestation, what we are doing is we are utilizing the areas which were agricultural fields or which were occupied by the dense forest. And, finally, we are disturbing the climate due to pollution and eventually we are disturbing to some extent the ecosystem and that is because of the human intervention.

So, there were lot of documentaries which were been put on, available on even the social media where people talk about that we have poured so much of plastics, or toxic

elements in the rivers or we have drained out in the oceans which are affecting the ecosystem. Some extent we humans are influencing the system, but there are few groups who talks that this is not exactly true, but we may not be influencing too much, which where people have to know the group of people are talking about the climate change and that is because of the anthropogenic activity that may not be true in full sense. So, this does not debate, but of course, we are experiencing the hazard.

So, the aim is and how to minimize the life loss and the property loss. It is so, if we have not proper understanding that when where, the hazard is going and what will be the magnitude of that hazard which one is going to experience, then we can minimize the effect of that particular hazard.

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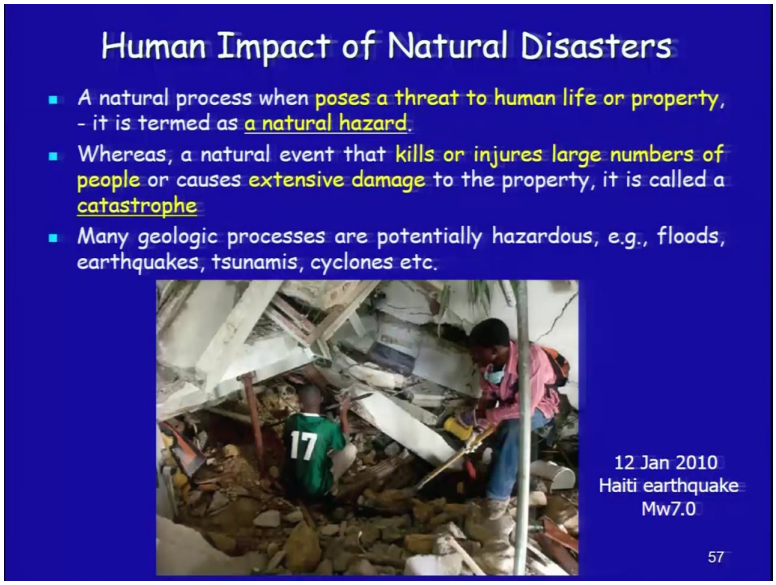

There is an example of 12, Jan 2010, Haiti earthquake magnitude was 7. So, human impact on natural disaster we will see little bit of some examples. So, natural process when possess a threat to human life or property it is terms as natural hazard; whereas a natural event that kills or injures large number of people or causes extensive damage to the property is termed as catastrophe.

So, whether the events or the hazards, natural hazards which are occurring are catastrophic events which are going to kill lot of people and is going to affect or result into extensive damage we should understand that. Many geological processes are potentially hazardous example floods because it will affect definitely a large area

earthquakes it will all, if it is magnitude more than 7.5 it may affect up to the periphery or the circumference or you can say the area it will cover in terms of the seismic wave propagation will be more than 300 kilometers.

Now, seismic waves can probably for thousands of kilometers, but the damage due to seismic shaking will be confined to that much of area that is 200 to 300 kilometers. Tsunamis could be transvers ionic. It can travel across the oceans and not only the areas where close to the subduction zone where the earthquake has been triggered will be affected, but the areas which are sitting very far off can also be affected. Like example in 1780 there was an earthquake and tsunami which was triggered by that earthquake along the Pacific region in US, but the affect was also been experienced which was severe close to along the Japanese coast.

Another, cyclones also are very much similar. It starts somewhere and the landfall where it is experienced that area is going to be more damaging.

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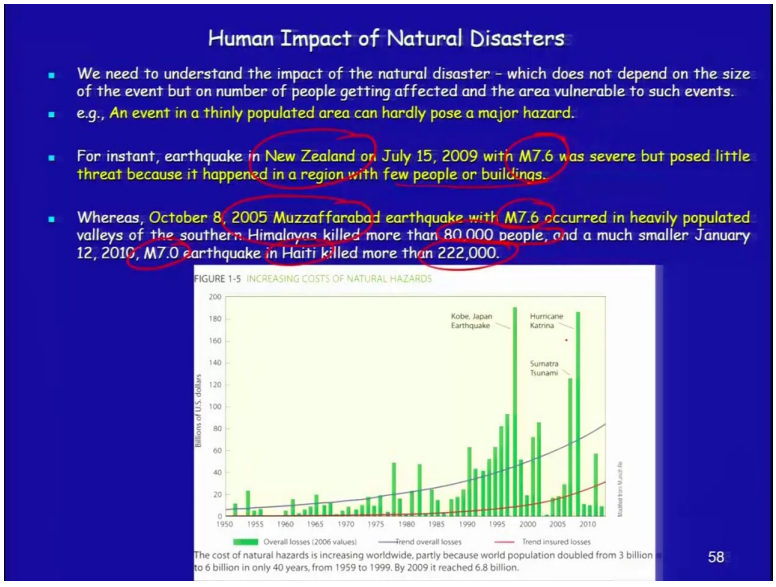

Further we need to understand the impact of natural disaster – which does not depend on size of the event, but on number of people getting affected and the area which is going to be vulnerable to such events. So, in the previous slide we were talking about that it poses the threat to human life in the property and here we were talking about natural events that kills or ingest large number of people,. This is very important.

So, of course, the magnitude of any event, either it is flood, either it is earthquake or tsunami is extremely important because that will tell us that what will be the area which is going to be affected. But, at the same time even the smaller magnitude events are going to affect large number of people, then that event is more disastrous as compared to even the large magnitude events.

Now, this is a very important a very good example: an event in a thinly populated area can hardly pose any major hazard because there are less people which who are staying there. So, they are going to be of the less number of people will be injured or get affected. So, thinly populated area can hardly pose a major hazard.

So, for instance earthquake in New Zealand which occurred on July 15, 2009 the magnitude was 7.6 was severe, but posed because 7.6 magnitude we considered as large magnitude earthquake was severe. But, posed little threat because it happened in a region where very few people and buildings are there.

On the other hand, October 8, 2005 Muzaffarabad earthquake, this was in Kashmir earthquake in Kashmir magnitude was very much similar 7.6, 7.6 here, occurred in heavily populated area. And if you look at the number of people got killed was almost 80000 people were killed and much smaller January, 2010, earthquake in Haiti magnitude 7 more than 222,000 people got killed.

So, even the magnitude of this Haiti earthquake of 2010 was 7 and this was 7.6 more people got killed. So, what could be the reason for this? The reason was one the thickly populated area another reason was the preparedness. Haiti was not at all prepared for even 7 magnitude earthquake which resulted into severe life loss.

So, this is what has been shown here the cost of natural hazard is increasing worldwide partly because world population is doubled from 3 million to 6 million in just 40 years and this data is from 1959 to 1999; so by 2009, already crossed, already gone. Now, we are 10 years after that ok, now in 2019 at that time it says that it will reach 6.5 billion in 2009. So, more and more people are exposed to such events. So, life loss in particularly is going to increase more number of people will be affected in terms of the damage. So, these two factors remain very important. So, one what we need to learn is that in particular area what will be the type of hazard; either it will be flood or it will be

earthquake or tsunami and how many people or in term in particular we can say that what will be the population which is going to be affected by that particular event.

So, irrespective of the magnitude this is what we have learned here that New Zealand and in magnitude of 7.6 very few people have been affected. October, 8, Muzaffarabad earthquake magnitude was 7.6, 80000 people were killed. Haiti 7 magnitude earthquake more than 200000 people were been killed and this also shows that how many people are getting affected by different type of events. This is on Japan earthquake Kobe in 1995, this was severe for Japan and then Sumatra in 2000, this was after that, but there were more events than an hurricane reaching we can see here.

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So, natural disasters impact on human again if you look at this is the example from hurricane Ike and 2008. So, similarly to what we were talking about the earthquakes if you look at an example of cyclone or the hurricane. On May second 2008, cyclone in Myanmar killed almost 1, 38,000 people mostly in rural areas. Urban areas they were bit safe having better building design, but almost like one 1, 38,000 people were been killed. Whereas, the super cyclone and with the category of 5, Choi-Wan that passed directly over the Northern Marianas Island south of Japan, this was on September 15, 2009 resulted in no deaths because few people live there.

Further the eruption which of this a volcanic eruption which occurred in 1980, Mount St. Helens very few fatalities we have been reported and remarkably little property damage

simply because the areas surrounding the mountains is sparsely populated. So, if an earthquake or any hazard which is occurring in a remote area where the population is very low it is not hazardous to me or to any one of us.

So, along with the magnitude, the type of process either it is flood cyclone or earthquake tsunami how many people are going to be affected that is very much important and for us we are overpopulated and for us it will be extremely important to understand each and every process or the natural hazard which we are experiencing although.

On the other hand, a similar eruption of Vesuvius, on the outskirts of Naples in Italy, could kill hundreds of thousands of people and caused huge property death this was came in very devastating because the population was high and the area the populated area was very close to the volcanic eruption. So, these are the points which we also keep in mind when we are talking about the natural hazards.

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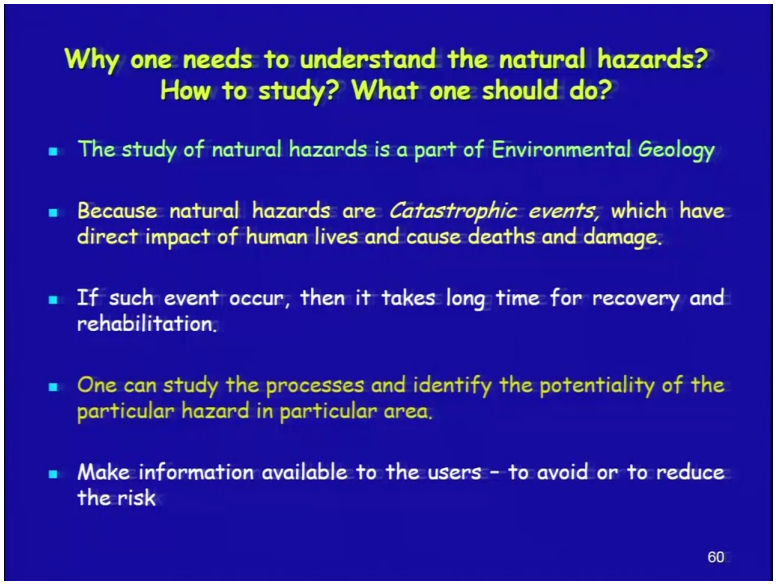

Now, why one needs to understand the natural hazards, how to study and what one should do? As I was discussing that if you know that where and particular location the earthquake is going to occur or cyclone is going to affect and how many people are going to be affected you can plan the things accordingly. For earthquakes, you will try to follow the earthquake building codes and all that and try to construct the buildings in such a way that it can withstand the ground shaking. Similarly, if a flooding event is going to occur because of cyclonic effect or may be because of high energy waves along

the coastal region how many people I need to evacuate that information if we can provide then we can minimize the damage and life loss.

The study of natural hazard is a part of environmental geology. This because one system is going to affect the another one this we have experienced and we are experiencing. Because national hazards are catastrophic events, which have direct impact of human lives and causes deaths and damage; this is one most important point. If such event occurs, then it takes long time for recovery and rehabilitation. So, in particularly India, we are just still progressing, we are still in developing stage, we will extremely face more problems in terms of recovery.

One can study the processes and identify the potentiality of the particular hazard in particular area. So, unless and until you cannot say that tsunami will occur in Himalaya, the location is not favorable or ideal for generating tsunami. So, the process which should be identified and we should know the potentiality of particular hazard occurring in particular area. And, then make this information available to users to avoid or to reduce the risk. So, risk to the people as well as the property.

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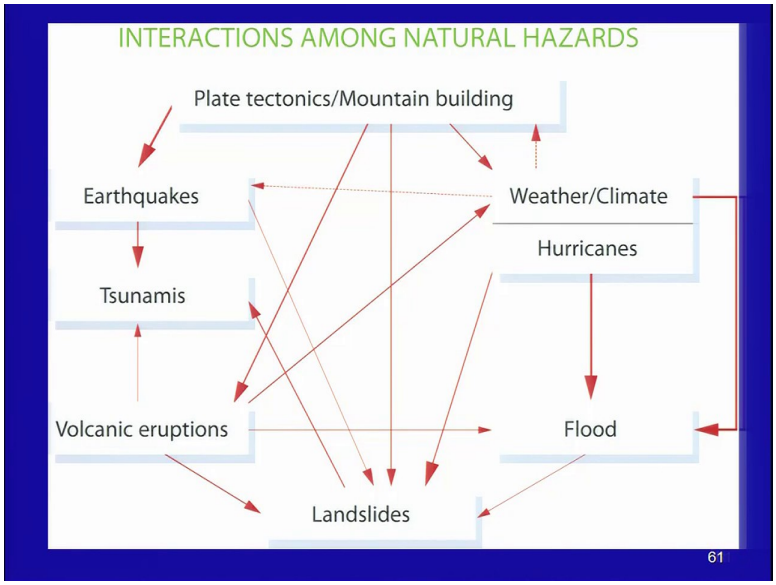

So, as I was talking about that this whole system is interlinked. This sketch explains not how it is sink interlinked. If we start from the plate tectonics or mountain building activity what it will result into. So, mountain building it activities will result to volcanic

eruptions, it will it can result into landslides, can result into earthquakes, earthquakes can result into tsunamis, volcanic eruptions can also result into tsunamis.

Very recent report from again Indonesia where Krakatoa volcanic crater, a mall huge chunk of the landmass it slipped into the ocean result into the tsunami that was because of the volcanic eruption which triggered the tsunami. So, volcanic erosion can also result into the landslide, this was experienced in the recent event in Indonesia.

Further mountain building activity will affect the weather as well as climate; it can further result into flooding events because if you are having heavy rainfall and all that erratic weather or climatic cycles you will end up having the floods. Floods can also result into landslides and weather extreme weather conditions can also result into floods. So, if this are these all are interconnected weathers can also result, but it is not very sure. Volcanic eruption can also affect the weather of course, with lot of ash if you put into the atmosphere it is going to cool down the area and it may result in to the reduction of the temperature by 2 to 3 degrees.

If you get back into the details of the geological cycles and all the geological history you will find that there were some extreme events which resulted into the extinction and this research which has been done, and what was the reason for the extinction of dinosaurs. Many of the researchers they are of opinion that there was an extensive volcanic eruption at that point of time.

So, it can also result into weather conditions. Volcanic eruptions can also result into the floods. The volcanic eruption is taking place where the volcanic cone is covered by thick snow. So, when the lava is poured on that snow-covered peaks it will result into the lahar flows, and local flooding will take place. So, this is what we can see that not a single system we can leave out, it is interconnect. So, if you disturb one another word is going to be affected. So, there were very important slide which you should look at carefully which talks about the interconnection amongst the natural hazards.

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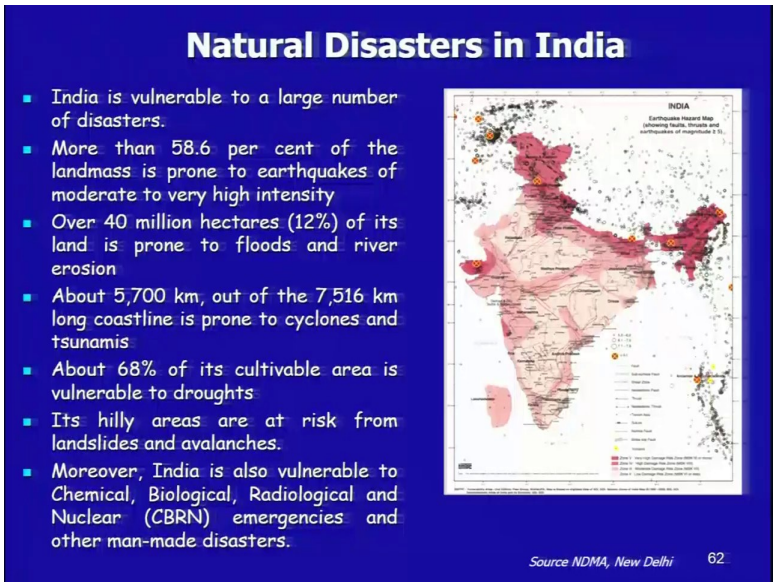

So, natural hazard disasters in India; mostly if you look at the seismic hazard so, nation map of India, this whole region the black dots if I can tell you is this is the black dots these black dots are also power earthquakes of different magnitude. And, the magnitude scale has been given here which starts from like above point 5.0 and goes up to 7.9 or so and, above 8 magnitude earthquakes have been shown by circular and cross here.

So, India is vulnerable to a large number of disasters. More than 58.6 percent of the landmass is prone to earthquakes of moderate to very high intensity earthquakes. Over 40 million hectares of its land is prone to floods and river erosion. About 5700 kilometers out of 7500-kilometer-long coastline is prone to cyclone and tsunamis. About 68 percent of its cultivated area is vulnerable to droughts. Its hilly areas are at risk from landslides and avalanches. Moreover, India is also vulnerable to chemical, biological, radiological and nuclear emergencies and other man-made disasters. So, not a single piece of land has been left out here.

So, I will stop here and we will continue in next lecture discuss, more about the hazards.

Thank you so much.