Natural Hazards
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Lecture - 01
Introduction to Natural Hazards

Welcome all. And I wish you a very happy new year. Now, this course in which we are going to talk about mainly the Natural Hazards; one or two courses which I gave last year. And I briefly spoke about natural hazards marginally, but in this course we will be exclusively focusing on the natural hazards. So, let us get started.

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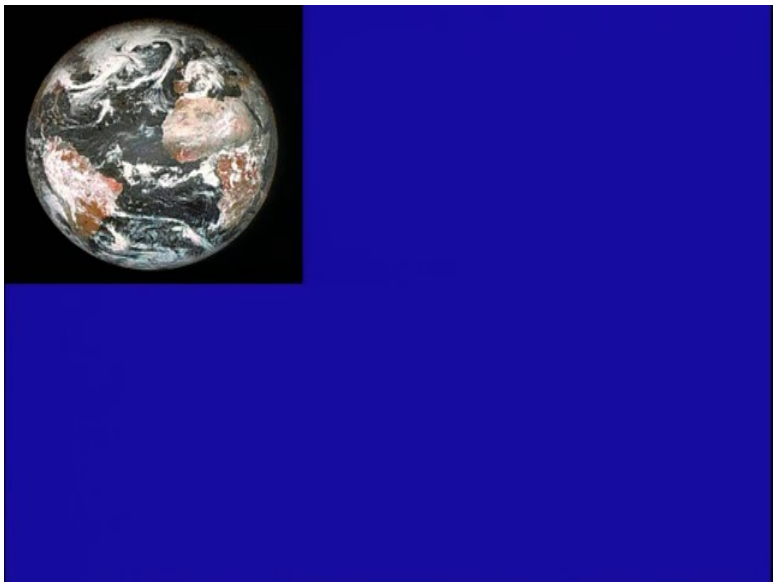

Now, we all know that the earth is a very dynamic planet. And we are exposed to number of hazards. And the risk based on those hazards are tremendous. And slowly as we see that we are experiencing more extreme events. And when I say extreme events means that which are devastating in total, which affects not only the property, but more affect is on the humans. So, we are society is affected more, and we are slowly exposing ourselves to more hazards. Now, either that hazard is related to the atmospheric disturbance or it is related to the ocean or it is on land.

So, we are mainly going to talk about those hazards and we will try our best to focus on India, nevertheless we will have few examples which we will be showing you from other countries, nearby countries or neighboring countries. But, mostly we will try to focus on

what type of hazards we are experiencing in India and how best we can understand those hazards depending on the regions.

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So, this is in picture of the flood in Kerala which was been experienced, and it was quite devastating in terms of the property loss mainly. Now, here the this question we are going to ask later on also when we are talking about floods, the question remains as whether this was really and complete sense the hazard which was because of the natural processes or it was manmade. So, this is another important aspect which we need to understand that whether the hazards which we are experiencing are completely climatic driven or seasonal driven or it is because of the human interference.

Now so, here is my email address. And as the process you will also get the email ID of the TA, Mr. Ishan who is appointed for this course. So, he will be active as well as I will be helping you people if you are having any questions on forum. So, I would say natural processes, because the natural processes are the processes which we include in two-fold like endogenic process and exogenic process. The processes which are taking place or occurring at the surface or above the surface that is in atmosphere, but it is everything is related or connected to the earth system. And another is the processes which are taking place or occurring subsurface below the earth crust.

So, the question comes again that how those processes are posing hazard to us. So, the answer is yes, how we will discuss that. But if you ask the answer for that I would say

those processes which are taking place that is endogenic processes, internal processes of the earth system are also posing hazard to all of us.

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So, in total if you look at what we say this is in geological process, and then finally, we say either it is a natural hazards or geological hazards.

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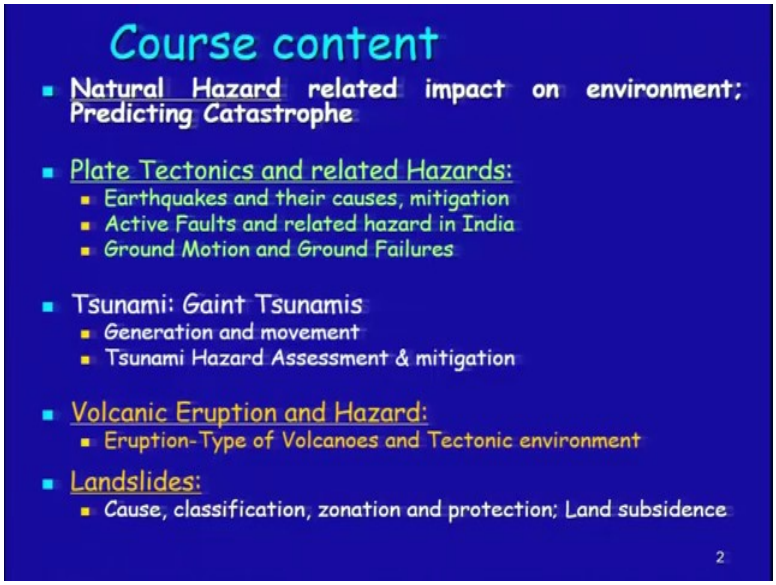

So, this is a broad course content, but the course content you must have caught by now in a template. So, we have tried our best to bifurcate all the topics, but wherever it is important we have discussed some part of those topics in our lectures. So, you will find

little bit that one topic is coming little bit ahead of what we have, but we will try our best to follow that.

So, in general what we will try to discuss here is natural hazard and related impact on environment, whether we can predict this such catastrophic event. Then this is in part of the internal process of the earth system where we will talk about earthquakes, their causes, and finally mitigation. Active faults and related hazard in India; ground motion and ground failure, because this is a very important portion of the hazards which is exclusively related to your internal processes. Then there are associated hazards which are linked or are triggered or we can say they are the secondary process related to the internal processes.

Now, this secondary event, we will discuss we will discuss some examples of giant tsunamis. And recently we observed or experienced the giant tsunami in 2004 that affected not only the other countries neighboring countries of Indian Ocean or the countries which are adjoining Indian Ocean, but also most affect was in Andaman Islands, Sumatra that is Indonesia, Thailand as well as along the east coast and west coast of Indian mainland.

Then we will talk about again the volcanic eruptions, but I would say here that we are blessed that we do not have any major active volcano in Indian Territory; only one is there which is not so active not so hazardous that is Barren Island which is located along the back arc of Andaman trench. So, we will talk about the process in terms of the eruption type of volcanoes if required. I will try to discuss that.

Then come to the landslides, this is the processes which are occurring on the surface, and these are absolutely confined to a particular geographic location. So, we will talk about the causes, classification, how the zonation has been done protection and land subsidence.

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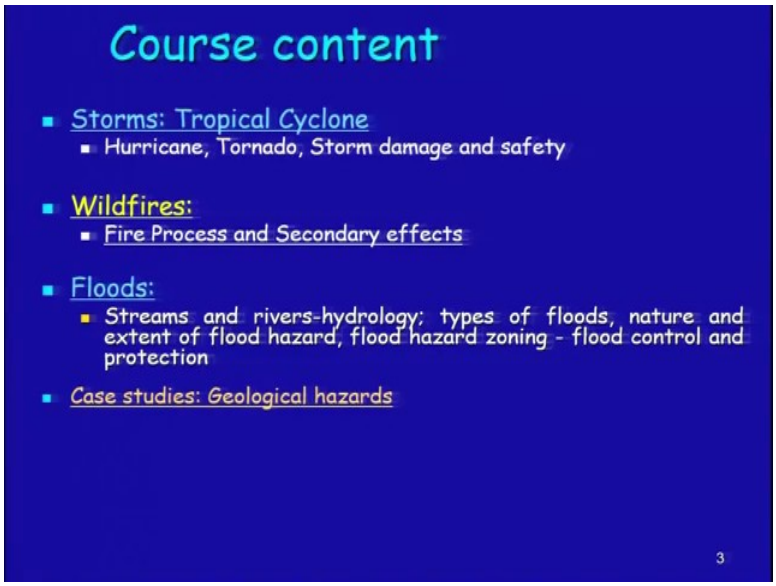

Then we can talk about the storms. And if you just look at the recent events also, I will just briefly tell you about such events, which we have experienced in India as well as in some neighboring countries or other countries or western countries. So, we will talk about hurricanes, tornado, strong damage and safety. We talk about wildfires, floods, then we will also as I told that we will be giving examples. So, in this we will talk about the case studies. So, we will take one particular event and we will talk in detail.

And attempt has been made to collect the videos, because nowadays the electronic media is one of the best mean to even understand the process. So, people have posted on public domain some videos which you must have watched and few of you must not have, but we will try to show those videos which will explain us and make us understand that how those hazards are dangerous in the sense, or how these events are hazardous, and how we are at risk at particular locations. So, we will talk about the cases.

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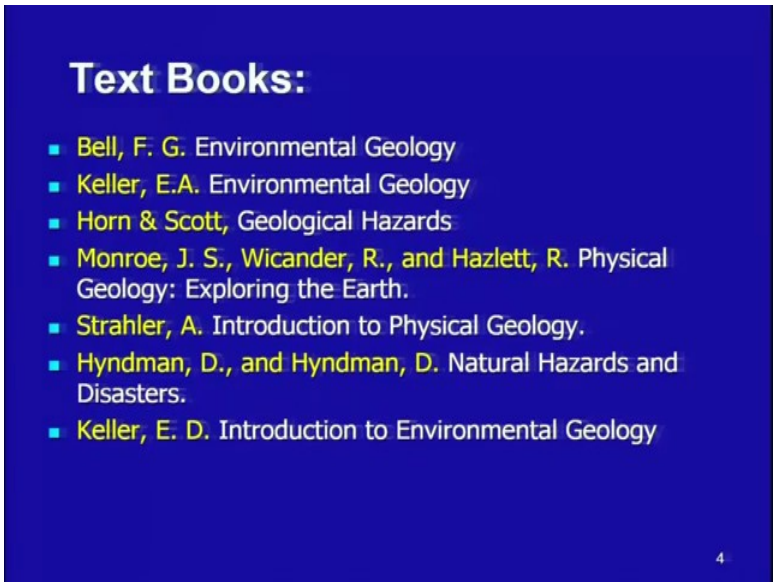

Now, about the textbooks you can refer, but I will I can assure you here, but whatever we are going to cover will be quite good enough for you to understand in these processes. So, there are textbooks by Bell, by Keller, Horn and Scott on Geological Hazards, Monroe and Wicander Physical Geology, you have Strahler, you have Hyndman that is again on Natural Hazards and Disaster, you have another book a new edition of Keller that is Introduction to Environmental Geology.

So, these are the textbooks which you can refer, but we have tried our best to extract most important information out of this literature. But at the same time as I told that we are going to talk about the case histories. So, whatever the research we have done at IIT Kanpur along with my team, we will try to present those also, so that you have a feel of what is going on in our own nation. So, we will try to do that.

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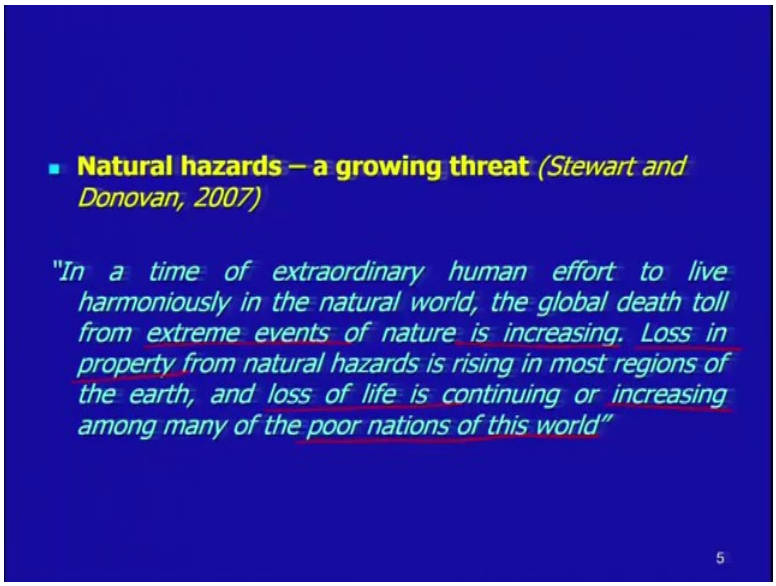

Now, before we get into this definition and all that, I will just like to briefly let you know that in recent last 2 years, we had a couple of devastating events like for example, we take in terms of the floods in Bombay which occurred in August 2017. Recent flood in May 2018 in Kerala which was quite devastating; recent cyclone named as Gaja cyclone which had a landfall in Tamil Nadu and Andhra Pradesh. Then we had a couple of wildfires which were like they were news as a breaking news one was in California in July, 2018; Uttarakhand we had in 2016 as well as 2018. 2018, it was in May.

Then we had a recent tsunami which was quite unexpected because the earthquake event which occurred the magnitude was large magnitude. And usually 7.5 magnitude along a fault which moves that there is a sense of default strike slip usually we feel a geologist or the seismologist they understand and they feel that no, no, this will not trigger any major tsunami, but it was and it was quite devastating. Now, they were almost like I would say two-fold affect, one was strong ground shaking during this Palu tsunami or the location where maximum damage was experienced was Sulawesi. This was the area this earthquake and tsunami occurred.

Now, the reason for this had been given that the fault on which this, the displacement took place or the earthquake occurred was on land as well as it was going submarine. So, on land you will find that there is a displacement of earth surface, but similar thing will happen sub submarine in ocean. And if this happens in ocean, the displacement of the

earth crust, it will disturb the water column which is sitting on the top of it, and that generated tsunami.

The third most important affect which was again a surprising and shocking for the people staying there was like faction, so that is what we call site effect. So, we need to understand that even the earthquake is occurring on land or ins marine area or in ocean, you may see or experience different type of affects, like, like factions' tsunami ground shaking collapsing of buildings and all that. So, this were a few of the events which were recently experienced, and they were quite devastating

Now, natural hazards, if we take in total is a growing threat to the community. And in particularly in India which I also emphasized in my previous course that the growth in terms of infrastructure is exponential, it is very high. Now, the question which we asked and we should to the builders, to the planners, and to the government that have you taken into consideration that what kind of hazard or type of hazard we are going to experience.

Now, here the example is for suppose you are sitting far away from Himalayas, which is one of the seismically active zone in the world. And it has a capability to trigger a large magnitude earthquakes in that particular region. But if you are sitting maybe 400 kilometers, 300 kilometers you cannot say that I am pretty safe from that hazard because the ground shaking will result in into fracture, ground shaking will result into the collapse of buildings.

So, have we taken into consideration that what will be the amount of or the intensity of shaking which we are going to experience if we are sitting several kilometers away from the active zones. Second example which I will give is that a tsunami is occurring or tsunami is triggered in US that is in Pacific Ocean. Now, Japan is sitting 1000 kilometers away the Japanese coast, whether it is going to be affected or not, the answer is yes.

So, even though we are sitting 100s of kilometers away we may have an effect of those events. So, how best we have understanding of such events which are occurring locally, locally in the sense I am talking about the source. And how many events have occurred in the past and what is the future scenario, can we work out that or not. So, these are few questions which with which we will go ahead in this course.

So, let us go with the further with the natural hazards a growing threat. Now, what it says is in a time of extraordinary human effort to live harmoniously in the natural world, the global death toll from extreme events of nature is increasing and that what I was talking few minutes back, that this extreme event how we would find extreme events. So, these extreme events are catastrophic. They are very disastrous events. So, they are increasing in number. Loss in property from natural hazards is rising in most regions of the earth, and loss of life is continuing or increasing among many of the poor nation of this world.

Now, why there is an emphasis given one here what we see is the extreme events increasing, loss in property and then loss of life increasing for nations. So, when we say the poor nation, then immediately it clicks our mind is that we are talking about the developing nations. The developed countries have already done their homework, for example Japan, for example US, they have already done their homework how to deal with such events. So, they have worked hard to get in get back into the history or they have deconstructed the history of such events and they have made some predictions.

But let me tell you that this type of predictions is having lot of like wide range in terms of the years ok, and this range may vary from 50 to 100 years. You cannot be like say that this time, this hour, this event is going to occur that is difficult, still we have not reached up to that point in our science to talk about that how precisely we are going to tell about that this event will occur on this date, this hour and all that.

But yes of course, we have reached to the point where we can tell the community that this is our understanding that this will be the magnitude of the event. And what will be the affect, how much area is going to be affected, how many people are vulnerable or the properties vulnerable to such events. So, this is a very important information which has been generated from the ongoing research which we are doing.

So, this piece of information can save many lives, can alert the people who are exposed to such events. So, the aim is to minimize the hazard part or you can say that we can minimize the loss inside in true sense, either the loss is in terms of the property or in terms of the life, we can minimize that. And suppose we are not having the complete understanding, then we keep exposing our people to such events. And we keep on like the time will keep passing where we just add our things towards the development. So, this you should keep in mind when we are talking about the hazard.

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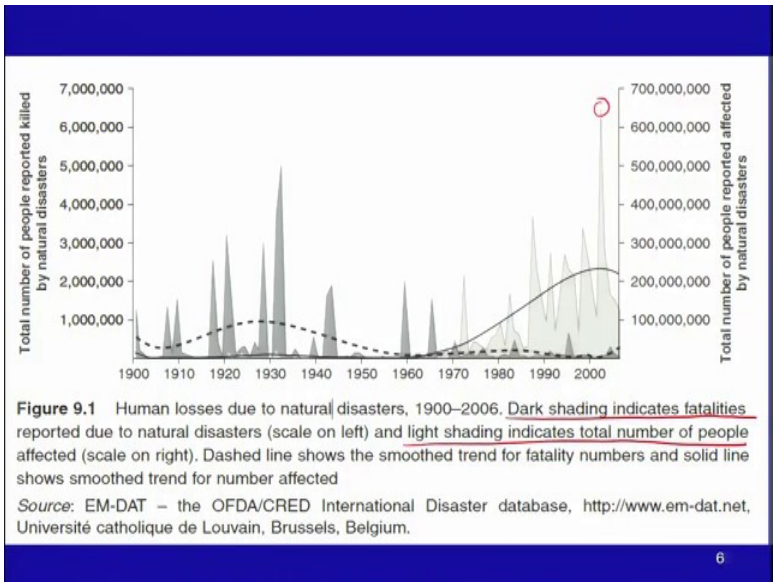

Now, this graph is not very old, but the data is between 1990, 1900 to 2006, which talks about the natural hazards and its affect on the life loss as well as the property loss. So, the dark shaded portion indicates the fatality. So, you can see here those are the dark shades. Slowly it has increased in some like 1930s; it was quite high it is reducing here. Whereas, the light shade indicates the total number of people getting affected, so you can see the spike here, it goes up to this. This is the number of fatality the people got killed, but the affect so is quite high here. So, this clearly indicates that we are exposing ourselves more to such events and that is the reason that we are getting affected, and that has increased tremendously.

So, again the question comes not whether we are in this situation in India or not? You might have seen or watched the advertisements coming on television or different channels which talks about that earthquake resistance building. Now, this started after 2001 Bhuj earthquake magnitude was 7.6. The government realized that such awareness is extremely important, and this type of advertisement was driven in most of the televisions. And this is done by the government, which is very important.

People have also like researchers, teaching community from various institutes for example, our own institute is involved in publishing booklets which are supplied or given that is what we call outreach programs. We go in schools, we deliver lectures, and we try to create awareness in children that is the school kids or the students who are in

10th or plus 2 level. But at the same time the attempt has also been made that such booklets that what to do and what not to do at the time of particular events. We have tried with the earthquakes.

So, if you go in the villages of course, they will not be able to understand the material which has been published, of course, it is not published in English, but with a very simple English, but most of the people can understand. But if they are not then we have tried an attempt has been made to translate those leaflets or handbooks in native languages. So, if they are aware of such events what they should do at the time of the earthquake, what type of construction they should do to minimize the damage and minimize the life loss the attempt has been made.

Thank you so much.