Natural Hazards
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Lecture – 09
Introduction to Natural Hazards (Disaster Prediction and Warning)

Welcome back. So, in last lecture we were talking about the recent devastating tsunamis. And this picture which is we discussed in the last lecture also is from Tohuku, 2011 tsunami of Japan.

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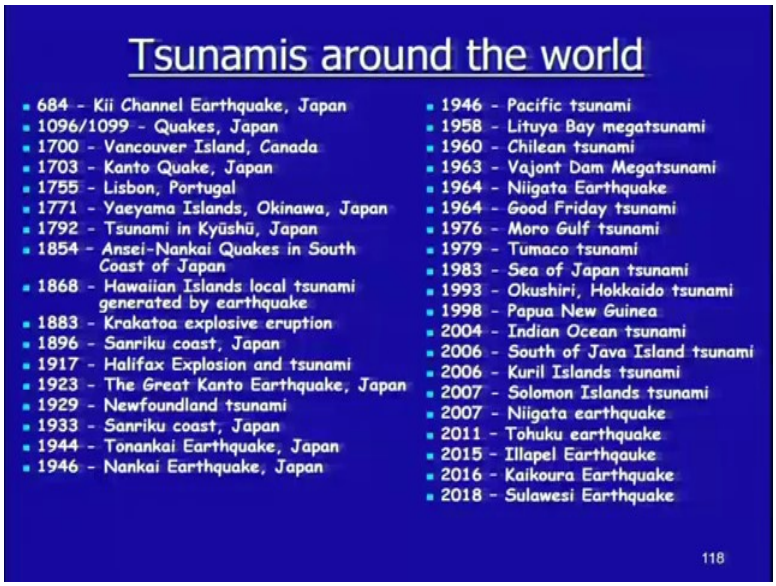

Now, there are historical records which are available in most of the countries, but the best record if you want to see or analyze for the future hazard assessment related to the tsunami is available in Japan.

Japanese literature and the historical chronicles has an very detailed record of tsunami; which is that the they get in detail the descriptions are given in detail. So, if you look at the list from the left hand side here; most of the tsunamis you will find they have been recorded from Japan. And the 1896, Sanriku coast tsunami was very much similar in the area where 2011, Tohoku earthquake tsunami was been experienced. So, we have listed couple of the recent tsunamis also which goes up to 2018 and that was in Indonesia.

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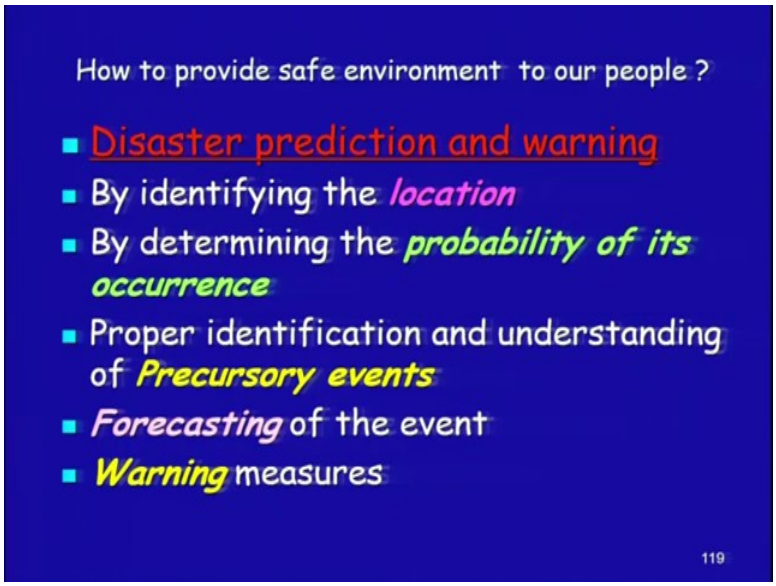

Now, how to provide safe environment to our people? This is the main aim of understanding the natural hazards. So, first is the disaster prediction and warning is extremely important.

So, one we should understand the hazard we give the prediction and also the warning to the local people who are going to be affected by a particular hazard. So, one way is by identifying the location because the hazards which we have been talking about either it is tsunami, earthquake, floods, landslides; they will be location dependent. Because you cannot expect all type of hazard in a same place over similar place also.

For example, if you are talking in about the Indian subcontinent, we have Himalayas in the north and we have the coast line more than 7000 kilometres. So, we will not be able to explore, but we are not expecting a tsunami in Himalayas because the ideal conditions does not prevail there. So, by identification of the location where a particular tsunami or maybe any particular hazard will occur by determining the probability of its occurrence; what is the probability in near future of that particular event that one can work out.

Proper identification and understanding of precursor events; now, this is possible about the precursor event in terms of the earthquake process. Because there will be some activity which will be unusual before the event that is the major event which we call main shock. So, seismologist and the geophysicist usually try to monitor the behaviour of seismicity before the major one. In some places for example, the intensity of the

earthquake or the frequency of the earthquake will increase and those are small magnitude difference or we can say micro earthquakes which will be followed by the main event.

So, foreshocks mainly seismologists and geophysicist will try to monitor very carefully. There are studies which have also indicated in terms of the land level change. Because for example, in terms of the coastal region where you have the ongoing deformation, whether those signatures will be reflected on land and that is related to the subduction zone deformation the answer is to some extent yes.

So, what best one can do to identify or the precursor events? Now in terms of as I told that earthquakes one can monitor the micro seismicity, but in terms of the land level change one can use high resolution GPS measurements. So, if you have the precise GPS measurements in this area because we know the location where a particular hazard is going to occur or maybe the event is going to occur; which is going to be an hazardous then a based on that you can use different methods.

So, if you have the GPS locations very precise you can talk about the ongoing deformation and one can talk about the strain budget and all that and based on that one can predict at this area will have the next event. Forecasting is very important, so once you know the location once you know the probability of the occurrence and the precise have precursor events; then you can forecast about that particular event warning measures. So, if you do all these exercise I believe that we will be able to provide the safer environment to our society.

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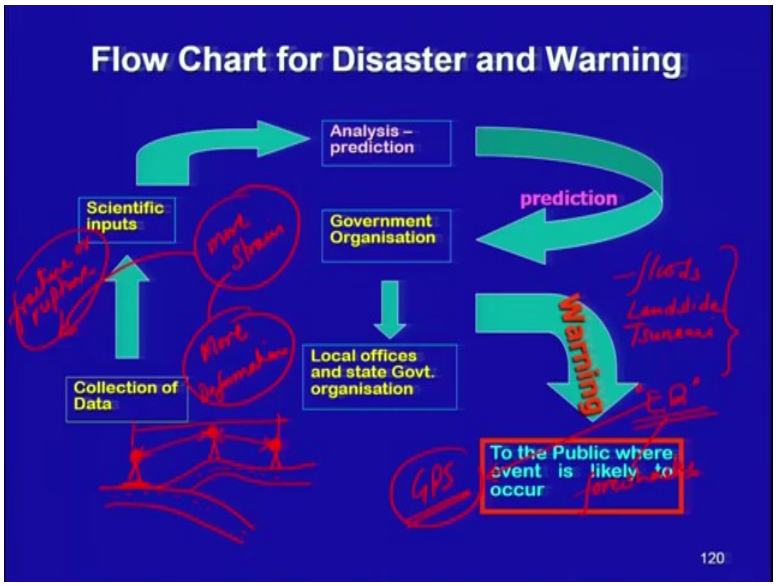

So, in flow chart if we take collection of the data; so, whatever the data is available as I was talking about that Japanese people are having very almost complete data set in terms of the earthquakes and tsunamis. So, if such data is available one can put the inputs from the scientific side scientific inputs analysis and prediction. Then prediction should be passed on to the local government or at the centre so that they can take appropriate action on it.

So, the if you pass on to the govern governed organisations; they will inform the local offices and the state that such event may occur in future and there is an high probability of that. So, they will at least try to pass on this information to the developer, to the local people there and what best one should do at the time of the event if it occurs during the stipulated time or else they try to reduce or minimize the risk part. So, warning can be issued; now in this the that warning its bit difficult in terms of the earthquake. But other hazards like if you take floods you can issue the warning; if you talk about like even landslide you can issue the warning in terms of tsunami, you can issue the warning.

Now, earthquake is bit difficult; nevertheless few attempts were successful in issuing the warning a related to the earthquake. And this was monitored based on the foreshocks. So, if you are carefully monitoring the foreshocks then you will be able to predict the future earthquake. But at the same time what attempt has been made is continuous monitoring or GPS measurement; continuous GPS measurements.

And as we will talk in the lecture where we have been we are going to talk about plate tectonics. Suppose two plates are one is sub ducting below another is hiding here. So, we have the moment which is going on between the two plates. So, there is some deformation which is been observed or experienced by this portion of the plate; as well as this portion of the plate.

So, if you have your GPS stations which are sitting on the area in this plates; suppose you have a GPS station here another GPS station you put here for example, I am just roughly putting that and then for example, you are having on GPS station here. Now, based on this measurements the coordinates between this two what is the behaviour; whether the plates are coming closer to one another, what is the relation between this two; one can easily make out that which area and this whole plate is getting deformed more.

So, when we say more deformation then we are talking about more strain developing in the rock or you can say crust. So, if you cross the threshold limit then they will fracture or we say they will rupture. This part we will talk later, but just I am trying to explain that if you are having good information available on earthquakes; one can predict the earthquake otherwise there is another way using precise GPS measurements which can help us in understanding that which area is going to rupture in future.

Then finally, the warning is been issued; it should reach the local people where the event is likely to occur. So, if you pass on this information to them; then it is useful for them to plan the evacuation and all that with the help of the local government. So, these are few steps which one can remember and it is not an (Refer Time: 13:03) and what we had we can say the rocket science in this. But of course, if you take and hold on this; then at least you will be able to minimize the hazard and impact of that particular event.

So, data collection, scientific input, analysis and prediction, prediction information should go to the government organizations either it is local or the state government; warning is been issued on that warning should reach the local public. Now there are a lot of means to pass on this warning to the local people may be either smart phones, you can do that on television, radio or in some places you have the hooters or the sirens which will run and indicate that or there is some serious thing is going to happen.

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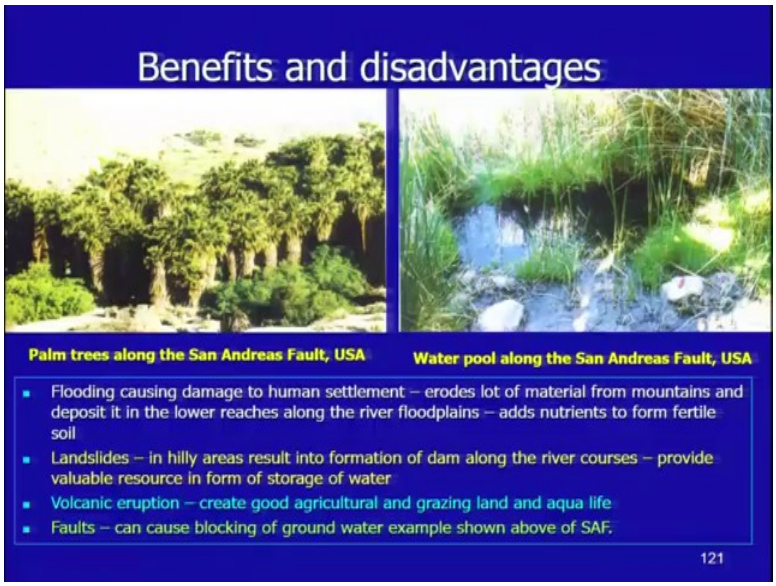

Now, this slide is of course, an very fascinating one because we talk about the hazard, but at the same time we also understand that any hazards which we are from which we are getting affected also have a benefits; so, we say benefits and disadvantages from that.

Now for example, if you take flooding of course, it is we usually try to avoid and I always pray god that this such event should not occur. But flooding caused damage to human settlement, but at the same time erodes lot of material from mountains and deposits deposited in the lower reaches along the river floodplain. So, eventually what it does? It adds nutrients to form fertile soil.

Second is landslides in hill hilly areas a result into formation of dam along the river course, provide valuable research and form of storage of water. This is natural damming which is experienced in most of the rivers. Volcanic eruptions creates good agricultural and grazing land and also along with that he will have and good aqua life which is been seen there. Fault; that is displacement along the on crust can cause blocking of groundwater example you can see here.

Now, this palm trees are growing along the San Andreas fault in USA and rest of the area we do not see the palm trees. So, the palm trees growth is aligned along the fault because it has an source of water there. So, these are couple of example which we can we should remember about or the benefits and disadvantages from the hazardous processes. The

geological processes are sometime and most of the time I would say that they benefit us of course, there are along with the benefits we will also have their disadvantages.

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Another example; a wonderful one now this is the example the satellite photo taken by NASA and the flat area here is the indo Gangetic plain. And then you cross the on the Shivalics and get into the lesser Himalayas then higher Himalayas and so on and then get into the Tibetan side.

So, this is indo Gangetic plain Sub Himalayas; Tibetan plateau. Now if we just quickly try to understand the advantages and disadvantages of this topographic development; which was because of the plate motion. Then what it has been it has given us is on is the Himalaya; then we can say Himalaya provided us the monsoon. And we got mighty rivers, erosion an erosion of the rocks and all that we got a fertile land and this what island is your indo Gangetic plains.

So, you can understand that what are the benefits of the plate motion and plate tectonics, but at the same time what are the disadvantages? Is the major one of the major disadvantages earthquakes? And this will range in magnitude from say M W 6.5 making up to 8.5 or so. So, extremely devastating earthquakes one can experience in India and we have already experienced in the past.

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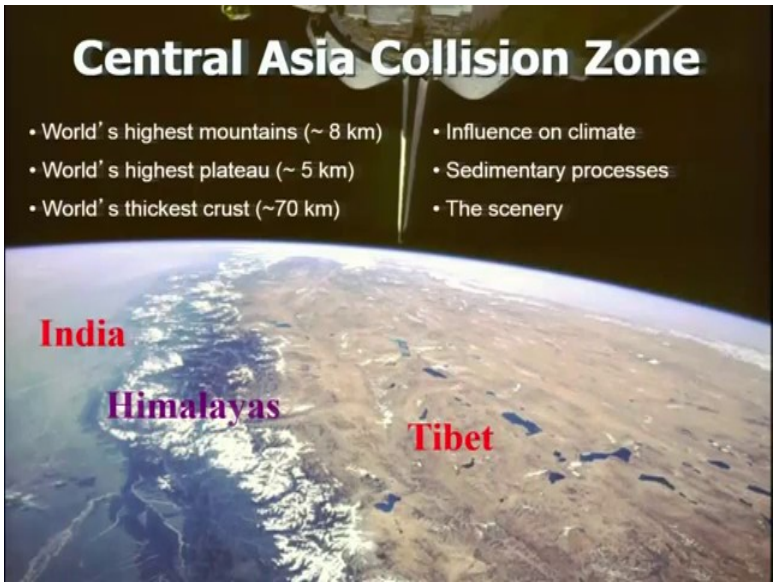

So, India Himalayas and Tibet; we have again another photograph. So, Central Asian collision zone, this is the Central Asian collision zone which we have; which has resulted into the formation of Himalayas. We have we got world's highest mountain; world's highest plateau which is sitting almost 5 kilometres above the MSL.

World's thickest crust influence on climate, sedimentary processes and also the beautiful scenic view.

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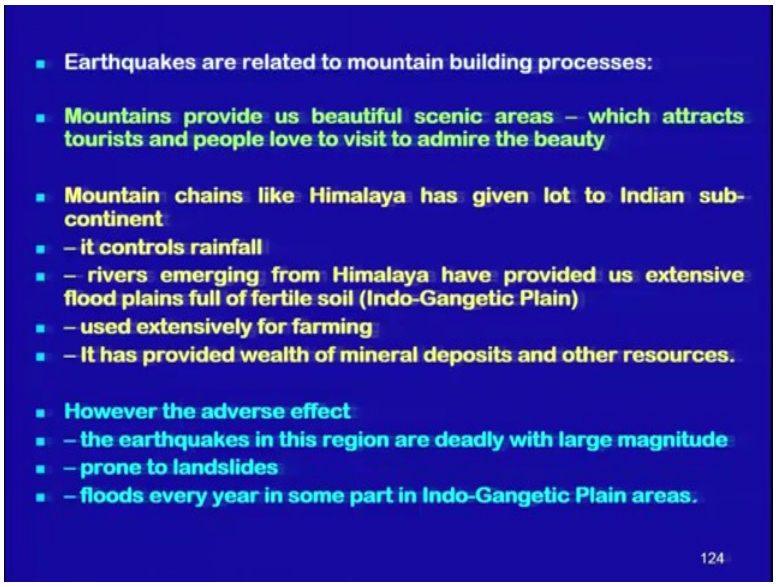

So, earthquakes are related to mountain building processes; the mountain provides us beautiful scenic area which attracts tourists and people love to visit to admire the beauty. Mountain chains like Himalaya has given lot to Indian subcontinent; it controls rainfall or rivers emerging from Himalaya have provided us extensive flood plains full of fertile soil that is indo Gangetic plain; used extensively for farming.

It has provided wealth of mineral deposits and other resources; however, the adverse effect is the earthquakes in these regions are deadly with large magnitude; prone to landslides; floods every year in some part of indo Gangetic plain areas. So, these are the advantages and disadvantages related to the mountain building processes.

So, as we were talking about that advantages and disadvantages in our mountain building processes. We will talk more in detail in coming lectures, but here maybe in the next lecture I will end here. But in the next lecture we will talk and we will try to show you some example of 2015, Gorkha earthquake; where we did the field survey and the results or the observations which we made I would like to share with you.

So, thank you very much; see you in the next lecture.