Natural Hazards
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Lecture - 32
Floods and Related Hazards Part I

Welcome back, another most important topic in natural hazard and this topic mainly about the hazard is very frequent in India and in most of the regions recently we have observed or experienced the flooding events.

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And this picture which you are seeing right on the screen is from 2018 Kerala floods. So, why we experienced this is definitely very easy to understand.

The most important factor which causes the flood is high precipitation or you can say high rainfall in the region, but sometime you find that this happens in urban cities and that is because of insufficient drainage available to siphon out the water as early as possible. Anyways we will see all this information in the next few slides.

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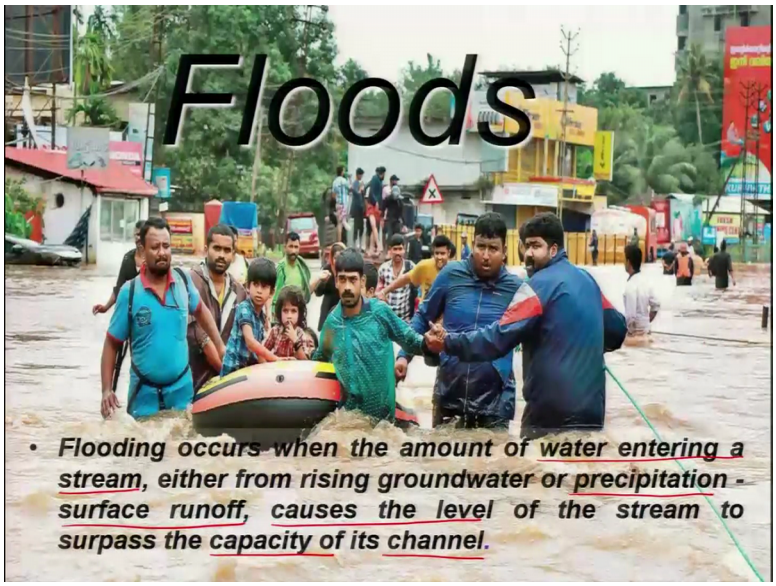

But mainly when you say that the there is a flooding in the area or a stream has entered into the flooding state, so flooding occurs when the amount of water entering a stream either from rising ground water or heavy rainfall or precipitation which will result into surface runoff causes the level of the stream to surplus the capacity of its channel.

So, there are a few very important points which have been put here as one is the precipitation water entering a stream. That means, we are talking about the channel, its carrying capacity surface runoff, how fast or how quick we are able to collect the water in an basin area, which causes the change in the water level in particular stream or in river channel.

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Now, this photograph is an aerial photograph which was taken in one of the monsoon season from the region of Indo-Gangetic plain, which shows that some part of the nearby floodplain areas are inundated due to flooding.

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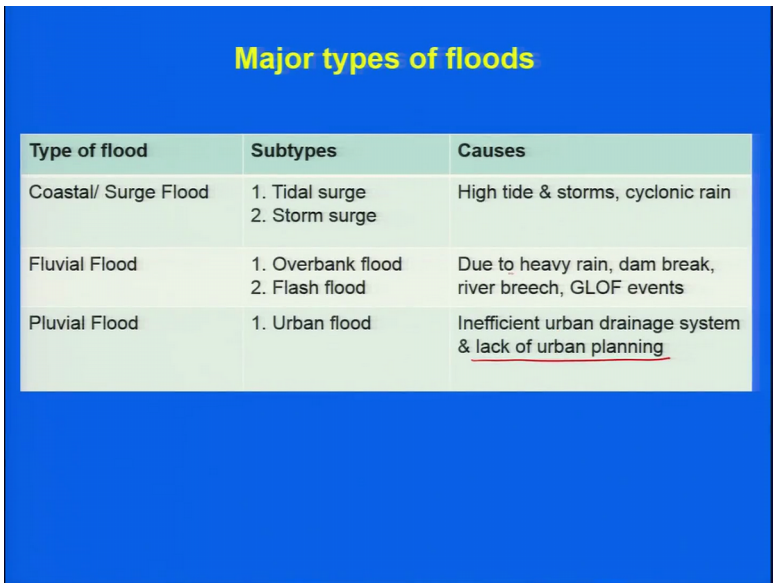

Now, major flood types if we take it is not only that we will be getting this or the floods are going to affect the regions close to the channel, but also in the coastal areas. So, we can also say the tidal storm even the Tsunamis are the can be categorized as a floods, ok.

But of course in the coastal regions mostly what we experience is the type of floods we have tidal surge, storm surge which causes high tides stormic conditions and cyclonic rain. Fluvial floods are mostly what we call which will affect the over bank areas. So, overbank flood or flash flood, flash flood can be due to the cloud burst also and there is only also possible possibility that, it can be due to a heavy rain or due to the breaking of dam at either the dam is naturally built or artificially built or that is by humans then river breech, if you have or you are having the glacial lake which bridges. So, these are the three causes which can result into the flash floods as well as the overbank floods.

Now when we come to the urban settlements as I was talking the city of Kerala or in some villages as well as in some towns of Keralas, so this we call as an pluvial floods and this is because of inefficient urban drainage system and that is mainly we always try to say very easily that this is because of lack of urban planning and this is absolutely true.

Because we do not understand that which area should be occupied and how much amount of water we can expect in that particular city or village and the same thing happened in Kerala, but whether in Kerala, the towns and the cities which experienced the floods were because of exclusively of heavy rain or it was because of the manmade disaster.

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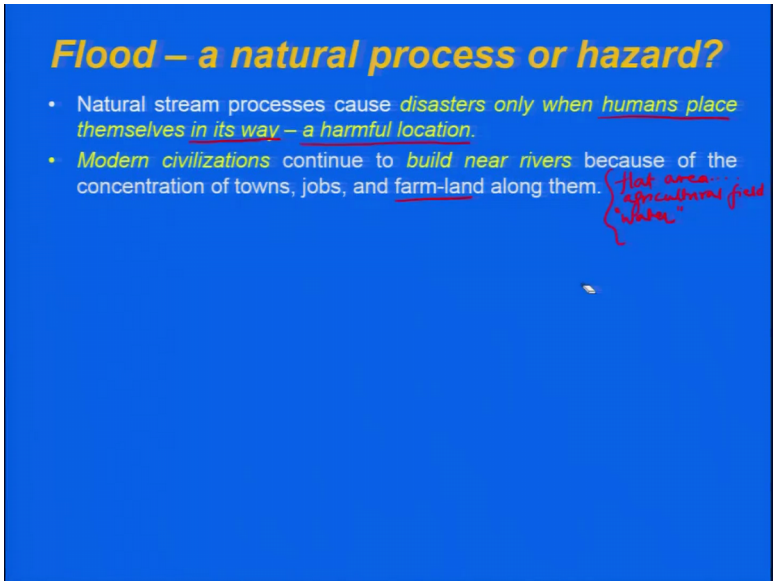

So, floods of course we understand that it is a natural process and it is hazardous of course when it comes to the property and life loss.

Now, the most important part is that if humans place themselves in the way of the river or the drainage system, then it becomes harmful and we have tendency in selecting in most of the cases the locations, which are harmful from floods. The reasons are for example modern civilization continued to build mostly near the rivers and this reason is because of you will get one of the flat area.

So, there is no need of modifying it much for getting the agricultural fields mainly for farming and of course you will get the water which is one of the important source or you can say resource for the settlement.

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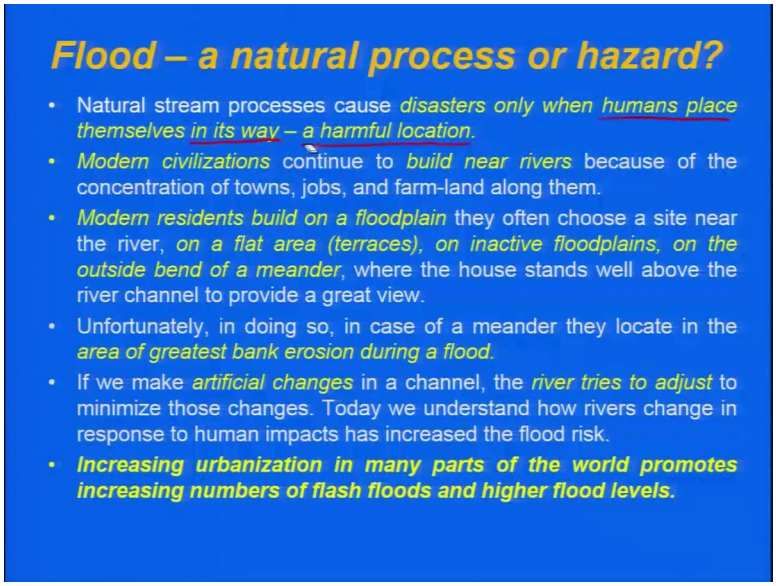

Then a location which has been taken up for building up the residential areas mostly we look at that if it is in flat area which are also termed as terraces.

So, terraces are mostly what we see if you are having in channel bed like this, then over the time you will find the formation of the terraces. So, you we are we are very much keen in having the flat areas and we will try to construct the regions close to the river riverbed or we try to look at the regions which are inactive in active floodplains on outside bend of the meander also. So, if you are having the meandering channel like this,

then you are having the outer bends. Usually what you find is the cliffy banks and you will have a higher location or the area or elevation as compared to this side.

So, people try to have more of construction over here. Now we know that this is good because the houses will stand well above the river channel and will provide a great view of the river valley, but in doing so what we always forget is that that in case of the meander that is an outer side the area is under erosion. So, it will keep eroding this during the heavy flood and this example we have discussed in the beginning in case of the Uttarakashi flood.

I have a slide which we will talk later. So, to protect the regions from floods what mostly we do is we do some changes that is not natural, but artificial changes, changes by humans. So, we do the artificial changes and the channels or the rivers have tendency to adjust, but they will adjust to some extent only.

So, these changes will not be very prominent, but they will try to adjust however we have seen that even though we have done the changes artificially in the river channels, they have reduced the flood risk to some extent. So, in the increasing urbanization in many parts of the world they will promote one is the higher level of floods and in most of the cases what we call is the flash floods.

So, these urban floods are mainly because of the heavy rain and inadequate drainage outlets. So, this can also play an important role.

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This is mostly the seasonal phenomena or the hazard and since it is seasonal the data which we have is a large amount and this can be predicted.

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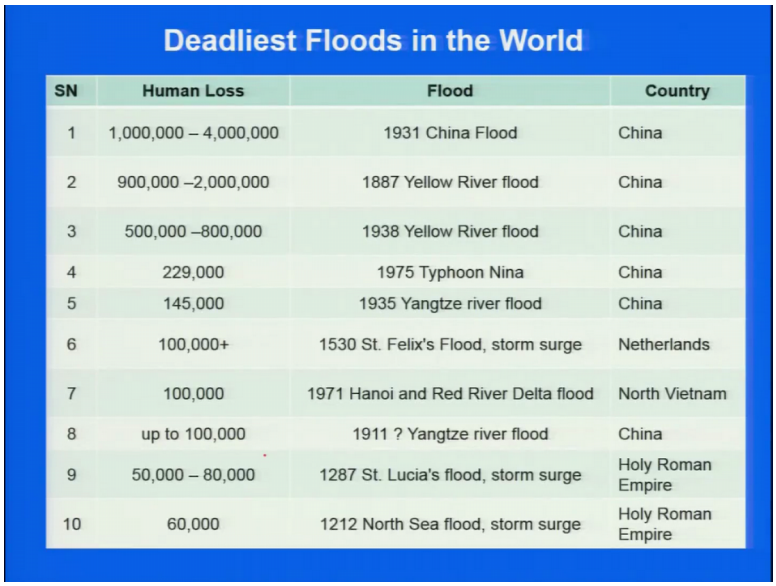

Deadliest Floods in the World

SN	Human Loss	Flood	Country
1	1,000,000 – 4,000,000	1931 China Flood	China
2	900,000 –2,000,000	1887 Yellow River flood	China
3	500,000 –800,000	1938 Yellow River flood	China
4	229,000	1975 Typhoon Nina	China
5	145,000	1935 Yangtze river flood	China
6	100,000+	1530 St. Felix's Flood, storm surge	Netherlands
7	100,000	1971 Hanoi and Red River Delta flood	North Vietnam
8	up to 100,000	1911 ? Yangtze river flood	China
9	50,000 – 80,000	1287 St. Lucia's flood, storm surge	Holy Roman Empire
10	60,000	1212 North Sea flood, storm surge	Holy Roman Empire

These are few deadliest floods and the flood in the in the world which has taken in terms of the life if you see is almost like 1000 or maybe 10 lakhs up to 4 lakhs people were being killed in 1931 in China and so on. If you can see down the list and different countries mostly this example is from China.

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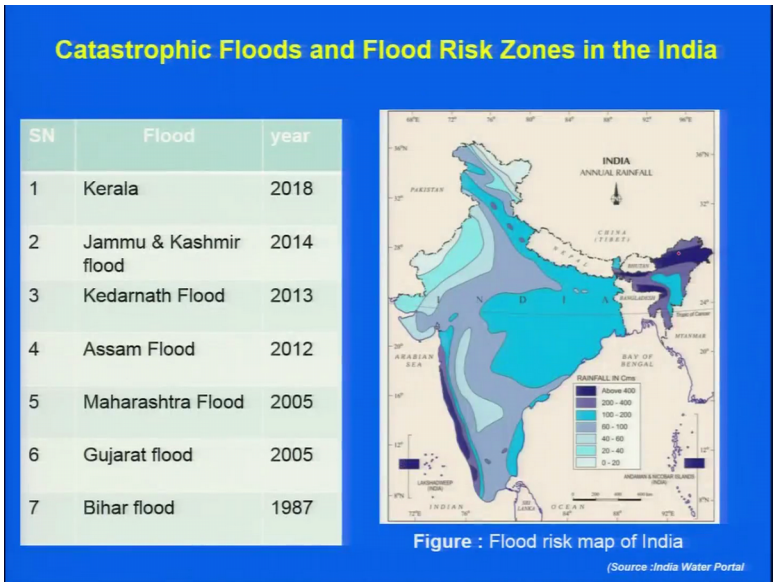

But of course, from India if you look at then what we have is the Kerala flood in 2018, Jammu Kashmir in 2014, Kedarnath flood 2013, Assam flood 2012, in Gujarat 2005-2006, Bihar 1987. There was another flood in Bihar recently which is not been listed here, but that resulted into the shift in the channel of land.

So, we very well understand that what is the rainfall pattern in India. So, here we have mainly the northeast region which sits in the zone of very heavy rainfall whereas, the west coast of India. So, what is expected that most of these regions which are falling in the region where we are having even being the rainfall which is given in centimetres around 100 to 200 will be affected during the monsoon season.

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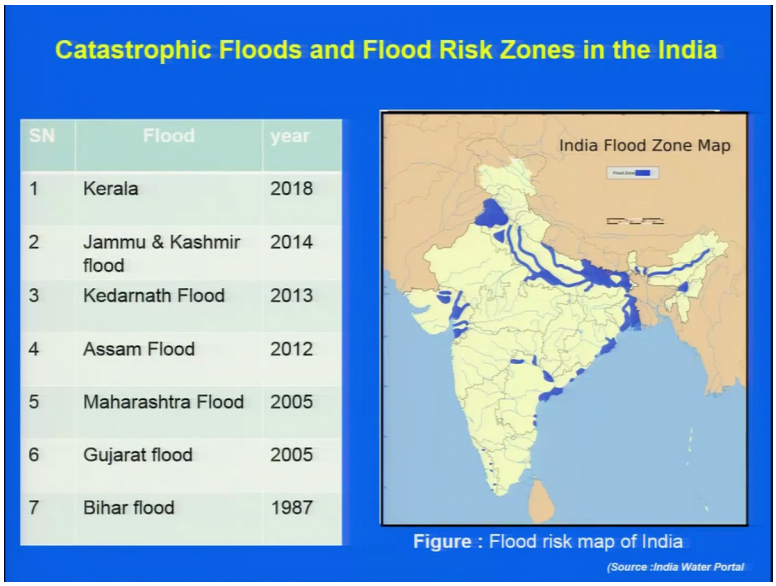

So, these are the regions which have been getting affected in last couple of years mainly Gujarat, then North-West part of the Indo-Gangetic plain and of course, this is the the Ganga river and Brahmaputra which is coming for here. Of course, the floods are affecting the Bangladesh area also, but this mostly this region is getting affected because of heavy down pouring of the rainfall.

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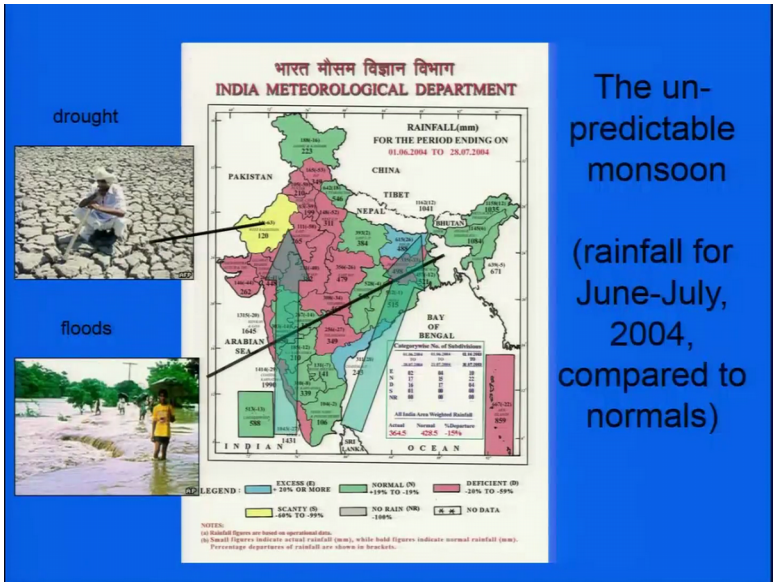

Some places that is quite erratic and again we see that for example in Bangladesh in the East we are having the flooding state in most of the other time in during the monsoons whereas, here it still remains dry that is Rajasthan area.

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This is in photograph which was taken from the Uttarkashi flood which affected in 2012.

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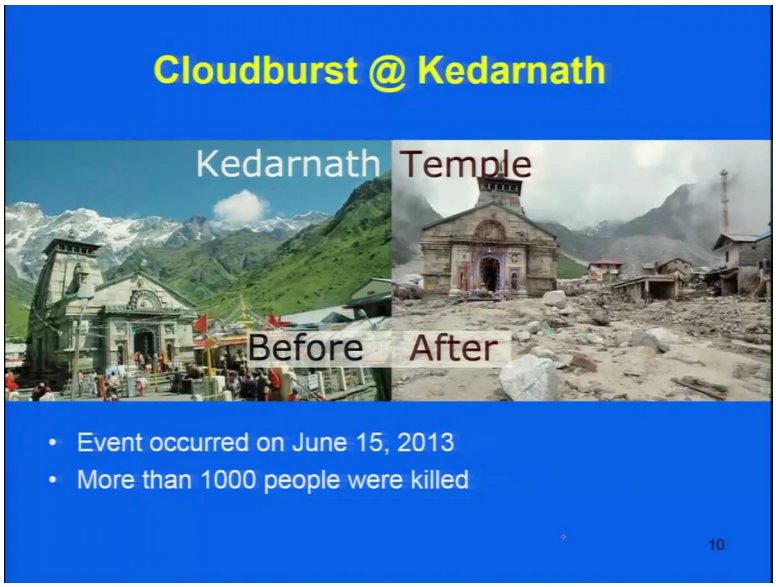

It is Kedarnath which shows the picture before and after and this was mainly because of the cloud burst. This happened in 2013.

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So, mainly the debris flow from Uttarkashi. Now in the one of this slide which we were talking about that we can go for a change of channel or we can do changes, that is an artificial changes in channel. This can be done mainly or this we do mainly for the to control floods, but as we were talking about that the location we choose for urban settlement is not correct and this is one of the example which you see here from the Uttarakhand from 2013 floods that most of the houses which were sitting of course on the on the floodplain area got affected.

So, this is what is here is the older floodplain, this portion here and the houses which are being constructed are on the older floodplain, but the down cutting of the rows of bank in this if you see the channel here if you take this is right now in the erosive mode which resulted into the cliff collapse and damaged or collapsing of most of the houses was mainly because of the downward cutting of the cliffs.

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Another example and as I was talking about the terraces and the meander let us put the line here this I discussed earlier also, but quickly we can we can talk about this ok. So, this is the cliff here and this is what we experienced the erosion. So, down cutting again the channel is meandering. So, the outer curve of the channel, so this is this portion will be having erosion, hence the down cutting has resulted into the land slip and you can see the hanging houses on those.

So, this is another disadvantage of putting the houses without having proper understanding of the river dynamics.

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Another clear photograph of that. So, undercutting of the cliff areas. So, even though we are sitting at the higher level or the height where the flooding waters are not reaching here, but because of the erosion along the bank resulted into the collapsing of this cliff and the houses which are sitting are just temple down.

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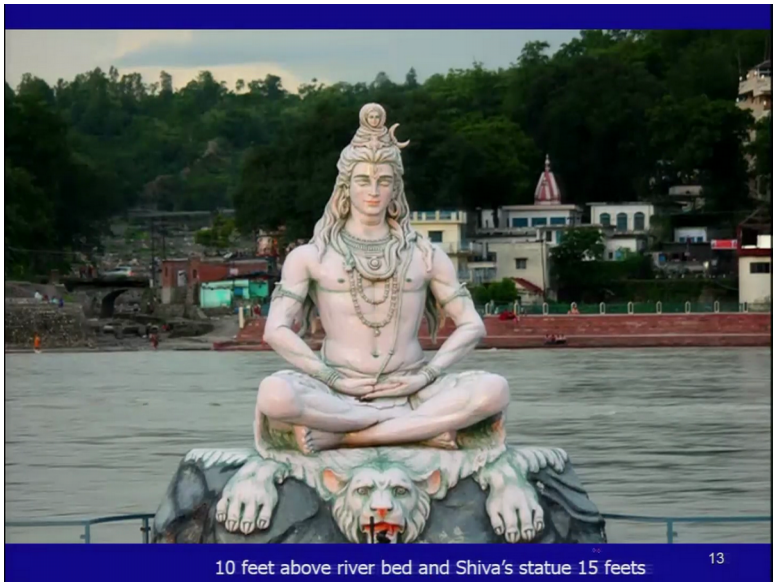

This also we discussed very quickly we look at the water level.

So, 10 feet above this statue has been around 10 feet about the riverbed and then Shiva statue itself has 15 feets, ok.

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So, the total height comes almost like 20 to 25 feet, but this was submerged. So, you can understand that what may be the water levels once the channel is in the flooding state.

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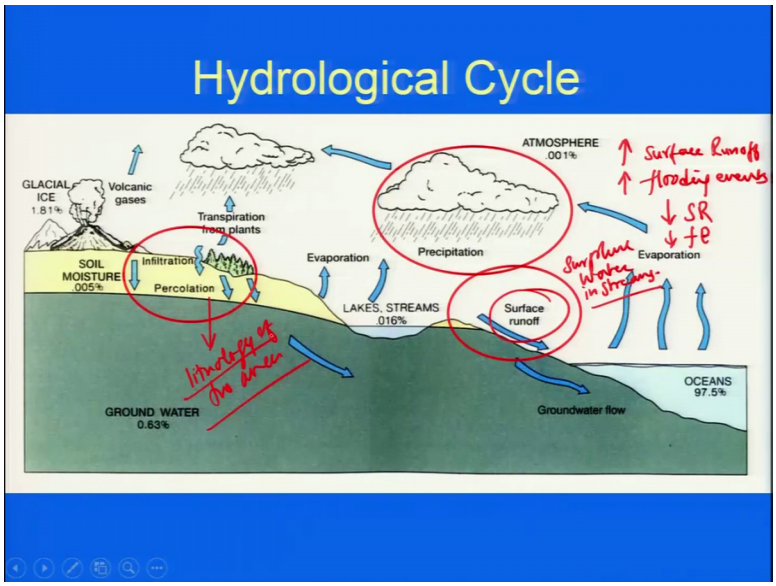

So, to understand the overall river dynamics and the processes which are interlinked, we need to have the understanding that what is the amount of precipitation we have that is the rainfall and what is the capability of the soil or the a geology of the area in terms of infiltration and of course, if you are having vegetal covers the infiltration will vary.

If you are having barren surface, the infiltration will vary and if you are having an concrete surface, the infiltration will vary and this particularly the infiltration will or is going to affect your surface run off. So, if you have less surface runoff, then chances of having the of the higher level of water in the stream will be reduced, but if you are having so, if you are having I would say that high surface runoff will have greater chances of having the flooding events and same will be, if you are having less surface runoff, you will have if you have less surface runoff you will have less chances of having the flooding events.

So, this is important to get the surplus water in streams and this of course will depend on the lithology of the area.

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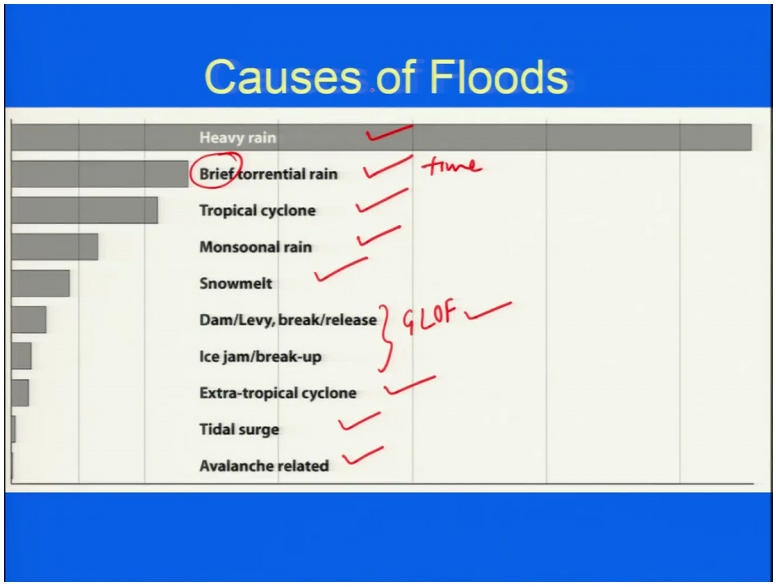

So, in one of the slide we also discussed the causes of flood of course is your heavy rain, brief torrential rain. There is briefest we are talking in terms of the time, then tropical cyclones. Yes we have we experienced in most of the areas in the coastal zones monsoonal rain that is very heavy rainfall which is linked again with the at the monsoon season, snowmelt dam and levy break and release ice jam breakup and as we were talking about that this is this could be related to your also a glacial lake outer outburst flood.

And then we have extra-tropical cyclones, tidal surge avalanche related. So, these are few examples which we should remember that this may be these are the causes for the flood.

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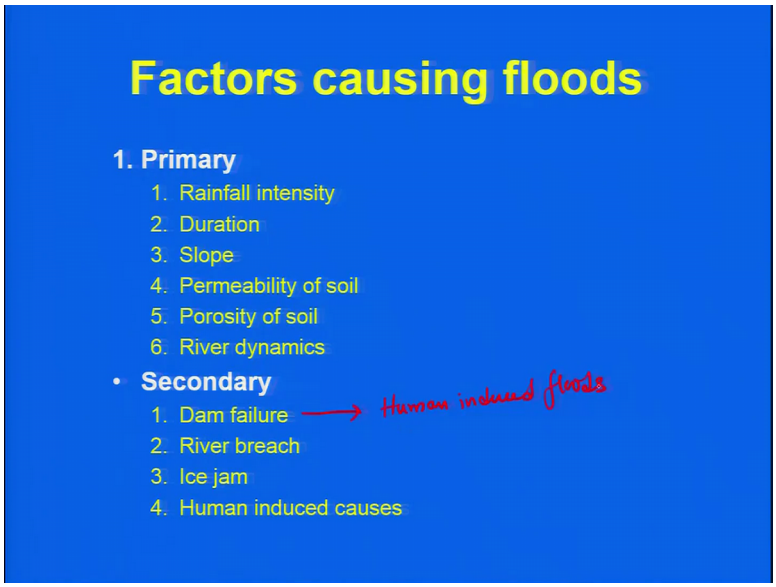

Flood factors similarly the primary are your rainfall intensity, duration, slope, permeability of the soil, porosity of the soil, river dynamics, then secondary is your dam failure, river breach, ice jam, human induced causes. So, these also can be considered as human induced flooding events.

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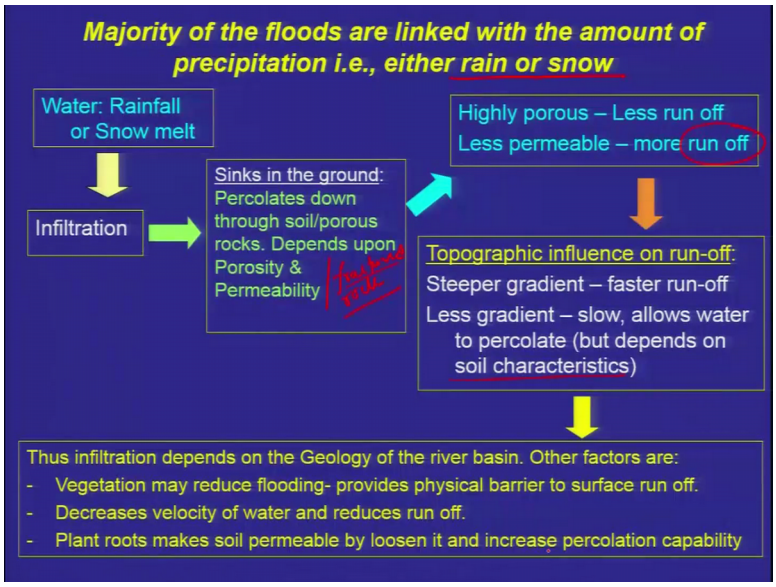

So, majority of floods are linked with amount of precipitation either in from the rain or snow.

So, water either from rainfall or snowmelt infiltration is extremely important, then this they sink in the ground that is percolate down through the soil. If you are having porous soil infiltration which will be faster, but if you are not having the permeability or the soil is not much porous, then you will have more of runoff. So, this depends on the porosity and permeability of the material. It is not only the loose material, but if you are having fractured rock surface can also allow the infiltration faster.

Then highly porous what you will see is less runoff, less permeable, you will have more runoff and as we are talking about that runoff is going to play an important role and this will be controlled by the type of material which we have. Other than that we have topographic influence on runoff.

If you are having steeper gradient faster runoff less gradient slope, it allows the water to percolate, but again depends on the material characteristics because the infiltration depends on the geology of the river basin. Other factors are one is vegetation may reduce flooding because this provide physical barrier to the surface runoff, decrease velocity of the water and reduce runoff plant roots make the soil permeable by loosening it and increases percolation capacity. So, these are very trivial we feel the factors, but they are very much important. So, I will stop here.

Thank you so much. We will continue in the next lecture.