Laboratory Practices in Earth Sciences: Landscape Mapping

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Welcome back. So, in the previous lecture we talked about alluvial fans and I have explained how alluvial fans are formed and what are the reasons for that and why they are. We have high hazard closer to the proximal part and less hazard or the lower hazard at the distal part. So, this is another example. So, this portion will have the proximal part will have higher hazard, the middle part will have moderate and the lower part will have lesser hazard. This photograph is again the corona satellite photograph and as I said that even if you go to the Google earth image you will find these features very prominently seen, but here there is again the foothills zones of Himalaya and you can clearly see what we have discussed. So, the channels are having very confined flows here and as soon as it is debauching into the alluvial plain areas then they are becoming unconfined with having multiple channels here.

So, these are all alluvial fans. So, this you are having one here going another one this is what we call coalesced alluvial fans. So, you have multiple fans here, smaller ones for the smaller rivers and then. So, mainly you can see here.

So, this is the out the front we can say this is the demarcation geomorphic boundary here between the hills and the alluvial plains. So, this is your endokangetic plain and this is your sub Himalaya or you can say Sivalik. So, amongst the mountain chains on Himalaya this is the youngest one which is close to the endokangetic plain. So, this is the again as we have talked about that the change in the gradient will allow the formation of the alluvial fan. Now, this is close to the water body again there is a change in the gradient here and this again a very similar landform what we call the alluvial fan.

So, you are having the alluvial fan deposit here and this portion has also been termed as pediment or we can say the pediment zone. So, this is what we are having the pediments or pediment zone. So, a sloping surface at the base of the mountain formed due to erosion covered by a thin winner of alluvium ok. So, alluvium is a loose material or river driven material. So, this is an example of that which you can see that this is the area where you are having the debris slope and the material alluvial material will be deposited here this has been termed as the pediment and also termed as the pediment zone.

So, the area of deposition developed adjacent to the Himalayan foothills or any foothills

ok mainly by the stream debauching into the endokangetic. This is the case we have talked about the Himalaya and endokangetic plain and they will have the cores or debris close to this. So, this has been termed as the pediment zone. Now, again this is an example where you are having the central Himalaya where you are having Halduwani here and this is the the area where you go up to the Nenithal looking. So, again you can see very clearly that there is a not confined flow here and this is again I am using the Google image ok.

I am using the Google image here and this is all what we see here is the major fan. And this is also been termed as because this channel which is flowing here is the Gola river and this is been termed as Gola fan. Now the last landform which is the major one of the major landforms is again very similar to fan, but this is not forming at the base of the foothills. This usually forms where it goes and meets the river goes and meets the ocean or ends its journey and meets the water body or maybe an ocean we can say. So, when a stream enters the standing water body you can say of the sea or a lake also ok.

Its speed drops rapidly, its ability to transport the sediment decreases very much similar to what we were talking about the alluvial fan. So, this will again be having a sort of a distributary that what we have we initially discussed about that if you start from the source area then you are having the tributaries then you are having a trunk stream then finally, you will have the distributaries ok. So, this will have a distributor here ok. So, a fan delta typically is built adjacent to the mountain fronts and the braid delta is a coarse grain delta constructed by a braided stream that builds outward into the standing body of a water. So, for example, one is the braid delta and as we have we talked about that the braid delta will have a coarser bed load ok.

And this one which has been shown here is a typical name as in bird foot delta. The reason is again if you carefully see this is very typical to the shape of the bird foot ok. So, these are basically the fine grain, but this will be the coarse grain braid deltas. Now, one of the best examples of what we have is your Ganga Brahmaputra delta in India and that is one of the largest ok. So, if this is an example of the stream getting into the water body depositing a delta and the term which has been coined ok.

The delta as we were talking about the fan and all that the delta is again a Greek term and it comes from because it is in the shape of the triangle and that is the reason why it has been termed as delta ok. So, as I said, this is one of the best examples we have in the Indian subcontinent. So, you have in Ganges and this is that both the river meets here like Ganga and Brahmaputra and that is the reason why this has been termed as Ganga Brahmaputra of delta. So, this is one of the I would say the largest delta ok like covering almost 1 lakh square kilometers and the area which has been covered here is the Sundarbans region ok. Now, one more example which I would like to discuss here is that about the active fan and

this comes from Bihar actually ok.

So, this is what you see is the Himalayan front here. So, you have Patna here. This is the alluvial plains endocan citic planes and there is a very sad story about this river that is Koshi river. So, if you carefully look at again what we were talking about, that you are having confined flow then you are getting unconfined here ok. This is the active channel now, but the fan goes like this ok. So, the fan boundary is somewhere over here and if you see the close up of this one then you have multiple channels which exist ok.

Now, these are all its older channels ok these are all older channels which you see and this river has a tendency. So, you can see there are a lot of meanings which are meaning channels which are seen here ok. So, this one is the present day course of the channel. So, you are having like braided channels and a combination of the straight and the meanders which we have seen here ok. Now, this channel that is Koshi has a tendency to reoccupy its own channels or own value channels.

Now, what has happened is that with not having an proper understanding people have been allowed of course, as we have discussed in the beginning also that why humans have that tendency to go and settle down close to the river channel and most of our ancient civilizations were also also flourished along the the river channel and one of the the best example is along the Saraswati river and that was your Indus valley civilization or Harappan civilization. Now, here in this case as I said that this channel has and has a tendency to reoccupy its own paleo channels I would say. Paleo is an ancient or older channel. So, we term this as in paleo channels. So, it is trying to occupy that and this type of incidents have happened in the last 100, 100, 200 years that is as per based on the records ok and then people who have experienced that ok.

So, this is as per the record the migration of the channel. Some geologist they believe that this formation of this Koshi fan is been governed or been controlled by two faults subsurface faults that is these are the two faults Begusarai and Bhawanipur faults it may be possible ok, but I and then there are multiple lineaments which are also responsible for the migration that is what their interpretations are, but the the main part which I would like to highlight here is that the shifting part ok and that again poses the hazard ok. So, these are the records in the historical chronicles which talks about that even this if you look at this is 1770 the channel the was occupied along this path here and this is since 1950, 1963 this is the present condition 1933 it was it flowed here ok and recently also it happened that one of the channel which was which got active here ok and many people were been killed because of that. So, and this is also been termed and that is one of the reasons this is also termed as sorrow of Bihar ok because this always gives trouble to the people who are settled in this area ok. Now along with what we have looked at till now is the channel

pattern and now what we are going to talk about is the drainage.

So, let us look at the drainage basin evolution we have already discussed in the beginning, but apart from that we can also use morphometry to understand the dynamics of the fluvial system ok and of course, the drainage pattern will also help us to know the subsurface material or the lithology of the area. So, with fluvial geomorphology we can have the linear aspect of the channel systems ok aerial aspect of the drainage basin we can talk about the channel geometry we can talk about the process domains and integrated hydrology and geology ok. We will try to put like in this course we will try to look at a few of them, not all, but I hope you will enjoy that ok. So, linear aspects of the channels what we look at is the surface area that is your basin area drainage pattern stream orders we will look at ok. We will try to see that what are the and how this can be used for different hydrological purposes and what the what is the what will be the role of the surface area of the basin and the drainage pattern also that is I told in the previous slide that this will help us in identifying the subsurface material what exist ok.

Based on the stream orders and all that we will also do one exercise on bifurcation ratios and why they are important . We will also discuss ok and drainage density again. So, these two will be connected ok like drainage pattern and the drainage density because this depends on your subsurface lithology. So, there are many similar methods which are available. One is known as Teller and the other is Hutton. So, we will use one of them now to categorize the channel or we can say the stream orders are mainly ok. So, these are you can give a number here from 1 2 3 4 5 or so on and then the number of streams you can say that this is the order of the streams ok.

So, first order how many streams are there, second order how many streams. So, this will help you in talking about the bifurcation ratio. So, here what has been shown is that you have the main basin you have here and this is based on the trunk stream ok. And then you have sub basins which have been termed which have been given here with the dotted lines ok these are all your subbasins. Now two first order streams joining at a point and further downstream will give you the higher order.

So, this is how you are going to talk about the stream orders ok. But if the first order stream because there is no other stream joining here. So, this will remain the first order if there would have been another stream which was joining here then this could have become the second order ok. But this remains the first order because there is no other stream joining here. So, this remains again the second order, but when two two second order streams join because there is a bifurcation here.

So, this becomes the second order. So, when two second order streams join, the further

downstream will become the third order and so on. So, you are having the third order two third order joining here. So, the trunk stream will become your fourth order. So, this basin, the main basin, is your fourth order basin.

This is how you are going to talk about the bifurcation plus you will talk about the ordering of the streams ok. And nowadays so, this is for your understanding, but now we have the softwares which is available which immediately gives you the stream orders ok. Now, what we need for that is for the stream order that you have been learning right from the beginning. So, once you will have like you are going to use stereo photos or images and then you will generate Anaglyph and third you will generate DM after that ok. And with this when you give the input of this to your software which you are using the QGIS, you will be able to extract stream order or I would say that you will be going to get the drainage of the area ok.

So, there are steps which you are going to do and then you will follow this for doing this exercise ok. Now, coming to the drainage basin as we have discussed in a number of slides, this is how we are going to talk about this. So, marking the drainage divide keeping in mind the elevated portion that is your ridgeline and the drainages which are flowing in either direction are ok. So, these are flowing, this is flowing in this direction, this is flowing in this direction. So, this is coming into this basin ok.

So, this will become your major or you can say the large drainage basin is the main drainage basin ok. So, this also you can mark here ok. So, this goes like this and then this goes something like over here ok. So, this is another basin which we are having over here. So, mainly based on the drainage divide you will mark your drainage basin which has been shown here that this is the elevated portion, this is your divide and then you are having the smaller streams joining in and the tributaries joining the mainstream here.

So, this is another example of your drainage divide and the basin area. This part we have already discussed. So, I will just go ahead, but this is what we can do and this will help us in understanding the bifurcation of the channels ok. So, you are having the smaller streams which are developing and joining. So, these are getting bifurcated further in the headward side and that is how the basin has evolved ok.

Another landform which is again important is your terraces ok, which represents the older abundant allure flood plains ok. They mark an older relative high water level that means that the river flowed at that point in the past ok and mark it as a step or or a scarp. So, it will mark something like this ok. So, you are having a channel here and this and it can have multiple terraces ok, multiple steps like this.

So, this is what we will see quickly. So, if you are having a flood plain here and then you are having the uplands on the side. So, slowly all channels or the river basins will have the terraces ok and these are also deposition and erosion terraces. We are not going to get into that part, but we will be interested in marking the terraces. So, this becomes the higher surface and this one is the lower surface and we can say that this is what we have the youngest terrace ok. So, mostly we need to understand how many terraces are there in the area and that also helps us in allowing the people to settle down ok.

So, this is another advantage of that ok. Now, for example, if you combine what we are talking about the levees. So, there is a terrace which is sitting here ok. This is a terrace here. So, this is a terrace here and this is in part of the floodplain active flood plain, flood along with the levees here. But during floods peak flood if even this levee is overflown then this portion will be like we can say inundated ok.

So, that is what has been shown here. So, this portion is inundated, but this terrace remains unaffected. So, you need to look at what is the peak flood which has been experienced by a particular drainage basin or a channel and how many terraces are there or exist along the river valley. So, we can also market landforms which helps us in the landscape evaluation. We can evaluate the landscape and we can identify the best areas to locate our citizens ok.

So, with this I will end here. And there are a few more things which we will be discussing about the bifurcation ratio and stream order in the next lecture. Thank you so much.