Geographic Information Systems
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Lecture - 52
Data Acquisition and Raster Functions - II

Welcome back to NPTEL online certification course on Geographic Information Systems. So in this particular session, we are going to see how to analyse various raster functions.

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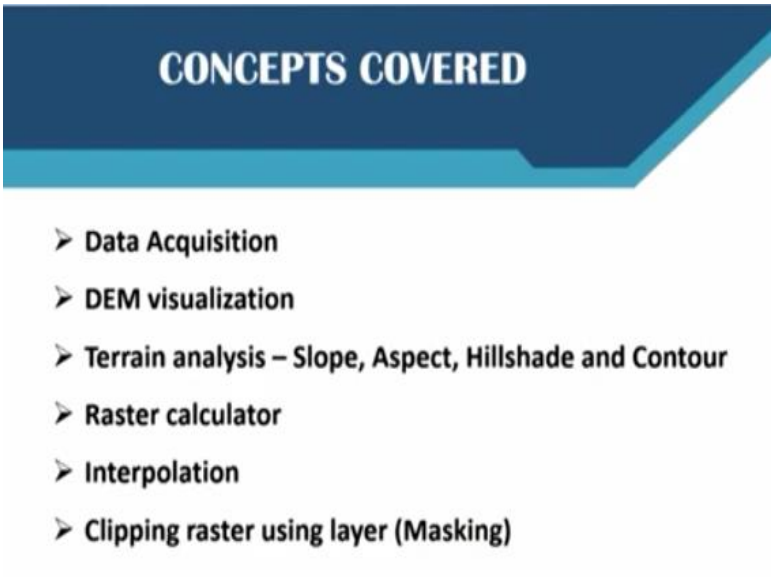

So in the previous sessions, we have seen how to acquire raster data and how to visualize digital elevation model and in this particular session, we are going to see how to analyse this particular digital elevation model, the terrain analysis such as slope, aspect, hillshade and contour followed by raster calculator and how to interpolate vector data and finally we will also see how to clip raster using masking.

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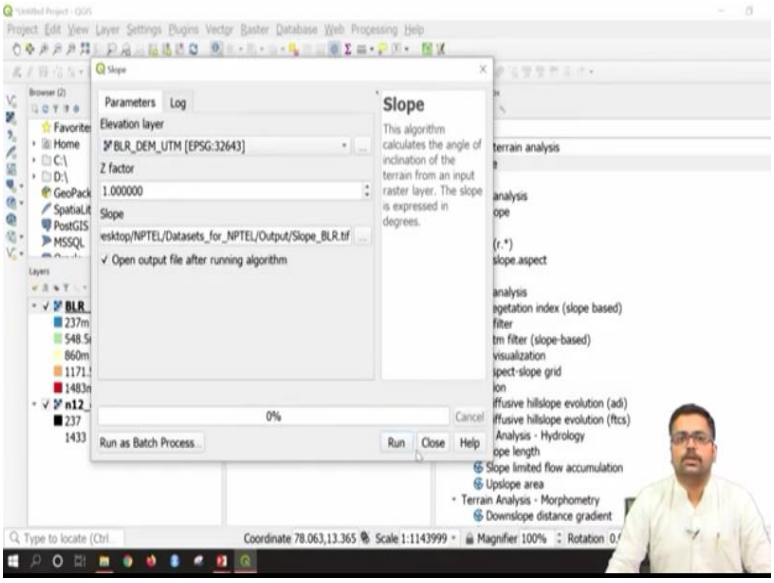

Now let us see how we can do various kind of raster analysis from the obtained digital elevation model. So first we will just go to raster or you can also go to the toolbox here in processing, processing toolbox and search for any kind of queries or any kind of tools or in the earlier session as Prakash has demonstrated, you can also go to QJS plugin and here you can search for terrain analysis feature. Now since this is not connected, it is not showing.

So what you can do is, you can close. In that case, directly you can go to search in the processing tool box. If you want to go to the processing toolbox, it will be in the menu bar toolbox, okay. Once you select the processing toolbox, here you can select for slope. So here under the raster terrain analysis, you have slope, double click. So slope dialogue box will be opened. Now here in this particular elevation layer, by default it is taking BLR DEM UTM.

Please mind that you should not take the earlier DEM, which is in latlong, because all our calculation will be in meters. So it is always better to take in UTM. So Z factor, no need to change and it is asking for slope output file. So here I will browse and I will save to file. I will go to data sets for NPTEL output. So here I can save it as slope, underscore BLR, that is Bangalore, then say save. So once this is given, you can just press on run.

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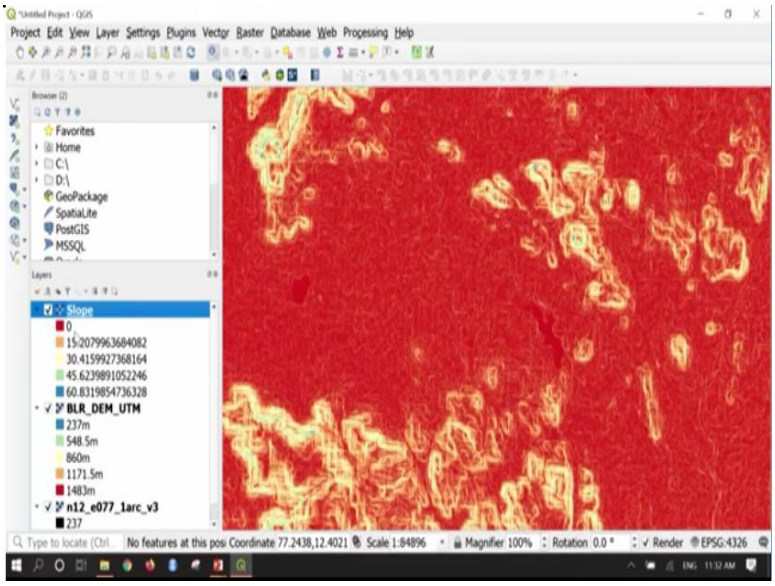

Once the command is finished on to that, you can close the slope dialogue box. Onto the left you can see slope map has come. So this is our slope map. So if you want to see the details of this particular slope map, you can see here it is varying from 0 to 60%. This is in terms of percentage. So if you want to assign some colours, you can also do that by right clicking properties, single band grey, you can give single band pseudocolour.

You can change this, if you want and then say apply and then say okay. So here whatever you are seeing in red, the slope is very less and whatever you are seeing in blue, the slope is very, very high that is around 60%. Now the next task is to understand how aspect works, aspect map. Again, I will go to the processing toolbox.

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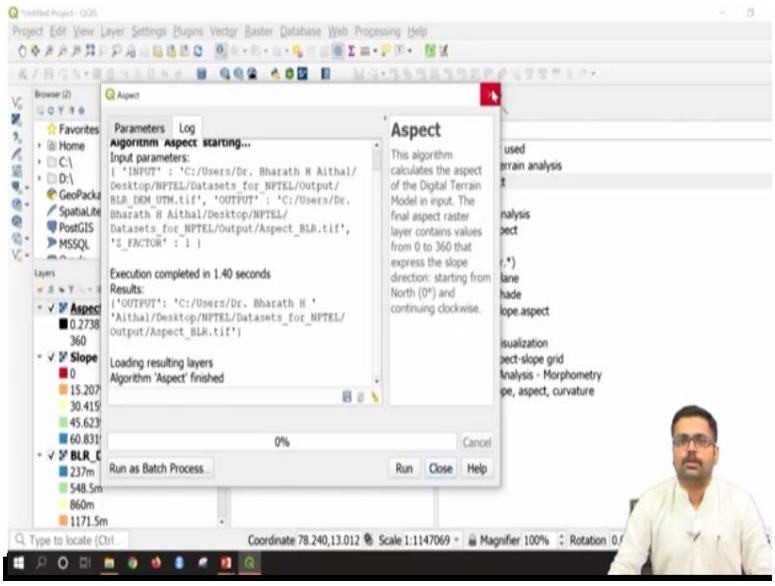

And here I will just select aspect. Here you can see under raster terrain analysis, double click on aspect. Here by default, it is taking the slope map, change this to Bangalore UTM and do not change the Z factor, you can right click and say save to file. So here this time, I will just leave this as aspect underscore BLR. Then, say save. So once that is done, you can say run. Once it is finished, you can close the aspect tool bar.

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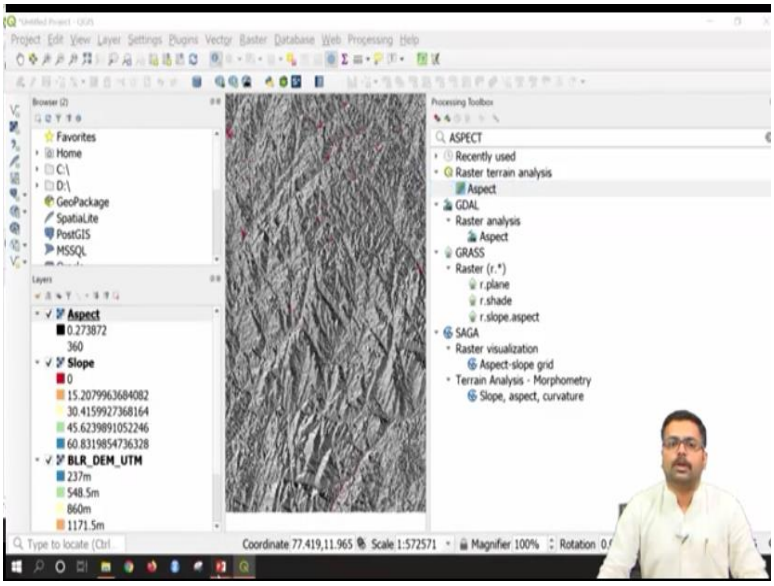

Here you can see aspect map. Now let us understand what is aspect.

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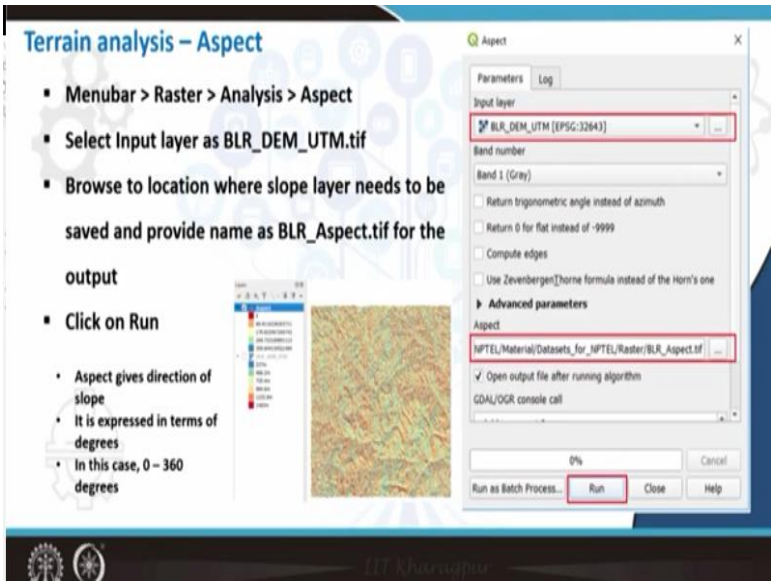

Aspect is nothing but, it is the direction of slope. So it is expressed in terms of degrees, okay. Here the aspect can go upto 360 degrees that means in which direction, whether it is north. North is considered 0 or 360. If it is east, it is 90 degrees. If it is south, it is 180 degrees and west is 270 degrees. Like that, we can identify which kind of direction the slope is falling. So that is about aspect. The next analysis would be on hillshade.

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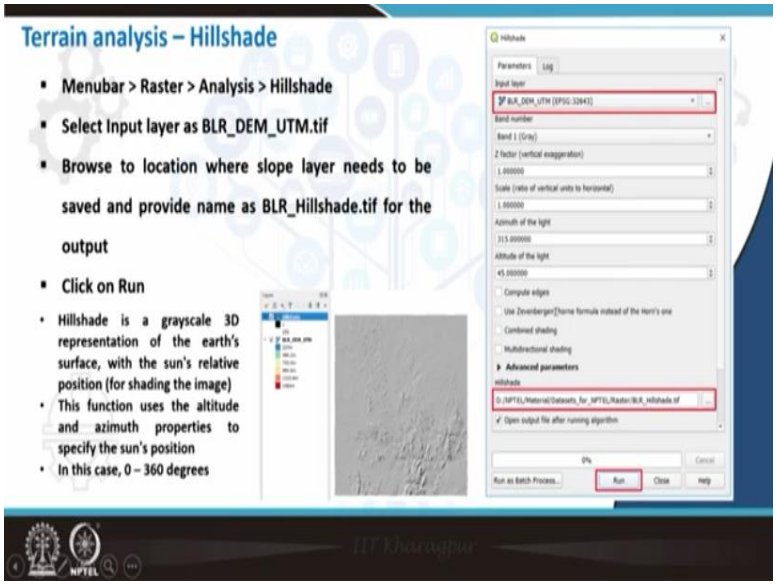

Hillshade is very important if you are trying to run any kind of urban models such as sluth. So here hillshade is one of the important layer. In hillshade, it is grayscale 3D representation of earth's surface with sun relative position. Here we consider sun as a relative position. Now for example, here we have two important properties, one is altitude and the other one is azimuth.

Altitude means at what height the sun is present. It starts from 0 degree and it goes up to 90 degrees.

90 degrees means right on top of your head. 0 degree means at the horizon, early morning or late evening is 0 evening and right in the afternoon, sun is just above your head, that is 90 degree. That is called as sun's altitude. Similarly sun's azimuth means you can consider the entire space as 360 degree at what angle, whether sun is in the north, east, or south to you that you can also specify in hillshade.

So by default, if you see the hillshade, it will be taking the azimuth of 315 degrees that is nothing but the northwest quadrant and altitude it will take 45 degrees, okay. Now let us see in QGIS, how we can do hillshade analysis.

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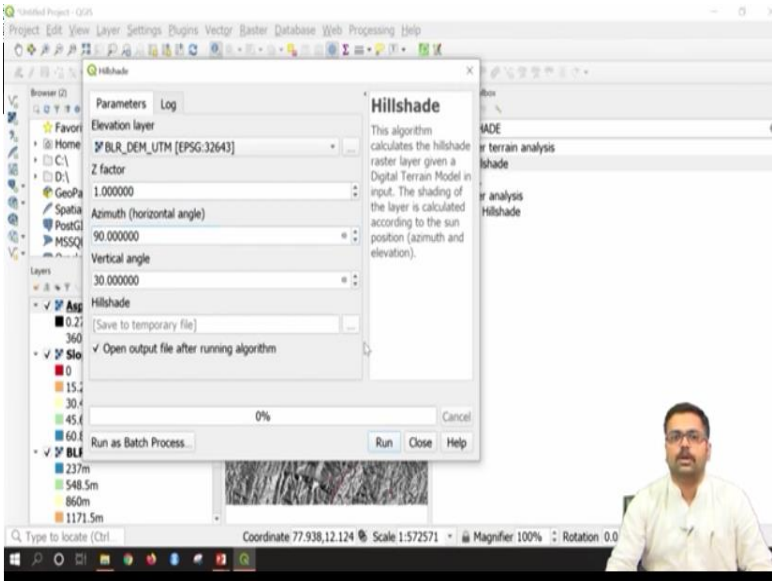

You just have to type hillshade here. So under raster terrain analysis, you have hillshade. This is the hillshade tab. Here you need to give BLR DEM, Z factor is 1, azimuth is 300 and vertical angle is 40. If you want, you can change this. You can put sun wherever you want. Suppose, let us say, I need sun exactly on top of my head. This will be 90 degree. Suppose, let us say I need sun somewhere in 30 degrees, I can give 30.

Azimuth, suppose let us say I need sun exactly east, then it will be 90 degrees. So like this, you can change the angles and check how the output will appear.

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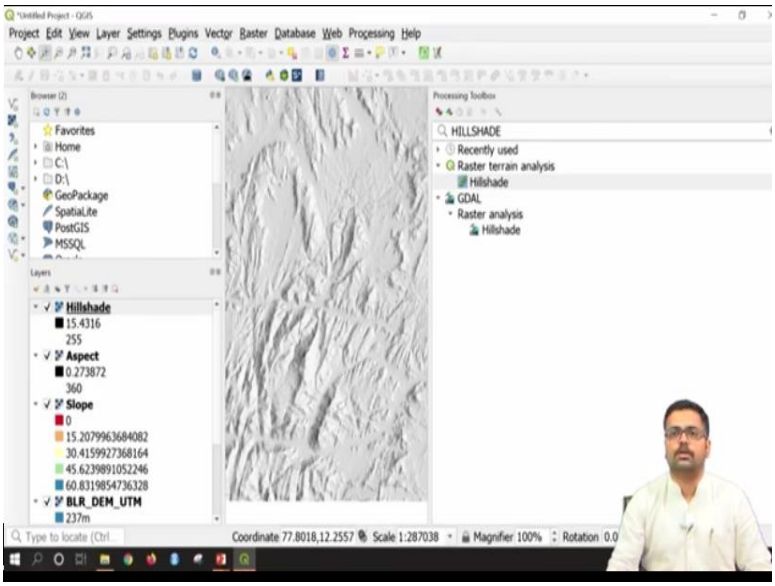

Then, here go to save file and this time I will give it as hillshade underscore BLR, then say save. Once the criterias are given, then you can run. Once the command is finished, you can just close this. Now this is the hillshade map. Now if you want to understand what it is showing, since we have given east, so that means all these areas are blacked out. That means, these are all some kind of depressions and you can see various colour representation here.

That means, the sunlight is falling from 90 degree and at an angle of 30 degree. So this you can change and see. Also, you can change the colour as well to visualize it properly. Now I will close this.

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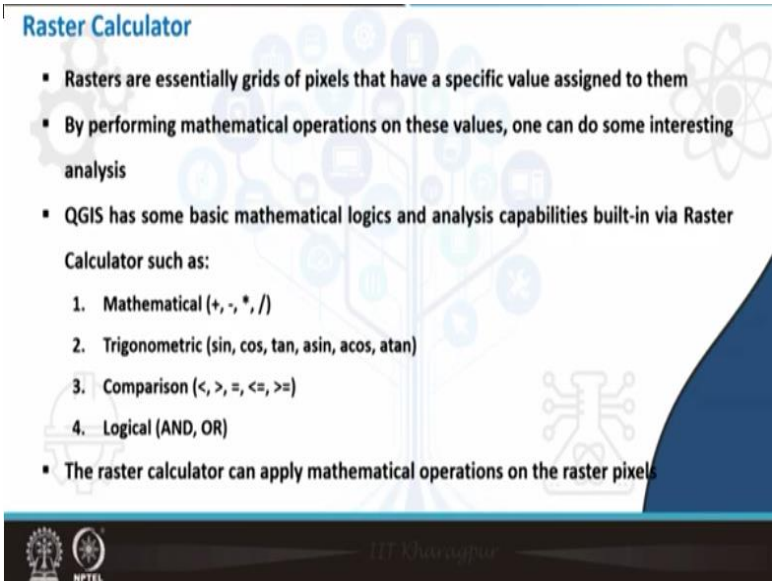

The next set of task, which we are going to perform will be raster calculator. How to use a raster calculator? Rasters are essentially grid of pixels that have specific value assigned to them. If you see a raster image, each and every pixel has one particular for that. So first for example, in this hillshade image, if I zoom in to the pixel level and if I take this i tab, that is nothing but the information tab and click on this. So this has a particular value, which is nothing but 195.25.

Like this, each and every image or each and every pixel has its own value. So you can perform various mathematical operations on these pixels to see some interesting results. QGIS has some basic mathematical logic operators and other operators, such as mathematical, if you take; it has addition, subtraction, multiplication, division. If you take advanced calculations, such as trigonometric operations, sine, cos, tan angles can be given.

Or if you take comparison, you can mention whether a pixel is lesser than 30 meter, whether a pixel is greater than 30 meter something like that and if you want to perform any logical operators, you can also perform that using and, or command, something like that.

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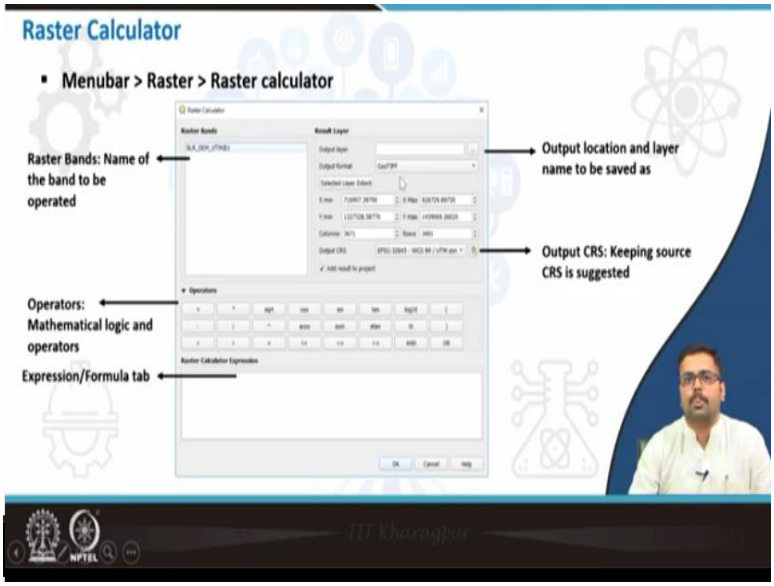

So once if we give the raster calculator tab, I will just demonstrate you that. So this is how the raster calculator tab looks. Here raster bands, this is the input which you need to give. Basically, we will give the DEM. Then, output layer, we have to save it as a new layer. You have to give a new name and then you have the extents and coordinate reference system, you can keep it as such. By default, it will be whatever you give for the UTM DEM.

Then, here you will find operators, all the mathematical, logical operators you can find it here and finally the expression tab. This is where you will type the formula, whatever you need the formula, you can type it here. Once you are satisfied, you can press on okay.

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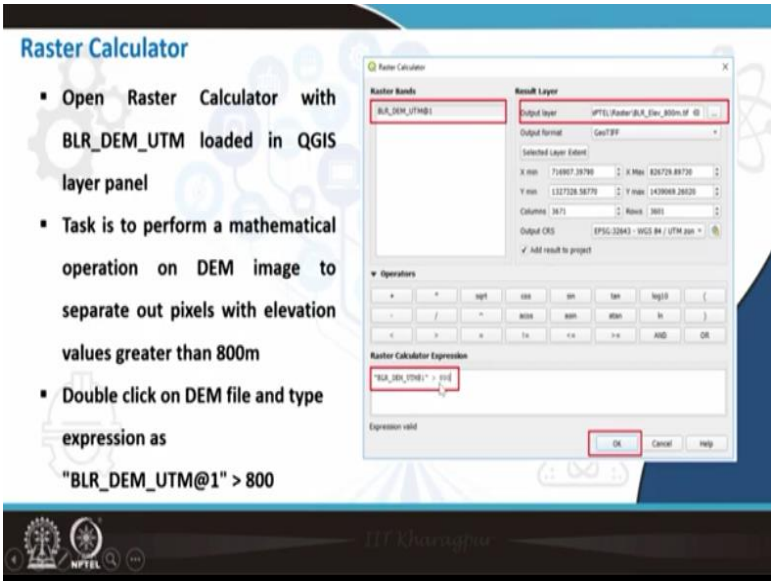

Now let us see one example, wherein we are taking the digital elevation model and let us try to get those pixels, which has elevation greater than 800 meters. As we already saw in QGIS, I will just, for the convenience sake, I will close this particular toolbox and I will remove this hillshade, aspect, slope, all these three I will just right click and say remove layer. So now this is our BLR UTM that is nothing but UTM digital elevation model.

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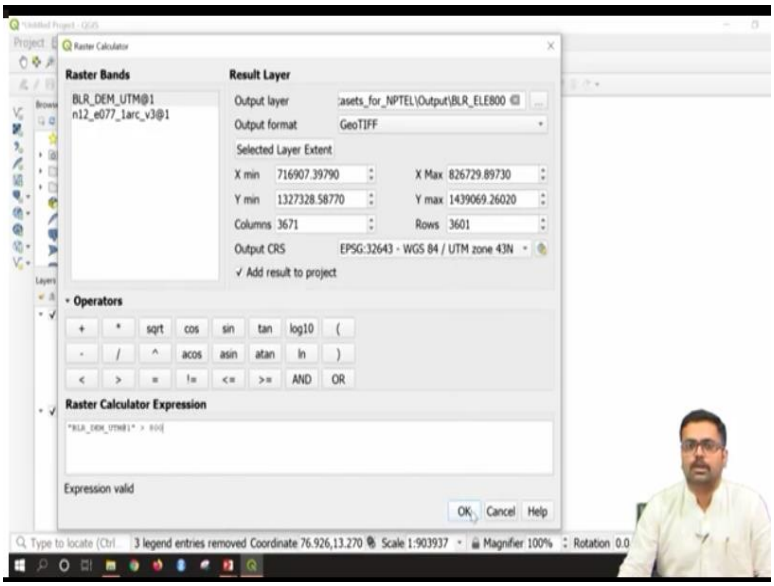

So now let us see how to perform raster calculator operation. I will go to the menu bar, raster, then click on raster calculator. So now it has taken two raster bands here, okay, yes. I want to query or I want to develop one more map, which has elevations greater than 800 meters. So what I will do is, I will select this Bangalore UTM, double click. Once you double click, you can see in the expression tab, it has come, okay.

So in this image, give me the pixels which are greater than, greater than symbol and value 800. So here you can see expression is valid. That means, the output is going to return me only those pixels which has elevation value greater than 800 meters above mean sea level. So I will just go to output layer, right click and then I will save this in NPTEL folder, data search for NPTEL output. So here I am going to save this as BLR elevation 800.

That means, this is the image, which is more than 800 meter elevation. Once, just have to check the coordinate reference system, this is already there in UTM zone 43, no need to change, then press ok.

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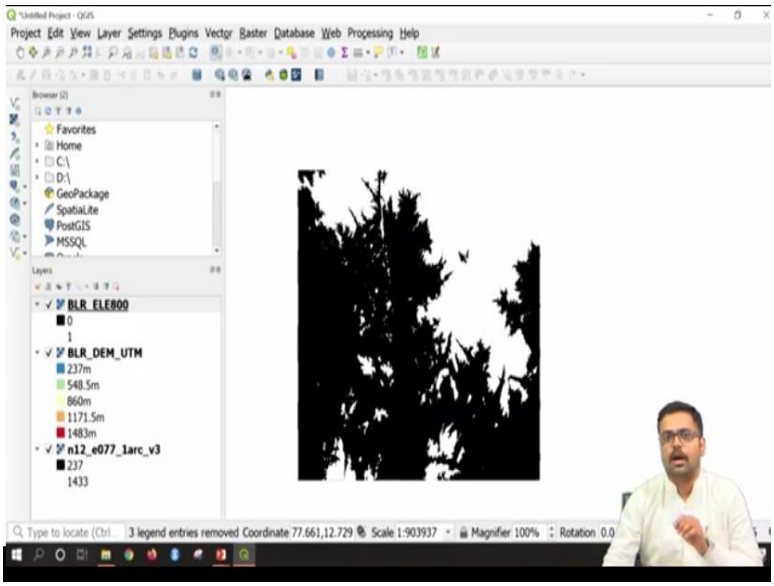

Now you can see a binary image, which is nothing but a black and white image. Here all the 0 that indicates values lesser than 800 meter and all the values with 1 indicates values higher than 800 meter. This is how; you can make use of raster calculator. Like that, you can explore lot of other options using angles, etc. Now let us see what other operations we can perform under the raster functions.

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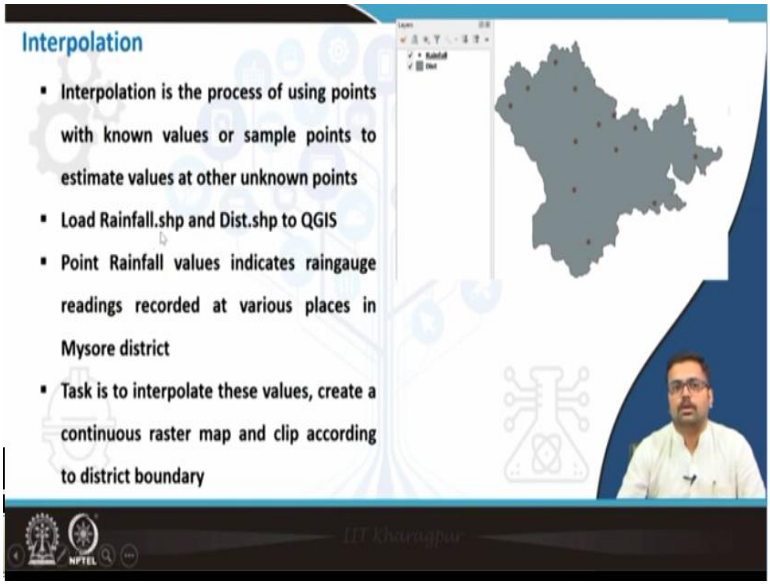

Interpolation is one of the raster operation. It is the process of using points with known values or sample points to estimate values at other unknown points. Now let us say this, suppose we use rainfall data. Rainfall is point data. Similarly, it may be a temperature data or it may be humidity data or anything else. All these are point data that means here on to the right you can see, I have taken Mysore district shape file, that is the polygon and you have point data.

So these are the points where you have raingauge stations. So now if I want rainfall at this particular place, let us say. I do not know what is the rainfall here? Because there is no point data. So I can interpolate. That means, from the already existing points, I can project for the entire district and see what is the rainfall. So you need to load rainfall shape file and district shape file to QGIS. So let us straight away go to this. At the end of this particular task, I will also show you how to clip data according to Mysore boundary.

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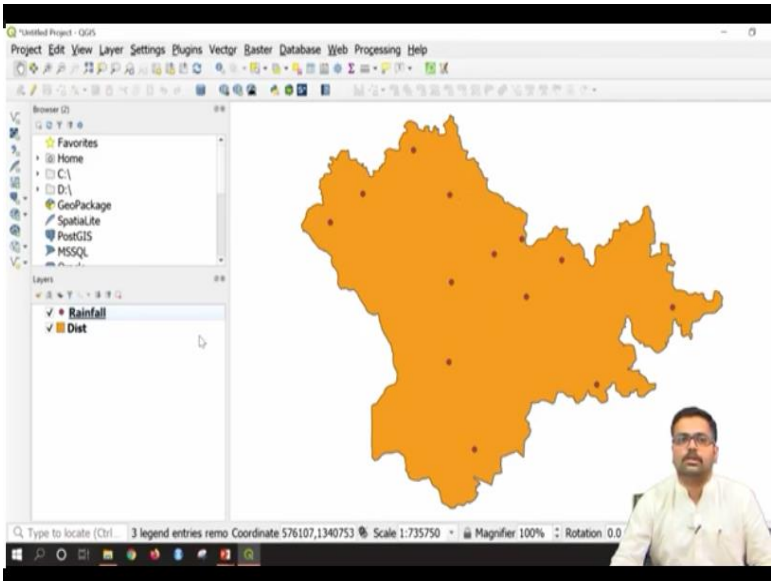

So here, I will go to project and I will say new project. I will discard this or if you want you can also save this. As of now, I will discard. So now let us try to add vector layer. You can go to layer, add layer, add vector layer, browse. So here I will go to NPTEL data sets vector. I will add district, that is district boundary shape file and then I will add rainfall that is rainfall point shape file. This we have already seen in our previous lectures.

I will say add, so once you give add, it will be added to the QGIS interface. I will just pull this district down. So now you can see these are all the raingauge stations and this is the district. So now let us directly interpolate this particular point file. To interpolate, you need to go to menu bar, raster, so here in the analysis you can find all the, whether it is aspect or hillshade, whatever we did in the previous sessions.

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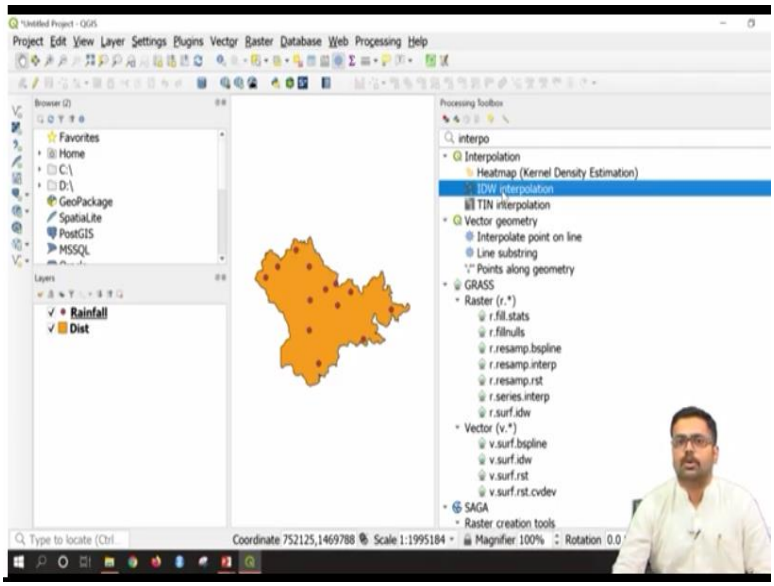

If you do not find interpolation in this particular raster menu, you can either go to plugins and manage and install plugins, search for interpolation. Again, if you do not get it here, alternatively you can go to processing toolbox. So here, just like we search for slope, hillshade, etc., you can also search for interpolation. So here under interpolation, there are three different kinds of interpolation.

As of now, I will stick to IDW that is nothing but inverse distance weight interpolation method. Inverse distance weight means from a point if the distance is more and more, then its weight becomes lesser and lesser. You are closer to the point, your interpolation values are better. So that is called as IDW interpolation. I will just double click. IDW interpolation tab opens.

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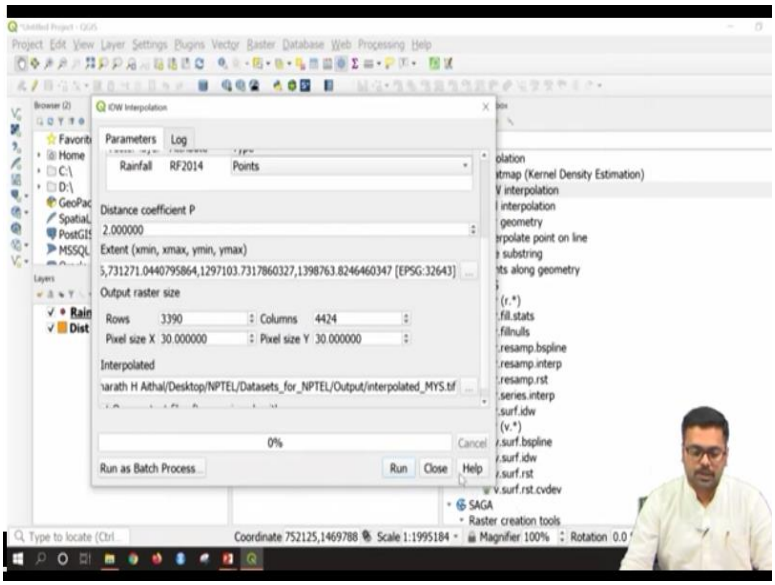

So here, what you can do is, under the vector layer, you can select rainfall, because we are going to interpolate for rainfall values. Interpolation attribute, I will take it for the rainfall 2014, for the year 2014 and then say add. Here, there is input layer add button, press on add and once you come down, here it is asking distance coefficient too. I am not changing it. I am keeping that default. Then the most important thing is, here you need to set the extents.

What I will do is, I will set the extent to our Mysore district shape file layer. So here, I will say use layer extent and this is district and say ok. So now it has taken the district extents and here one more important thing is since we are using the digital elevation model of 30 meters. So you need to maintain the pixel size as 30 by 30. So pixel size X and Y both are 30, then interpolated map, I am going to browse this, save to file. Here I will say interpolated underscore Mys.

That is interpolated map for Mys and then say run. Now once this algorithm is completed, we can see the point data has been transformed into a raster. The vector has been transformed into a raster map with all the values. Wherever you need to see values, you can just zoom in and query that particular cell. I will close this tab. So this is our interpolated map. I will close processing tool bar.

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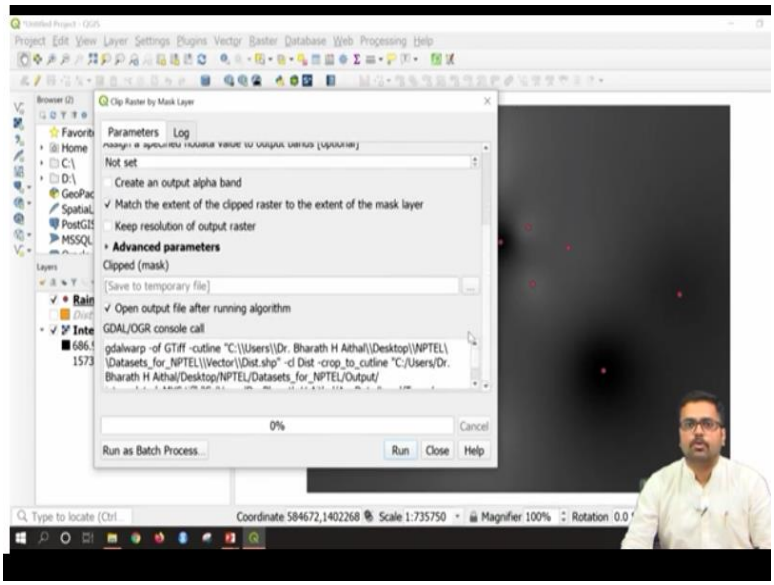

So now if you want to bring points on top of this, I will just pull this interpolated map down or we can also pull this rainfall to the top, yeah. Now you can see the points and the district. I will just turn off the district, so that I can visualize it properly. So the next step is to clip this particular interpolated map according to the district boundary. To do that, I will go to raster and here in extraction, you have raster clip by mask layer.

That means you are just masking the layer and you are just extracting that particular information. So input layer will be interpolated map and masking layer will be district, that is correct and I will not change any of the other options. Straight away, I will go to clipped file. So here, save to file, here I will give interpolation underscore clip. Once that is given, I will say save and then say run.

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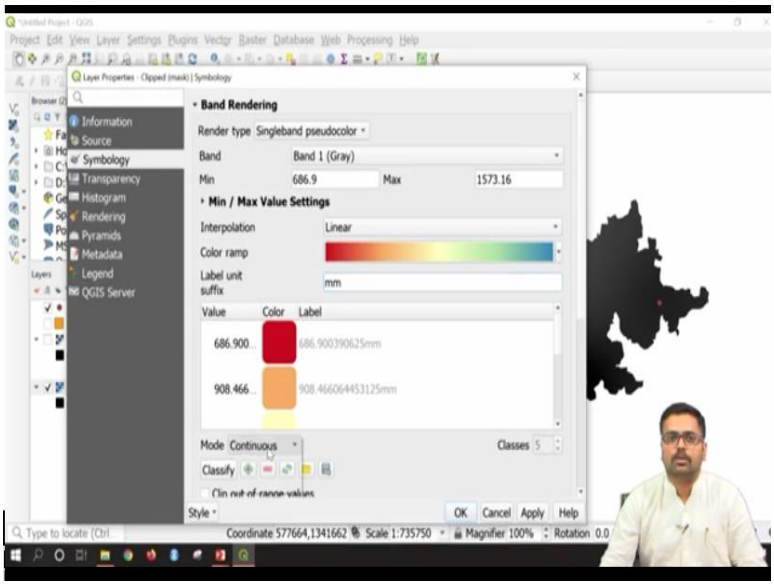

It would not be taking much time. So the clipping operation is done. You can close this. Now I will just turn off this interpolated map. So now you can see, it has been clipped exactly according to our district shape file. I will bring it down, so that you can visualize better. Now the last task is to assign colours for this particular map. So to do that, I will go to clipped; go to properties, just like we assign the colours for our digital elevation model.

I will also assign here taking single band pseudocolour and this may be linear, colour ramp you can select as spectral and interpolation, here the rainfall values are in mm, so I will keep it as mm and you can continuous or equal interval you can take 5 classes, classify and then say apply, ok.

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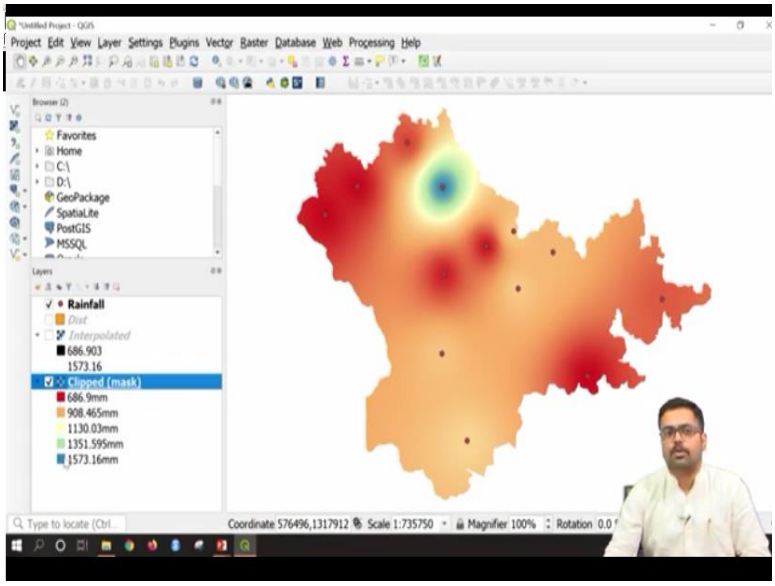

So here you can see our map has now assigned with various colours. Each colour indicates rainfall value. For example, wherever you are finding the red colour, it is having, roughly it is 700 mm rainfall. Wherever you are finding blue colour, it is having very high rainfall that is nothing but 1500 mm. So this is how, you perform interpolation.

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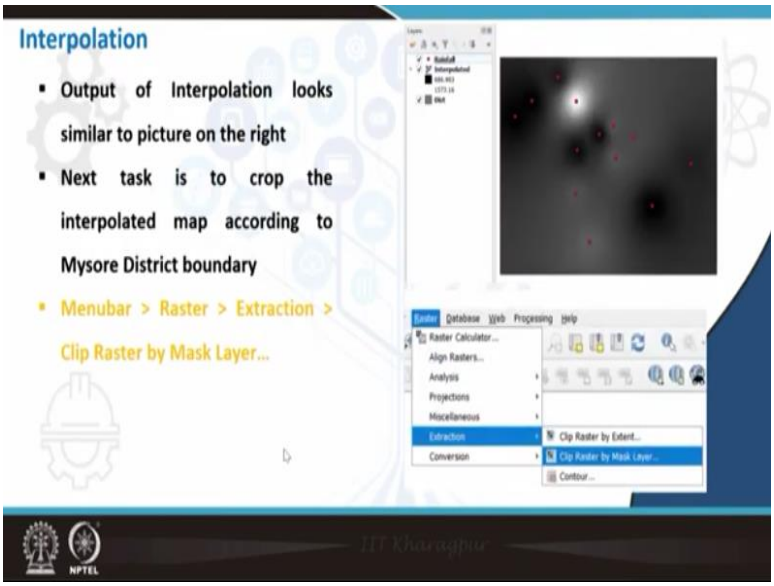

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So we have already clipped according to the boundary.

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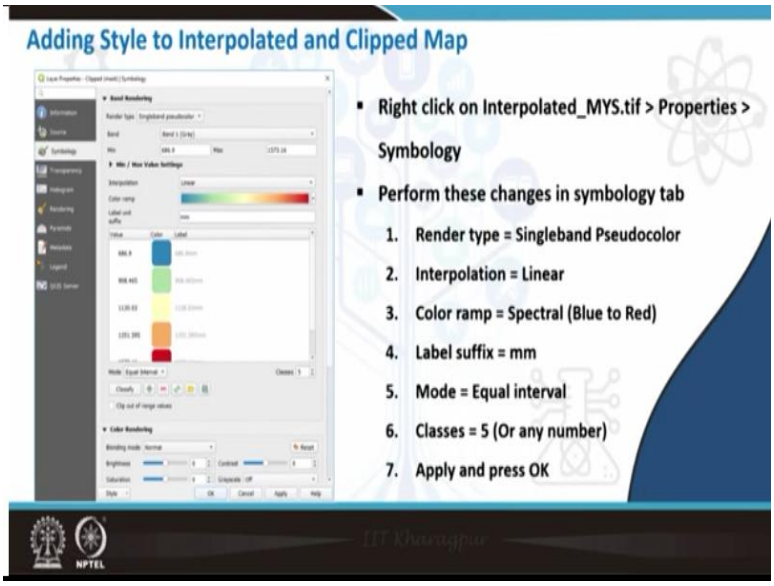

All these are given in the manual. So you can also try with various other combinations.

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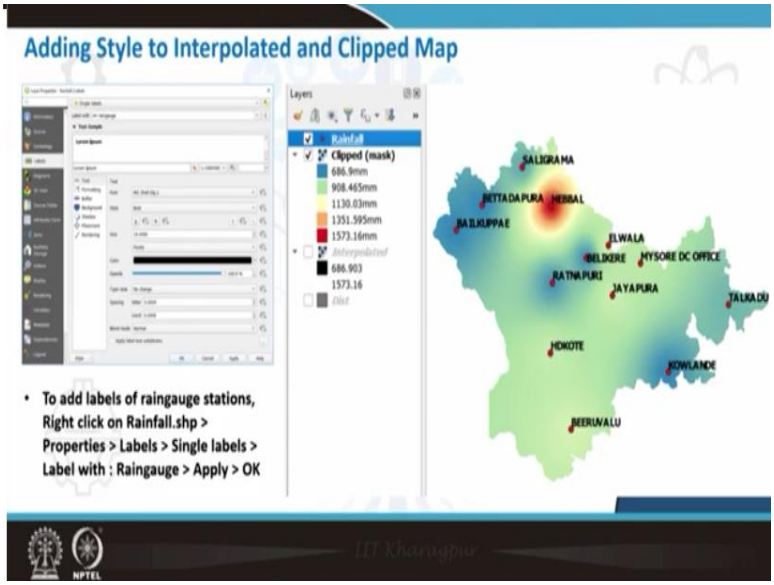

So this is how our final clip map look like.

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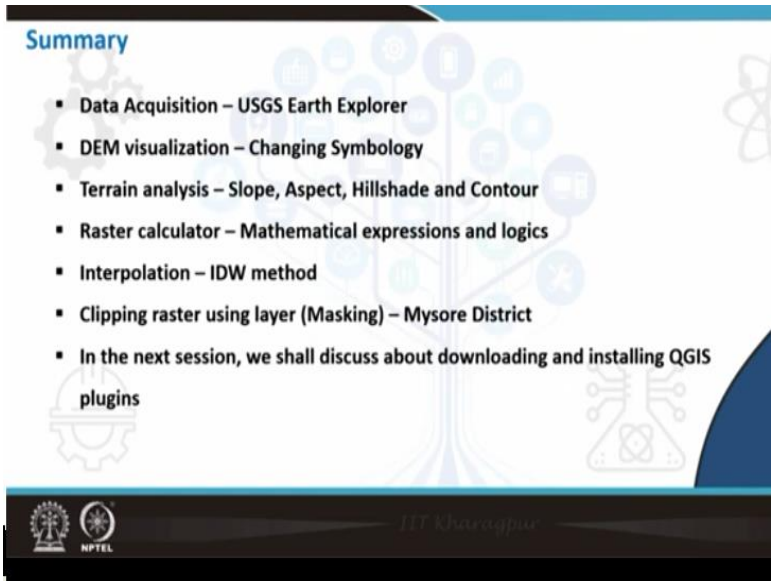

So in this particular lecture, we started with data acquisition; we saw how to download data from USGS earth explorer. We have to register with your email and then we saw how to visualize them. The raw DEM will be in black and white format. How to change the symbology, how we can add various colours and then we performed terrain analysis, slope, aspect, hillshade. Contour I did not show, you can explore contour by clicking on the processing toolbox and we then saw raster calculator.

We saw what are all the mathematical expressions that can be given, followed by interpolation for Mysore district and rainfall values that is the point values, how to interpolate with IDW method and getting that as a raster layer. Then we saw how to clip that particular raster layer and in the next session, we shall discuss how to install QGIS plugins or how to manage that and other things. Thank you very much.