Remote Sensing and GIS for Rural Development
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Centre for Technology Alternatives for Rural Areas (CTARA)
Indian Institute of Technology, Bombay
Week 4 - Lecture 04
Vector Tools in QGIS

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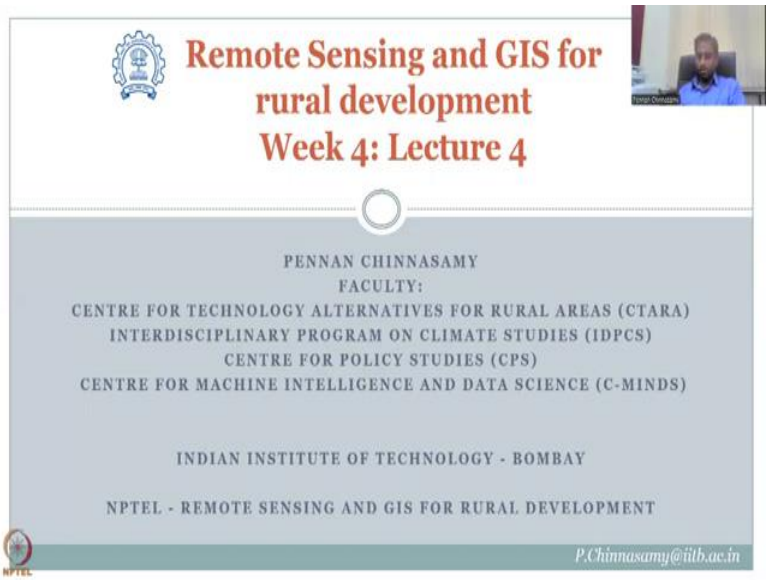

Hello everyone, welcome to Remote Sensing and GIS for Rural Development, this is week 4 lecture 4. In this lecture, we will be concentrating on the specific tools in QGIS that can be used for vector analysis.

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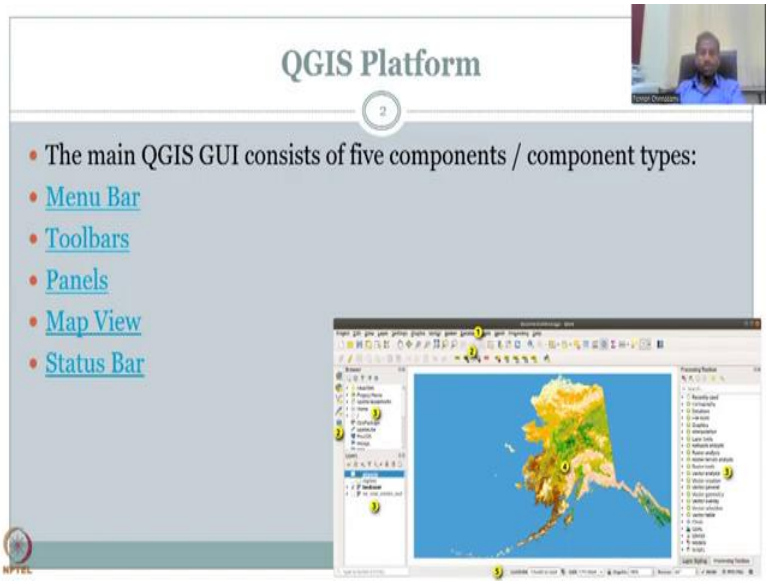

As seen in the last lecture, the GIS platform or the page the page where you the image comes up when you open QGIS has five distinct panels of which one is called the menu bar which is

on the top, then you have the toolbars where tools are being used for analysis and then you have the panels where the layers and others are being stored can be looked at number 3, and number 4 is where your map document is being loaded and you play with or you do the analysis on it and then the status bar to show how the tools are working, what condition it is and when you move your pointer you will go through it.

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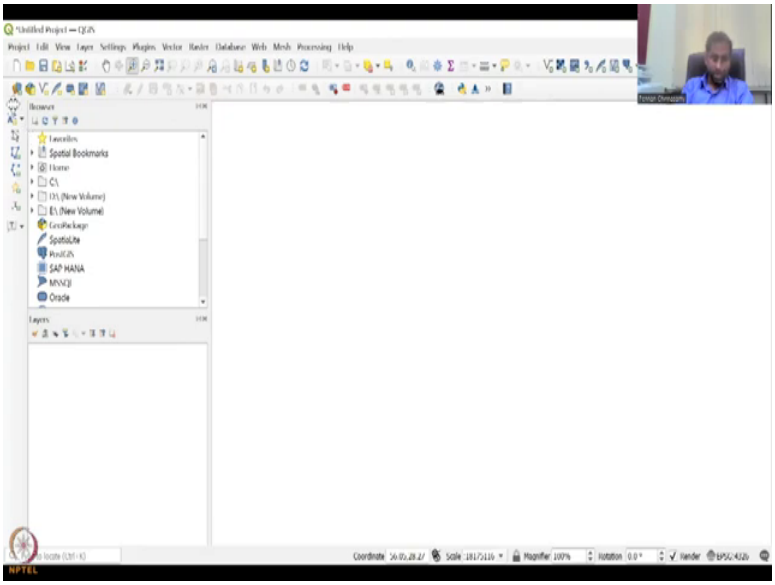
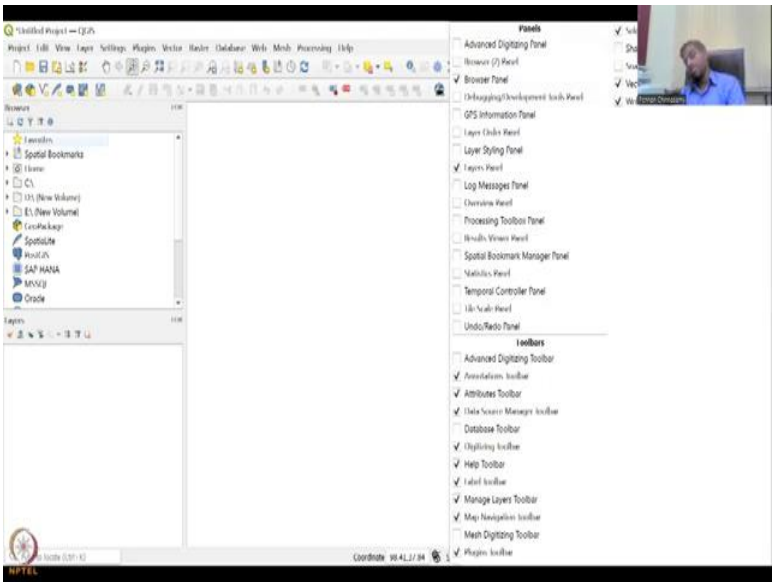
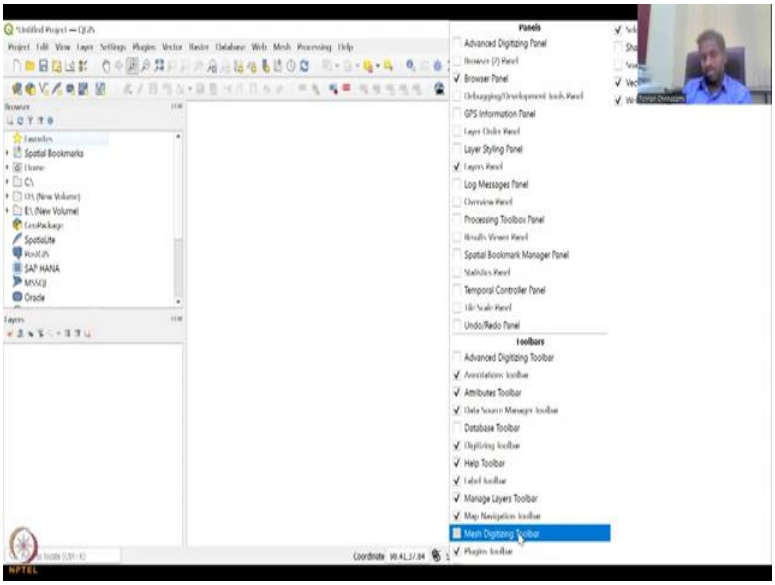
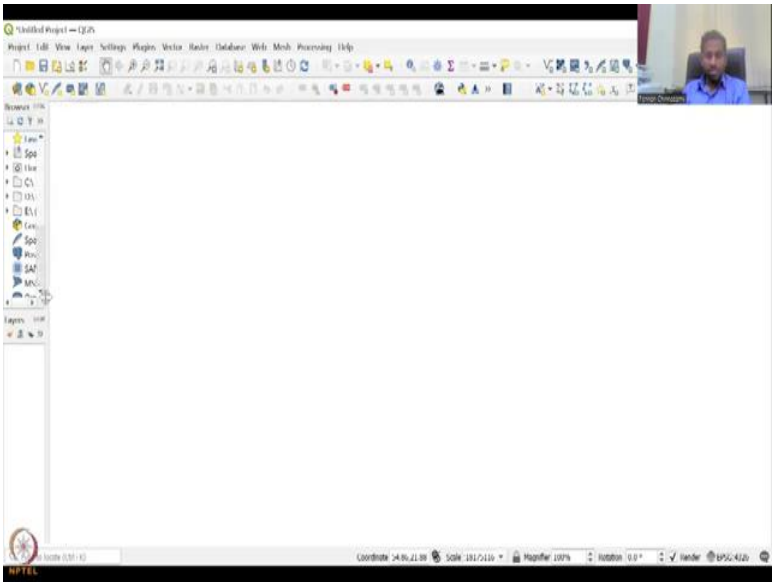





Panels
Advanced Digitizing Panel
Browser Panel
GPS Information Panel
Layer Styling Panel
Log Messages Panel
Processing Toolbox Panel
Spatial Bookmark Manager Panel
Temporal Controller Panel
Undo/Redo Panel
Toolbars
Advanced Digitizing Toolbar
Attributes Toolbar
Database Toolbar
Help Toolbar
Manage Layers Toolbar
Map Navigation Toolbar
Mesh Digitizing Toolbar
NPTEL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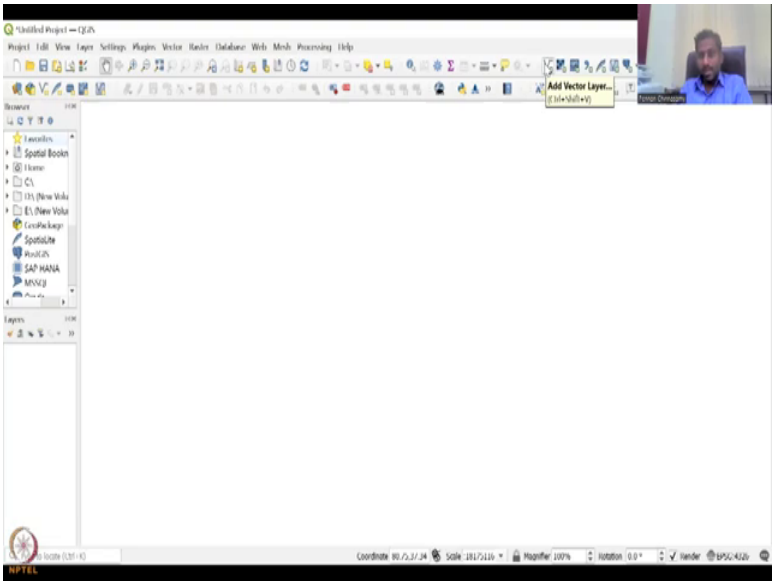
Add Vector Layer...
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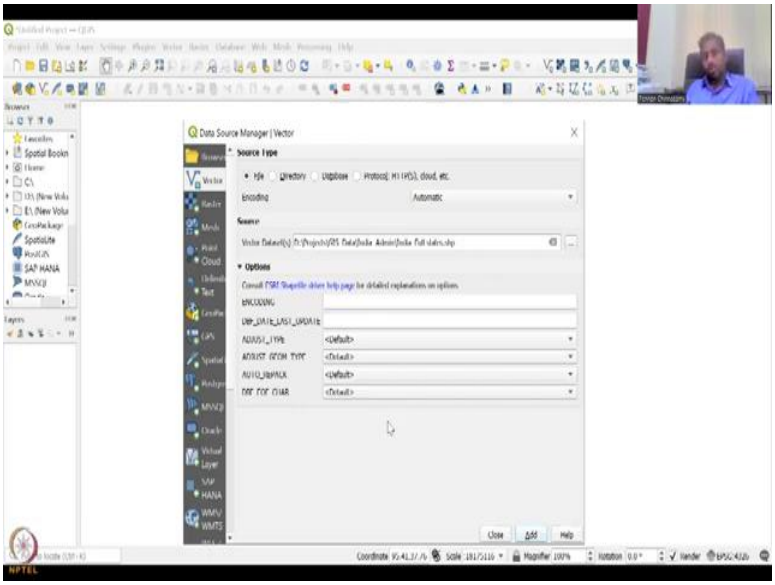

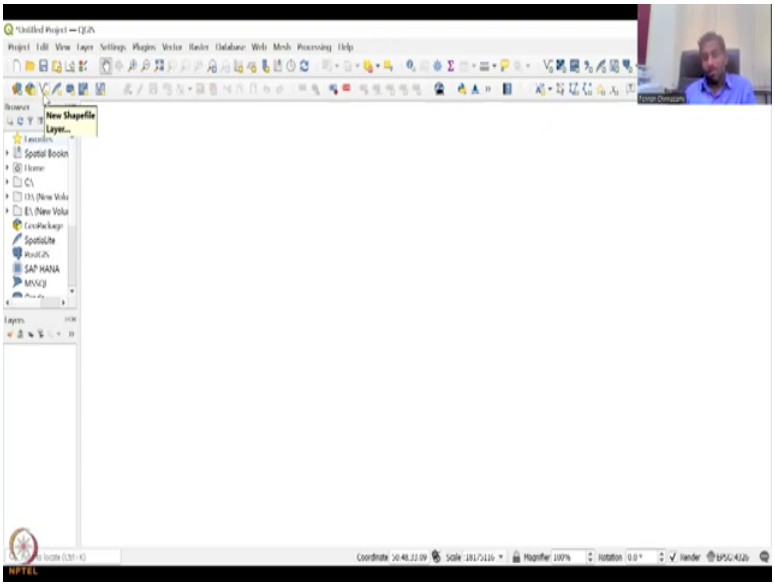

So, let me share the page that comes up when you open QGIS, so you have a blank document when you open QGIS, move my window here. As we discussed earlier this is your menu bar on the top where you have menu or project edit view, layer settings, plugins vector that is database etcetera, we will be today focusing on the vector tools, today and tomorrow in the lecture series the week 4.

And then we have your number two is your toolbars as you could see the toolbars come on the top and on the left, so for some people this would look on this side. So, now if you see when it is on the left what happens is this space is constrained. So, what I do is I go click the pointer and then pull, pull it to this area and I have multiple other tools that I use in an advanced level, so I have that listed here for some this need not be the case and you may or may not use it.

So, what you could also do is you can see right click on the menu bar and you can see like what panels and toolbars can be added or removed, let us say I am going to say mesh designing toolbar and then it opens out here, I do not want it to open here because three rows are happening, so I am going to pull it to this part and keep it but anyway I am not going to use it so I will just remove it what I am trying to say is you can actually look at what is needed for you and then keep only those layers, so that the mapping area this mapping area is maximum for you.

Then you have a browser and the layer panels when you add data the layer panels come up and then you have the number 3 these are, number 4 is your map area, so this is your map area you can you can pull it to the side to increase your map area or you can even close these two if you want just keep it a minimum, so that you can see the layer panels.

I am going to add data, so to add vector data you see this V and the plus, so we have seen this V mark as a line and a point on the line is the type of vector data, so that is what this denotes, we will not be looking at all the toolbars, again there are multiple tutorials for this, we will only look at what is required for this course.

As I said we will go into the vector but before that let us add a vector tool to the map vector data to the map. So, I am going to hover on the tools that you see and one of the tool is a V-shape kind of thing but it is basically a line with points along the line and it is a point shape file. You see a plus sign on the side, so what it means is you click and it is a vector addition layer. So, you can go here and then pick what data you have from your database.

But before that do not get confused with this shape file symbol, it is also same B, but the plus sign is kind of orangish in colour that is for new vector shape files. In this course, we will be looking at shape files that have already been created and used for general public research and outputs.

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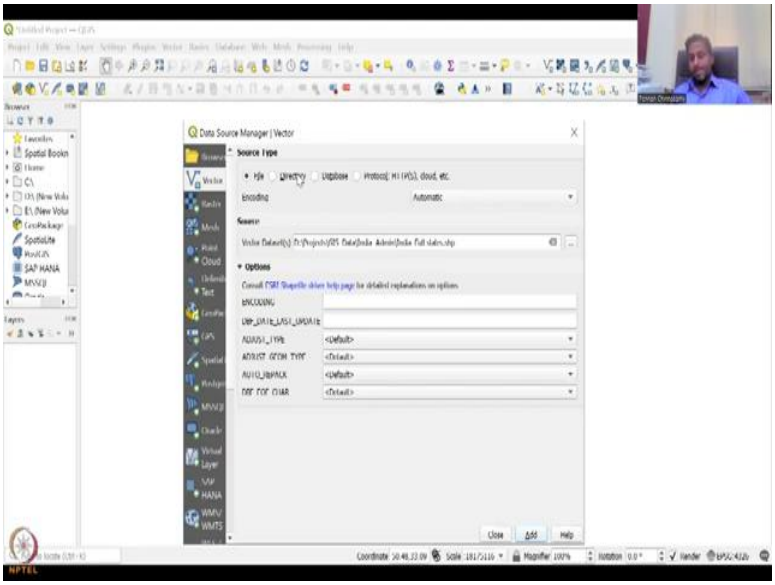

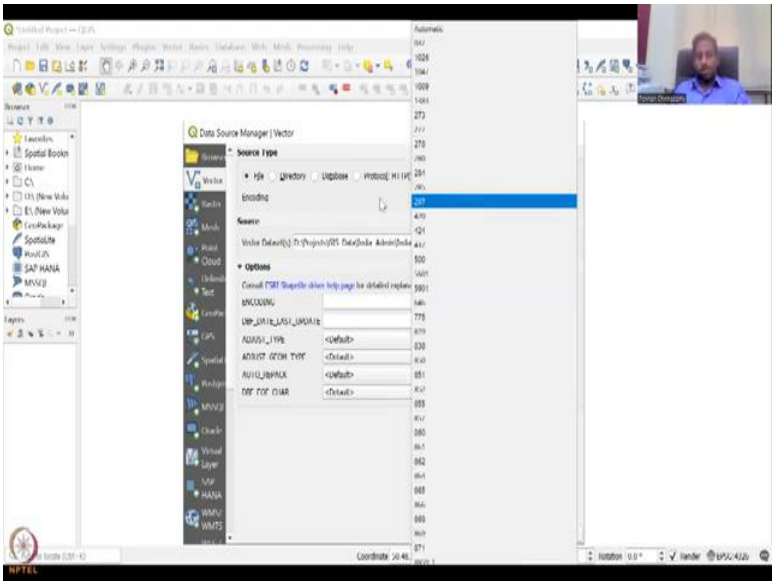

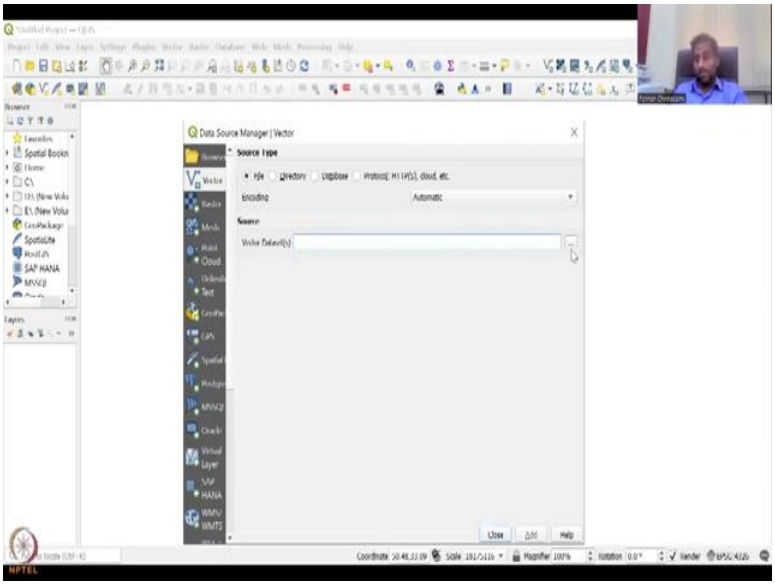

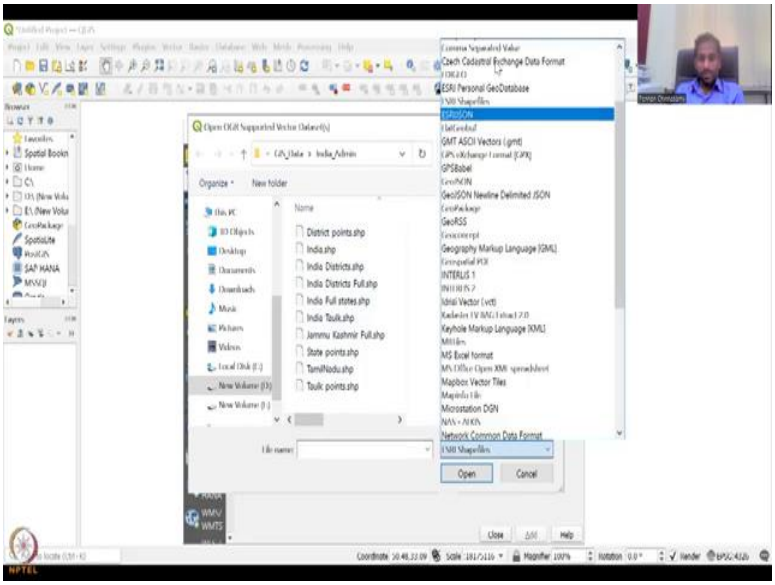
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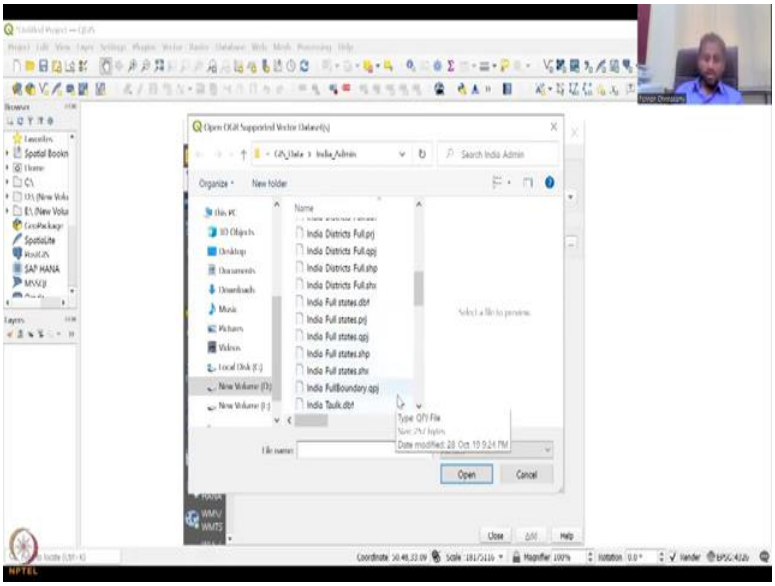
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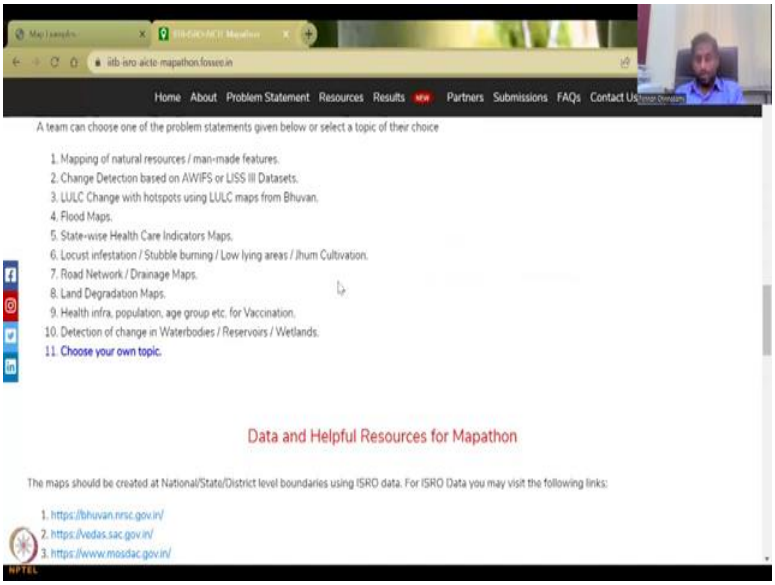
IITB-ISRO-AICTE MAPATHON
Submission: 14 Dec. 2020 - 31 Dec. 2020
Results : First Week Of Feb. 2021
Registration Statistics
bhuvan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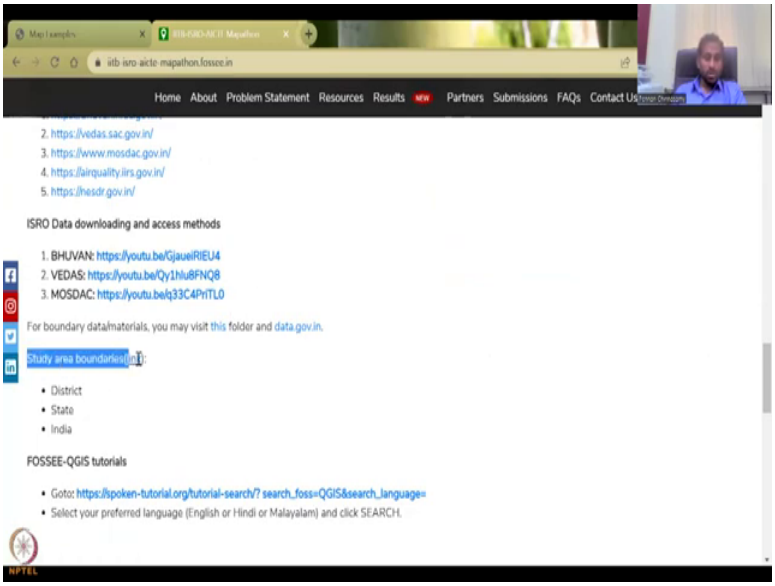
A team can choose one of the problem statements given below or select a topic of their choice
1. Mapping of natural resources / man-made features.
2. Change Detection based on AWIFS or LISS III Datasets.
3. LULC Change with hotspots using LULC maps from Bhuvan.
4. Flood Maps.
5. State-wise Health Care Indicators Maps.
6. Locust infestation / Stubble burning / Low lying areas / Jhum Cultivation.
7. Road Network / Drainage Maps.
8. Land Degradation Maps.
9. Health infra, population, age group etc. for Vaccination.
10. Detection of change in Waterbodies / Reservoirs / Wetlands.
11. Choose your own topic.
Data and Helpful Resources for Mapathon
The maps should be created at National/State/District level boundaries using ISRO data. For ISRO Data you may visit the following links:
1. https://bhuvan.nrsc.gov.in/
2. https://vedas.sac.gov.in/
3. https://www.mosdac.gov.in/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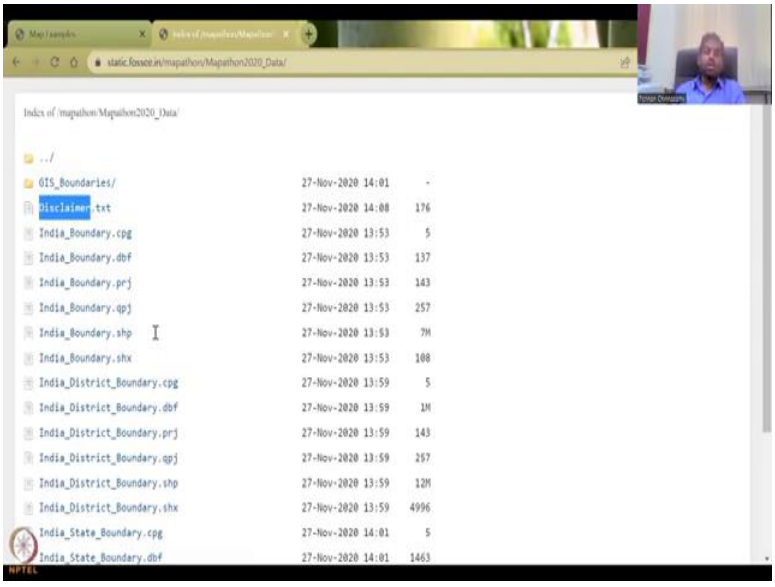
2. https://vedas.sac.gov.in/
3. https://www.mosdac.gov.in/
4. https://airquality.iirs.gov.in/
5. https://nesdr.gov.in/
ISRO Data downloading and access methods
1. BHUVAN: https://youtu.be/GjaueiRIEU4
2. VEDAS: https://youtu.be/Qy1hlu8FNQ8
3. MOSDAC: https://youtu.be/q33C4PriTL0
For boundary data/materials, you may visit this folder and data.gov.in.
Study area boundaries(in):
• District
• State
• India
FOSSEE-QGIS tutorials
• Goto: https://spoken-tutorial.org/tutorial-search/?search_foss=QGIS&search_language=
• Select your preferred language (English or Hindi or Malayalam) and click SEARCH.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GIS_Boundaries/ 27-Nov-2020 14:01 -
Disclaimer.txt 27-Nov-2020 14:08 176
India_Boundary.cpg 27-Nov-2020 13:53 5
India_Boundary.dbf 27-Nov-2020 13:53 137
India_Boundary.prj 27-Nov-2020 13:53 143
India_Boundary.qpj 27-Nov-2020 13:53 257
India_Boundary.shp 27-Nov-2020 13:53 7M
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India_District_Boundary.dbf 27-Nov-2020 13:59 1M
India_District_Boundary.prj 27-Nov-2020 13:59 143
India_District_Boundary.qpj 27-Nov-2020 13:59 257
India_District_Boundary.shp 27-Nov-2020 13:59 12M
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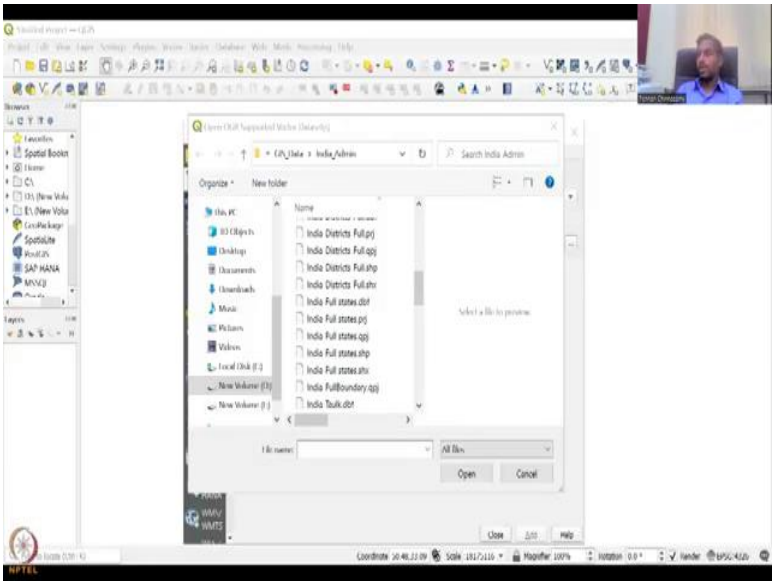

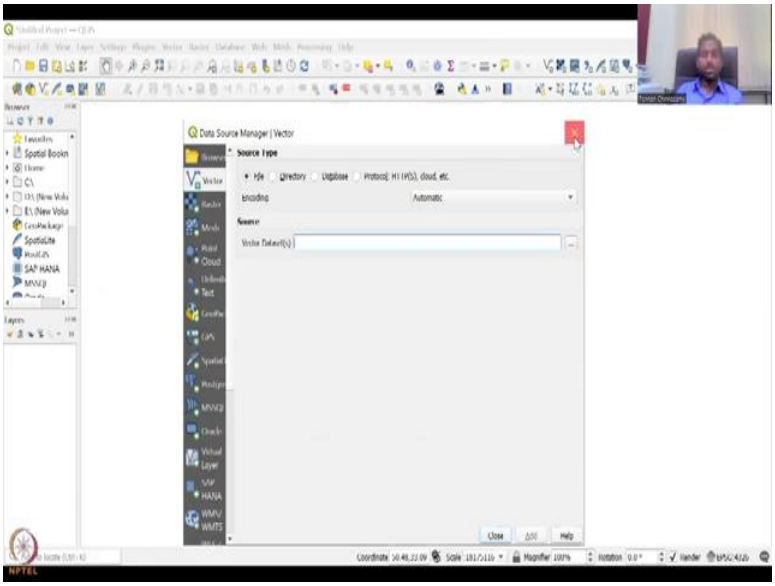

So, for that I have downloaded some data I will click here the downloading data part will come in other sessions where we focus on one or two thematic areas to download the data. So, for now let us look at what happens when we click this tool it opens out a browser and all these are other tools that can be used for adding data.

So, the first is what we want we do not want CSV, we do not want new shape file, we want the vector shape file. So, let us open the vector, it will ask where you want to have stored your data and since I have stored it in a file, I have clicked file but for others you can have database directory, remember in the last session we had a directory or a database type of storage for vectors, it is called coverage's for Geo database.

Encoding keep it automatic because on the fly encoding will be done and these are just default keypad there is a lot of things just keep it as default in the vector data set normally

this will be empty it will be empty like this. So, what you have to do is click the three ellipses three points when you click it, it will open your database the last database that you access, I had access this database you will see many, many files if you have all files.

For example, as I said the shape file name has at least 6 to 7 depending on the length 6 to 7 different extensions. So, you see here we have the India full States and the India four states boundary has dot dbf PRG, QPG, SSP SHX and then QPJ. So, 1, 2, 3, 4, 5, 6, 6 extensions are there whereas some will have 7 also, right here.

But let us click it and which one to click is important, so if you have data downloaded, I have downloaded it from the India WRIS website and the IIT Bombay, Mapathon website which I will open right now, so that you could also see. So, in this web page you can see here this is an annual Mapathon event that is conducted by IIT Bombay with very key Partners like ISRO, AICTE for CE Rudra.

So, what will happen is, if you come here this is an old Mapathon, the new Mapathon is coming in February 2023. So, every year stay tuned for it and you can see here if you come down boundaries, states, India boundaries are given you can click this link and it will go into this database where all the state boundaries India State boundaries, District boundaries and India other full whole country boundaries are kept.

Again, there is a disclaimer that we do not promote a particular type of data and the data accuracies lies with the data provider we are just posting the data we are not the data Creator. So, if there are some minute differences in the data please consult with the government agencies, we did not make this create this data we borrowed it from their website, so that everyone can access it here. So, in this year's boundaries layer we have.

So, this data is important and we will be using it for the QGIS, so I have downloaded it from that link and the link also I will add in the presentation down now, so what I will do is I will be adding I will be showing the presentation where you will have the data included for the link of the data where you can get the data, yes.

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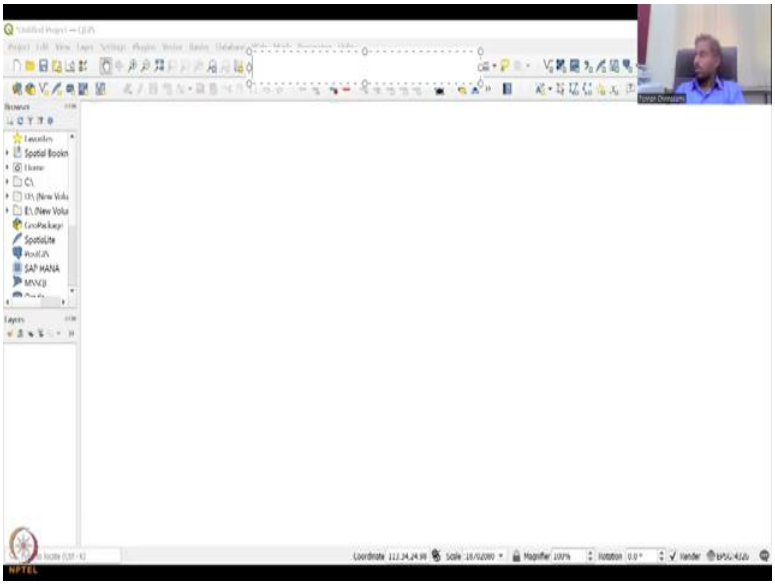

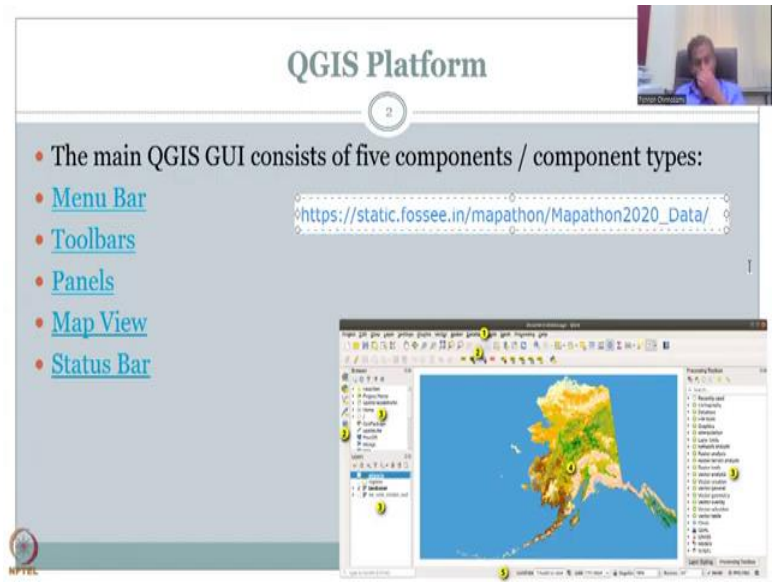

So, we have I will put it in this chat box itself, let me put it in the chat box, so that you can um see it in the writing. So, rotate text, so what we see here is the data that we want you can take it from the video itself, but if people who cannot see it in the video let me put it also on the page where we will be looking at in the QGIS platform.

So, I am going to put it here for those who would like to see it the link for the India data set is given here. So, you can copy paste it into your browser click it and it will capture your data for the boundaries.

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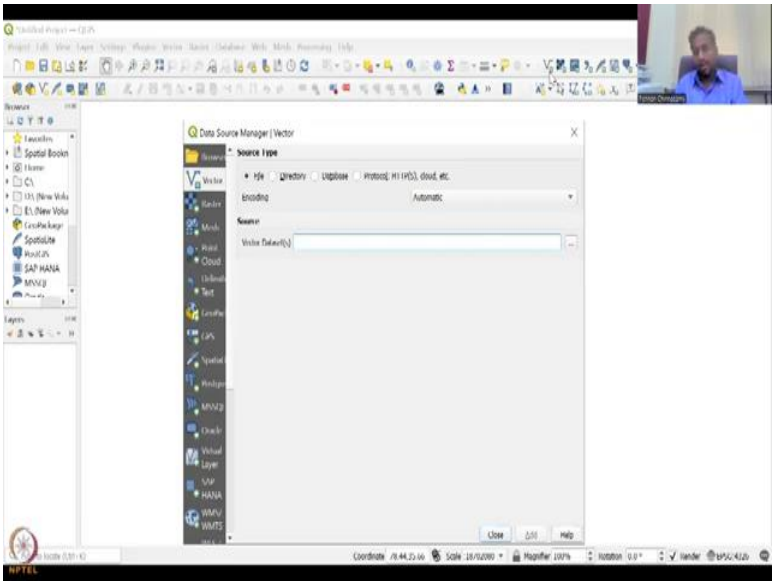

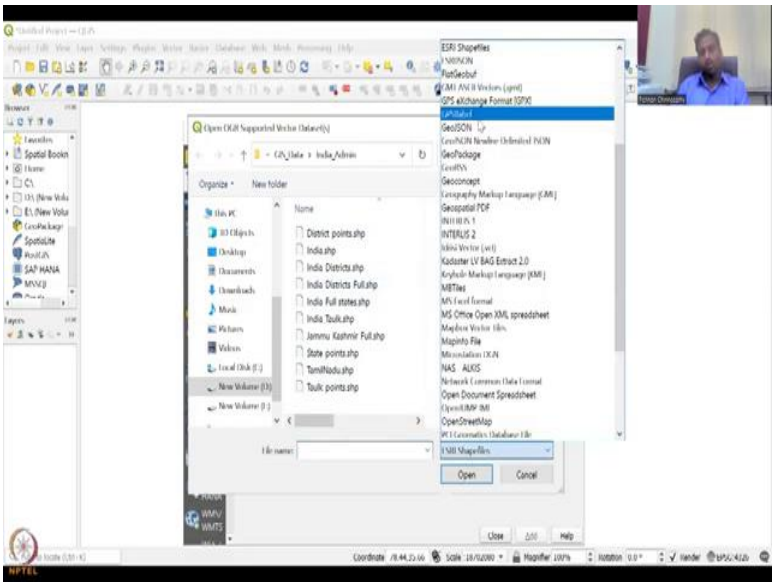

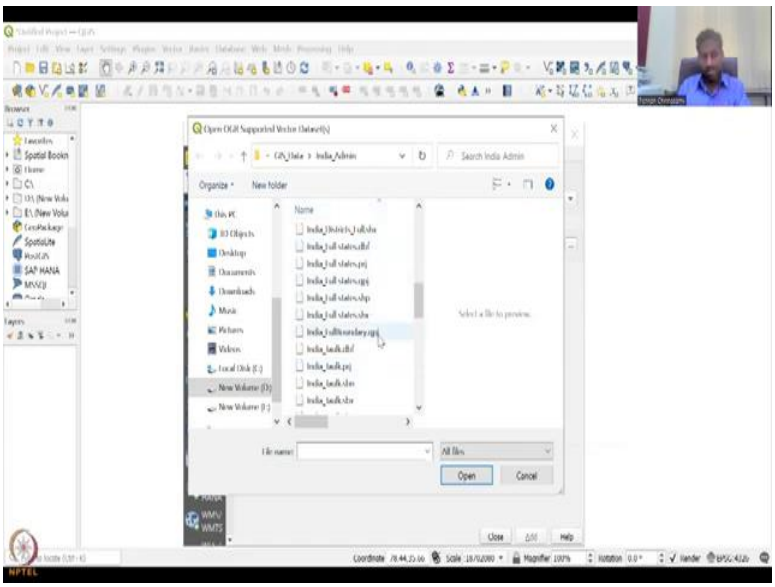

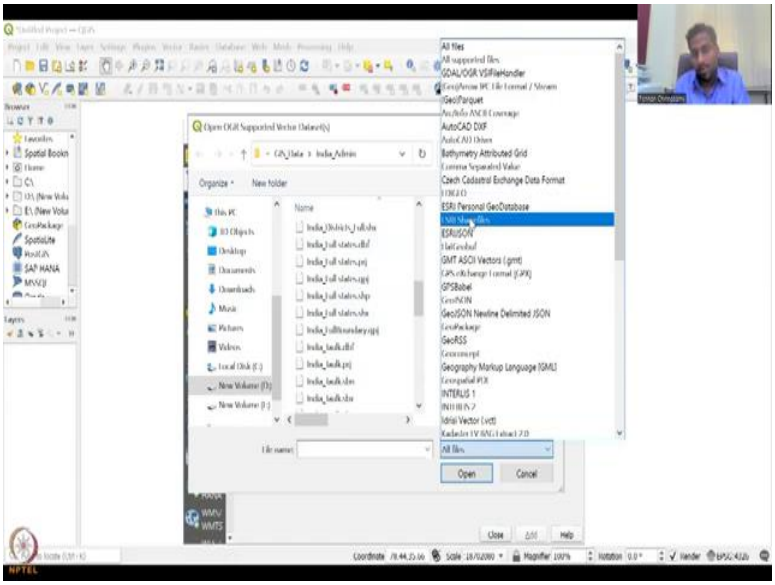
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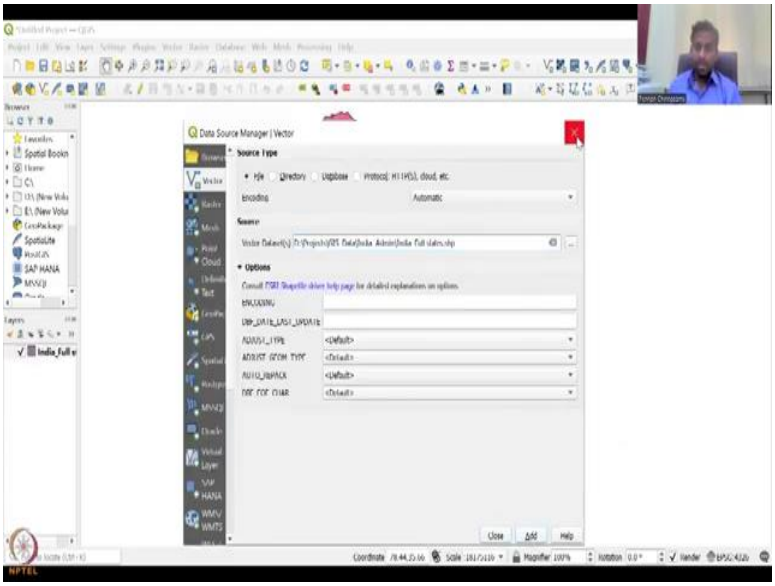
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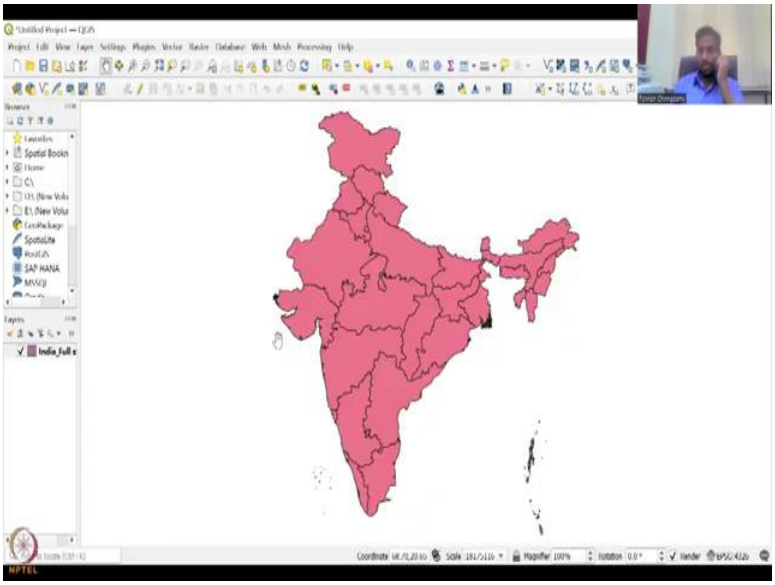

So, now I will go back to the layer where we are going to use the QGIS software. So, this is the layer and I have downloaded the data as I said download all the data just does download .shp, if you just download dot shp you are missing on the projection and coordinate systems, so please download the entire data set which is very important for your data showing up on the screen property.

So, now I will be clicking the vector add layer and then I will go to where I have stored it all the when you open it first it will be like this where all the all the extensions will be there I want India full state, yeah, so I have India full State and only the shapefile dot shp you should open when you open one all the others will open again, so but just for simplicity QGIS has given that option S3 shapefile, so just click it, it will filter only the S3 dot shp shapefile extension.

And if you look here, you have India full states, so I am just going to click it open and then say add not close you should say add and then it adds the colour is default everyone will not get the same colour some people will get different, different colours based on the computer's preference but you will get the whole of India.

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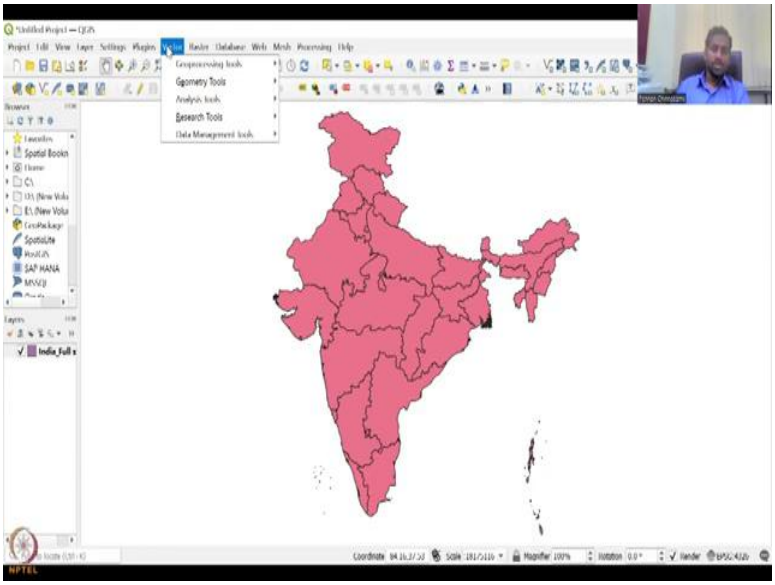

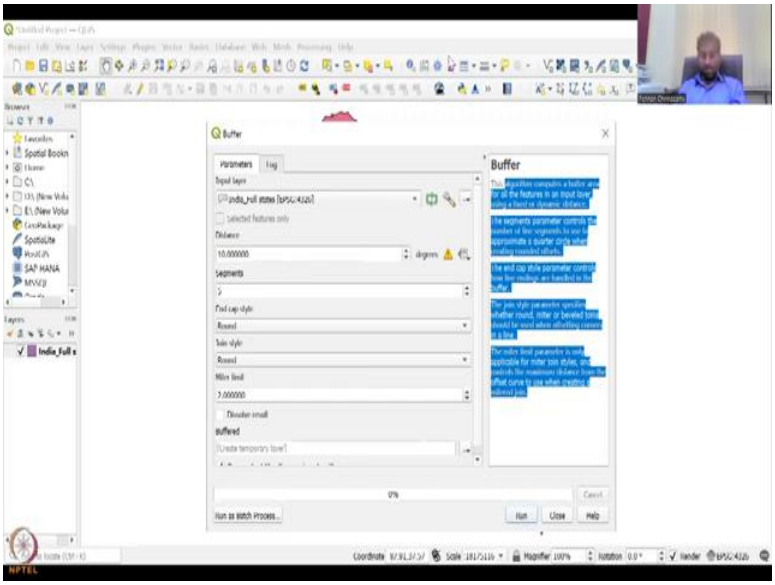
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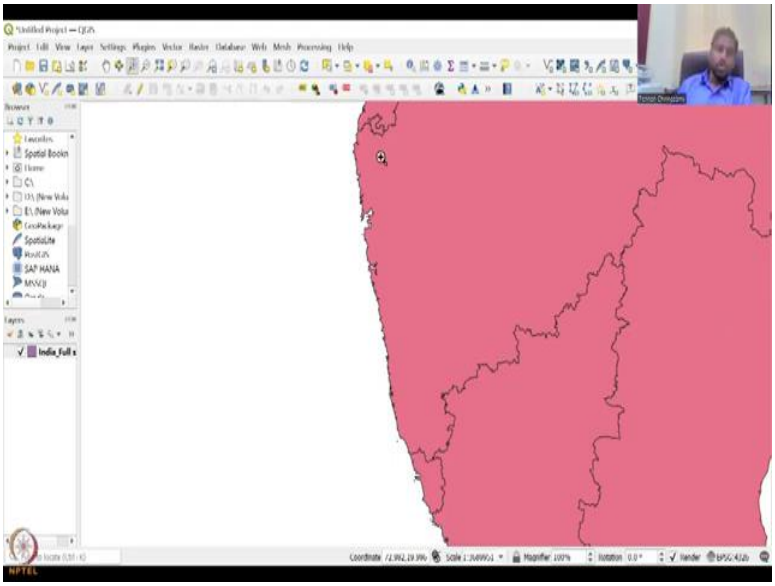
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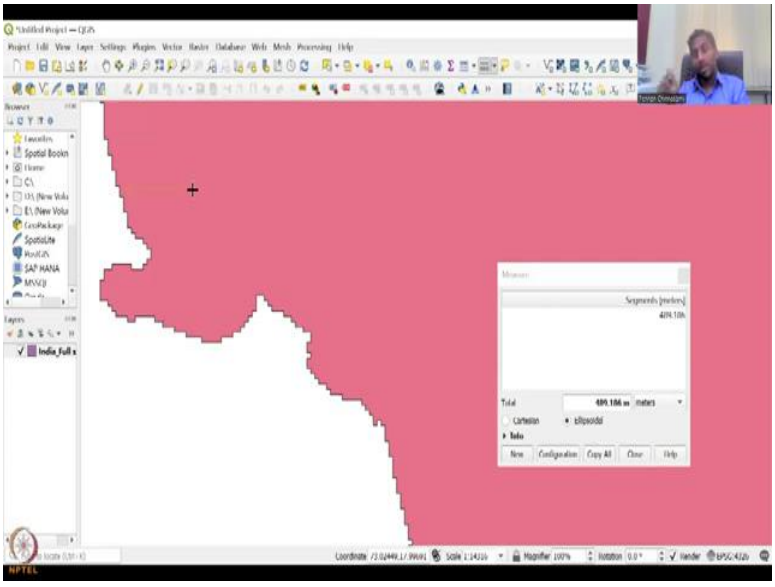
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meters
Cartesian
Ellipsoidal
Help
Layers
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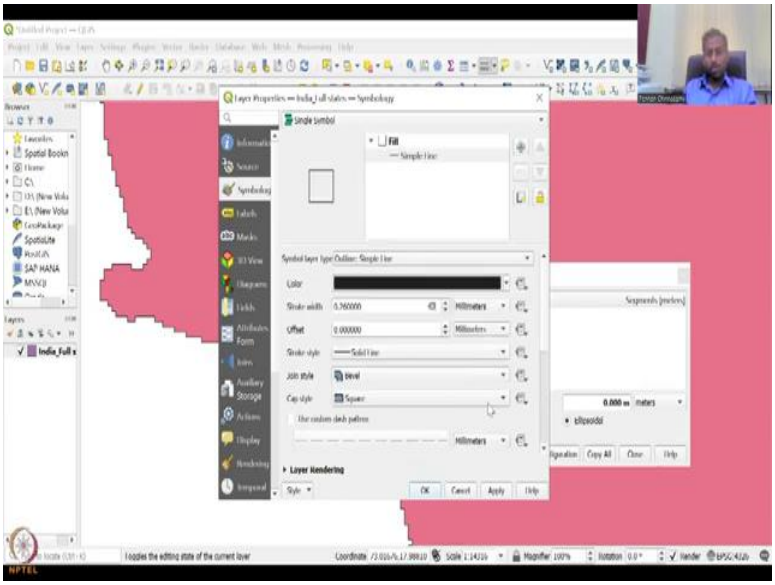

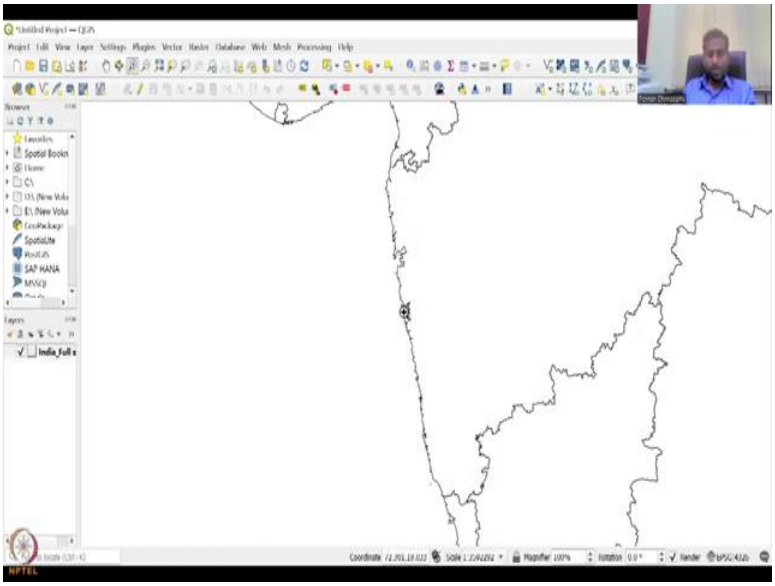

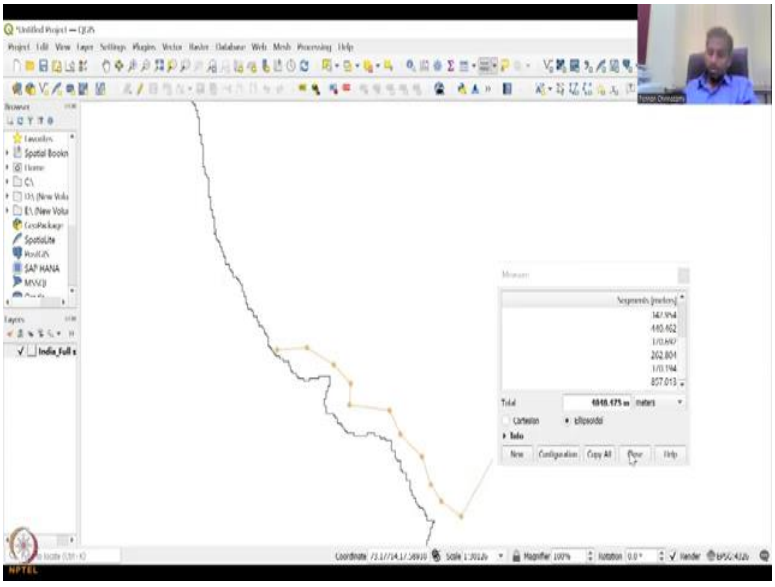

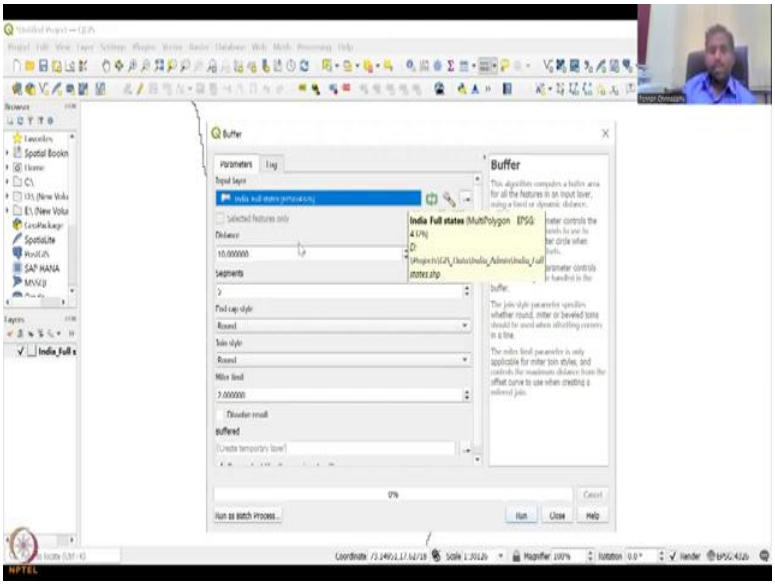

Now, I will go into the different data sets or for vector tools and other things that are available on QGIS. So, if you look here on the top there is something called vector and not all tools we will be using because some are advanced some are basics we will be looking at some that are relevant to rural development, for example buffer, buffer is very, very relevant I am going to click buffer and above the tool is given.

So, you can you can make it big, so that you can read it here, I recommend you to read this before using any tool, it is like a data about the tool it is good to run the tool but make sure you listen and understand what the tool is about.

So, the tool is putting a buffer so for example, if you have let me close this and let us create an example. So, if you have India and I am looking at Maharashtra coastal line, I need to have a buffer for the thickness where Coastal regulations can be used. So, for that you need to let us zoom in to Maharashtra again the tools and what they do please go into some basic GIS course you will get to know like how to use these tools and what do they do.

So, I have clicked on magnifier and then I drew a box and then it magnifies, so we have the western coast of Maharashtra on this image and what I am going to do is I need a distance. So, let us say within 100 meters you cannot build any or let us say 500 meters you cannot build any anything on the land because those are coastal regulation zones. So, I am going to click here and then move so around here this is 600 but still just let us say 600 you cannot build, let us keep it at 500.

So, you see how difficult it is to do manually, so this is where you can automate the process by saying okay this is a buffer and then the buffer here is also 500 meters 500 meters and it

does not look as clear as it should be, let me open this. So, what I am going to do is I am just going to say outline simple line I do not want, so I have the India boundary made and just for the coastal regions I am going to go into Maharashtra, so I will go into Maharashtra let us take this region and I said I need to have around 500 meters no building zone, so I am going to click here and then I have I am zooming in, so I am clicking here around 500 meters.

So, you could you could start here and then say 500, 500, 500, and it does not look good in terms of it is not perfectly done. So, for this you can automate the process using a buffer tool and that is what this tool does, if I say vector and then go to buffer it will create a buffer along the line as per my requirements. So, you could see here I it automatically picks the data set because there is only one data set India full states with the particular coordinate is taken and then it asks like what units do you want.

So, it is only coming in degrees which is fine you can have it in multiple different units like meters, feet, degrees, etc, see what degrees you want and then you can put it. So, maybe you can put one degree for it and then segments how many segments you want what type of end cap minimum and then you can just say do you want a temporary output which is created here buffer create temporary layer or you can add ask the layer to be stored in the in your folders where you want to create.

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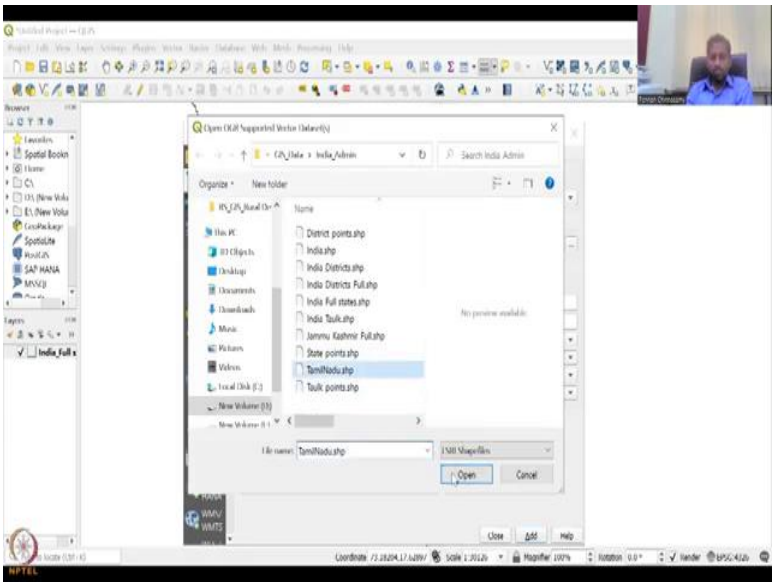

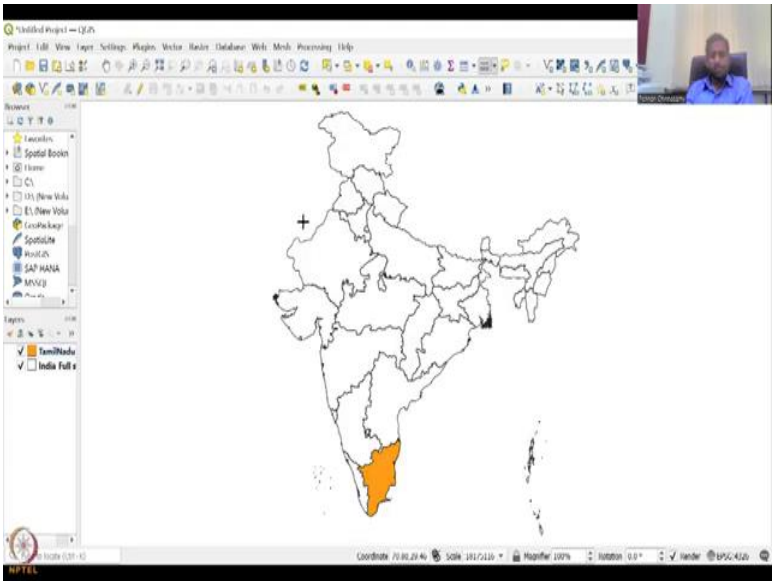

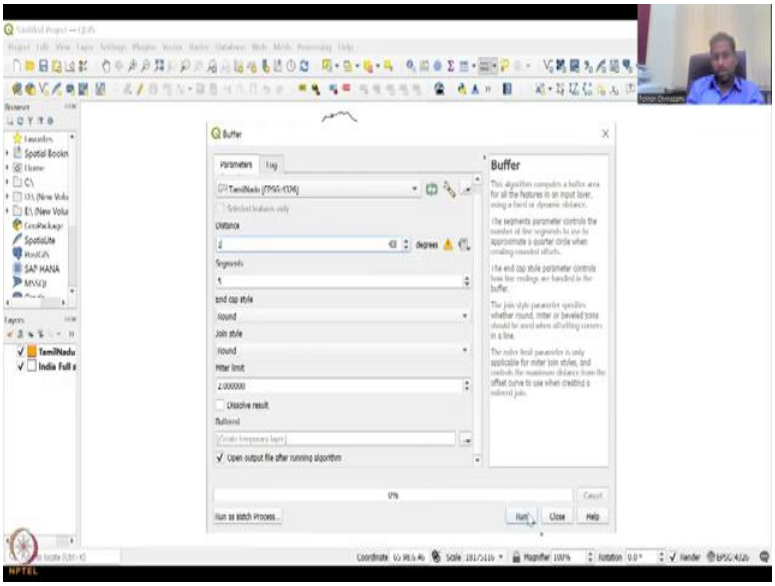
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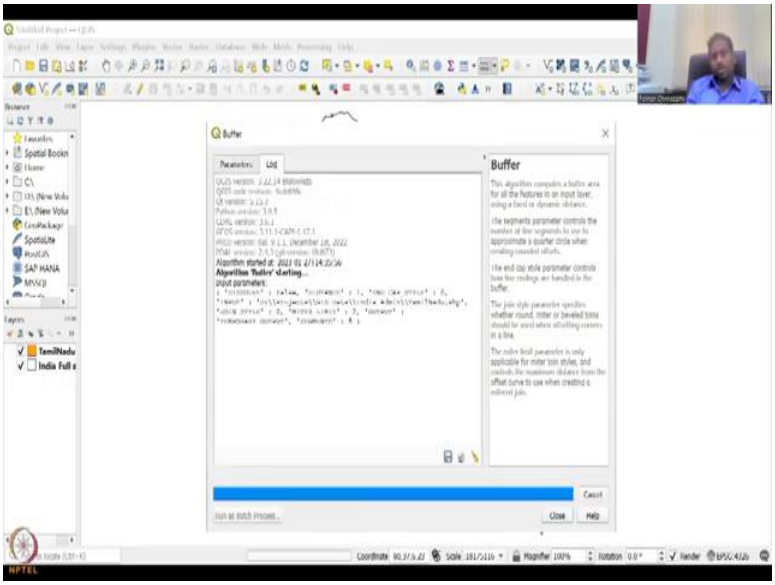
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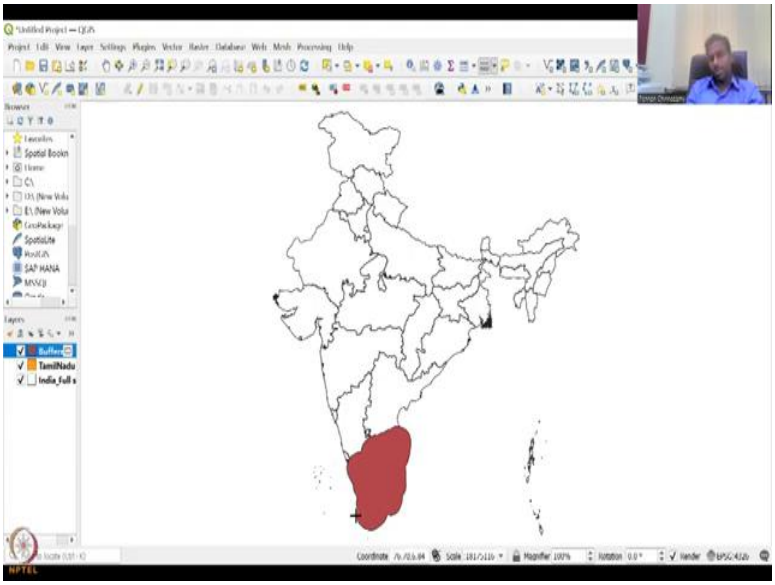

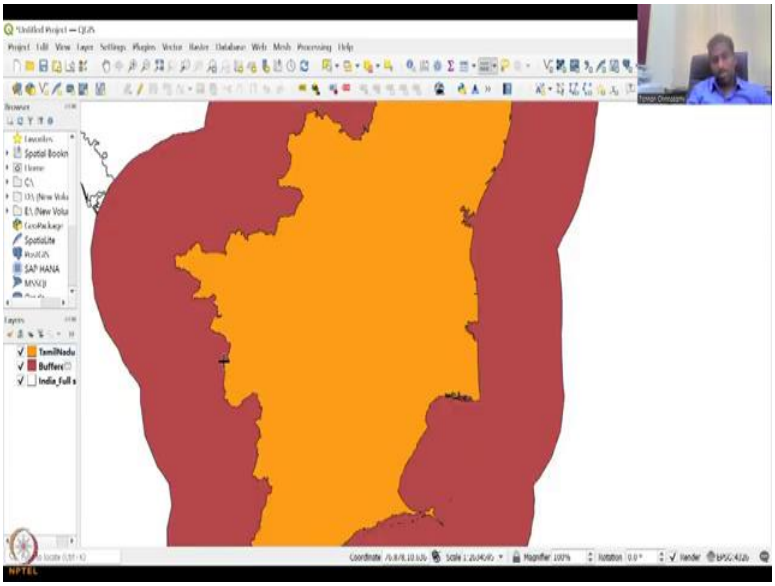

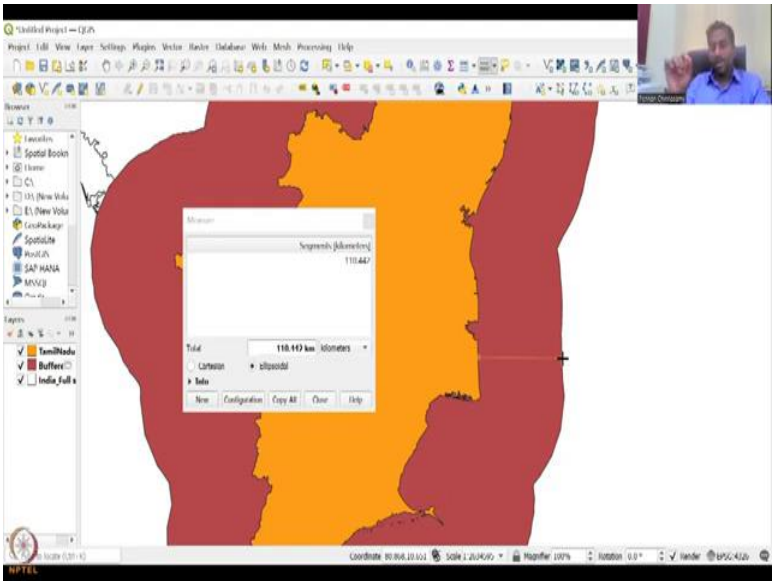

Just for simplicity let us add one more layer let us say Tamil Nadu, so that we can do it very small not all sometimes it does take time depending on your computer's performance and I am going to zoom to all the layers. So, you have India and Tamil Nadu and then let us do the buffer just for that one and then create a temporary layer and then run, so it is running.

So, here is the status also is given and then it will put it on the buffer, so you could see that the buffer has been created and the buffer is one degree from the boundary, so you and at every single location the boundary has been created, so this is very, very accurate so from each line there is only one degree distance and one degree is approximately 100 kilometers from at the equator.

So, if you do the measurement, you would see that it is approximately 1000 meters 10,000 meters 1 lakh meters sorry, we do yeah 1 lakh meters taken here at one degree distance from this. So, we are only doing a degree so do not worry about the units here, so degree let us see if it is doing it at one and that is one degree, so one degree at that location is 1 lakh meters, so as I said it is 100 kilometers, 1 kilometer is 1000 meters.

So, you have a hundred thousand meters which is on which is given as 1 degree. If you have to do it in in kilometers also you can do it, so it is all the same it should be 100 approximately. Since, we have to zoom in to actually look into the point where the point is placed, so if you do it very accurately it will be 100. So, there is no going over and beyond good.

So, what happens here is you have created the buffer and the buffer is being placed as a tool, this is very important because even a road can have a buffer, a school can have a buffer where you cannot have liquor shops or paan shops along the School boundaries, these are rules set by the High court and Supreme Courts, but without these special information they are not practiced. So, now you can actually add these buffer layers and then practice it, so this is one layer as I said it can be done.

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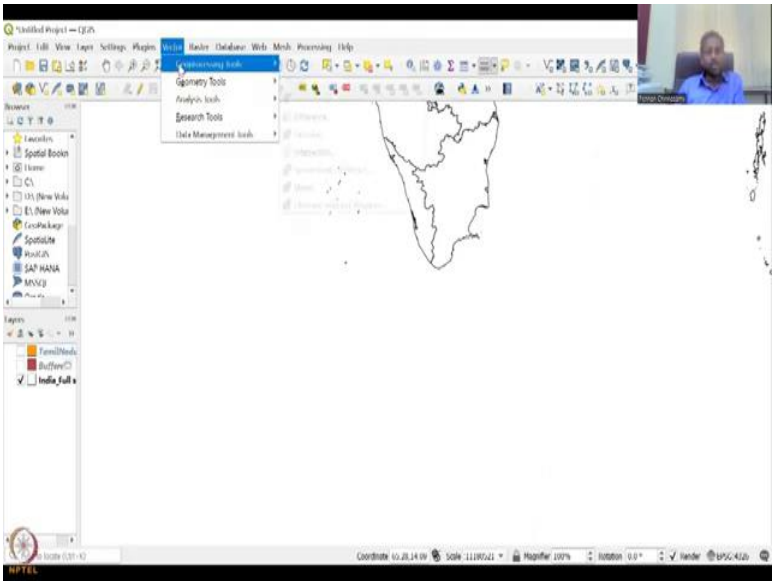

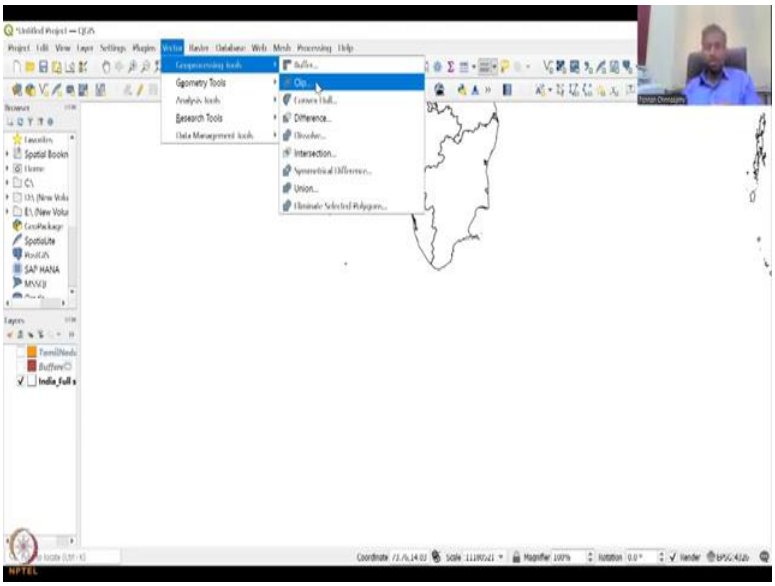

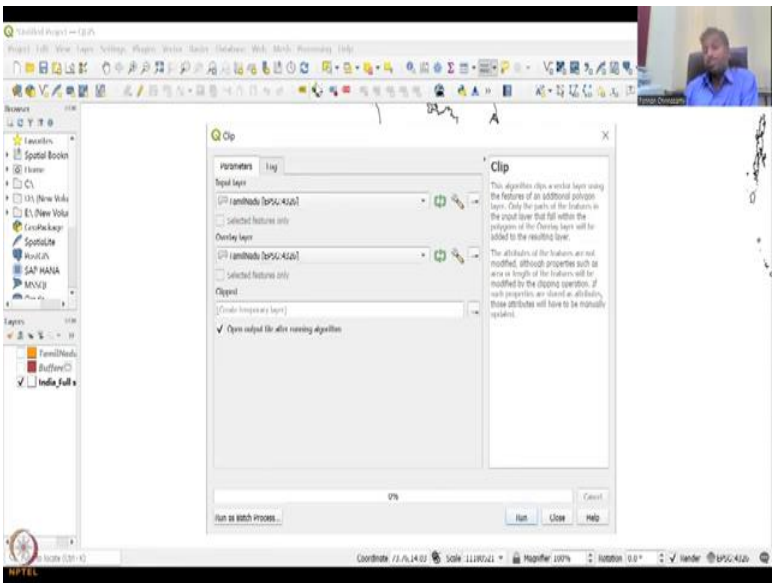

But there are multiple vector tools let us quickly look into that and there are again there are ways you could go and learn this, here we are going to just give one or two examples and then require you to learn it by yourself. So, buffer we have finished the other geometry tool is geo processing tool is clip.

So, basically if you have two shape files you can click the shape file to get the smallest part. So, you can take two shape files and then where it is merging or where it is clipping only that part can be taken on out. For example, in India boundary you can only take Tamil Nadu out by using a Tamil other clip, so if you do not have the time and need to do the entire India boundary research analysis, you can zoom only into Tamil Nadu by taking it out as clip. So, this is how you actually take the India boundaries and take your District out or your village out using the clip tool.

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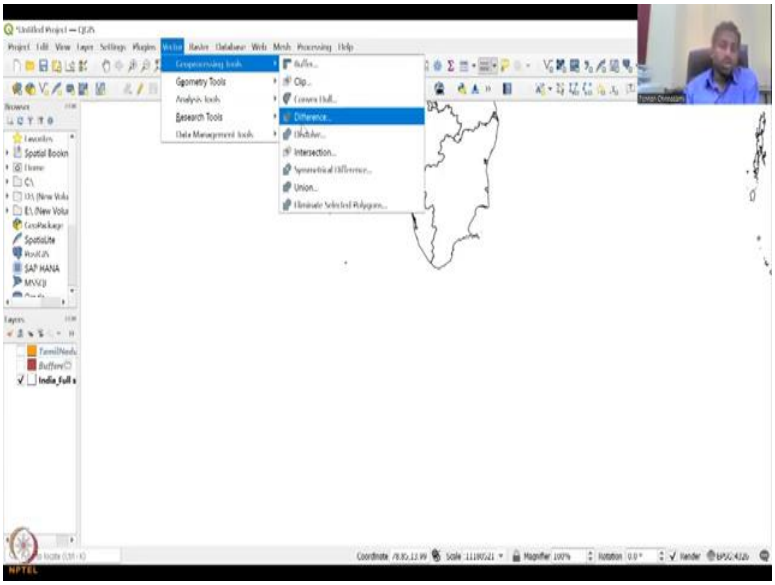

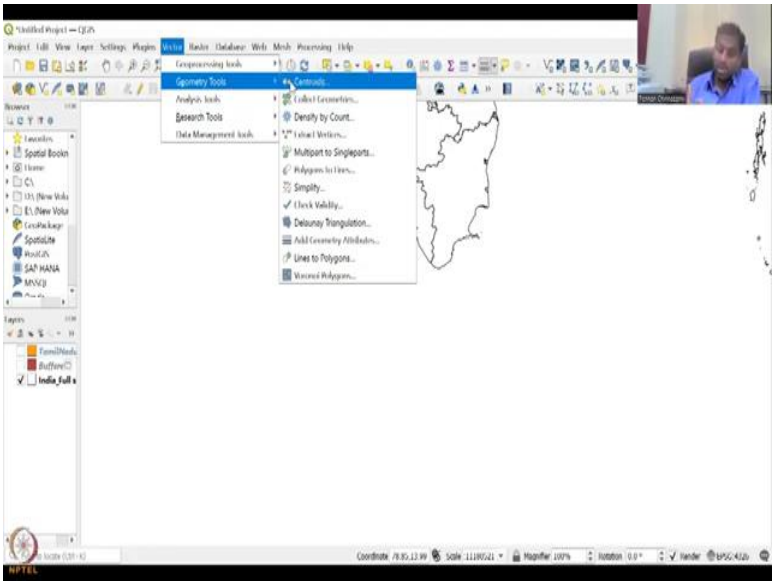
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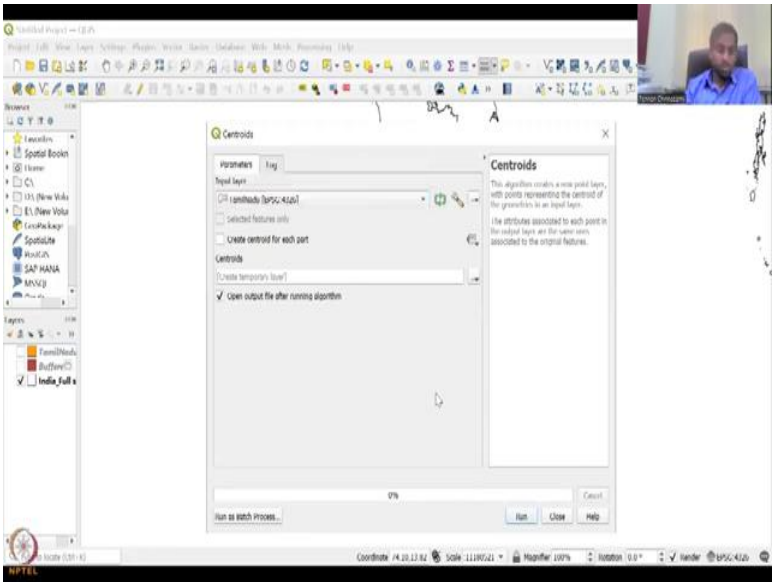
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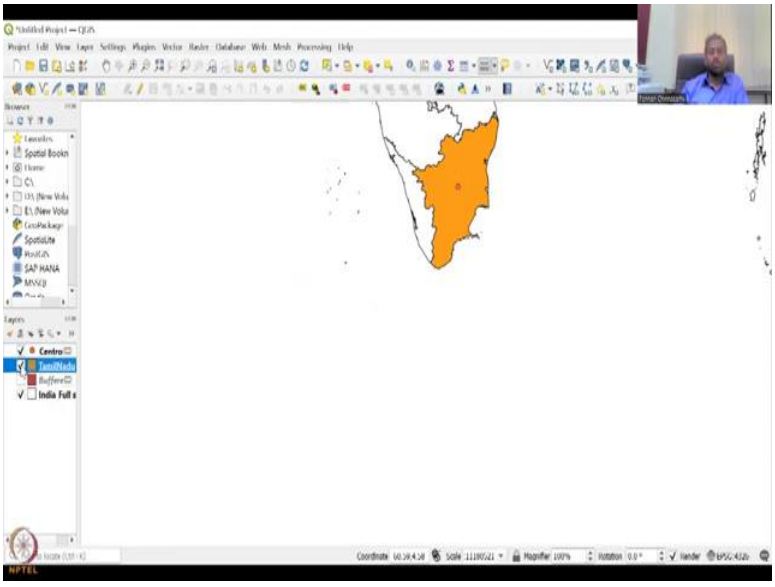
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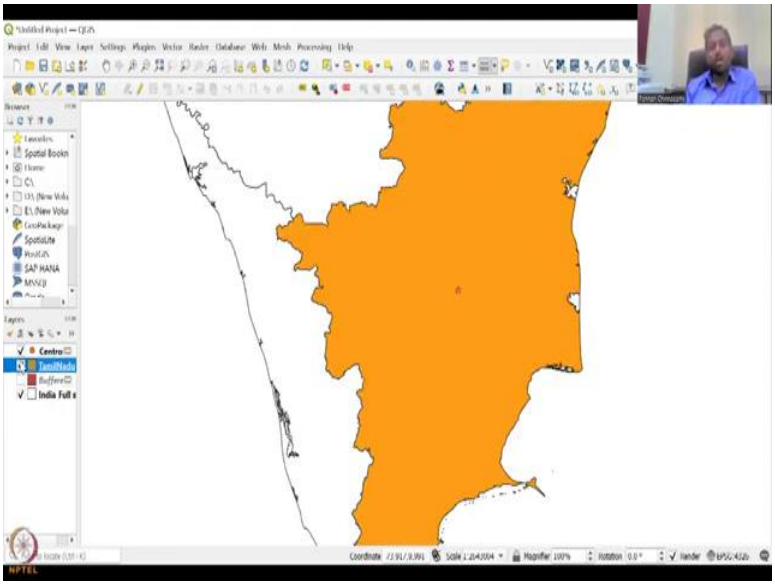

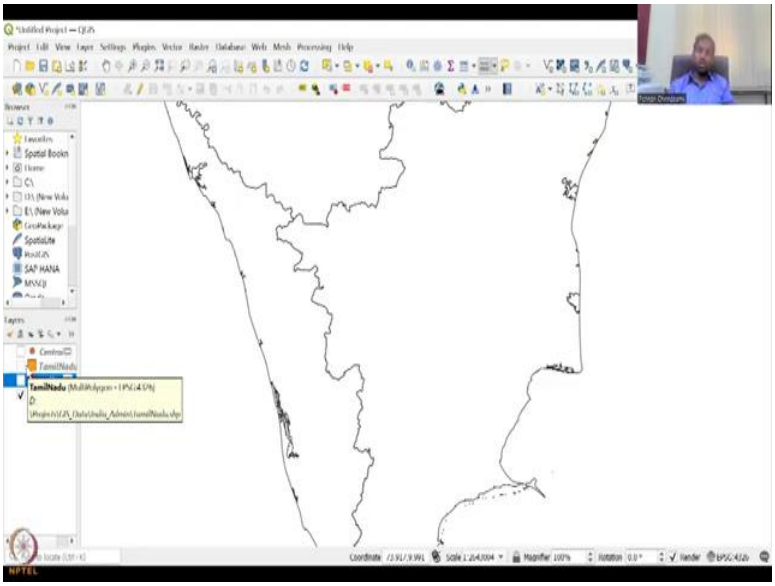

And then there is a difference tool so what is not unique between the two shape files it will be taken off, dissolve actually dissolves the shape file. So, you have boundaries within a shape file and if you don't want the lines etc you can dissolve it most of the time the state boundaries can be converted to National boundaries using the dissolve tool.

Intersection is what is common between them if you look at the image of the tool you can actually see the way it is being performed. So, there is an intersection, so you have two shape files and what is intersecting these two shape files will be taken out as intersection. So, depending on your research team your research idea these different tools can be used.

Then you have geometry tools this is also very important I will do one quickly here, centroid, centroid means I have a shape file but I need the centre portion of it, let us say you have a

state and the state let us we will use Tamil Nadu here again because we already have it on the layer panel you can see the layer panel activated.

So, you have you need to create a centre point to see that it is equidistant from the boundary and that is the location where you want to collect data or average the data at that point let us say rainfall, you have entire thumbnail of rainfall but you want to see what is the rainfall in the centre location.

So, I am just going to quickly do it you click centroid you click which shape file you want to do, I am going to pick Tamil Nadu shape file create a temporary shape file and then open it after the algorithm is run. So, you click run it is done you say close and the point has been created in the middle of Tamil Nadu, so you can click Tamil Nadu to see to make sure if it is in the middle, yes it is.

So, this is where how you create from a shape the centre point and that is very important to for example you want to equally distance from all the boundaries that is the centre point and most the capitals are kept here logistically the capitals should be kept in a location where all the state can contribute and that is the part where you can have the Capital operating logistic capital.

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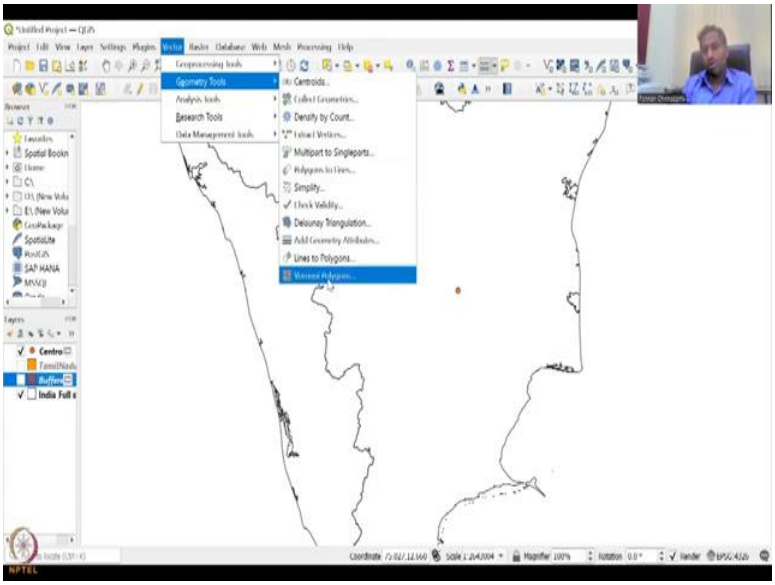

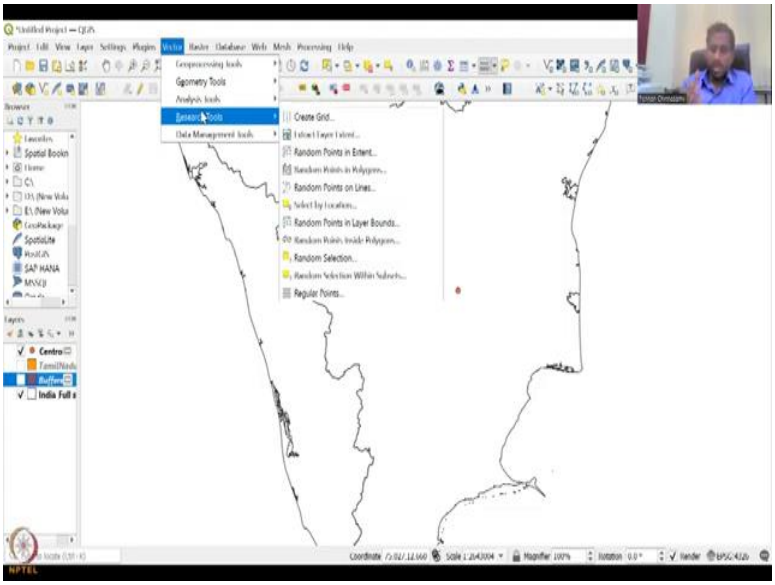
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Geoprocessing Tools
Geometry Tools
Analysis Tools
Research Tools
Data Management Tools
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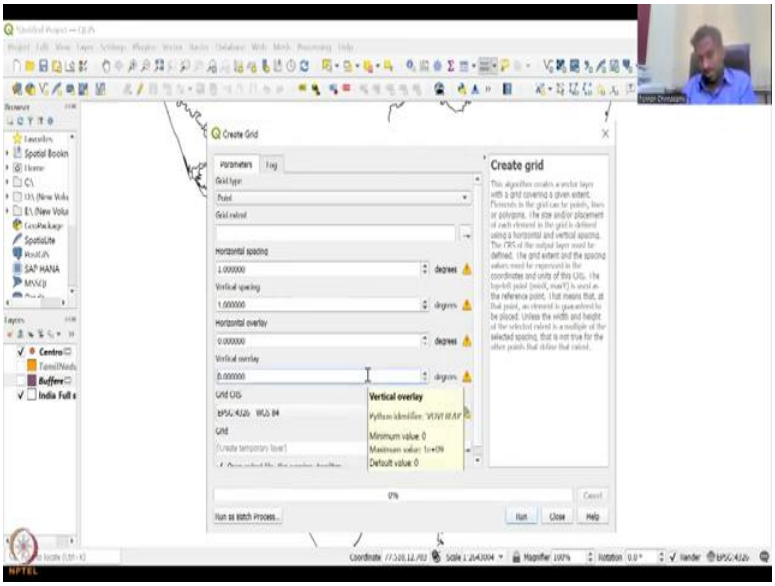
Regular Points...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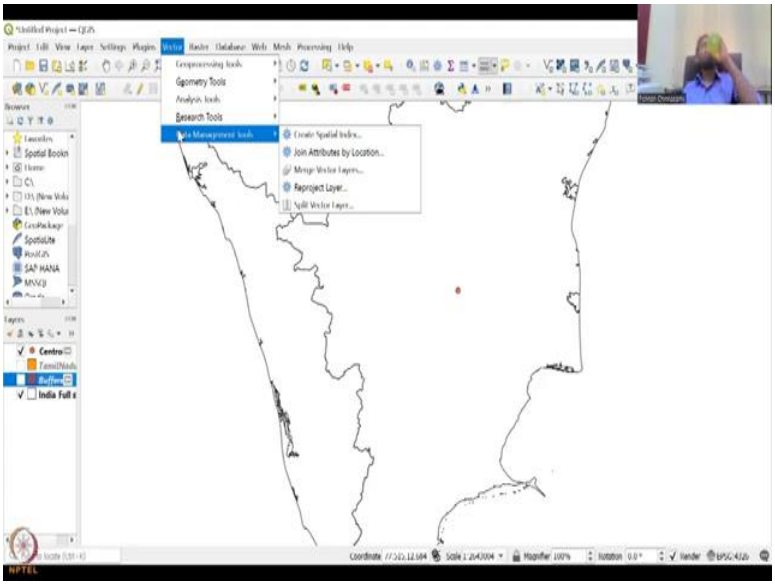
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Geometry Tools
Analysis Tools
Research Tools
Data Management Tools
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Then you have other tools that are needed most probably the varanoi polygons are needed lines to polling can be done, if you have a line graph line shape file it can be converted to polygon and also a line can be taken out as vertices which means a line can be converted to points polygons to be converted to line, you can break the polygon into smaller lines. So, all these can be done in this tool.

In the analysis tool you can count line of intersections nearest neighbour analysis, some line segments, distance method all these things can be done in the analysis tool. In the research tool you can create grids discretizing your boundary, it will be used to create a grid, so that you have equidistance from all the points. So, depends on your research question as I said and these are standard tools that are available in QGIS, you can also add other tools by doing the plugins, we will come to plugins later.

And then you have data management tools where you have create tools, split tool etcetera, so you can merge select vector layers you can add vector layers into one layer. For example, you have a district layer and then a state layer these are different layers but you want to open it into one layer, then you can put it here and then merge them, so that they convert into a single layer.

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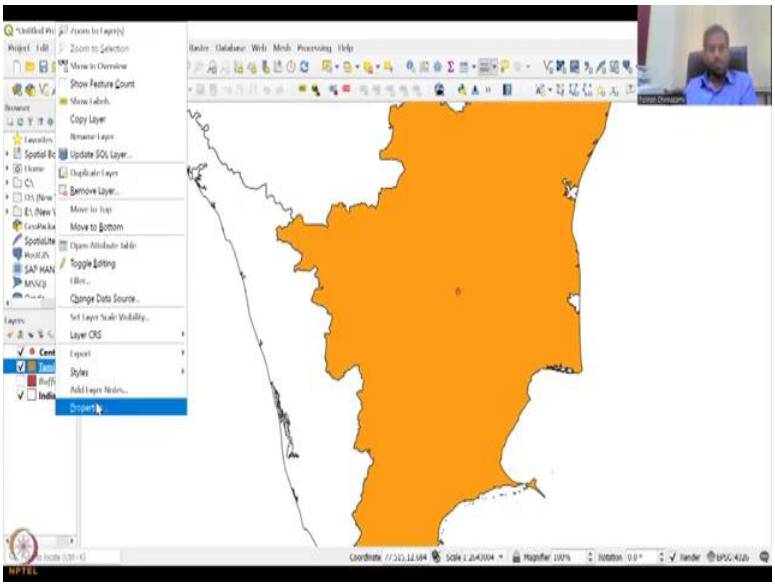

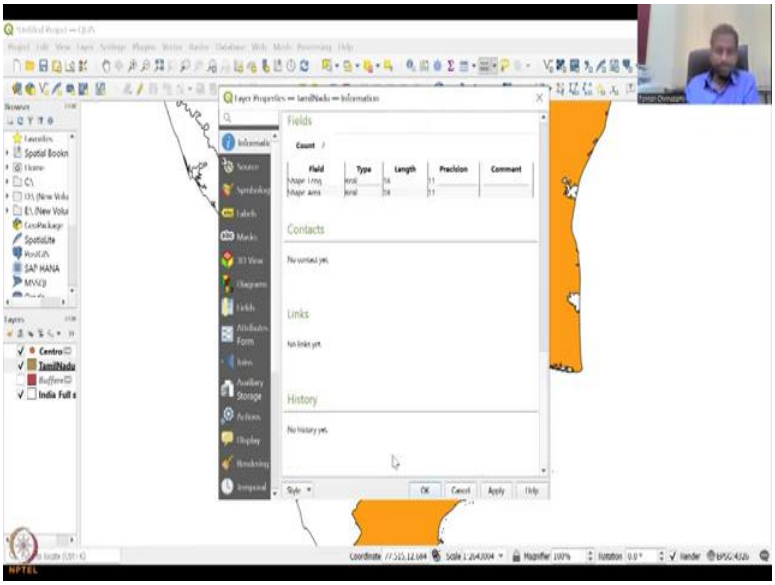
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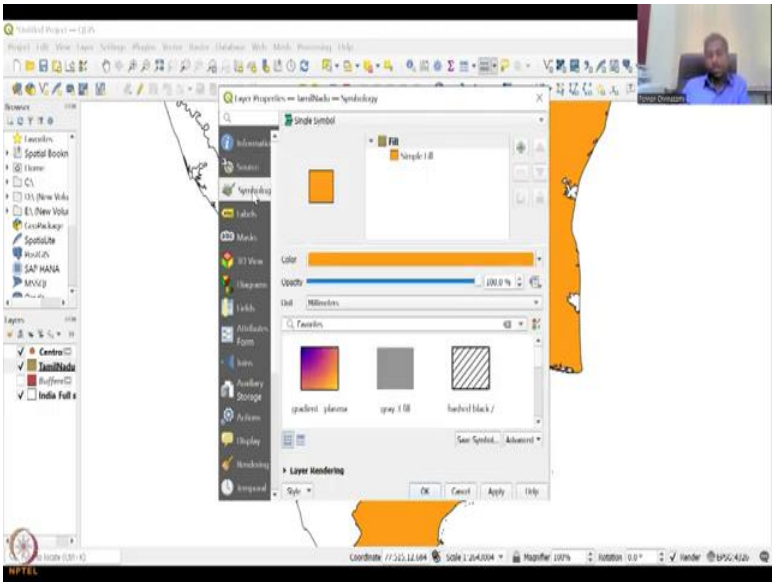
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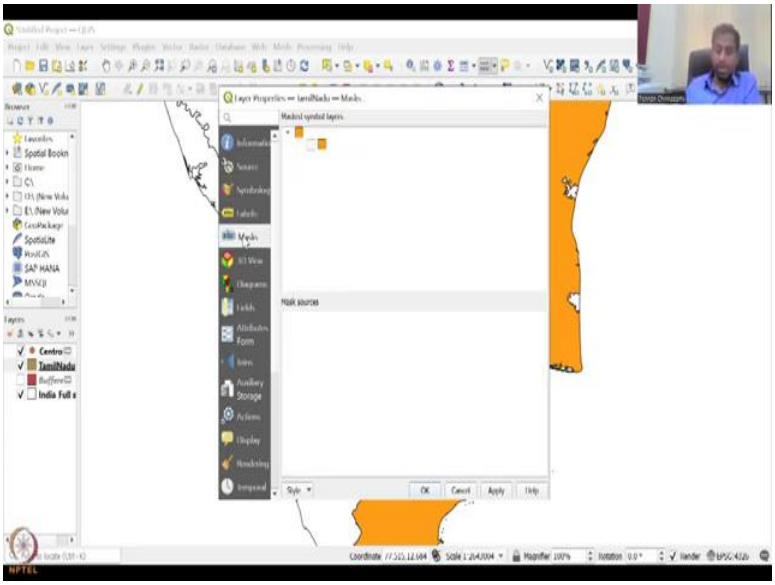
Mask sources

Then we also have your properties of these layers, so let us click on Tamil Nadu, open it up and then if you click on properties there are multiple data that is there is information about the data metadata is there who created the data, where the data was stored, what was the projection coordinate system etc, etc, shape area length and then the source of the data where it was downloaded, sometimes this is empty but most of the times if you download data they will provide these inputs, so that you can contact them if there is any questions.

Symbology, as I said you can create it as simple fill or dashed lines based on your need you can do it and as I indicated again this is not a QGIS course, so we will not get in depth on how to label, how to provide these access, labels we will look at it later when we are actually doing the labels. And then we have the others which are kind of advanced level QGIS server and stuff which we will not be using here.

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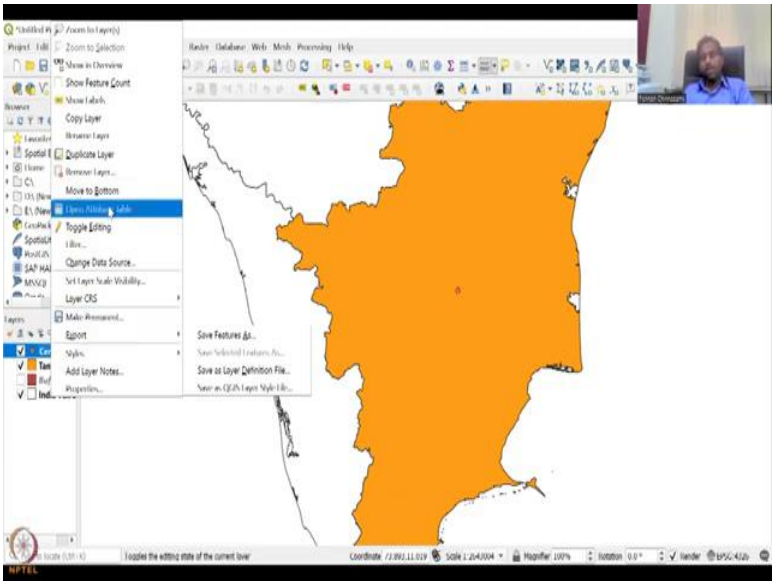

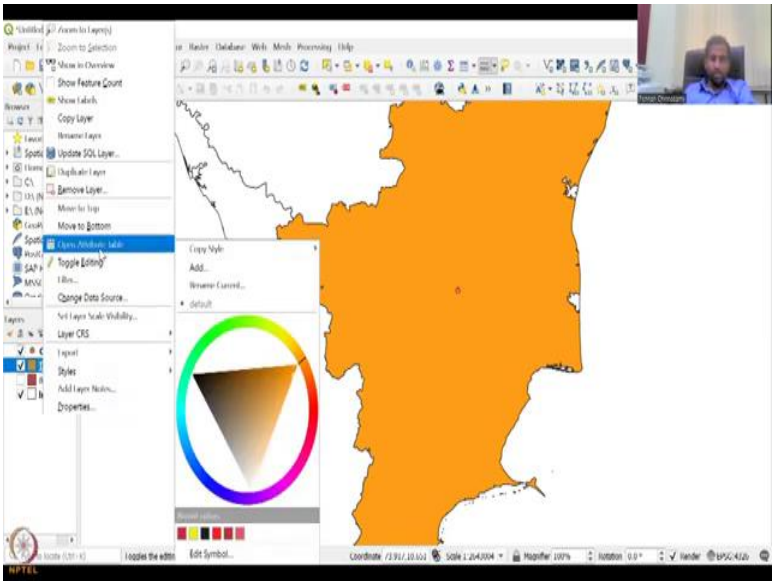

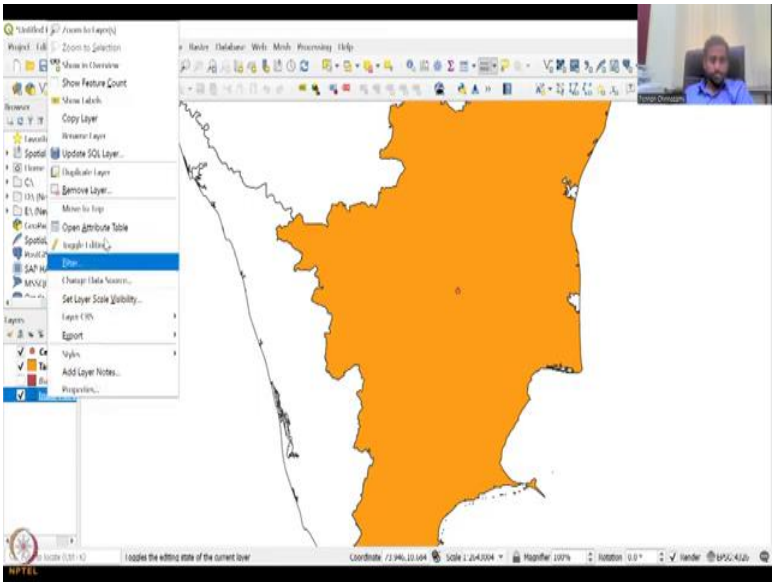

The centroid does not have a point, so let us open the attribute table I have told that every vector layer has an attribute table, if I open the attribute table by right clicking an open attribute you can only see the point only one point was created and it is shaped and then shape area.

There is no other details along with it because it was only one created, but if you open the Tamil Nadu open attribute table you also get only one shaper because it was extracted from the all India data set. Here you have all the districts and union territories data set, so all of them are being populated.

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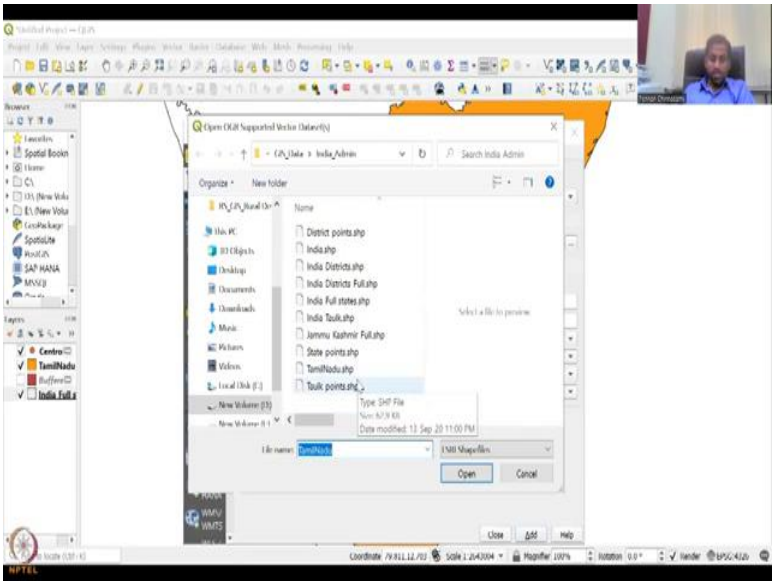

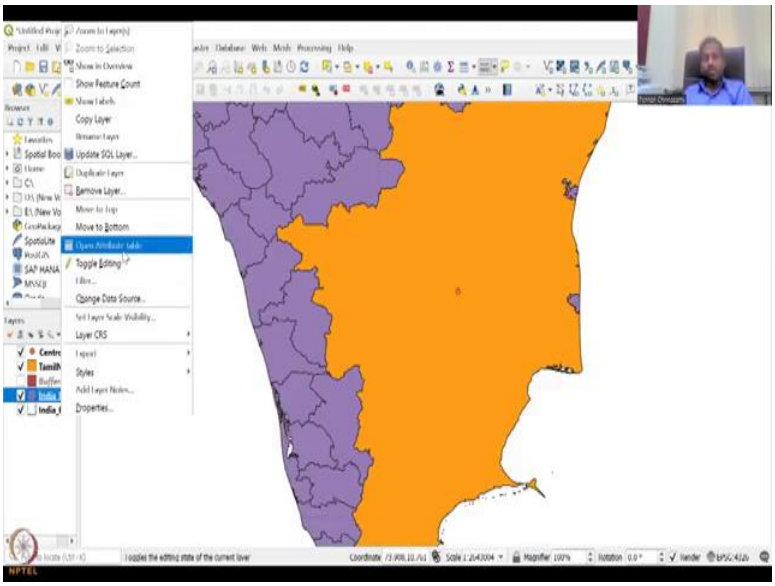

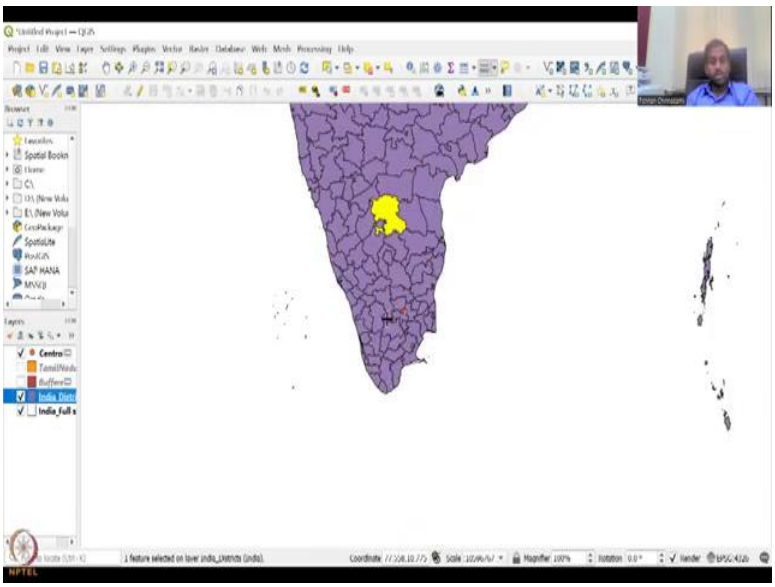

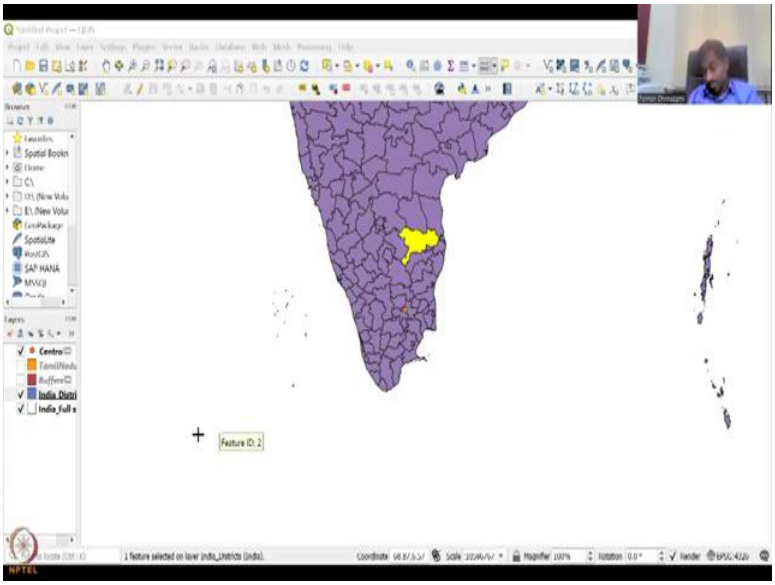

In some other data sets these are data sets which have been actually converted from different data sets. So, let us say India districts and so if you look at here you have a number of other columns, I have added the India District layer and you could see the different names different suggestions have been given, you have the first row is the first object, it is the district name is given as Andaman Islands.

So, let us leave Andaman, let us go to Andhra Pradesh which is number 2, so if I click here on the board district is there you can order it by alphabetical order or number order whatever is your preference you can order it, but the point here is it has gone to Anantapur if I click, there will be some box that highlights because it wants to see, so there it is Anantapur district has been highlighted, because I do not have any clicking here, so it has been highlighted because it was using that point as a selection. So, if I do not select it, now what happens it is moving the selection is moving.

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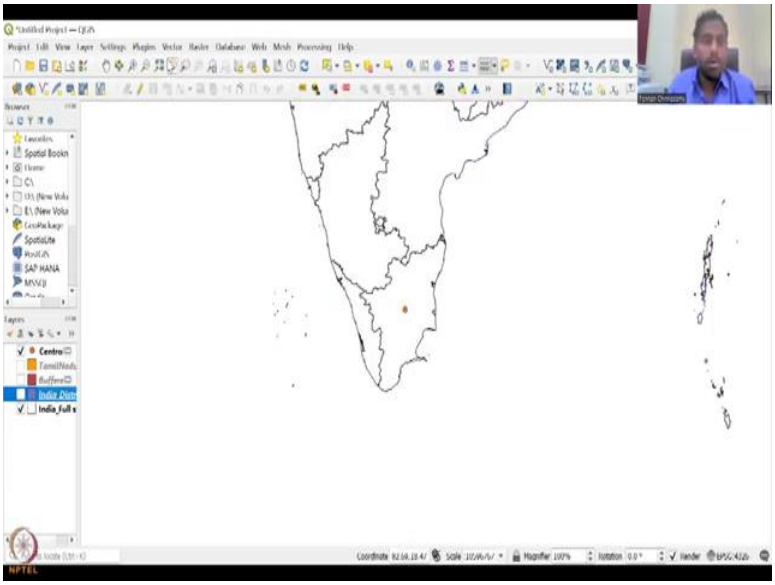

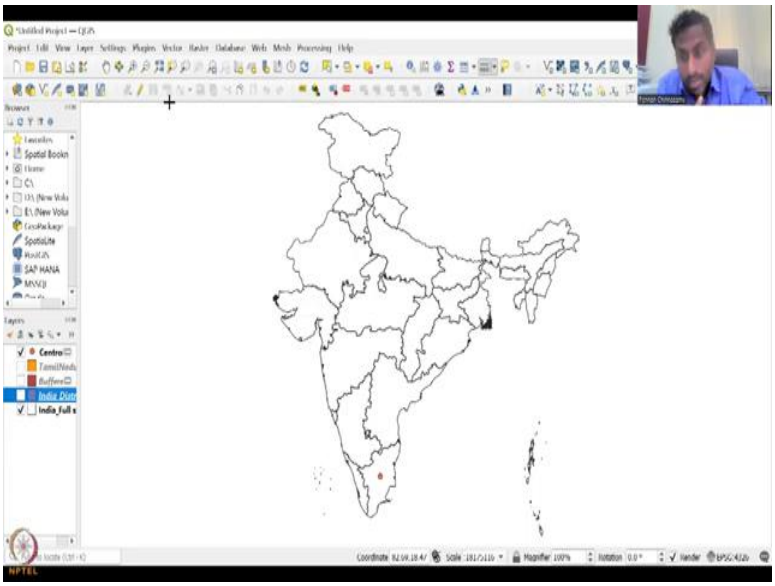

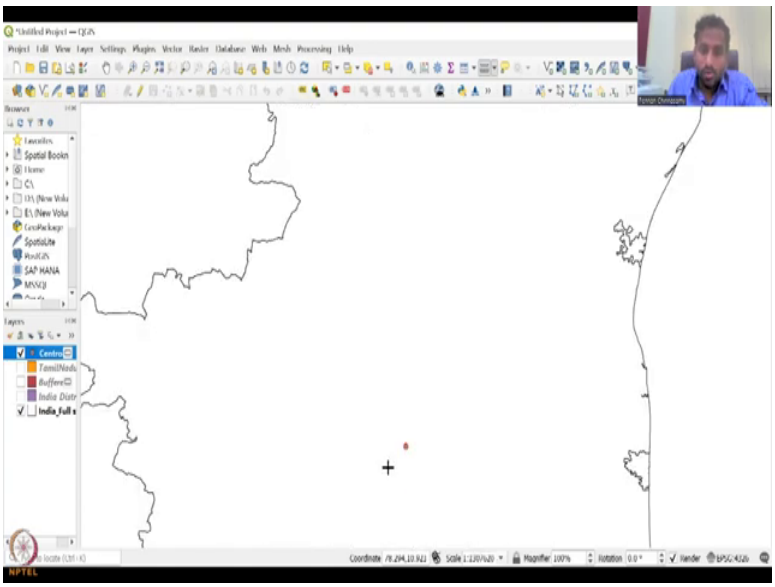

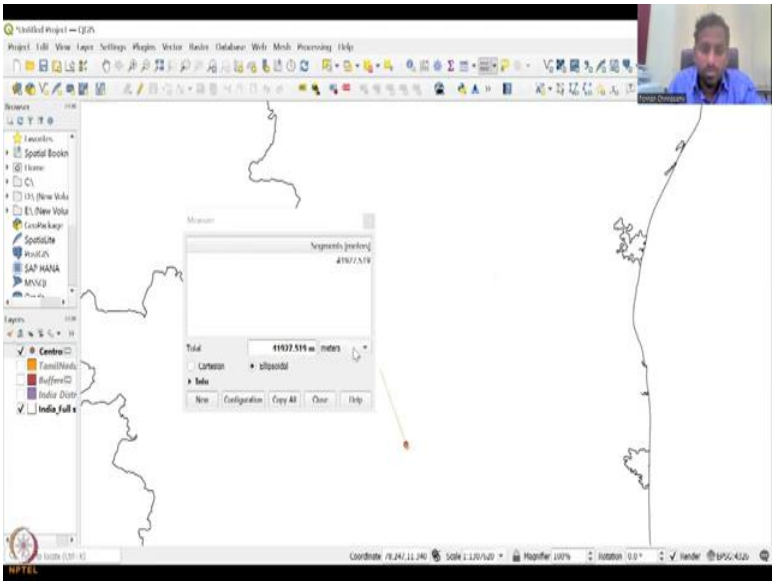
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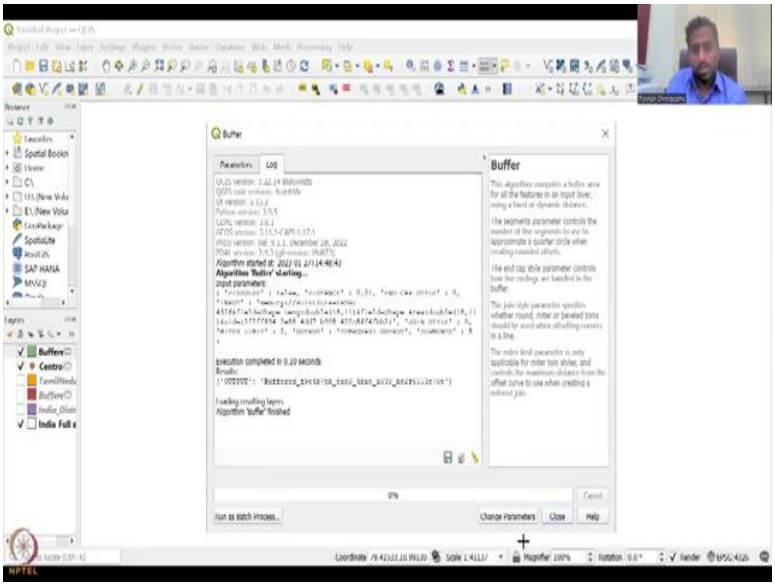
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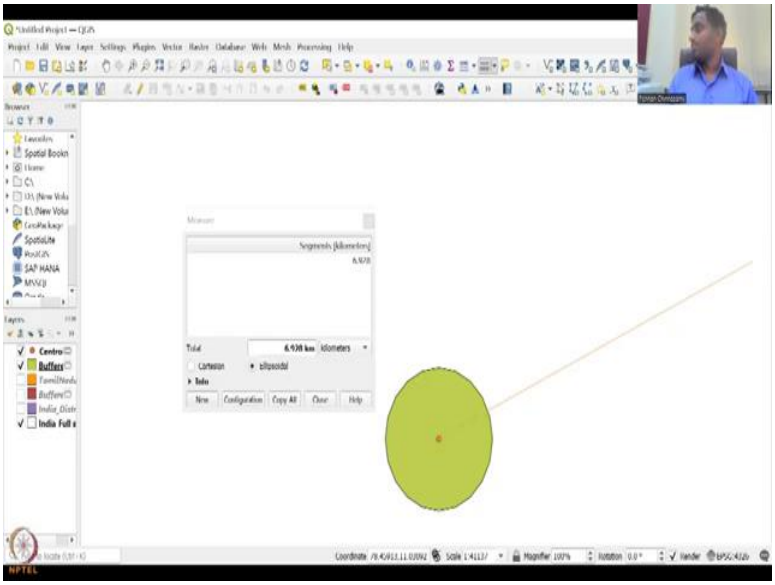
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So, these again are just a very small refresher for you to look at vector data and how to incorporate it in your boundaries you can click here again to have the bigger boundary of India. So, we have seen at least one example of a vector tool with an application buffer is very important, we can quickly also do a centroid buffer.

So, let us say as I said we have this as a school and there is a law that within 100 meters you cannot have let us say for one kilometer you see if I zoom in the point is more accurate. So, I have let us say one kilometer there should not be a any liquor shop, so this is a one meter but one meter totally around. So, if I run the buffer, it will create a circle around it saying that within the buffer you cannot have there any liquor shop.

So, we are not allowed to change this thing, so as I said one degree is 100 kilometers we are going to put one kilometre, so it will be 0.01 degree and I am going to run it, it runs it finishes it already created the buffer. So, I am going to put it on the top and now you could see that on the around the point the buffer has been created and it is at a distance of one kilometer approximately, it should be exactly one kilometer but where you click the point and the line is also there.

So, within this area we propose that there should be no liquor shop, no paan shop, because the kids are getting affected, if it is a rural Hamlet I can also say that this could be the school area catering to the one kilometer radius. So, around the one kilometer it is easier for kids to at least work rather than walking 10 kilometers, 20 kilometers like my father did for school, so that should be avoided you should conserve the energy in the kids to go to school and 1 kilometer is still long, but at least cycling they could do within 10 minutes which is also healthy.

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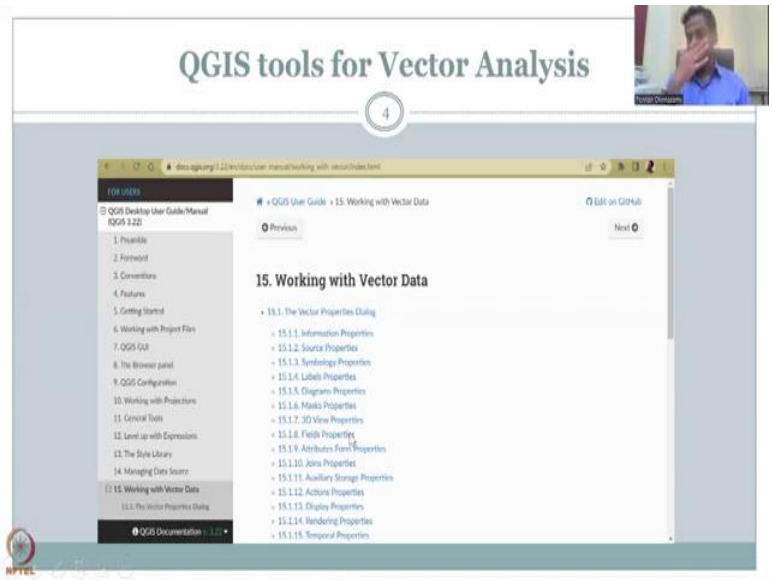

So, with this I am also going to show the remaining part of the links, where we will continue in the next class, we will be looking at the QGIS tools for vector analysis especially these parts and then we will jump into some vector analysis in the next class, with this I will stop today's lecture. Thank you.