Remote Sensing and GIS for rural development
Professor Pennan Chinnasamy
Centre for Technology Alternatives for Rural Areas (CTARA)
Indian Institute of Technology, Bombay
Lecture 39
Analyzing Bhuvan LULC data (Part 2)

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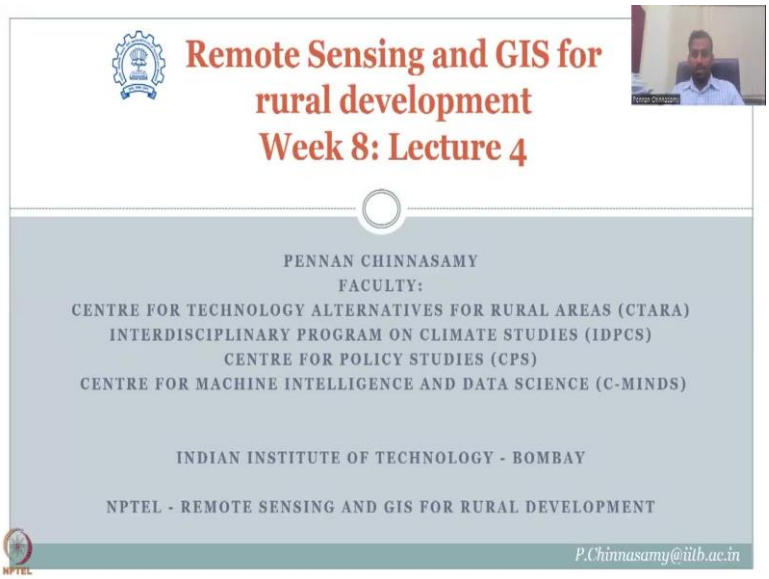

Hello everyone, welcome to Remote Sensing and GIS for Rural Development. This is week 8 lecture 4 NPTEL course. In this week, we have been looking at land use land cover as a metrics for assessing and improving rural development. Very focusly, we have looked at how accessibility to land and water are very, very important criteria for rural development. On that note, it is imperative to have good data about land use land cover and how the conversion happens from one form to the other. Which is now documented through the LULC change. Land use land cover is one phenomena. And then accessing between two different time periods or multiple time periods gives you land use land cover change.

So, in this lecture series, the initial part we looked at the land use land cover the definitions, classifications, FAO notifications. Now, we will be looking into the data that is available freely in open source systems for assessing land use land cover change. Please note that you also had looked into Google Earth as a very important tool, open source tool for downloading some metrics about land use land cover change. In the last lecture, we have looked at the Bhuvan's website and some data products.

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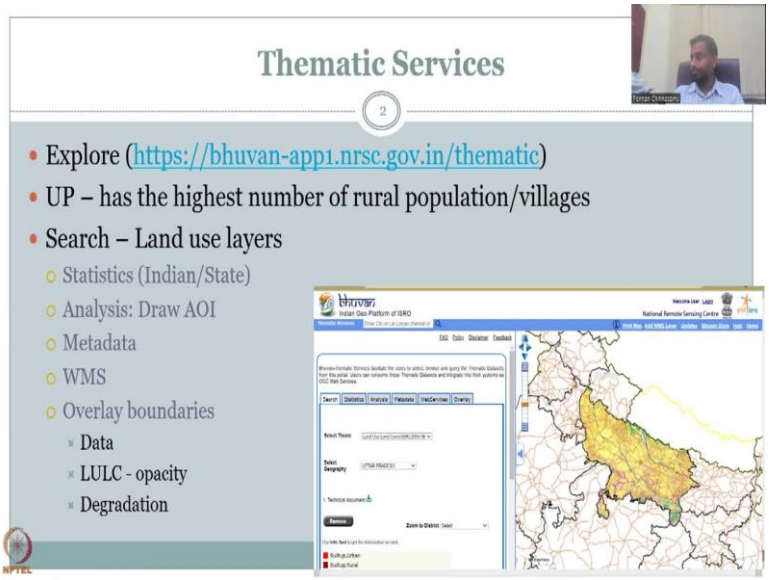

On the same note, we will continue the important tabs that are given in the Bhuvan website. Even though there is limited datasets, both spatially and temporally, I am teaching Bhuvan in one way to promote these software and data because sooner or later, I foresee that this portal and ISRO's database will compete on international platforms. Remember, the budget available for this resource is much much less compared to NASA or ESA and that is where there is a lag of data and some delay in data processing.

However, if you know how to do this, through understanding the process, and understanding the importance of the data, you will be able to do these maps by yourself. On that note, let us continue the discussion on using Bhuvan's open source system. The next lecture I will touch base on the NASA system. I still stick a lot of my exercises my mapathon with NASA data less used and a lot of new data used from ISRO and Bhuvan because as an Indian, it is my duty to promote the Indian software and Indian Space Research Data. How you can improve it is by contributing to these land use land cover changes through events like the map account that is currently going on.

Right now, we will come back to the exploration of this thematic service in Bhuvan. And as indicated will open the first tab which we already looked at UP has the highest number of rural population and villages. And then we looked at statistics Indian state analysis will draw an area of interest all these are the tabs, these are given in the tutorial, but it is not explained as a video tutorial as a NPTEL lecture so I am doing it as a lecture and then we will touch base on the statistics, analysis, metadata with WMS as I said, I will not get into much because that interfaces between the GIS software and the Bhuvan right now we are just looking at the

LULC data and then we will do some overlay boundaries and data LULC opacity and degradation. So, please allow me to share my webpage.

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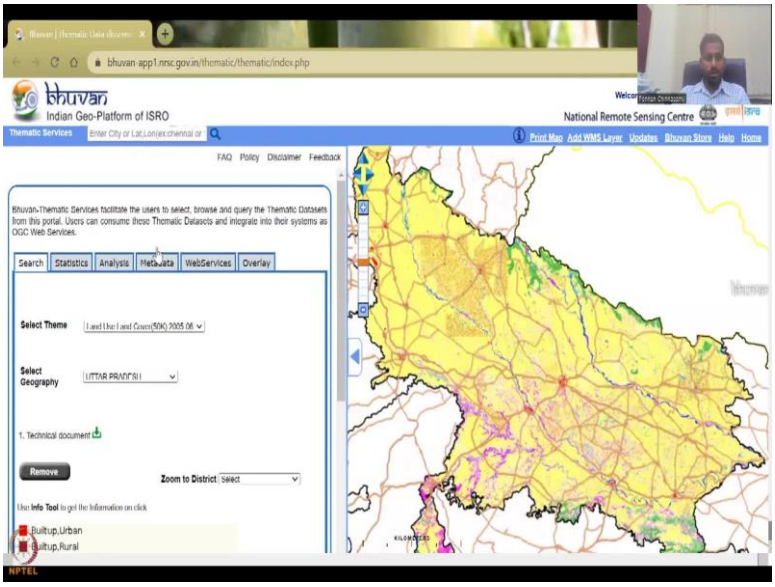

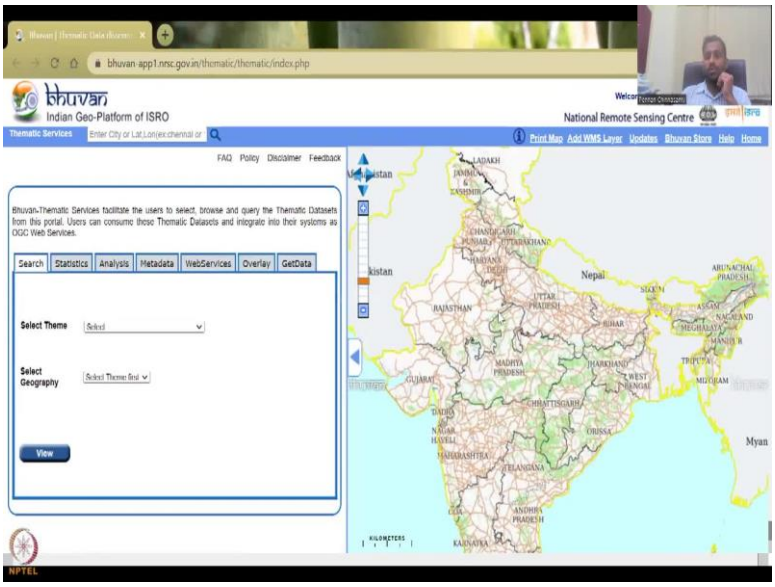

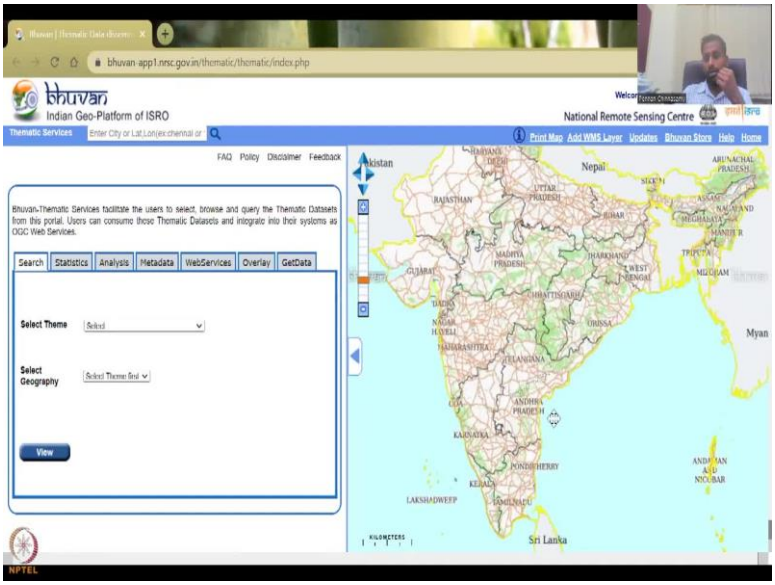
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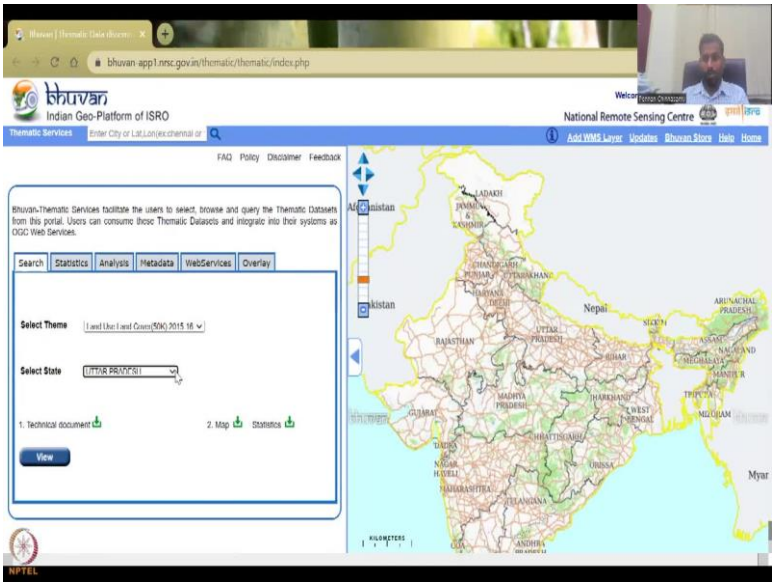
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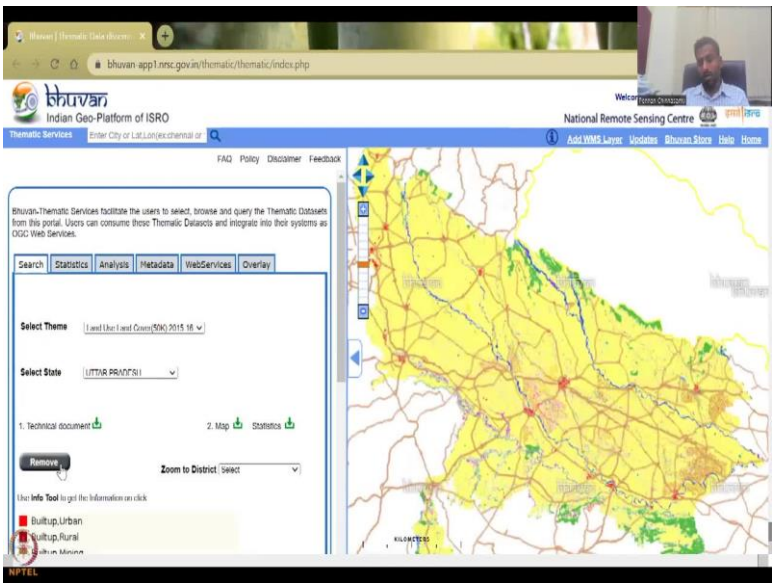
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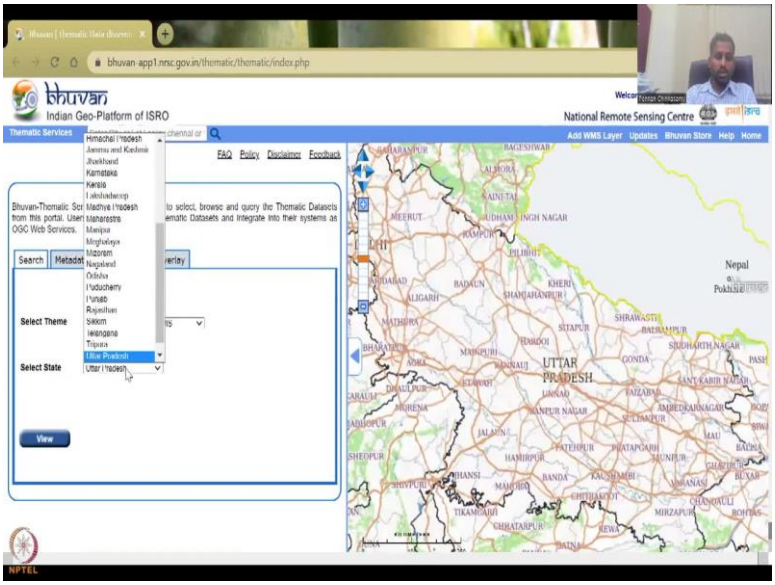
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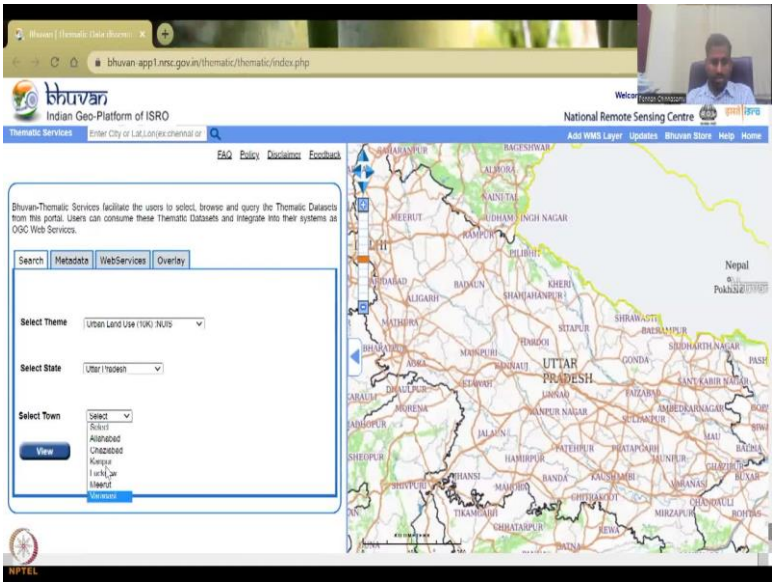
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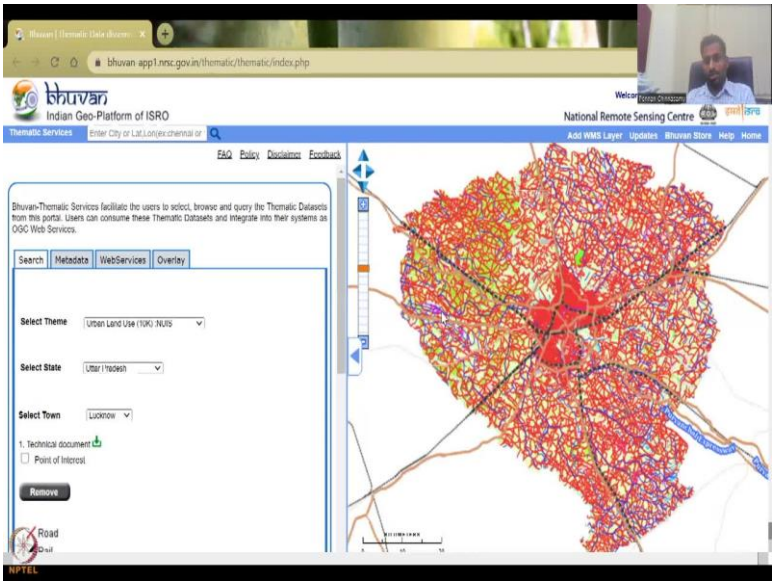
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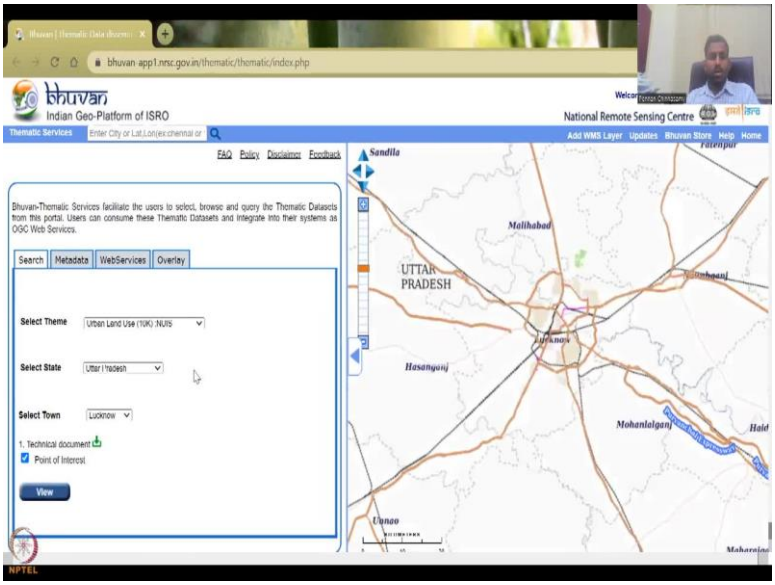
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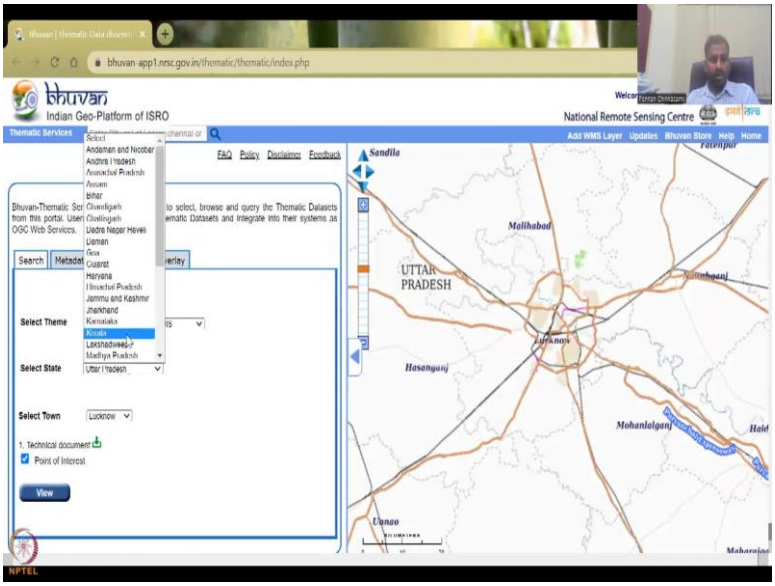
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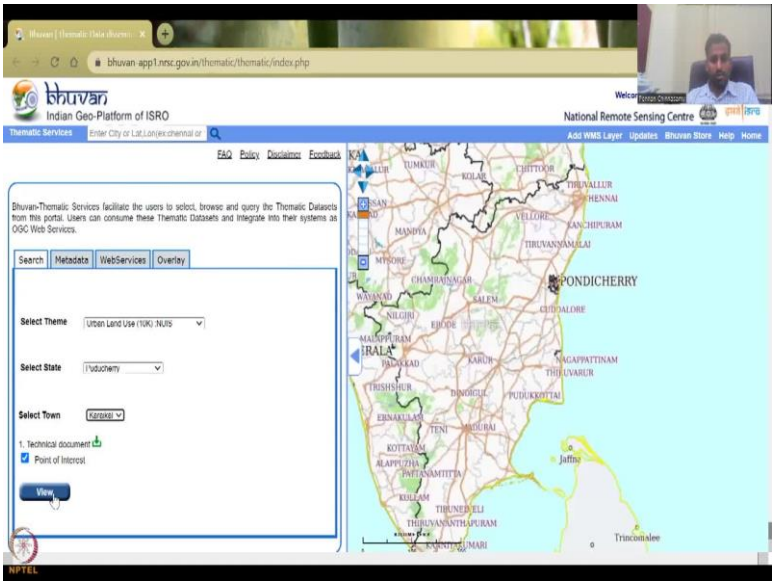
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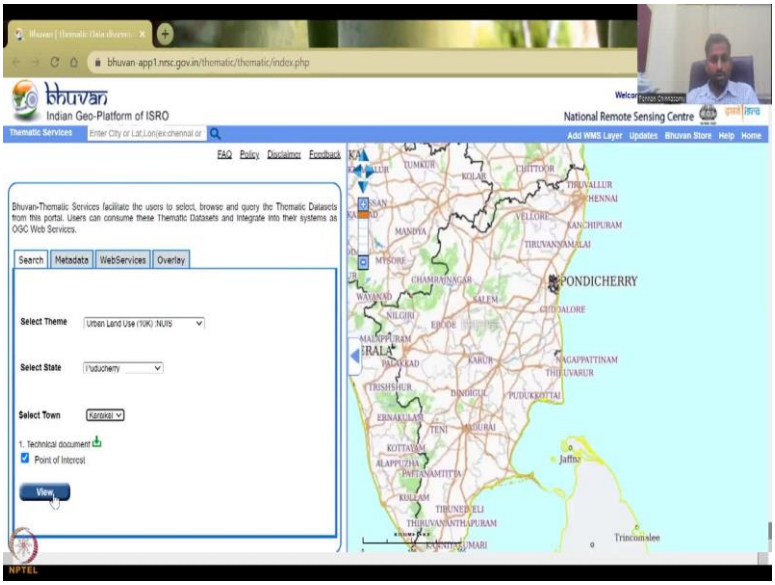
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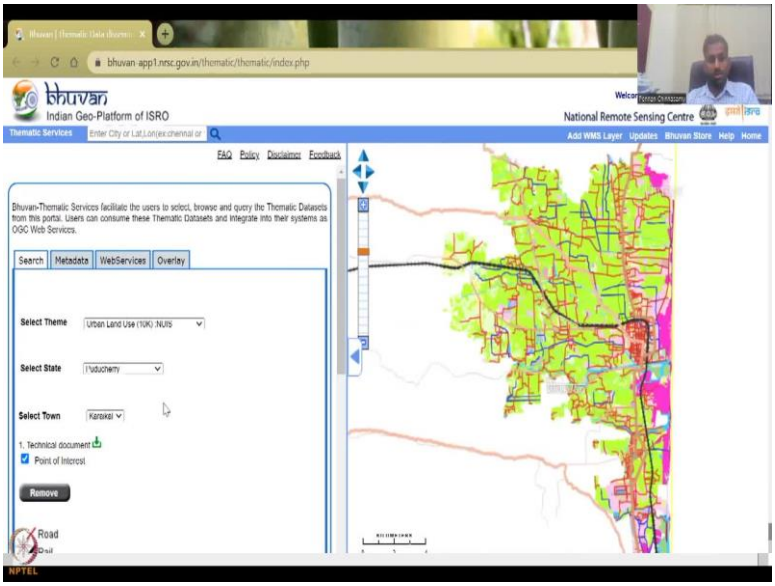
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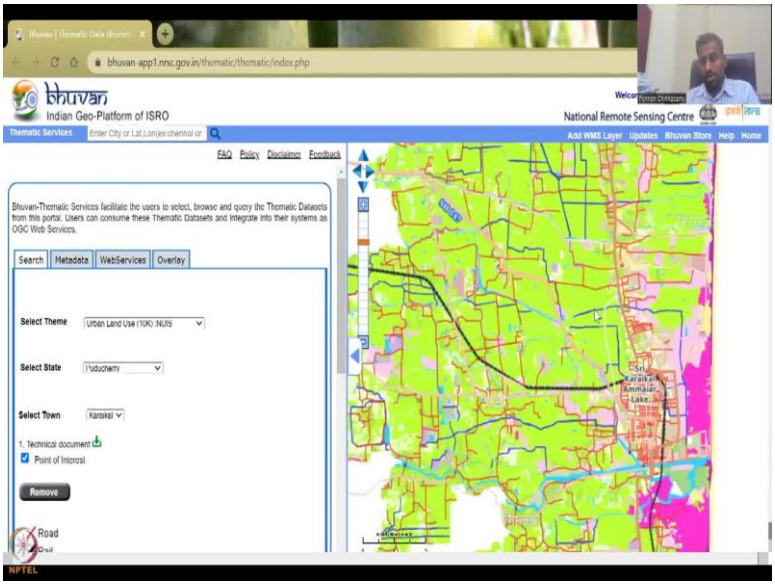
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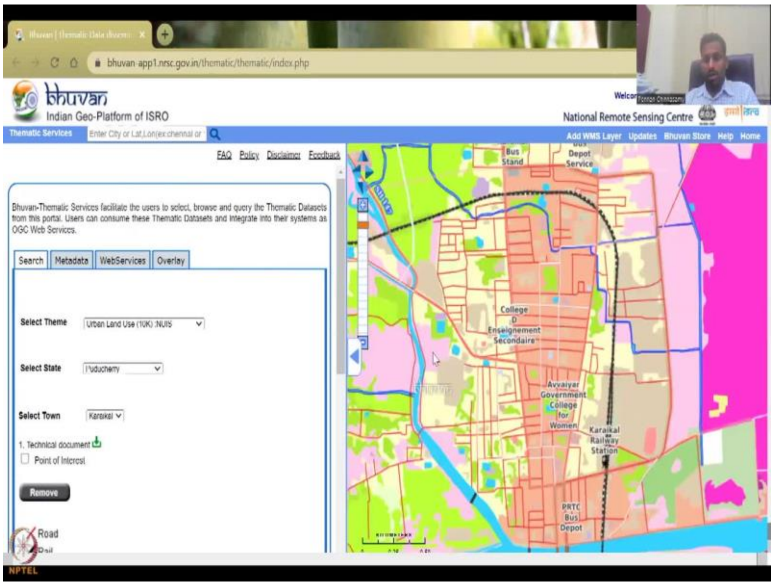
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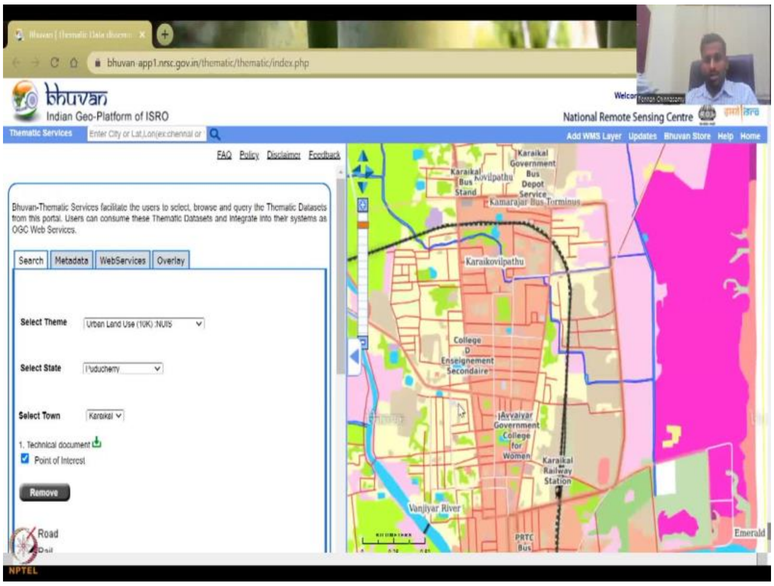
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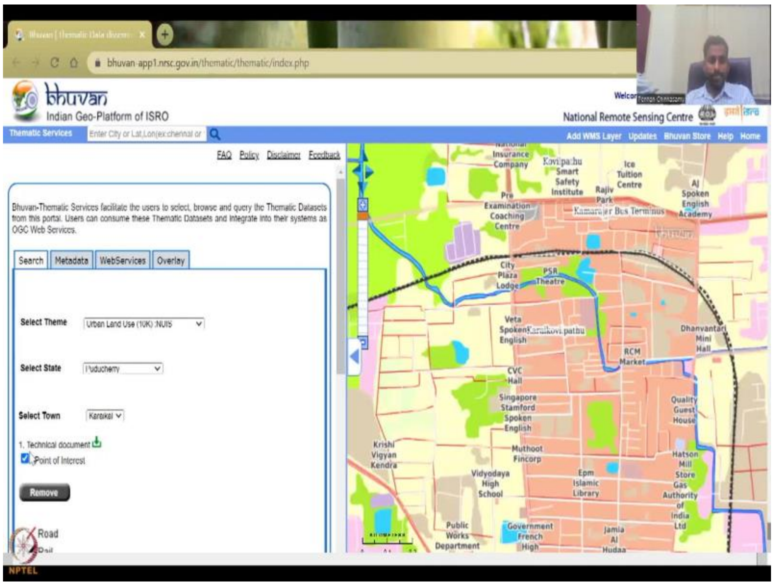
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RCM Market
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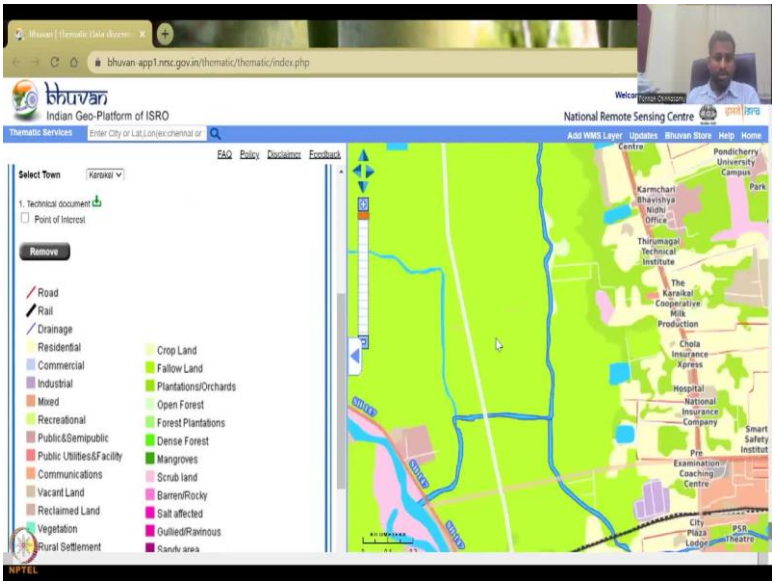

So, this is where we stopped again we can do a refresh to start from scratch, when you start you will have this India boundary and of course, India even including Andaman and Nicobar Islands, you see highlighted in yellow, Lakshadweep island etc. So now as I said, we will be doing the land use land cover the latest version, let us say 2015-2016, we will do UP because UP has highest villages and number of population, rural population and we will say view.

So, we stopped here where we analyzed the different data sets, different LULC timeframes we had, we had different resolutions 1 is to 50, 1 is to 250, and 1 is to 10. 1 is to 10,000 is too focused on the rural, urban periphery or mostly in the urban, so, we are not going to use it, we can quickly show how it is done, say UP not all states are there you could see, and only some districts are there.

So, these are the highest urban districts. And then we can just take this out for now, we can say view and you will see how the Lucknow city district has emerged. You can see the roads, the rails, drainage, some land use land cover, etc. So, point of interest, I do not know, maybe it comes up or not, it does not come up so we can remove it. We can also say Tamil Nadu for Chennai, if it has not. There is no Tamil Nadu, but there is Puducherry and there is only Karaikal you can view it. And then you can see that this is Puducherry and there is no point of interest. So point of this is not coming up.

So maybe they are working on it. So this is the 1 is to 10,000k very, very high resolution compared to your other data that you have. I am just saying that the point of Mayor Lake is a point of interest maybe. But it does not show on the dataset. If you turn on and off, there is

some things which comes so for example, this is Vanjiyar River, the bus stop is a point of interest. So if you click it, it goes up and down.

So you will see that the river names, college and then some smaller locations go up and down when we click. So this is important as the cartography image or cadastral maps, it gives you the boundaries of the urban settlements. There is very less agriculture here so you do not see much stuff but there is some plantation happening on the boundaries, some fallow land, mangroves etc.

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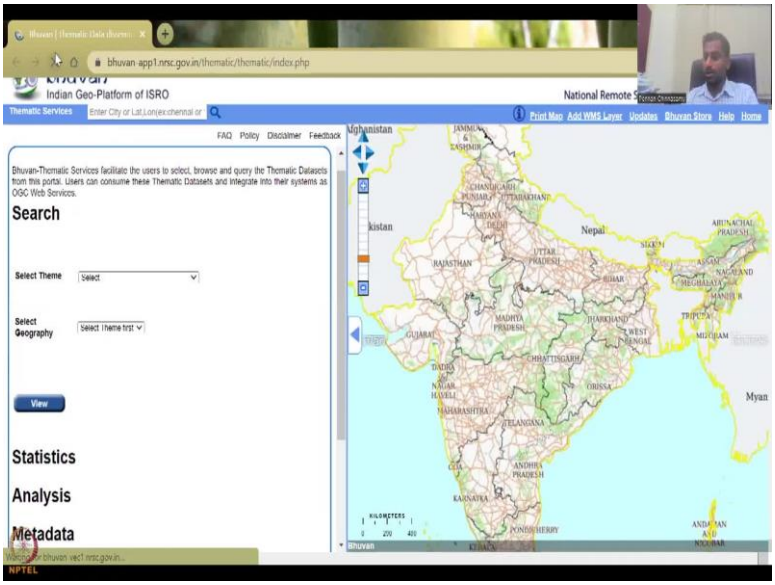

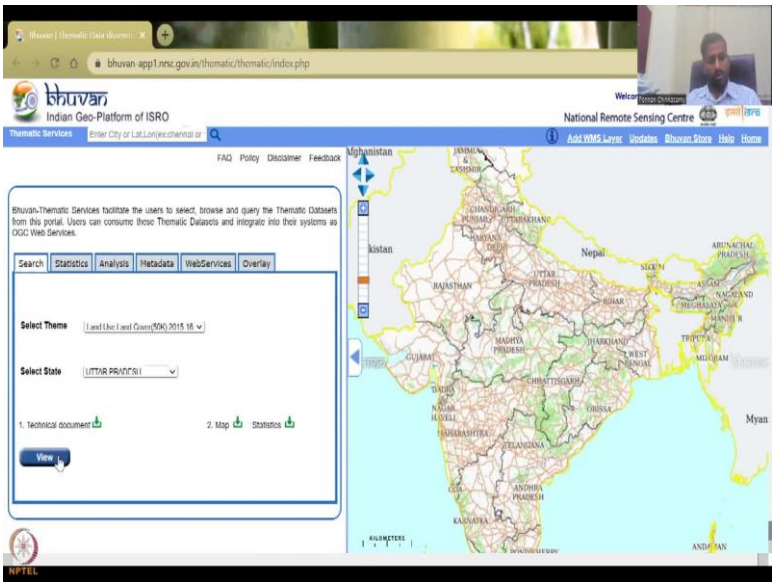

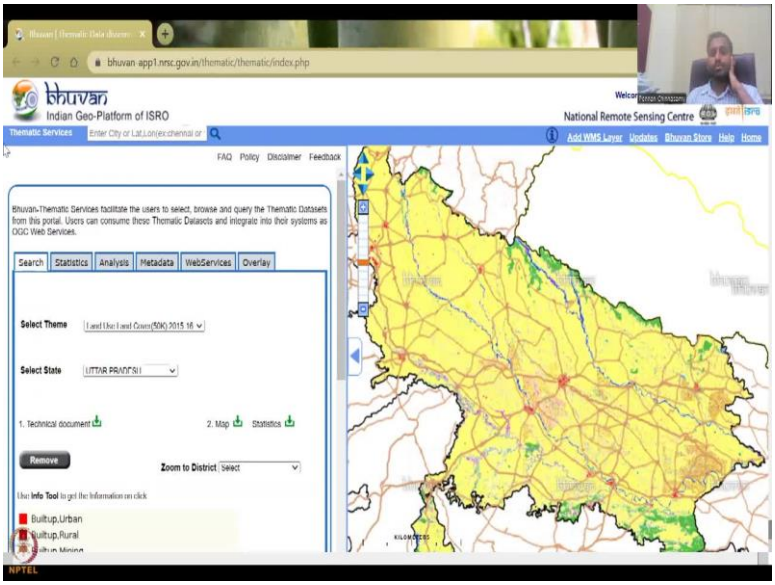
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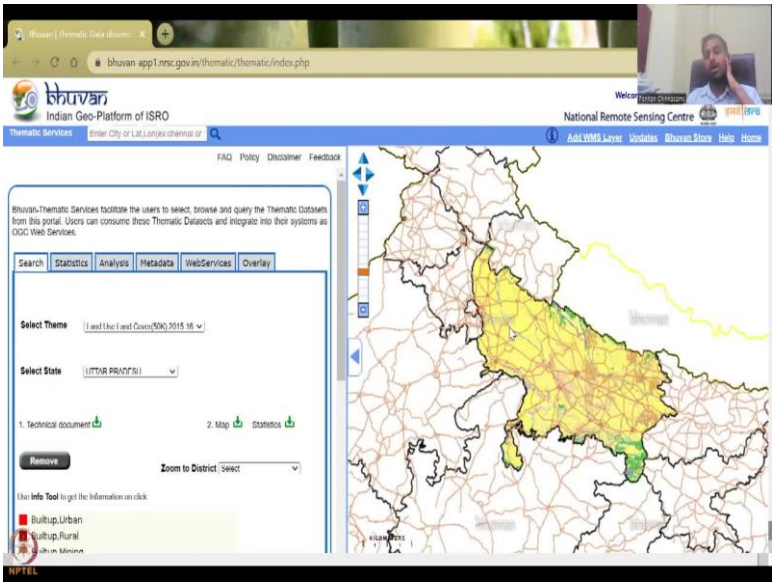
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Select
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Builtup,Rural
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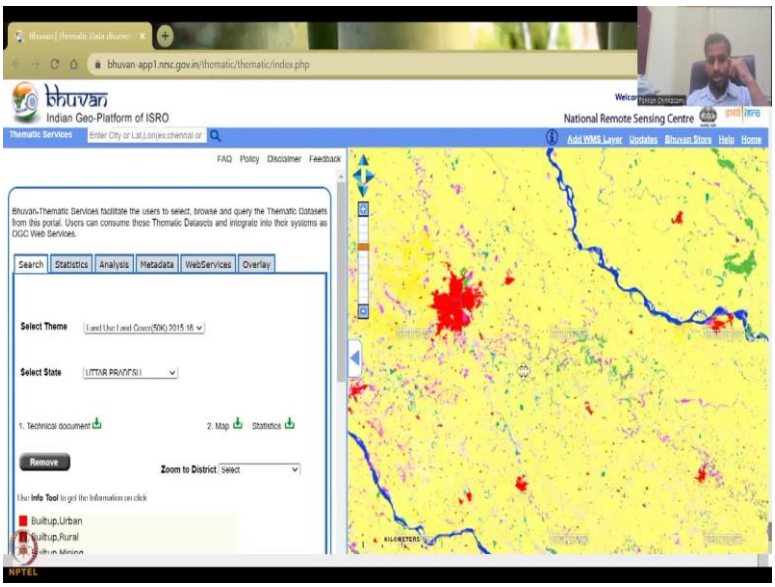
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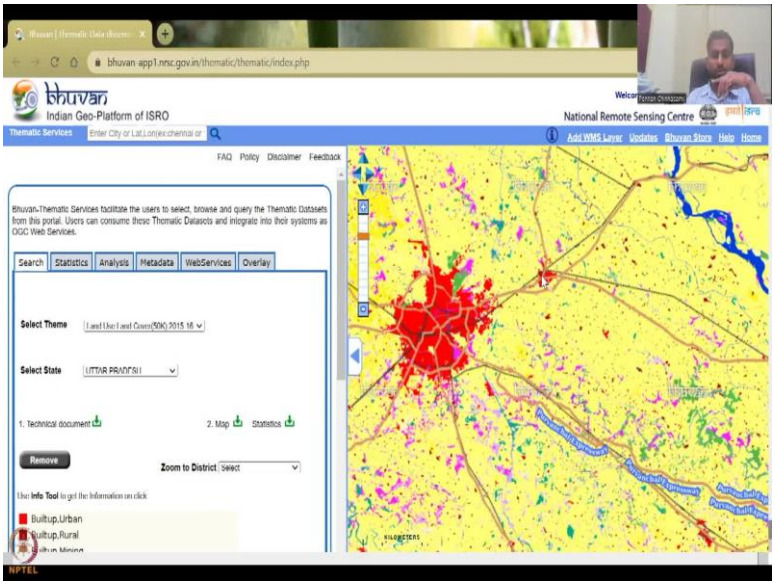
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Builtup,Rural
Builtup,Mining
Agriculture,Crop land
Agriculture,Plantation
Agriculture,Fallow
Agriculture,Current Shifting Cultivation
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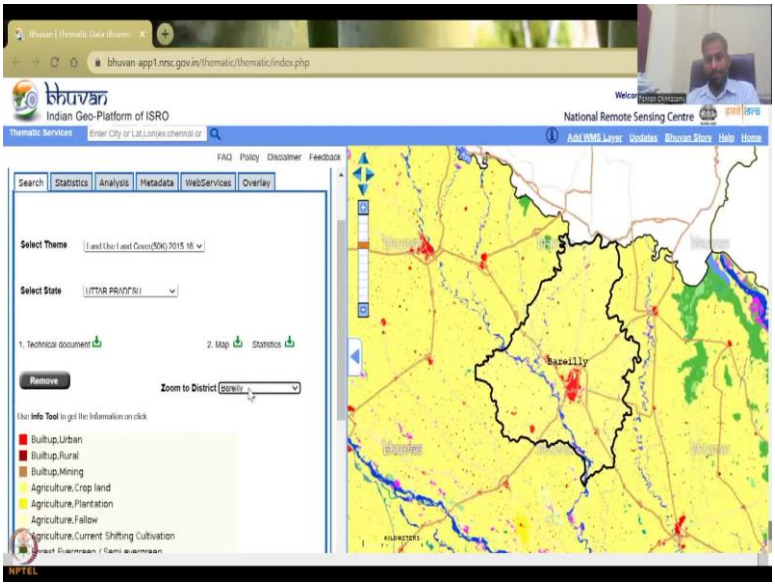
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Agriculture,Current Shifting Cultivation
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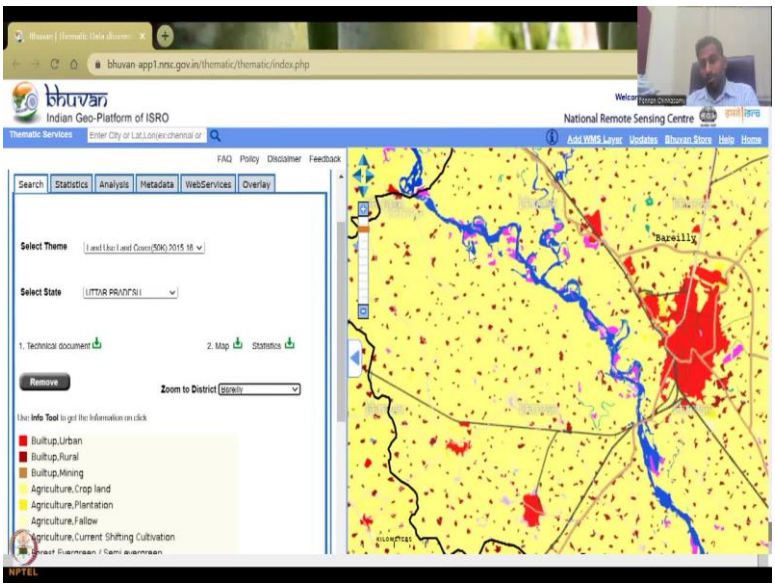
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Agriculture,Fallow
Agriculture,Current Shifting Cultivation
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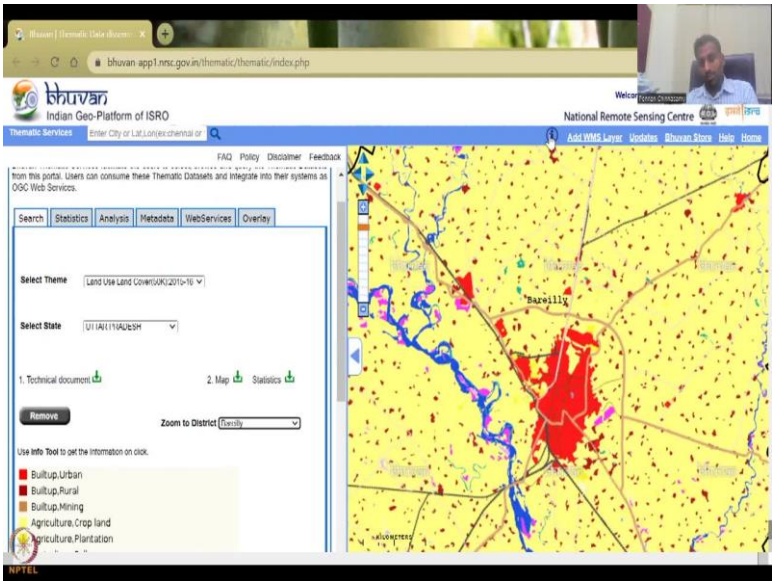
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Select State
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Zoom to District
Bareilly
Use Info Tool to get the information on click.
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Builtup,Rural
Builtup,Mining
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Agriculture,Plantation
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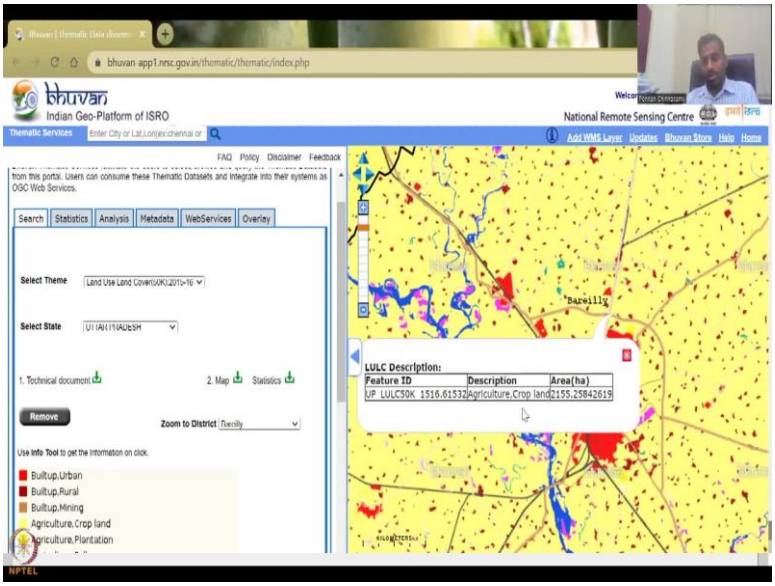
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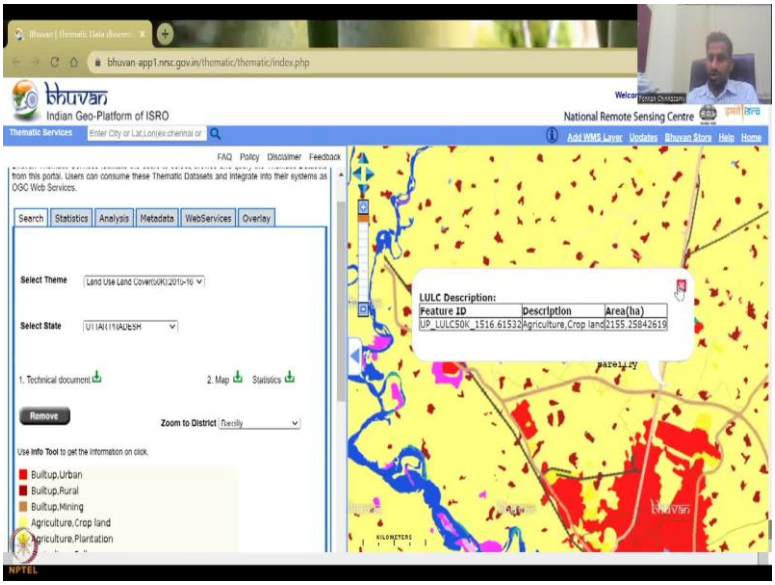
Zoom to District
Bareilly
Use Info Tool to get the information on click.
Builtup,Urban
Builtup,Rural
Builtup,Mining
Agriculture,Crop land
Agriculture,Plantation
LULC Description:
Feature ID
Description
Area(ha)
UP_LULC50K_1516.61532
Agriculture,Crop land
2155.25842619
Bareilly
KILOMETERS
NPTEL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Bareilly
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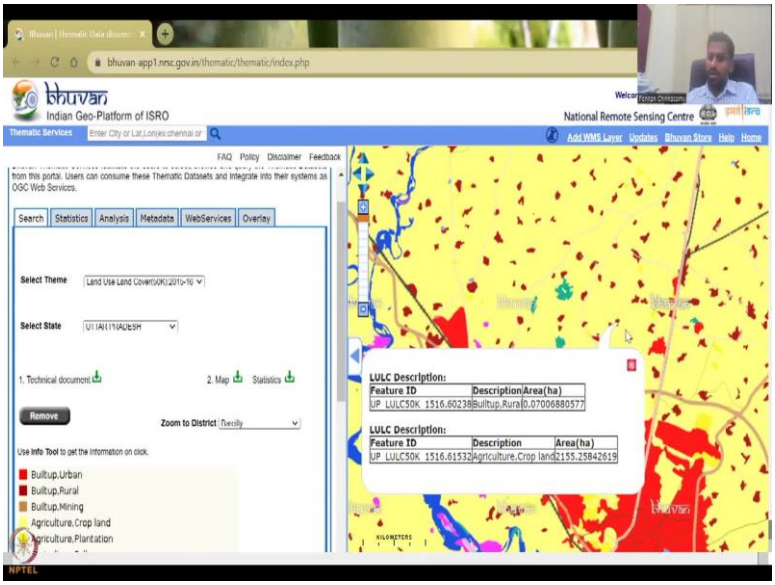
Builtup,Urban
Builtup,Rural
Builtup,Mining
Agriculture,Crop land
Agriculture,Plantation
LULC Description:
Feature ID
Description
Area(ha)
UP_LULC50K_1516.61532
Agriculture,Crop land
2155.25842619
KILOMETERS
NPTEL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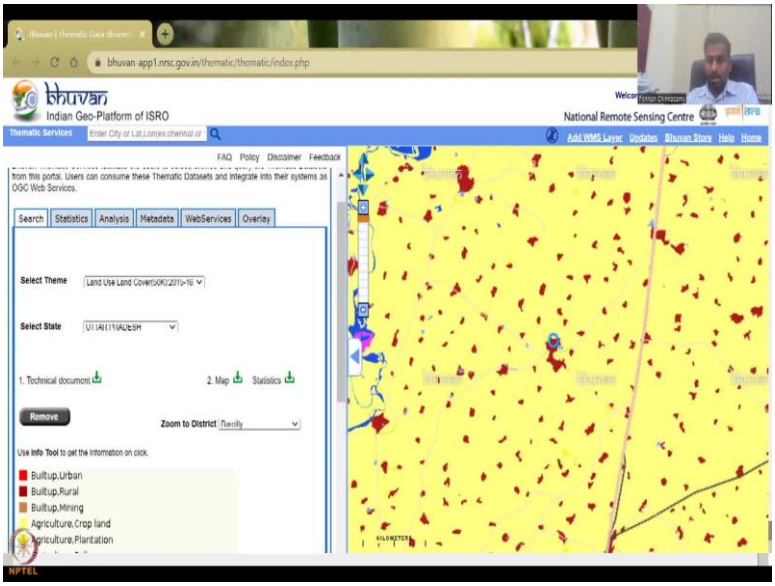
Zoom to District
Builtup,Urban
Builtup,Rural
Builtup,Mining
Agriculture,Crop land
Agriculture,Plantation
LULC Description:
Feature ID | Description | Area(ha)
UP_LULC50K_1516.60238 | Builtup,Rural | 0.07006880577
LULC Description:
Feature ID | Description | Area(ha)
UP_LULC50K_1516.61532 | Agriculture,Crop land | 2155.25842619
NPTEL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Builtup,Rural
Builtup,Mining
Agriculture,Crop land
Agriculture,Plantation
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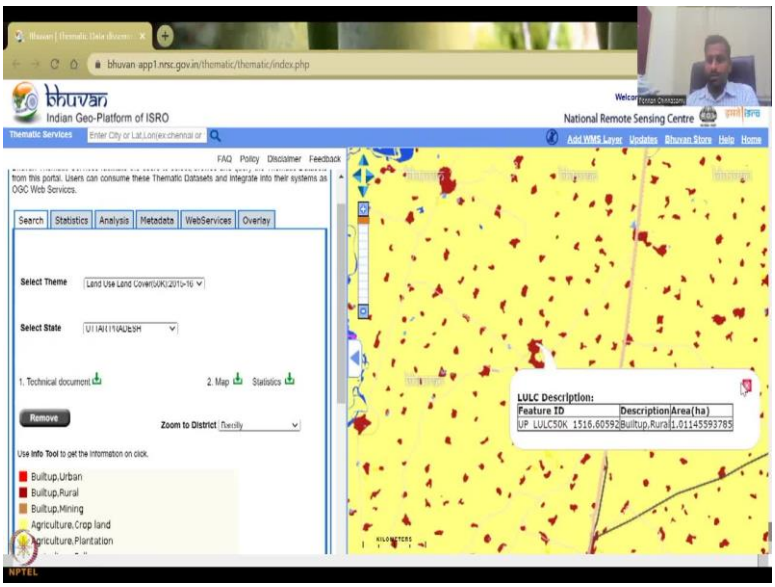
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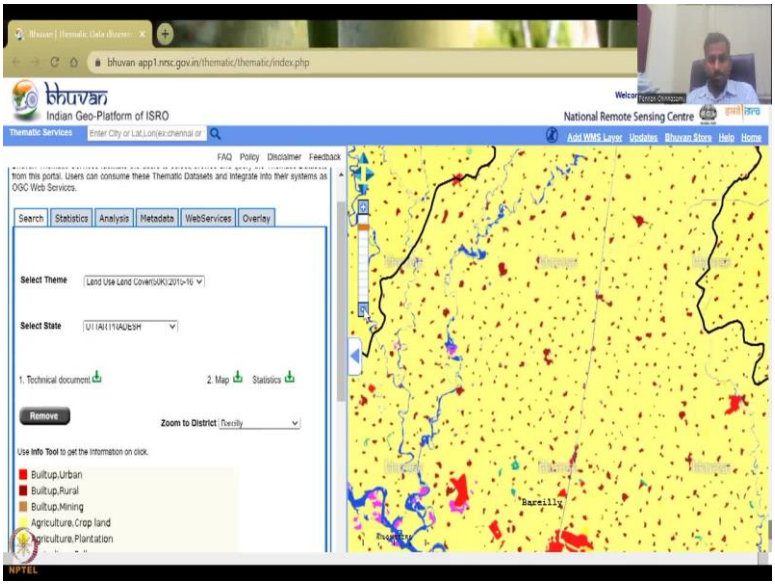
WebServices
Overlay
Select Theme
Select State
Remove
Zoom to District
LULC Description:
Feature ID | Description | Area(ha)
UP_LULC50K_1516.60592 | Builtup,Rural | 1.01145593785
Builtup,Urban
Builtup,Rural
Builtup,Mining
Agriculture,Crop land
Agriculture,Plantation
NPTEL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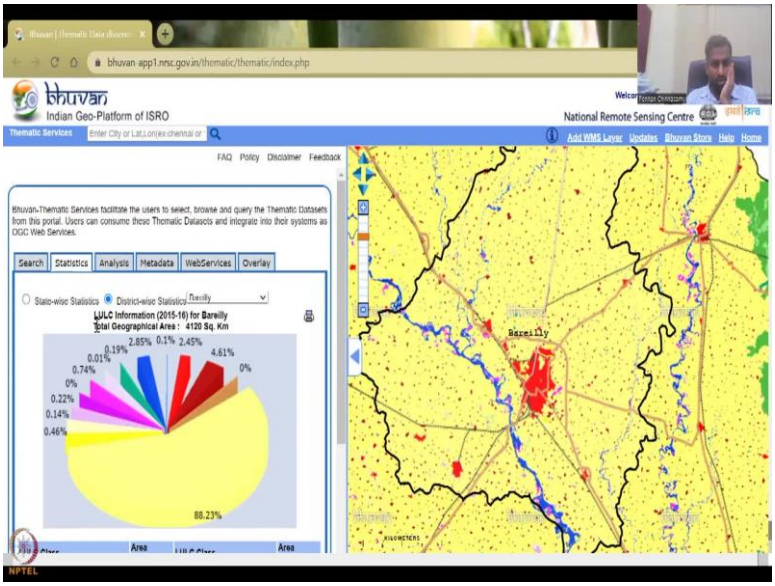
Builtup,Mining
Agriculture,Crop land
Agriculture,Plantation
Bareilly
NPTEL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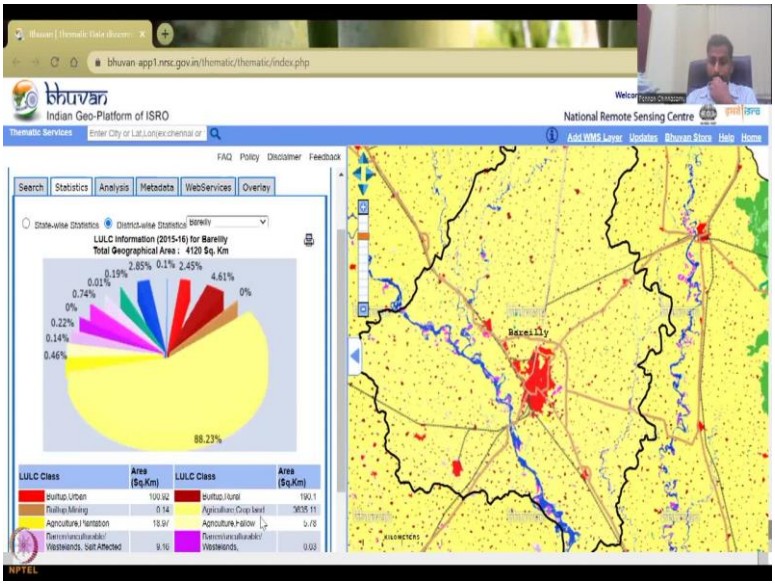
Search Statistics Analysis Metadata WebServices Overlay
State-wise Statistics
District-wise Statistics
LULC Information (2015-16) for Bareilly
Total Geographical Area : 4120 Sq. Km
2.85%
0.1%
2.45%
4.61%
0.19%
0.01%
0.74%
0%
0%
0.22%
0.14%
0.46%
88.23%
Area
Bareilly
NPTEL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State-wise Statistics
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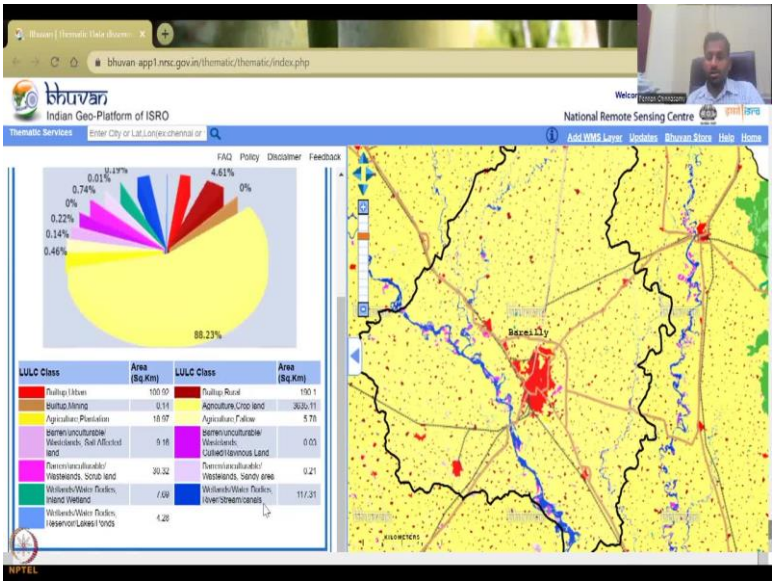
LULC Information (2015-16) for Bareilly
Total Geographical Area : 4120 Sq. Km
2.85%
0.1%
2.45%
4.61%
0.19%
0.01%
0.74%
0%
0%
0.22%
0.14%
0.46%
88.23%
LULC Class
Area (Sq.Km)
Builtup,Urban
100.92
Builtup,Rural
190.1
Builtup,Mining
0.14
Agriculture,Crop land
3635.11
Agriculture,Plantation
19.97
Agriculture,Fallow
0.78
Barren/unculturable/ Wastelands, Salt Affected
9.16
Barren/unculturable/ Wastelands,
0.03
Bareilly
NPTEL



So let us go back to our initial discussion on UP where we will look into the 2015-2016 land use land cover depending on your computer speed and internet speed, it will take some time so please give it some time. And then you can see that this image has been populated. It is a beautiful image of the entire land use land cover in UP with a lot of districts and village boundaries. If you zoom in you will see all these boundaries. The big NH roads are also connected. So you can see that this there is a small grayish line which gives you the different set of boundaries. It could be district village, Taluk boundary etc etc.

So, as I said let us go to Bareilly. We have this because I want to also see the Ganges plain, floodplain and stuff. So, you could see that there is a lot of rural settlements across Bareilly and you have this info tool already is done. So, what it says is you can also use this info tool. So this is really good to see what is the information on each parcel for example, here, it says LULC description is agriculture, cropland and the acerage is this 2155 hectares.

Do not pay attention to the number of decimals, it is too many decimals. It is done because the pixels calculate by itself, and you have different locations. So if you, for example, click on this one, it should pick up as a rural, built up rural, and you could see it is a very, very, very small area. This is how much you can zoom in, you can zoom in as much as you can, and then it does not zoom any see to move out.

So this is a rural urban, I am sorry, rural settlement housing, so you can see that it is built up rural. It is very, very small hectare, one hectare, approximately the land holding size of the farmers. So now we are Bareilly again, I will take out the info letter. So you have all this done for Bareilly the land use land cover is done, we are happy.

Now we will go to the different aspects that are given in the table. So let us do the statistics for this particular location. So district wise for Bareilly, so you can see that LULC information for 2015 16 of Bareilly of the total area, you could see that 83 percent is agriculture cropland. So all the statistics you do not have to do so normally how, as I said, a master's student or a PhD student doing the thesis would have to do all this by the by the GIS layers, download it, give it colors, and then extract the pixels that are agriculture and then put a total. So the master's thesis will take approximately one year working on this GIS layer. But now with a click of a button, you get all this data for 2015 2016.

So a quick question can come as find in UP, which is the district with highest number of agricultural land, and you can Google it and find it. Yes, but let us do a quick Google and find that but before that we can also see it from here so for example, this is 83, 88 percent. But just looking at the different districts, you can see that other districts have very less urbanization compared to this Bareilly, so Bareilly even though it is fully agricultural, there is a little bit of a city as I said Bareilly does take some part of urbanization.

So, there is 4.61 percent of rural area has been taken up 2.45 percent is your urbanization urban part. So, if you look at it, what this statistic say is your built up urban is lesser than the built up rural but in the image you can see that red is big. So, the idea here is even though the red is big, the small small, rural urban, which is maroon so the small small rural built up accumulates into a bigger area than the urban built up so this is where it is very important to do a land use land cover assessment, because it gives you the accumulation of all these small parcels, all these small parcels is very, very difficult for the land surveyor to map to calculate the area and bring it as a table.

Whereas in GIS format using remote sensing satellite data, the color can be extracted and the color can now be cumulative added to get a net addition of total rural built up area. And now you could see that that is 4.61 percent You could also see that the other parts is very less 2.85 percent is the water and that is this the ganges tributaries that flow through Bareilly of these tributaries and the water bodies. But more importantly, you have a better idea now of the statistical division of this area.

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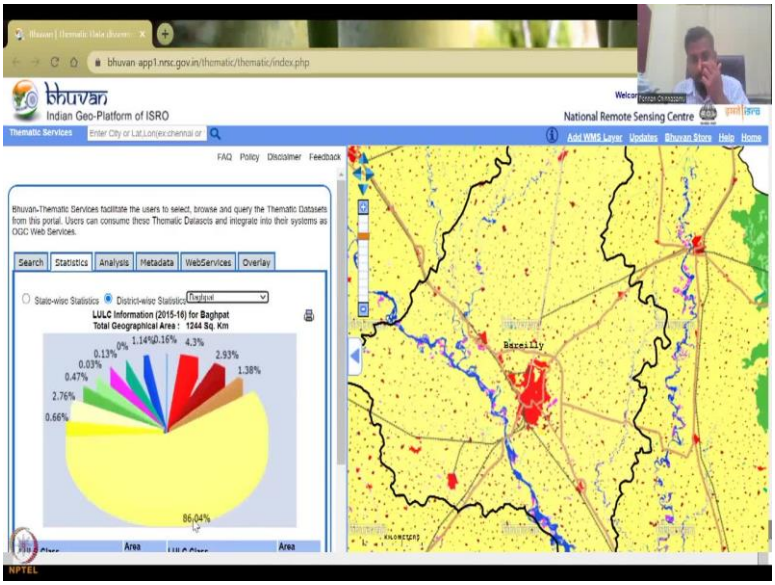

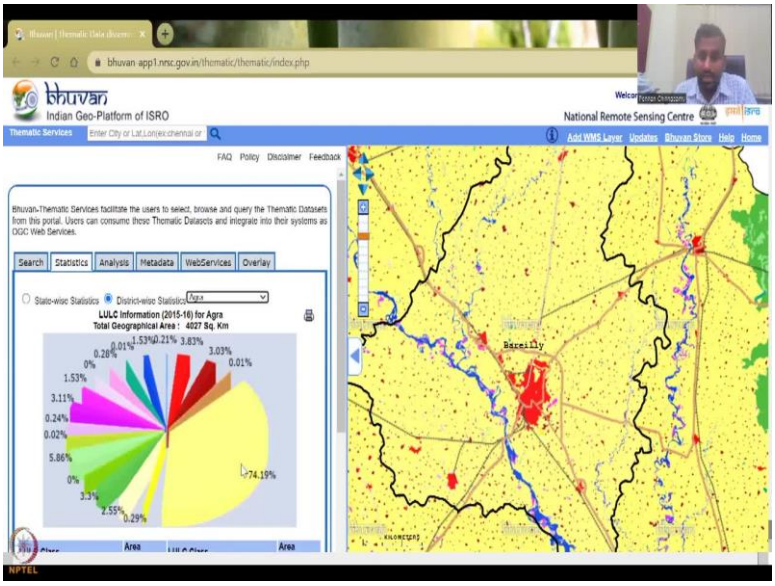

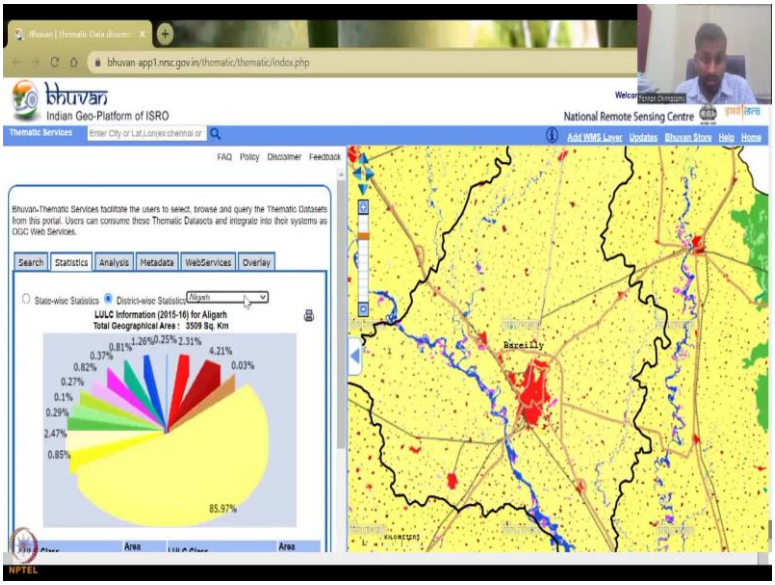

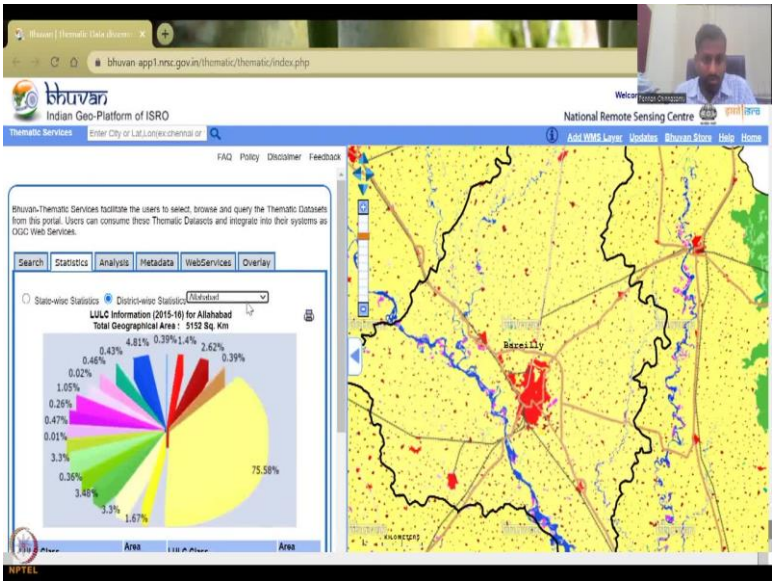
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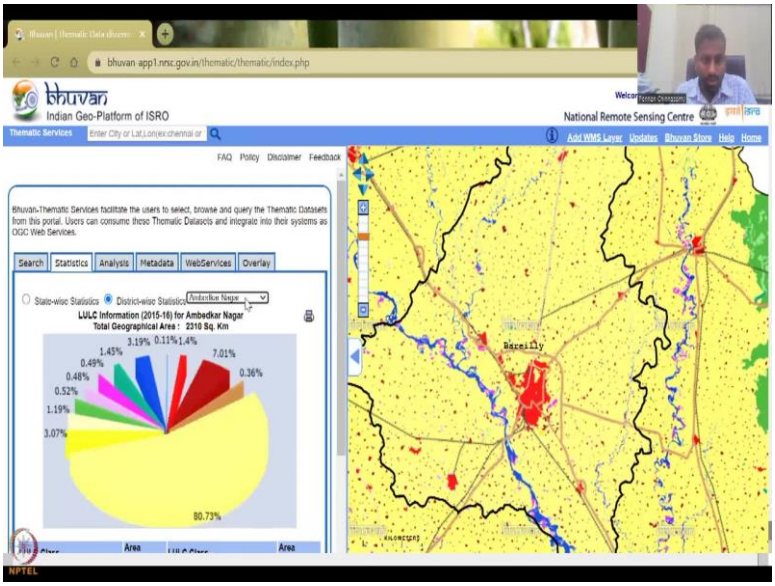
State-wise Statistics District-wise Statistics Allahabad
LULC Information (2015-16) for Allahabad
Total Geographical Area : 5152 Sq. Km
4.81% 0.39% 1.4% 2.62% 0.39% 0.43% 0.46% 0.02% 1.05% 0.26% 0.47% 0.01% 3.3% 0.36% 3.48% 3.3% 1.67% 75.58%
Area
Bareilly
NPTEL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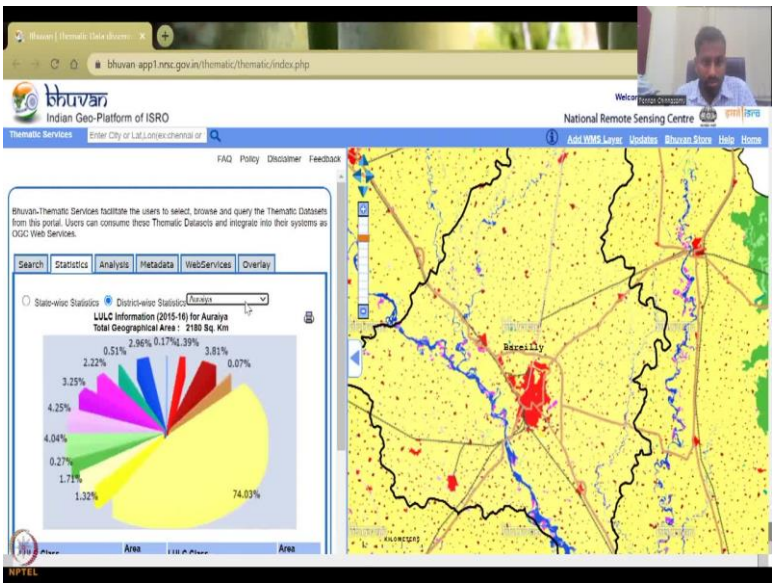
Search Statistics Analysis Metadata WebServices Overlay
State-wise Statistics District-wise Statistics Ambedkar Nagar
LULC Information (2015-16) for Ambedkar Nagar
Total Geographical Area : 2310 Sq. Km
1.45% 3.19% 0.11% 1.4% 7.01% 0.49% 0.36% 0.48% 0.52% 1.19% 3.07% 80.73%
Area
Bareilly
NPTEL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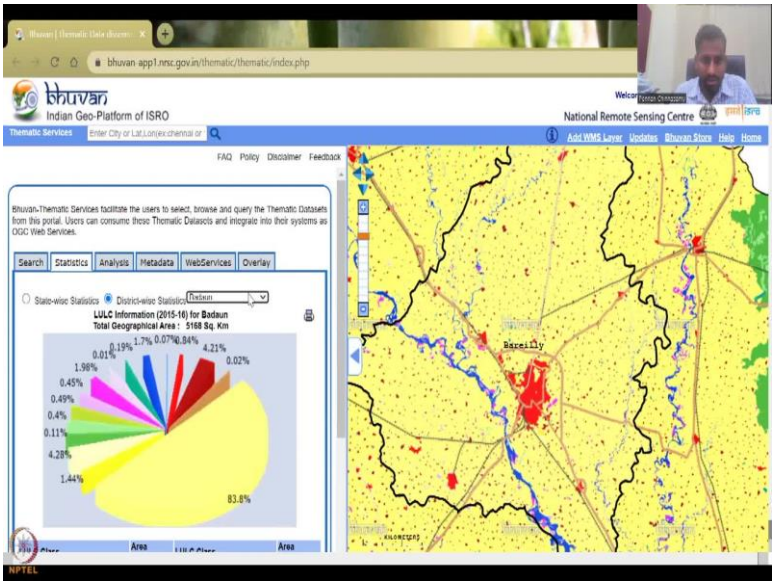
State-wise Statistics District-wise Statistics Auraiya
LULC Information (2015-16) for Auraiya
Total Geographical Area : 2180 Sq. Km
0.51% 2.96% 0.17% 1.39% 3.81% 0.07% 2.22% 3.25% 4.25% 4.04% 0.27% 1.71% 1.32% 74.03%
Area
Bareilly
NPTEL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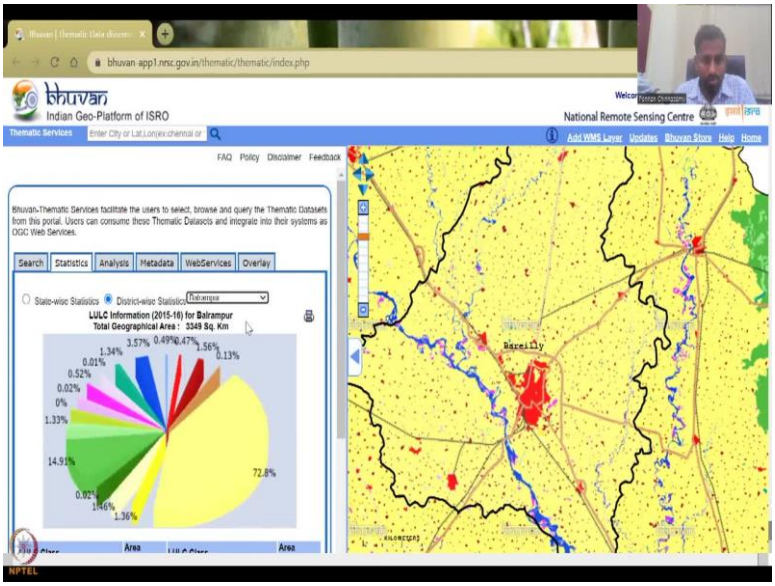
State-wise Statistics
District-wise Statistics
Badaun
LULC Information (2015-16) for Badaun
Total Geographical Area : 5168 Sq. Km
0.19%
1.7%
0.07%
0.84%
4.21%
0.01%
0.02%
1.98%
0.45%
0.49%
0.4%
0.11%
4.28%
1.44%
83.8%
Area
Area
Bareilly
NPTEL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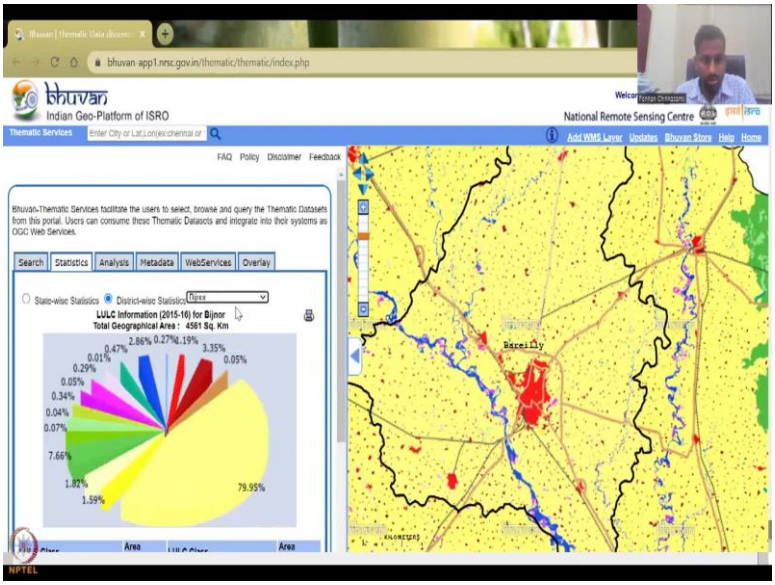
Overlay
State-wise Statistics
District-wise Statistics
Balrampur
LULC Information (2015-16) for Balrampur
Total Geographical Area : 3349 Sq. Km
1.34%
3.57%
0.49%
0.47%
1.56%
0.13%
0.01%
0.52%
0.02%
0%
1.33%
14.91%
72.8%
0.92%
1.46%
1.36%
Area
Area
Bareilly
NPTEL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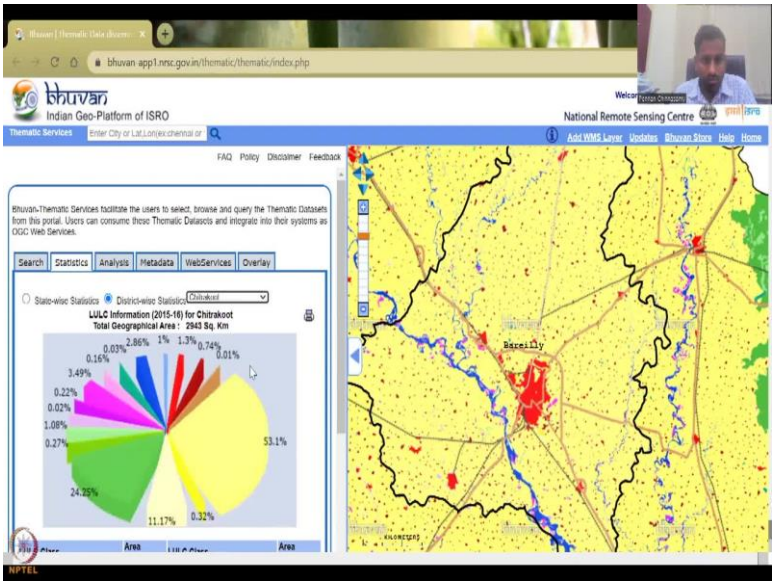
State-wise Statistics
District-wise Statistics
Bijnor
LULC Information (2015-16) for Bijnor
Total Geographical Area : 4561 Sq. Km
0.47%
2.86%
0.27%
4.19%
3.35%
0.01%
0.05%
0.29%
0.05%
0.34%
0.04%
0.07%
7.66%
1.82%
79.95%
1.59%
Area
Area
Bareilly
NPTEL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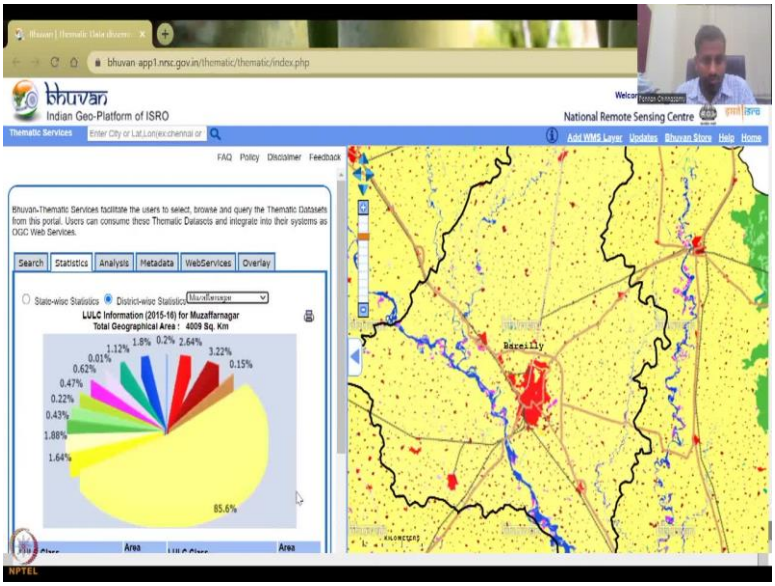
State-wise Statistics District-wise Statistics Chitrakoot
LULC Information (2015-16) for Chitrakoot
Total Geographical Area : 2943 Sq. Km
2.86% 1% 1.3% 0.74% 0.01% 0.03% 0.16% 3.49% 0.22% 0.02% 1.08% 0.27% 53.1% 24.25% 11.17% 0.32%
Area
Bareilly
NPTEL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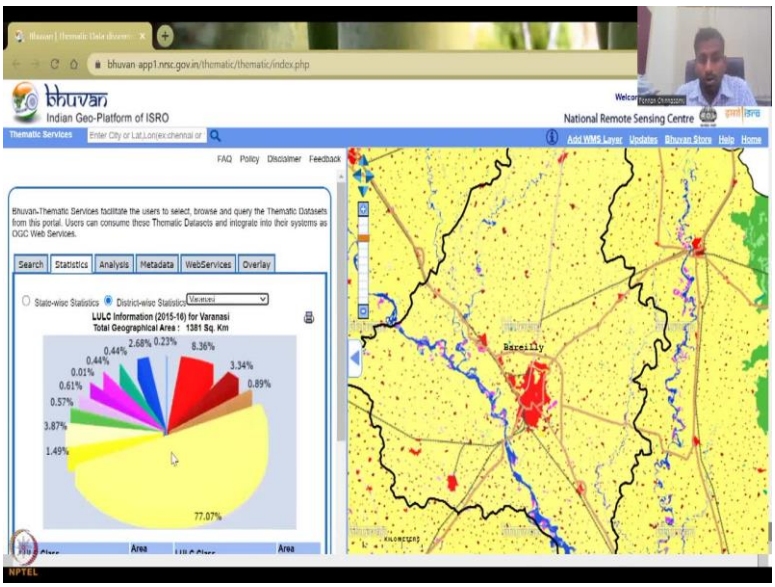
State-wise Statistics District-wise Statistics Muzaffarnagar
LULC Information (2015-16) for Muzaffarnagar
Total Geographical Area : 4009 Sq. Km
1.12% 1.8% 0.2% 2.64% 3.22% 0.15% 0.01% 0.62% 0.47% 0.22% 0.43% 1.88% 1.64% 85.6%
Area
Bareilly
NPTEL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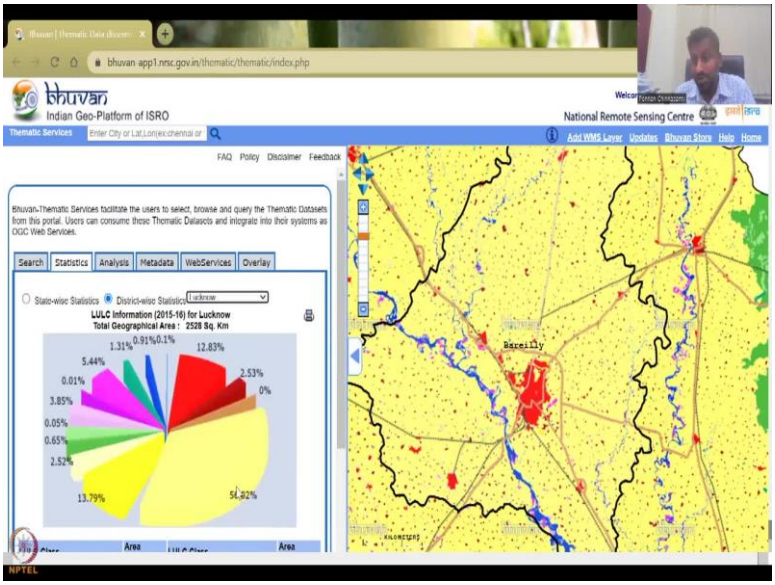
State-wise Statistics District-wise Statistics Varanasi
LULC Information (2015-16) for Varanasi
Total Geographical Area : 1381 Sq. Km
0.44% 2.68% 0.23% 8.36% 0.44% 0.01% 3.34% 0.61% 0.89% 0.57% 3.87% 1.49% 77.07%
Area
Bareilly
NPTEL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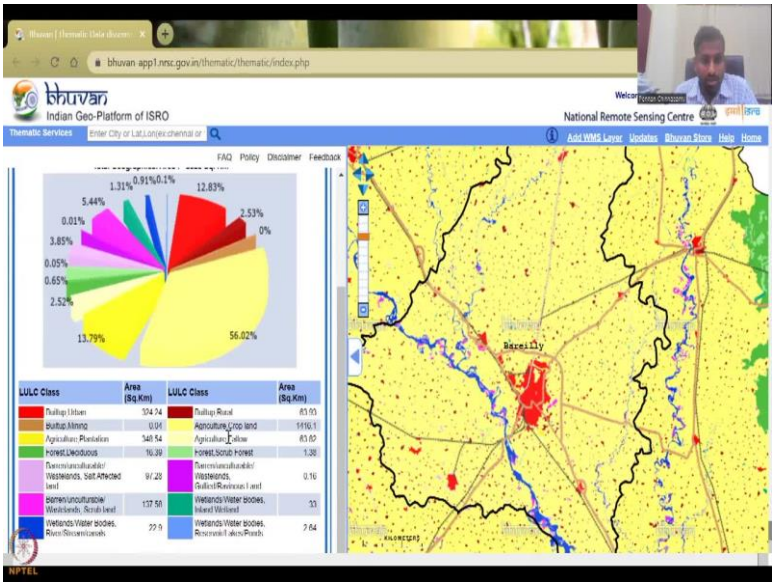
State-wise Statistics District-wise Statistics Lucknow
LULC Information (2015-16) for Lucknow
Total Geographical Area : 2528 Sq. Km
1.31% 0.91% 0.1% 12.83% 5.44% 2.53% 0% 0.01% 3.85% 0.05% 0.65% 2.52% 13.79% 56.82%
Area
Bareilly
NPTEL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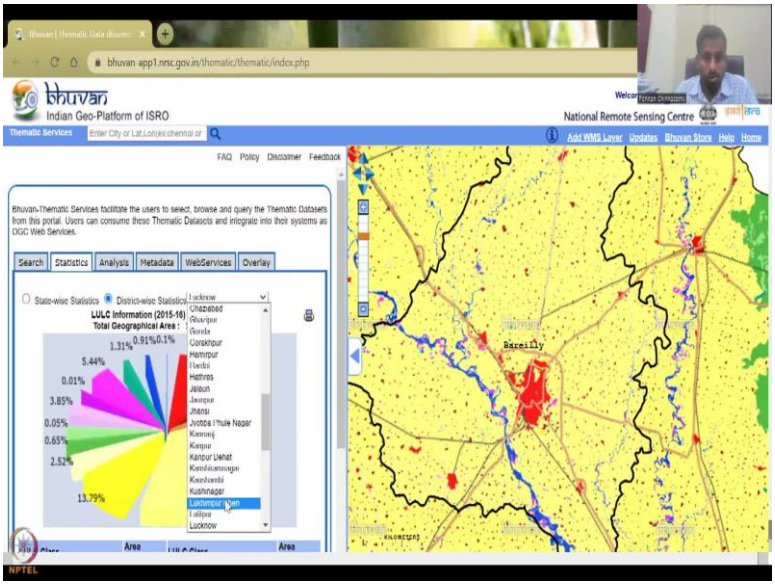
1.31% 0.91% 0.1% 12.83% 5.44% 2.53% 0% 0.01% 3.85% 0.05% 0.65% 2.52% 13.79% 56.02%
LULC Class
Area (Sq.Km)
Built-up Urban 104.74
Built-up Rural 83.93
Built-up Mining 0.04
Agriculture Crop land 1419.1
Agriculture Plantation 148.54
Agriculture Fallow 83.62
Forest Deciduous 16.39
Forest Scrub Forest 1.38
Barren/uncultivable/ Wastelands, Salt Affected land 97.28
Barren/uncultivable/ Wastelands, Gullied/Ravinous Land 0.16
Barren/uncultivable/ Wastelands, Scrub land 137.58
Wetlands/Water bodies, Inland Wetland 33
Wetlands/Water bodies, River/Reservoir/ponds 22.9
Wetlands/Water bodies, Reservoir/Lakes/Ponds 7.64
Bareilly
NPTEL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State-wise Statistics District-wise Statistics Lucknow
LULC Information (2015-16)
Total Geographical Area :
1.31% 0.91% 0.1% 5.44% 0.01% 3.85% 0.05% 0.65% 2.52% 13.79%
Ghaziabad
Ghazipur
Gonda
Gorakhpur
Hamirpur
Hardoi
Hathras
Jalaun
Jaunpur
Jhansi
Jyotiba Phule Nagar
Kannauj
Kanpur
Kanpur Dehat
Kanshiramnagar
Kaushambi
Kushinagar
Lakhimpur Kheri
Lalitpur
Lucknow
Area
Bareilly
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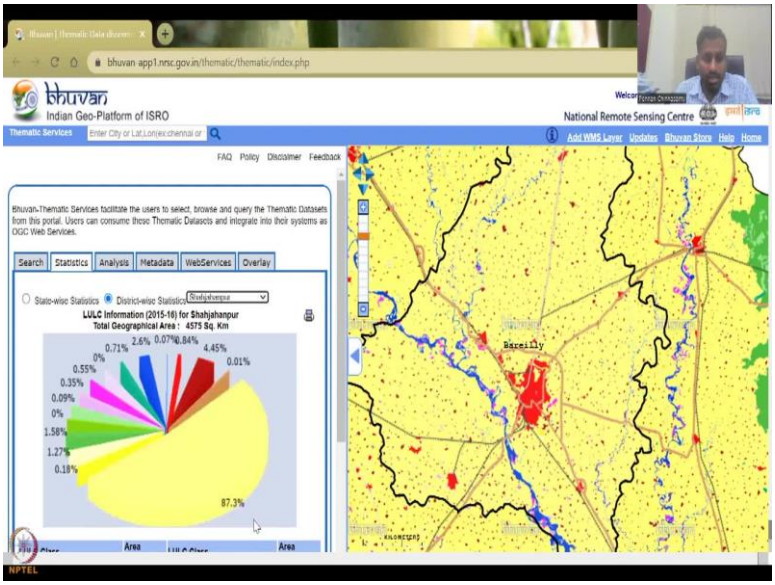
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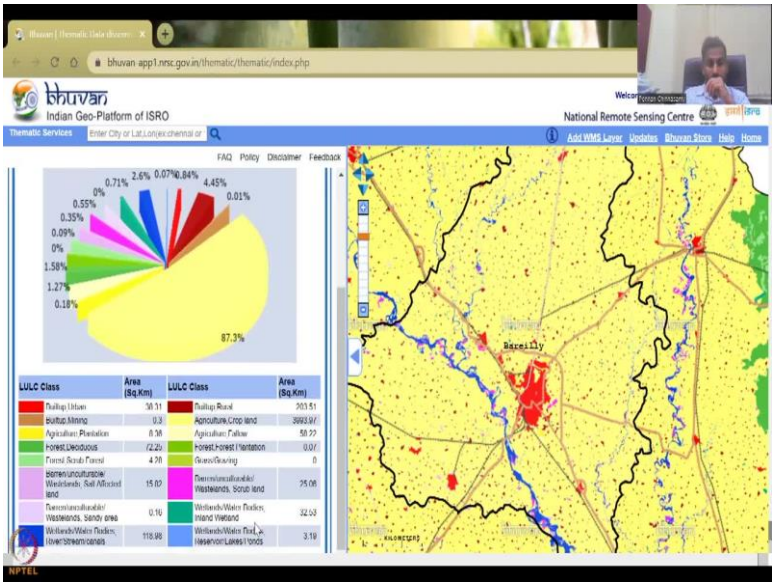
LULC Information (2015-16) for Shahjahanpur
Total Geographical Area : 4575 Sq. Km
0.71% 2.6% 0.07% 0.84% 4.45% 0.01% 0% 0.55% 0.35% 0.09% 0% 1.58% 1.27% 0.18% 87.3%
Bareilly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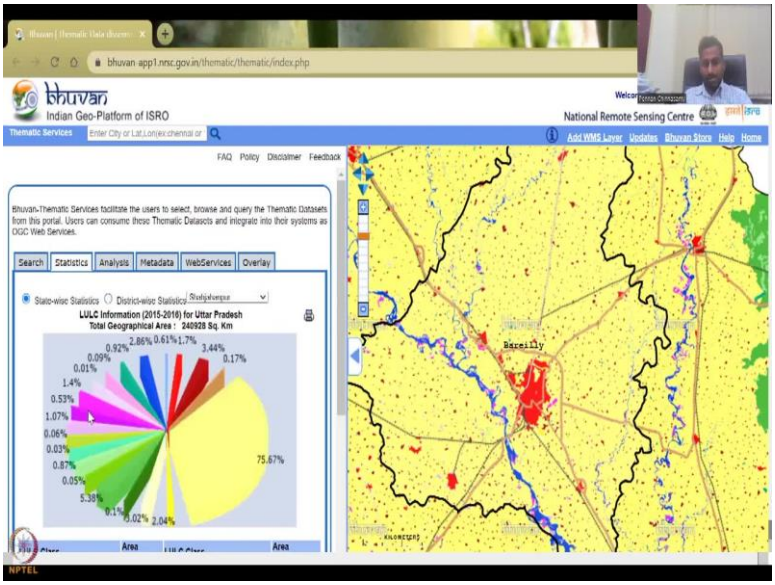
0.71% 2.6% 0.07% 0.84% 4.45% 0.01% 0% 0.55% 0.35% 0.09% 0% 1.58% 1.27% 0.18% 87.3%
LULC Class
Area (Sq.Km)
Bareilly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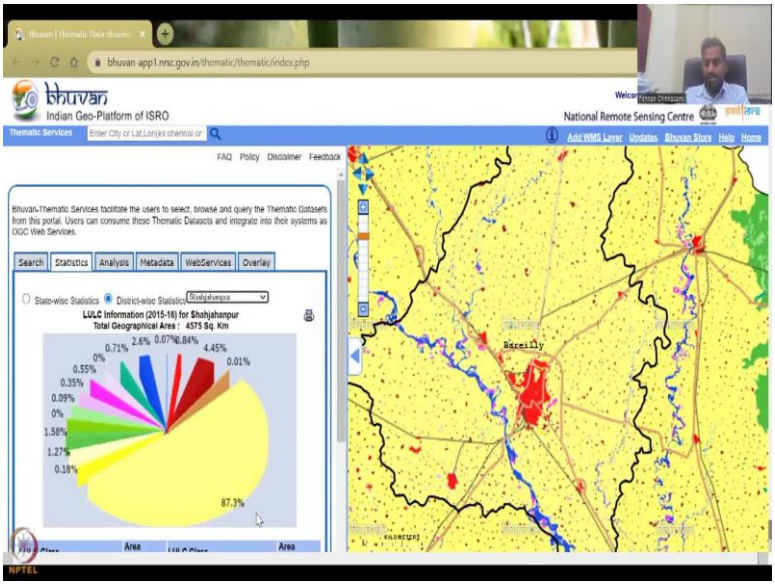
State-wise Statistics District-wise Statistics
LULC Information (2015-2016) for Uttar Pradesh
Total Geographical Area : 240928 Sq. Km
0.92% 2.86% 0.61% 1.7% 3.44% 0.17% 0.09% 0.01% 1.4% 0.53% 1.07% 0.06% 0.03% 0.87% 0.05% 5.38% 0.1% 0.02% 2.04% 75.67%
Bareilly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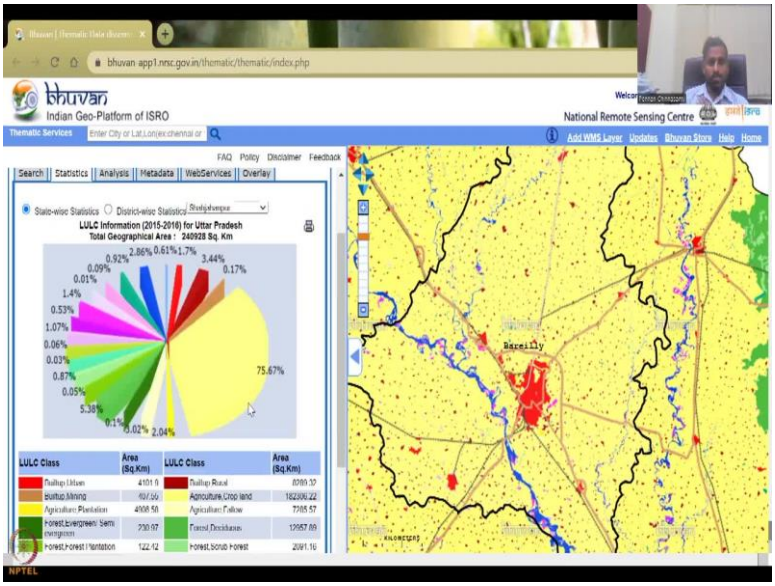
LULC Information (2015-16) for Shahjahanpur
Total Geographical Area : 4575 Sq. Km
0.71%
2.6%
0.07%
0.84%
4.45%
0%
0.01%
0.55%
0.35%
0.09%
0%
1.58%
1.27%
0.18%
87.3%
Area
Bareilly
NPTEL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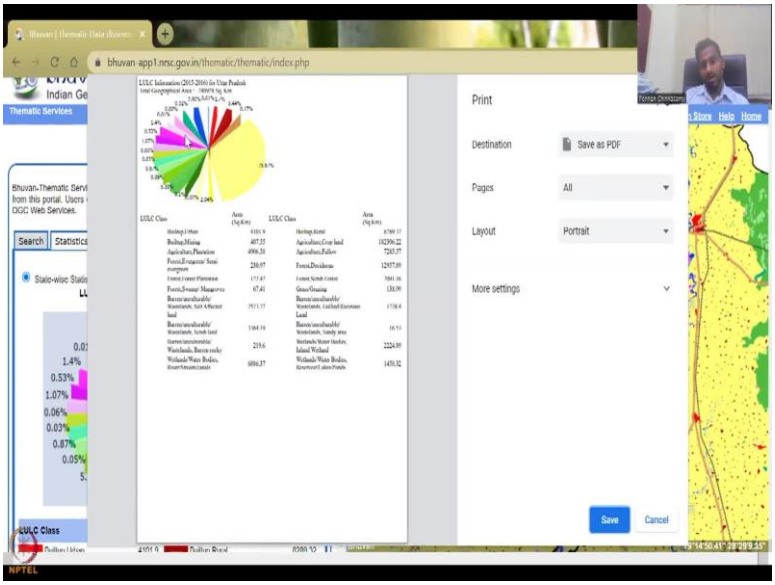
District-wise Statistics
LULC Information (2015-2016) for Uttar Pradesh
Total Geographical Area : 240928 Sq. Km
0.92%
2.86%
0.61%
1.7%
3.44%
0.09%
0.17%
0.01%
1.4%
0.53%
1.07%
0.06%
0.03%
0.87%
0.05%
75.67%
5.38%
0.1%
0.02%
2.04%
LULC Class
Area (Sq.Km)
LULC Class
Area (Sq.Km)
Bareilly
NPTEL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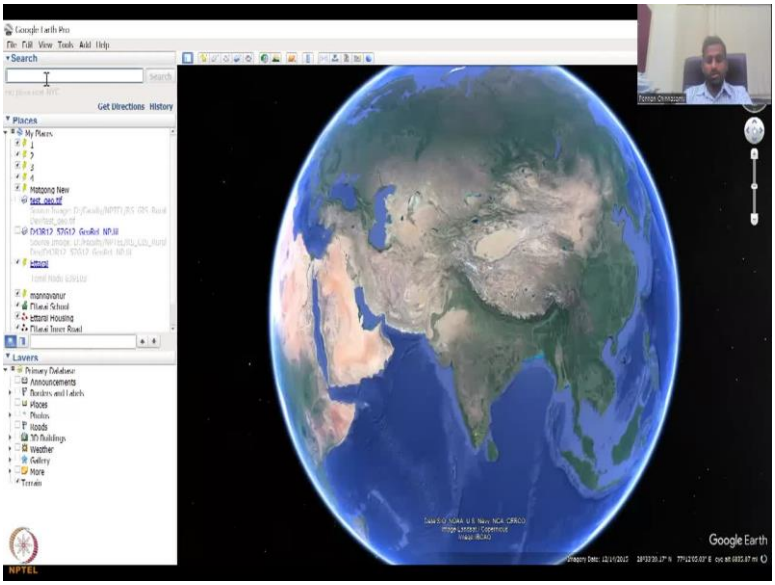
You can also do a state wise location and here also you can select different districts. As I said this is 86.4 percent. But, the image does not change so do not worry about it. But quickly we can see Agra has very less it has more built 74 percent of agriculture, you can have Aligarh 85 percent, Allahabad 75 percent, Ambedkar nagar 80 percent Auraiya 74 percent certain random Balrampur 72 percent, Bijnor 80 percent, Chitrakoot 53 percent, Lucknow should be much less Muzaffarnagar, so Muzaffarnagar has higher agricultural area compared to Bareilly and Varanasi would have more water resources, because that is where the Ganges flows.

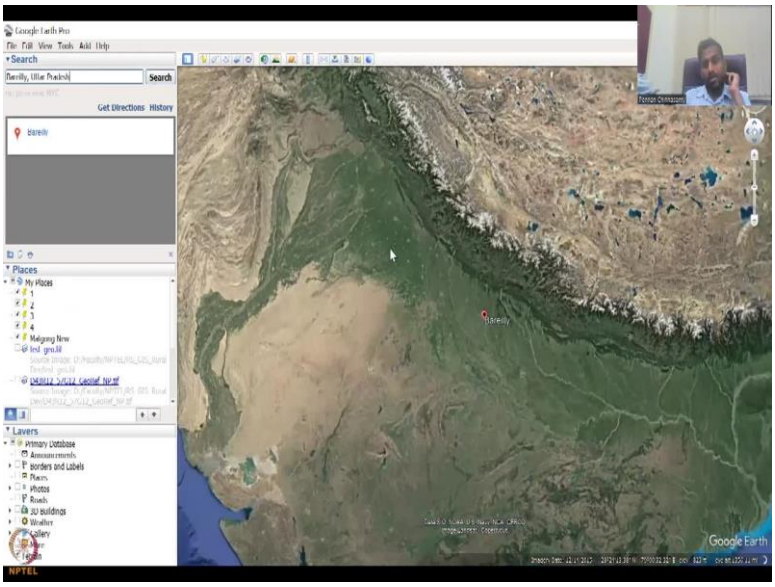
So you have 77 percent still on the banks of the river, which is an agricultural land. We will have Lucknow, so Lucknow has only 56 percent. Approximately 12.83 percent is urbanized, which is very, very high compared to the other regions. And then there is agriculture cropland, and then fallow agriculture plantation all these will combinedly be very less. So, you can see here how the land use land cover has changed. So this is higher Shahjahanpur as 87.3 percent. At this around 88 percent, you have agricultural activities happening.

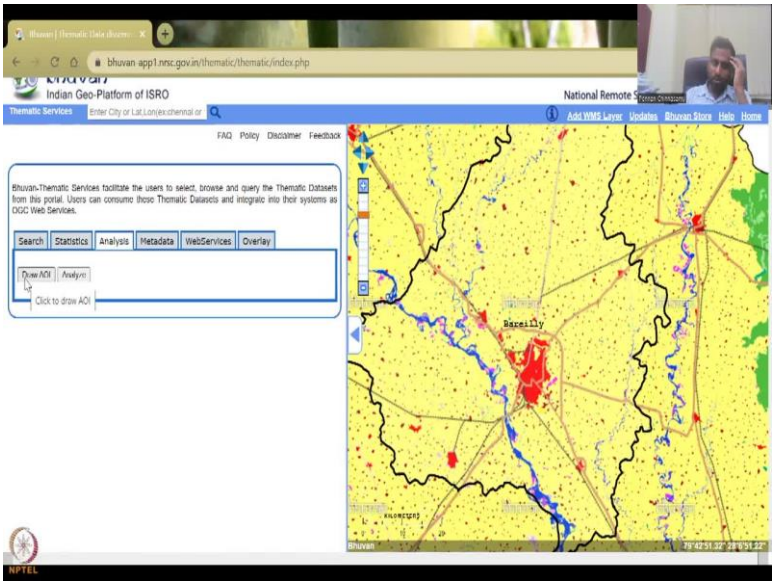
So this is where different different statistics can be plotted up quickly for 2015-2016. And it is giving you a total area of the district and within the district how it is divided. So if you add all these areas, it will come to 4500 or 4575 square kilometers. If you add all the different land use land cover types that is given. We will give you a statewide statistics you can see that, as per the state wise 75 percent is agriculture. But Shahjahanpur is above the average.

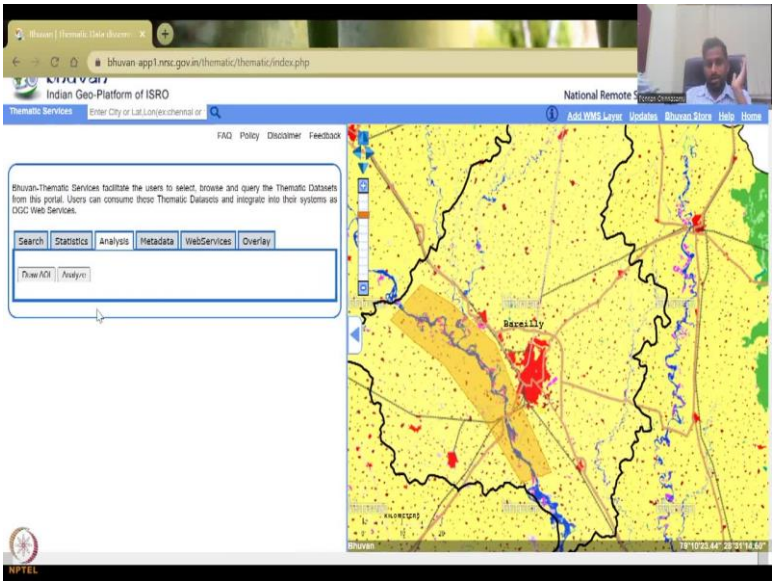
It was 87 percent. So let us double check. Yes, it is 87 percent. So 75 percent is the overall state average. And now you have 2 averages. So basically, you can do this state wise, you can come down and then see the different land use land cover, you can see that 75 percent is your agricultural or allied agriculture activities, you can print this as an image, save as an image as a PDF, and you can use it in your reports. Do not forget to cite, citations should be given to the data providers.

(Refer Slide Time: 17:15)





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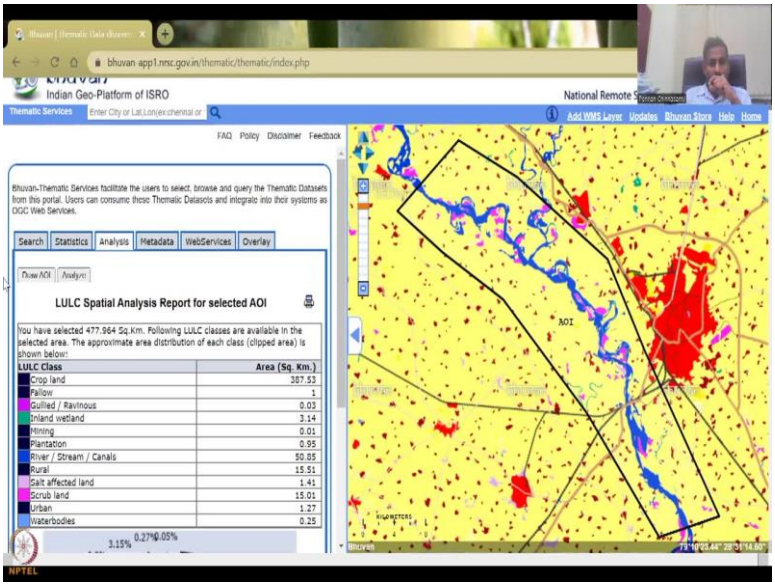
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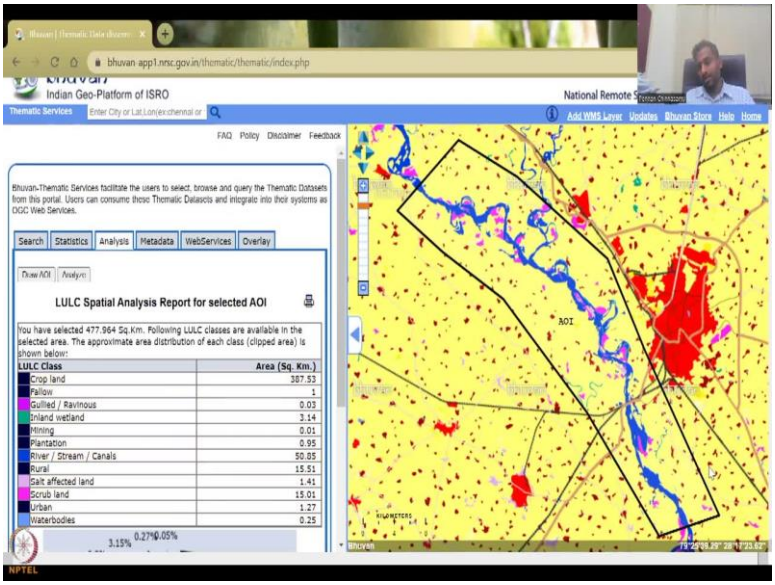
LULC Spatial Analysis Report for selected AOI
You have selected 477.964 Sq.Km. Following LULC classes are available in the selected area. The approximate area distribution of each class (clipped area) is shown below:
LULC Class
Area (Sq. Km.)
Crop land 387.53
Fallow 1
Gullied / Ravinous 0.03
Inland wetland 3.14
Mining 0.01
Plantation 0.95
River / Stream / Canals 50.05
Rural 15.51
Salt affected land 1.41
Scrub land 15.01
Urban 1.27
Waterbodies 0.25
3.15%
0.27%
0.05%
AOI
NPTEL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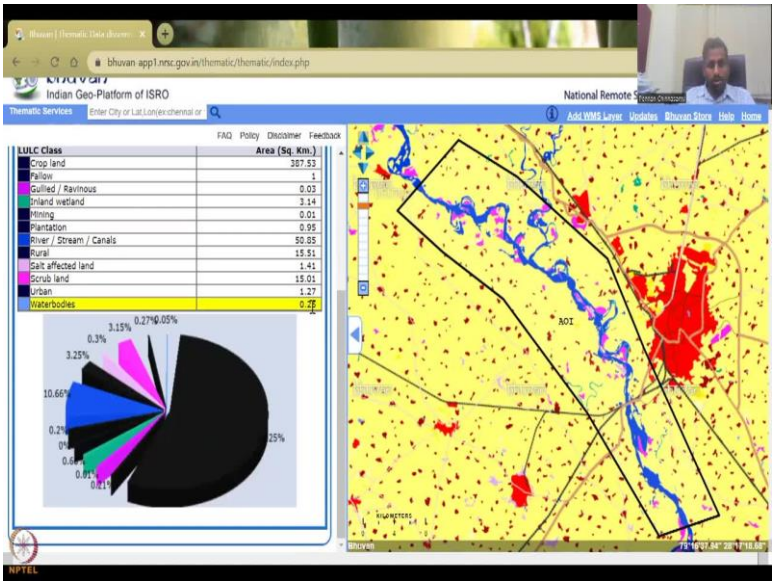
Salt affected land 1.41
Scrub land 15.01
Urban 1.27
Waterbodies 0.25
3.15%
0.27%
0.05%
AOI
NPTEL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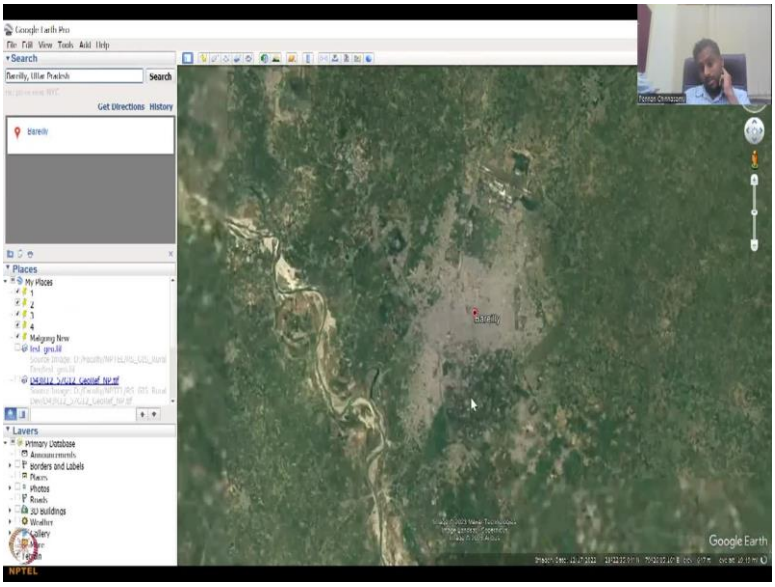
Inland wetland 3.14
Mining 0.01
Plantation 0.95
River / Stream / Canals 50.85
Rural 15.51
Salt affected land 1.41
Scrub land 15.01
Urban 1.27
Waterbodies 0.28
3.15%
0.27%
0.05%
0.3%
3.25%
10.66%
0.2%
25%
AOI
NPTEL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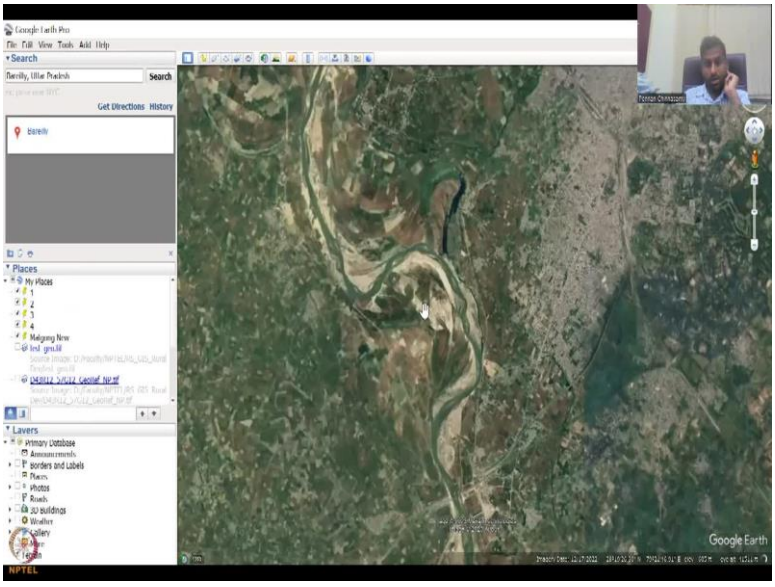
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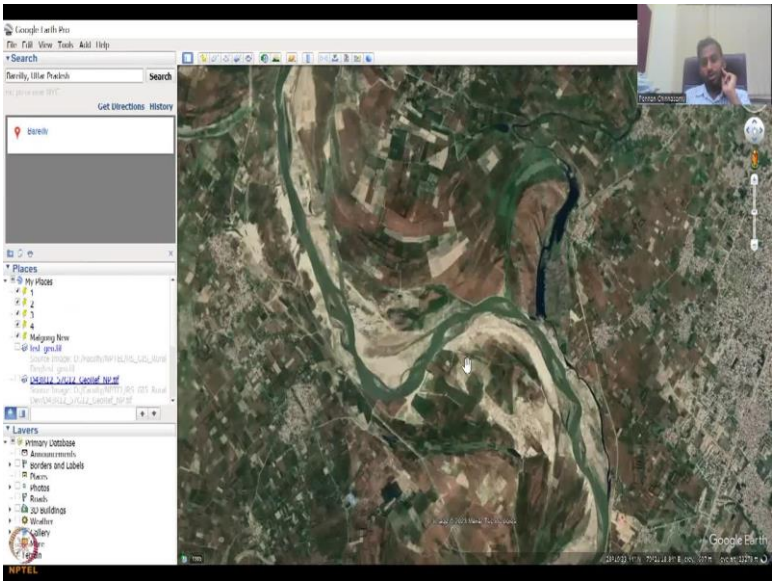
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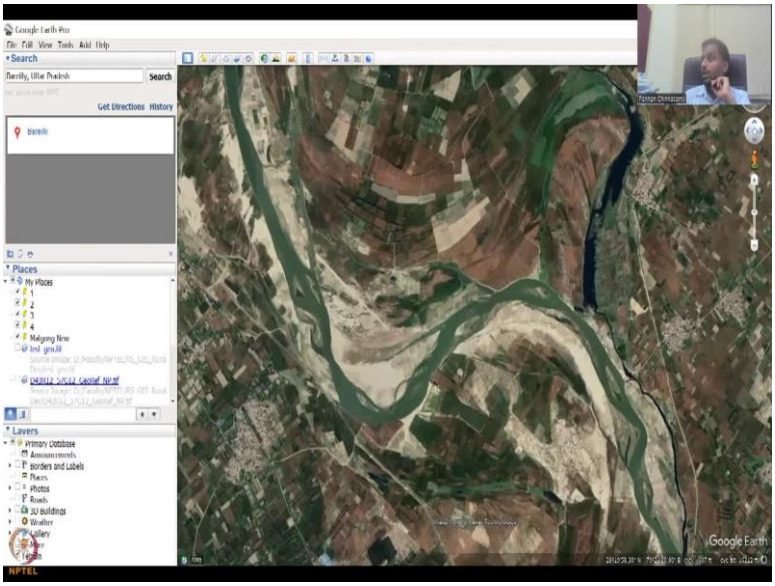
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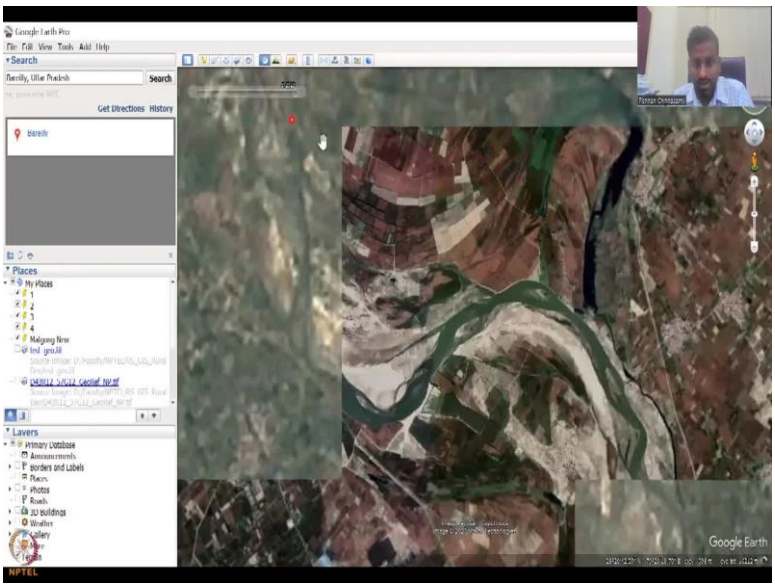
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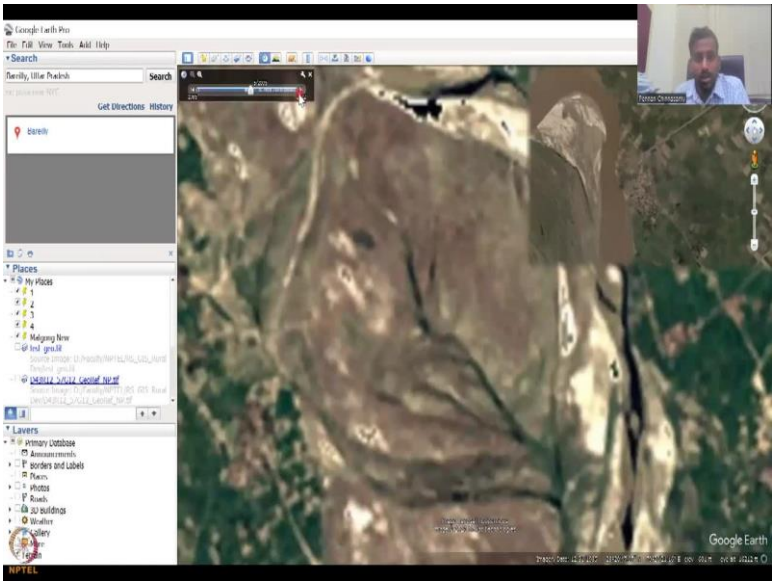
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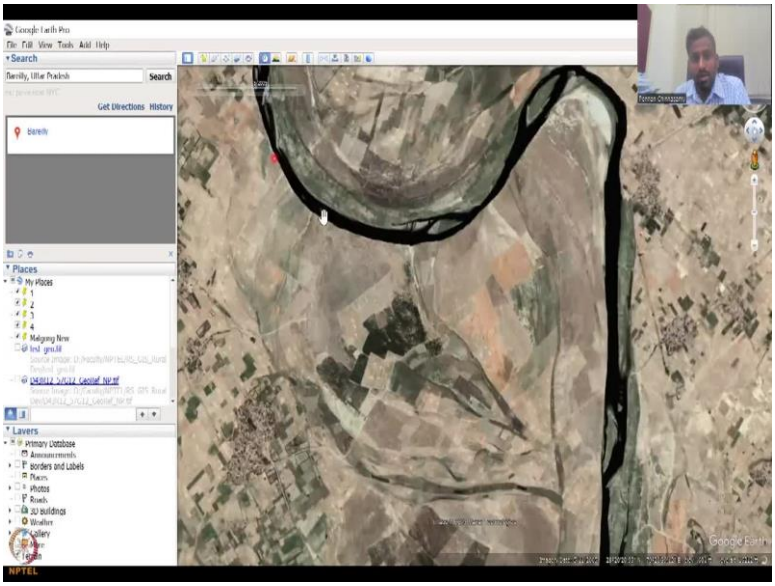
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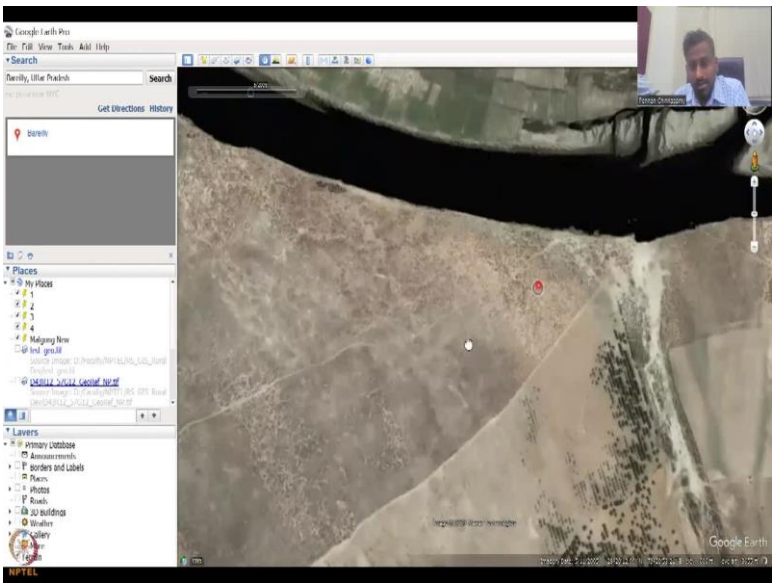
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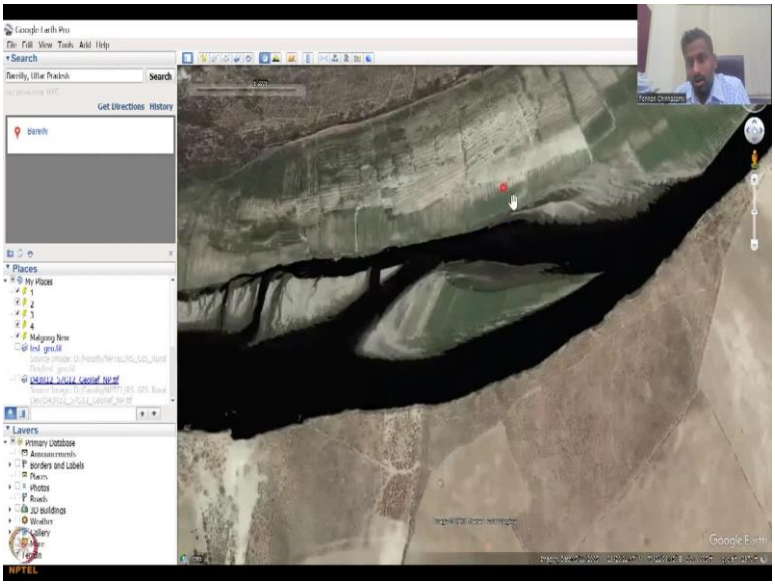
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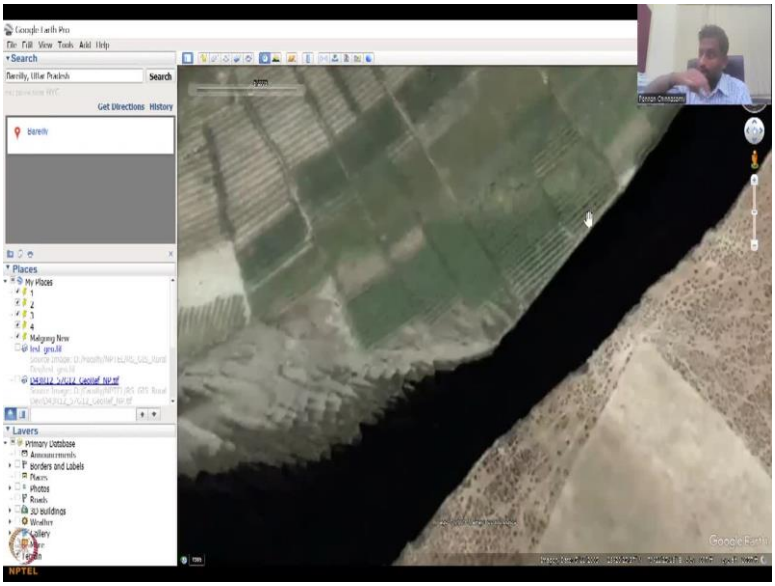
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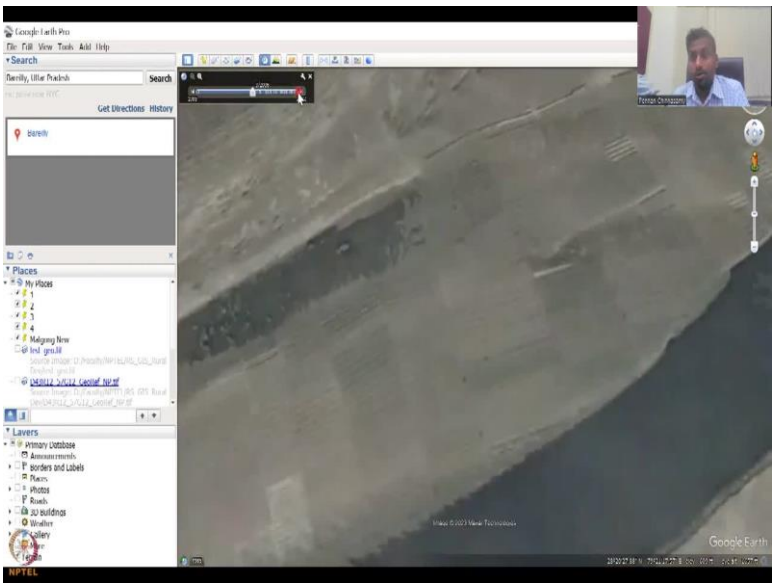
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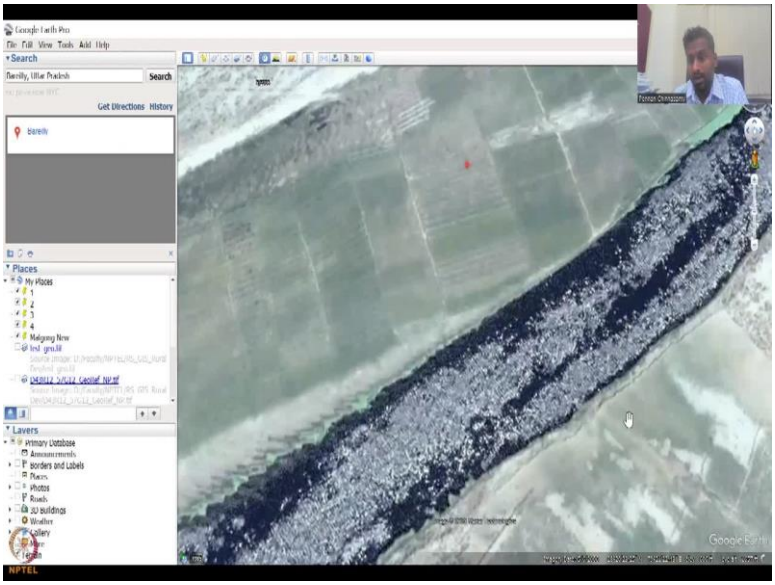
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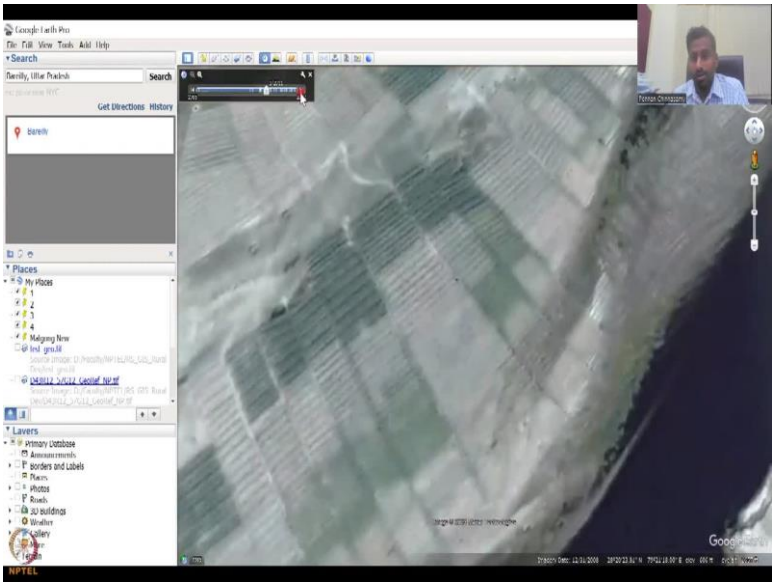
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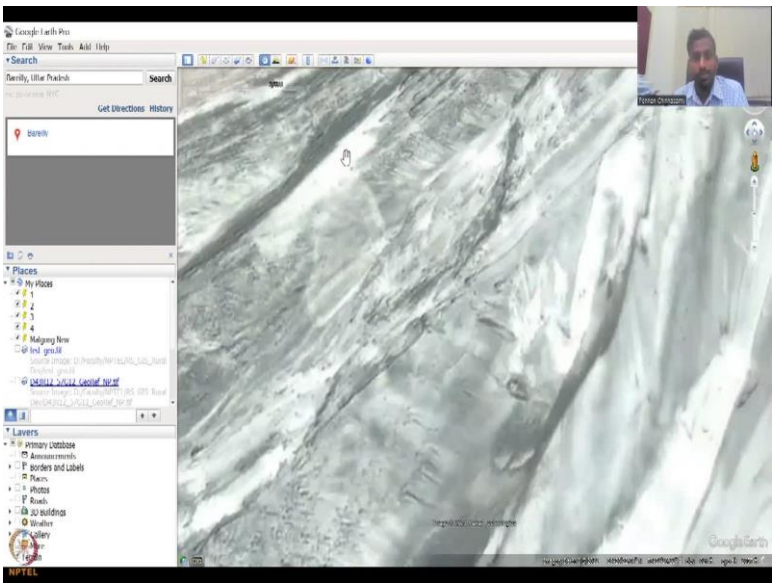
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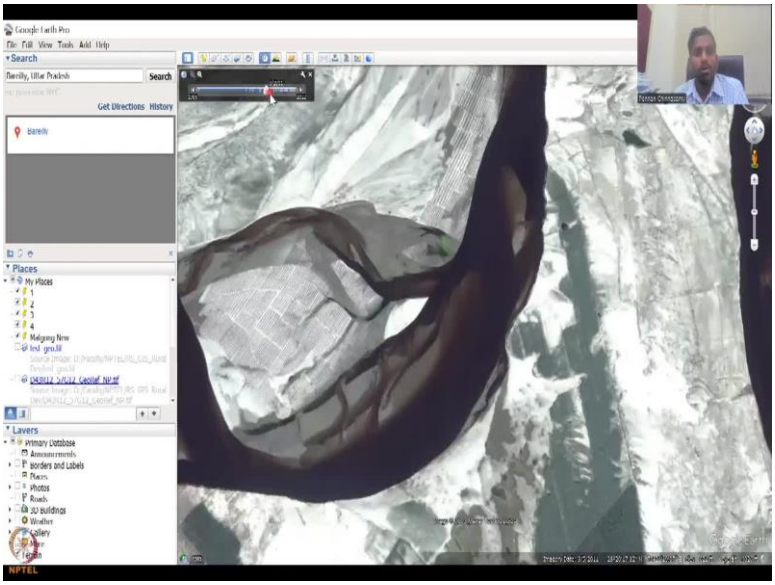
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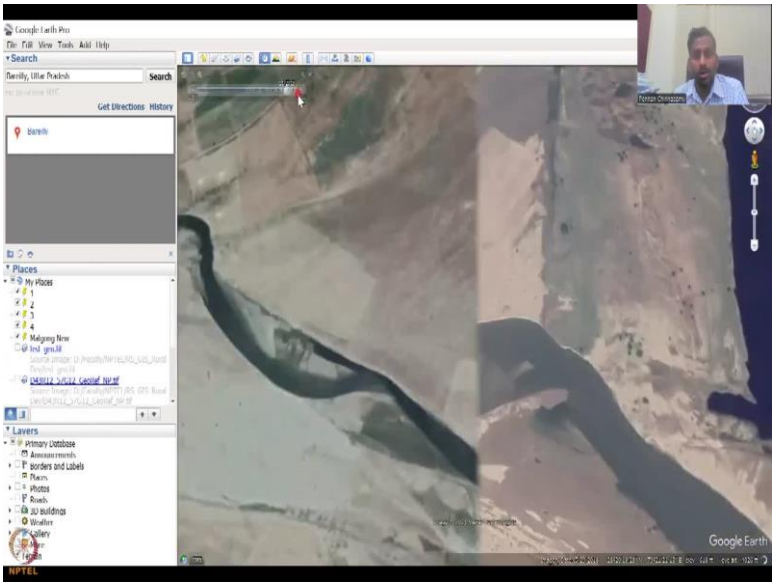
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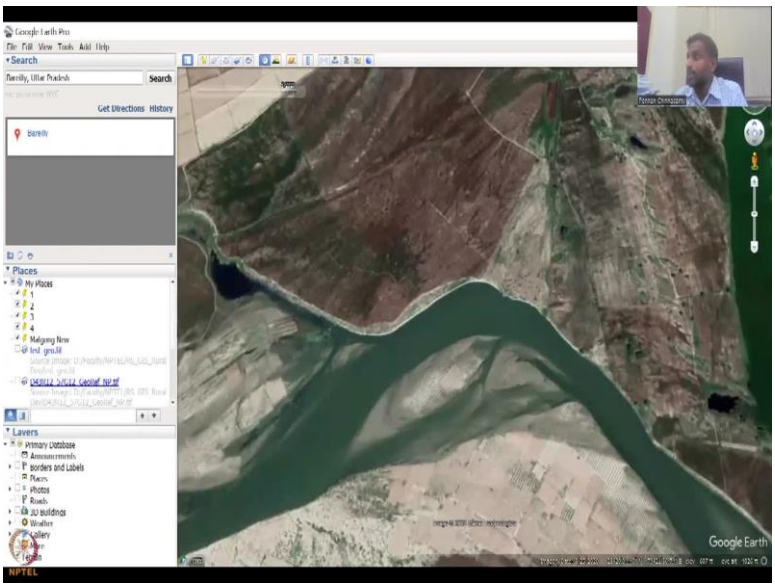
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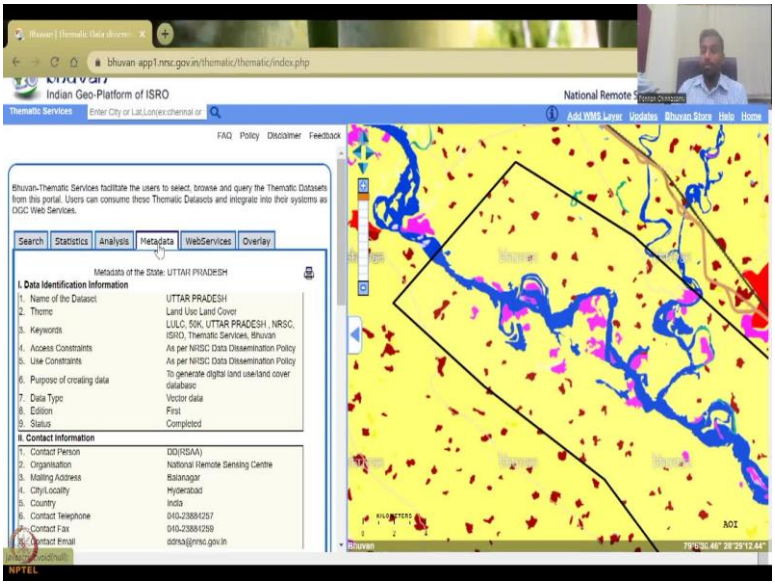
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Metadata of the State: UTTAR PRADESH
I. Data Identification Information
1. Name of the Dataset: UTTAR PRADESH
2. Theme: Land Use Land Cover
3. Keywords: LULC, 50K, UTTAR PRADESH , NRSC, ISRO, Thematic Services, Bhuvan
4. Access Constraints: As per NRSC Data Dissemination Policy
5. Use Constraints: As per NRSC Data Dissemination Policy
6. Purpose of creating data: To generate digital land use/land cover database
7. Data Type: Vector data
8. Edition: First
9. Status: Completed
II. Contact Information
1. Contact Person: DD(RSAA)
2. Organisation: National Remote Sensing Centre
3. Mailing Address: Balanagar
4. City/Locality: Hyderabad
5. Country: India
6. Contact Telephone: 040-23884257
7. Contact Fax: 040-23884259
8. Contact Email: ddrsa@nrsc.gov.in
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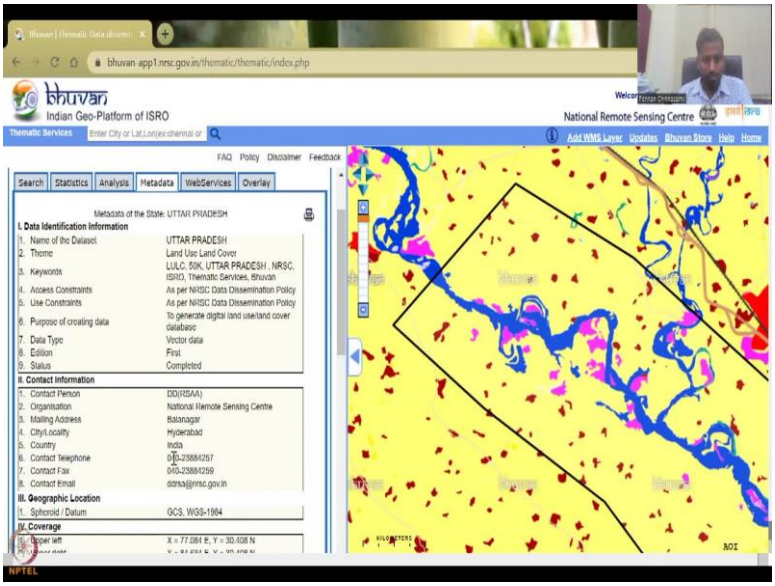
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8. Contact Email: ddrsa@nrsc.gov.in
III. Geographic Location
1. Spheroid / Datum: GCS, WGS-1984
IV. Coverage
1. Upper left: X = 77.084 E, Y = 30.408 N
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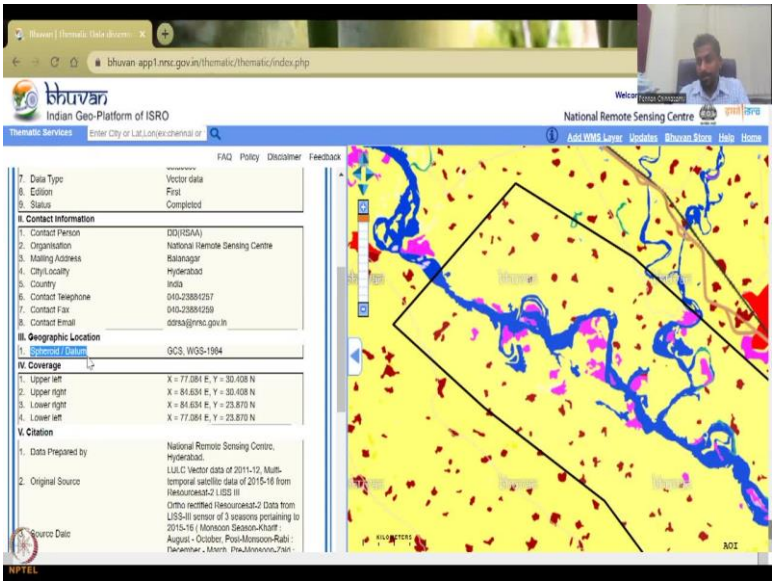
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IV. Coverage
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2. Upper right: X = 84.634 E, Y = 30.408 N
3. Lower right: X = 84.634 E, Y = 23.870 N
4. Lower left: X = 77.084 E, Y = 23.870 N
V. Citation
1. Data Prepared by: National Remote Sensing Centre, Hyderabad.
2. Original Source: LULC Vector data of 2011-12, Multi-temporal satellite data of 2015-16 from Resourcesat-2 LISS III
Ortho rectified Resourcesat-2 Data from LISS-III sensor of 3 seasons pertaining to 2015-16 (Monsoon Season-Kharif : August - October, Post-Monsoon-Rabi :
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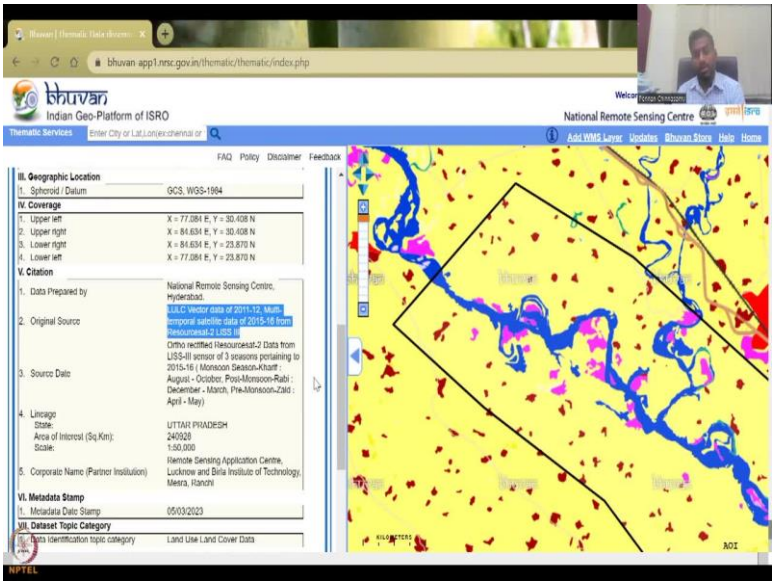
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4. Lineage
State:
UTTAR PRADESH
Area of Interest (Sq.Km):
240928
Scale:
1:50,000
5. Corporate Name (Partner Institution)
Remote Sensing Application Centre, Lucknow and Birla Institute of Technology, Mesra, Ranchi
VI. Metadata Stamp
1. Metadata Date Stamp
05/03/2023
VII. Dataset Topic Category
1. Data Identification topic category
Land Use Land Cover Data
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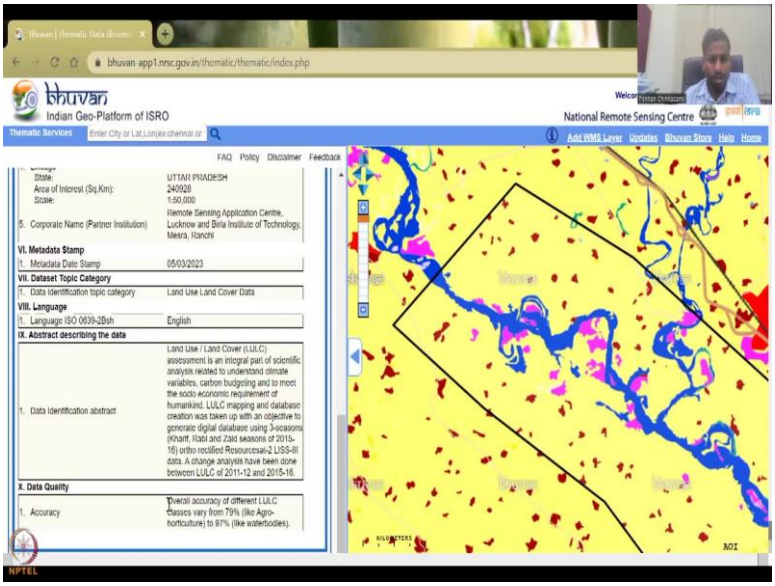
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VIII. Language
1. Language ISO 0639-2Bsh
English
IX. Abstract describing the data
1. Data Identification abstract
Land Use / Land Cover (LULC) assessment is an integral part of scientific analysis related to understand climate variables, carbon budgeting and to meet the socio economic requirement of humankind. LULC mapping and database creation was taken up with an objective to generate digital database using 3-seasons (Kharif, Rabi and Zaid seasons of 2015-16) ortho rectified Resourcesat-2 LISS-III data. A change analysis have been done between LULC of 2011-12 and 2015-16.
X. Data Quality
1. Accuracy
Overall accuracy of different LULC classes vary from 79% (like Agro-horticulture) to 97% (like waterbodies).
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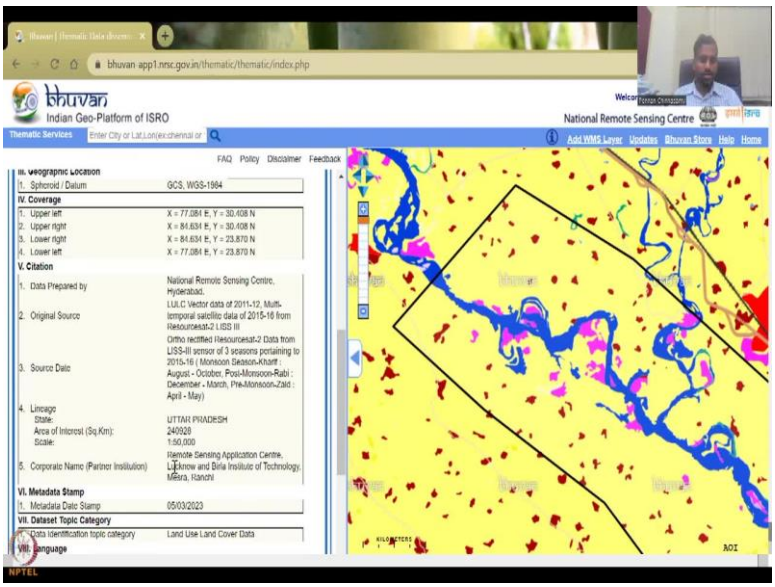
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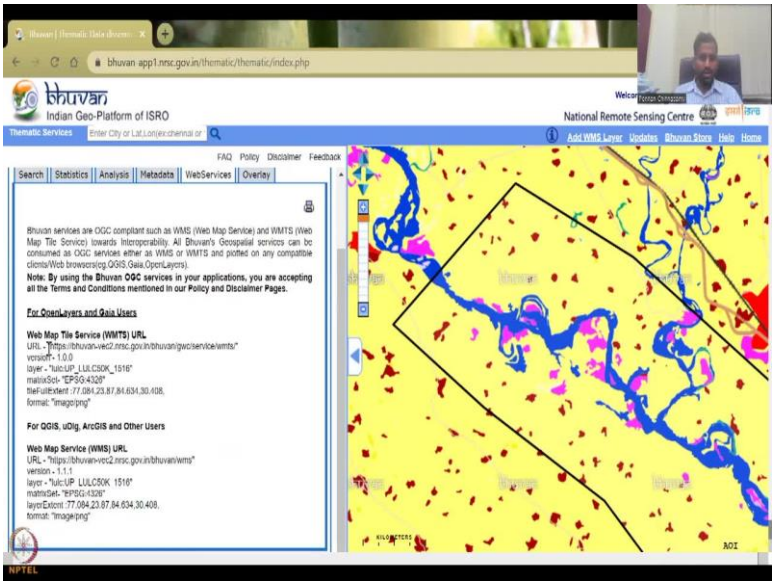
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version - 1.0.0
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For QGIS, uDig, ArcGIS and Other Users
Web Map Service (WMS) URL
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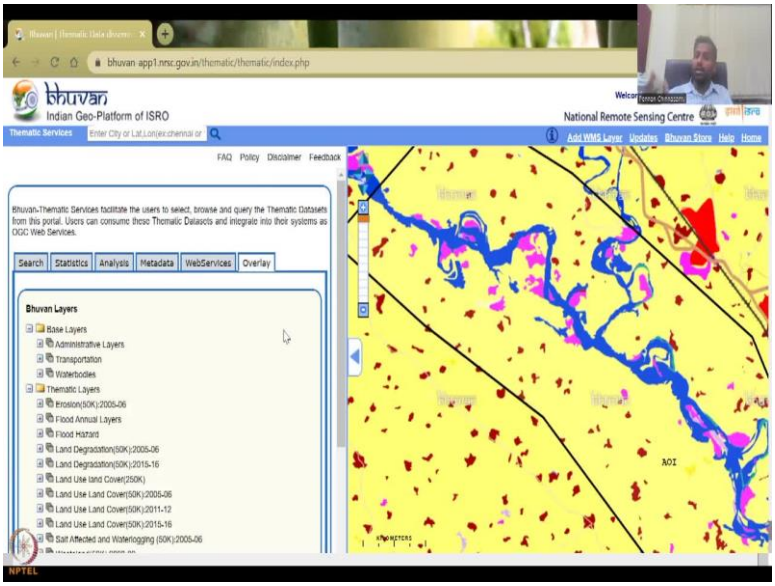
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Flood Annual Layers
Flood Hazard
Land Degradation(50K):2005-06
Land Degradation(50K):2015-16
Land Use land Cover(250K)
Land Use Land Cover(50K):2005-06
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Land Use Land Cover(50K):2015-16
Salt Affected and Waterlogging (50K):2005-06
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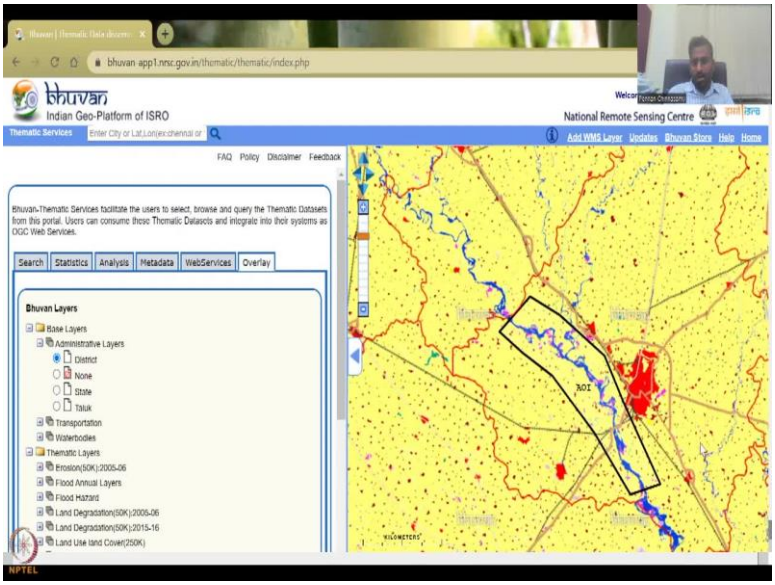
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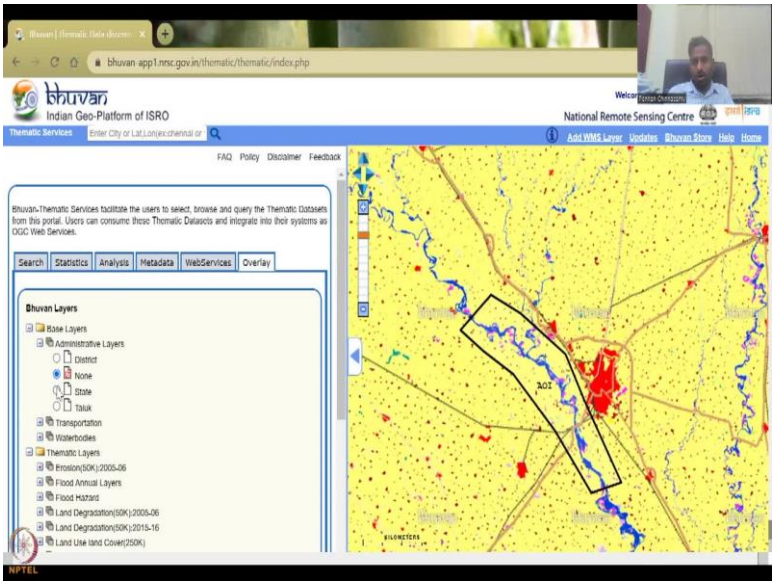
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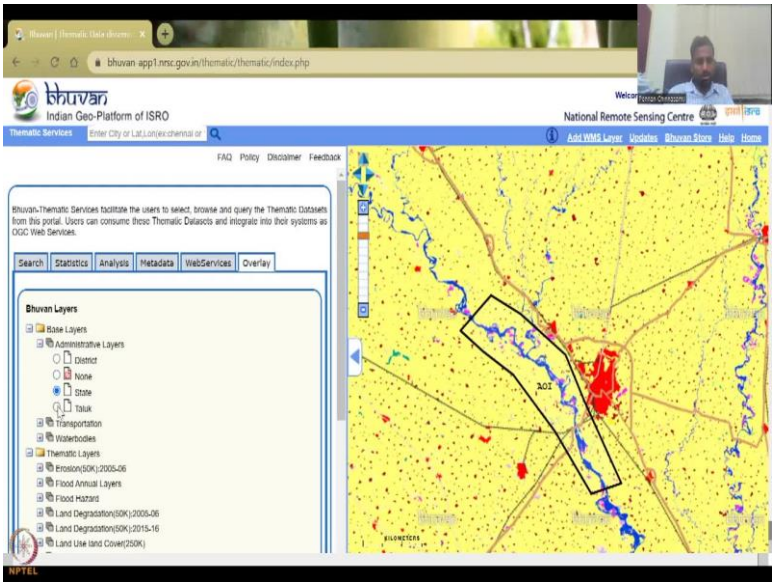
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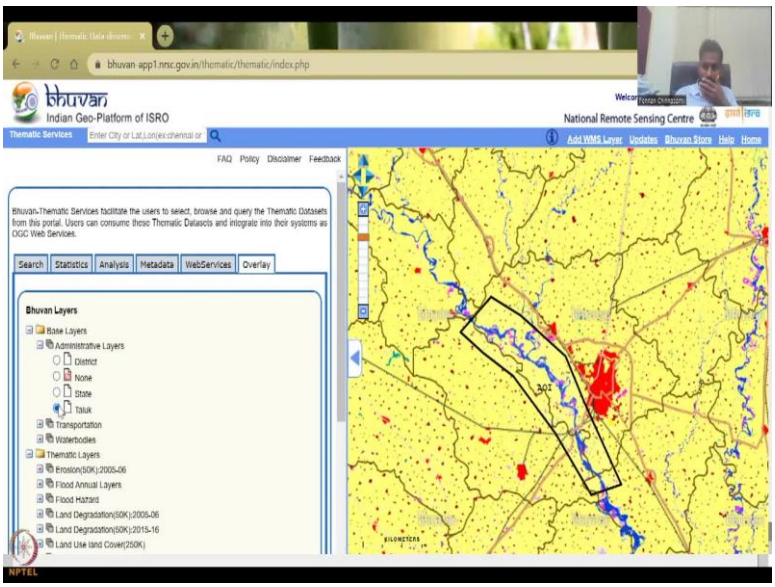
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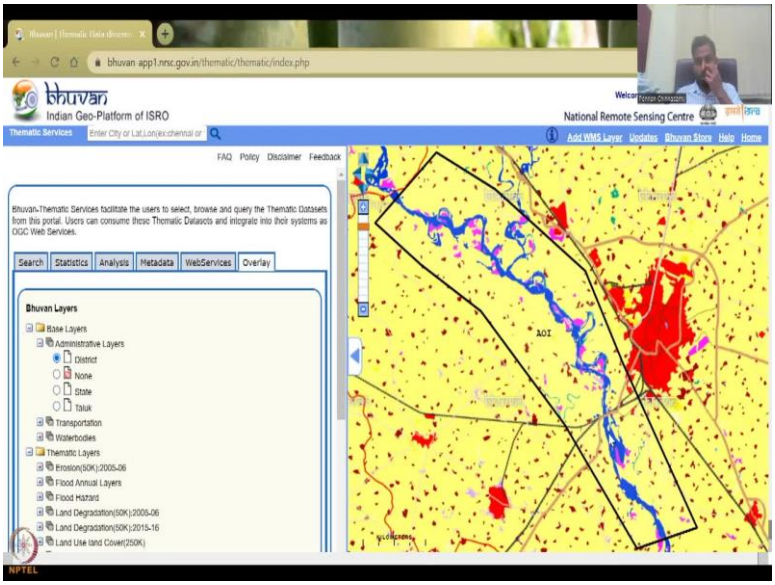
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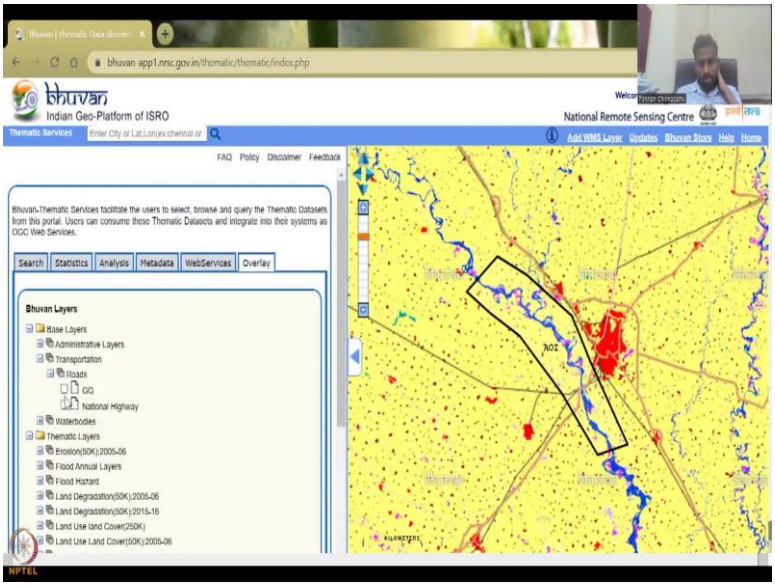
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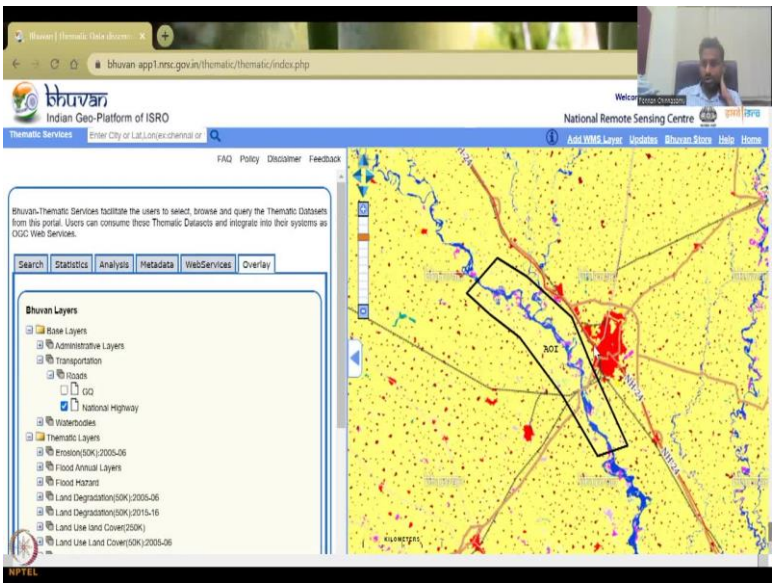
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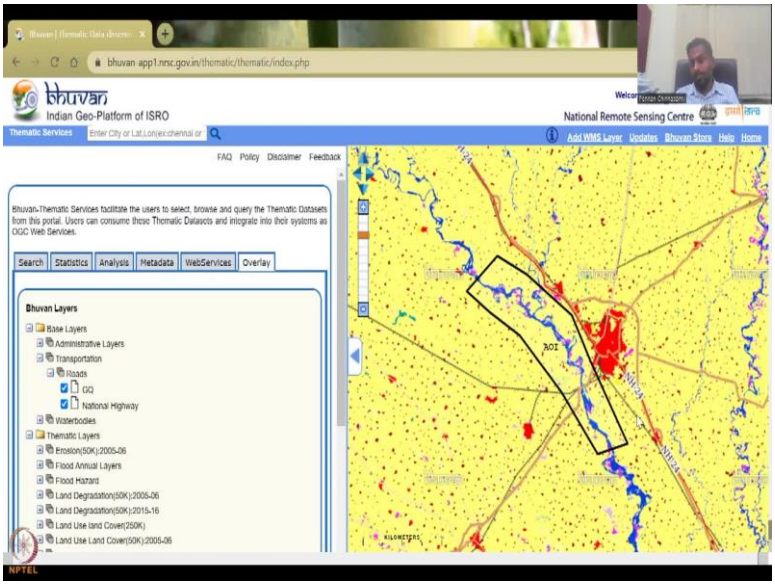
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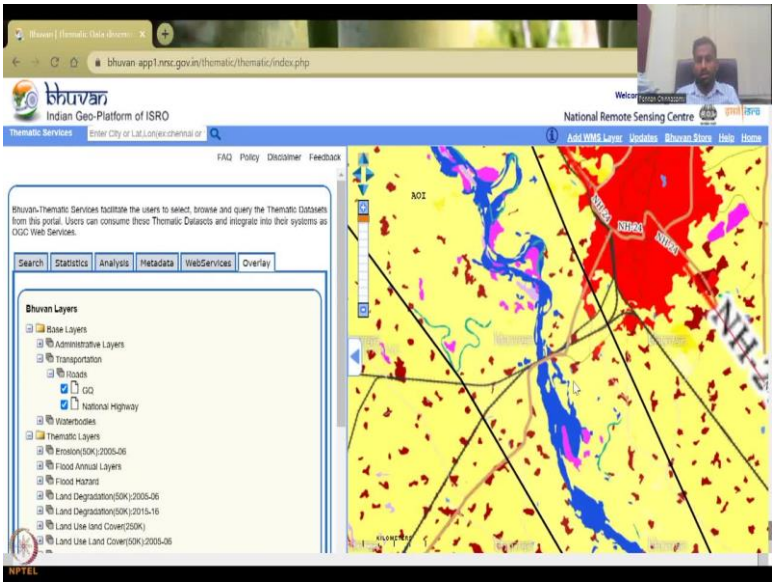
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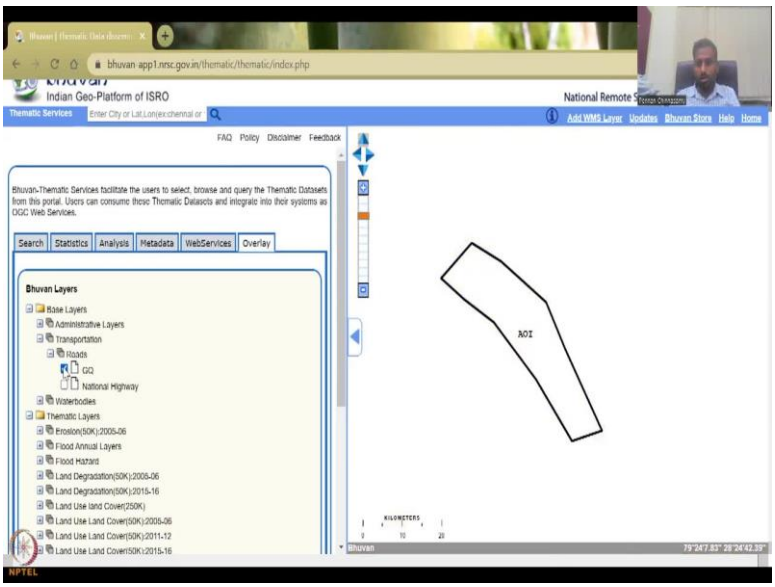
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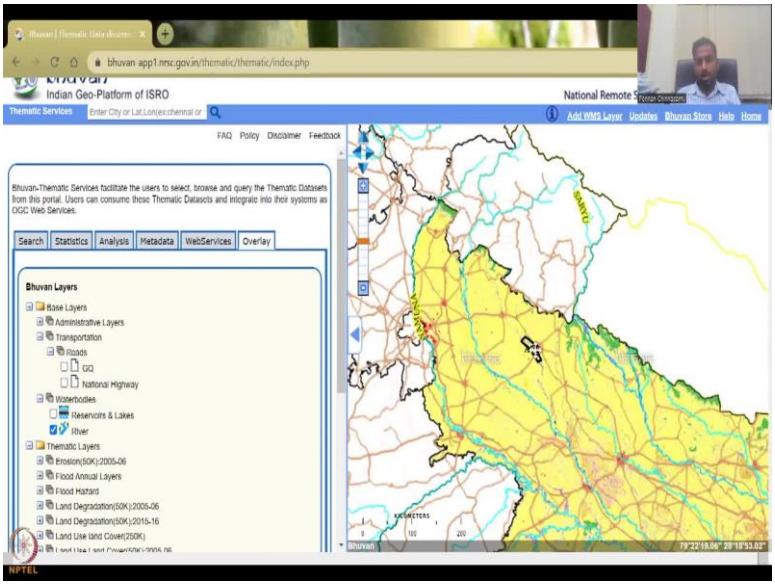
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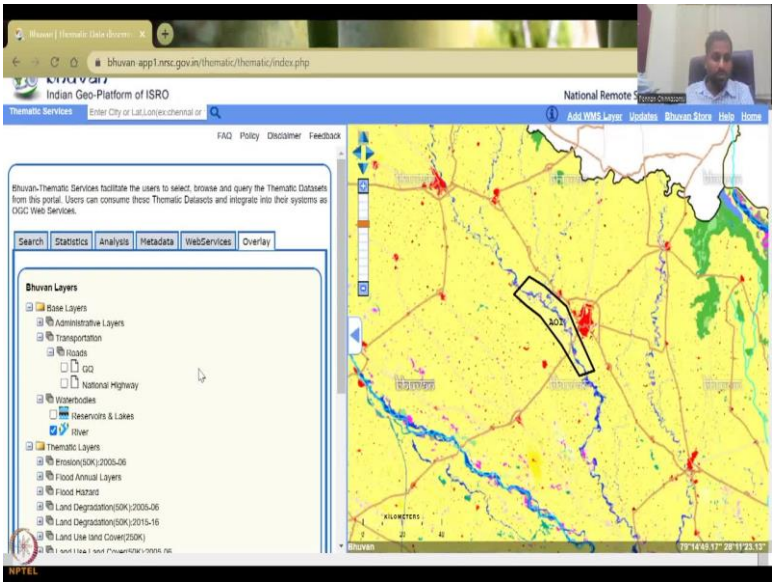
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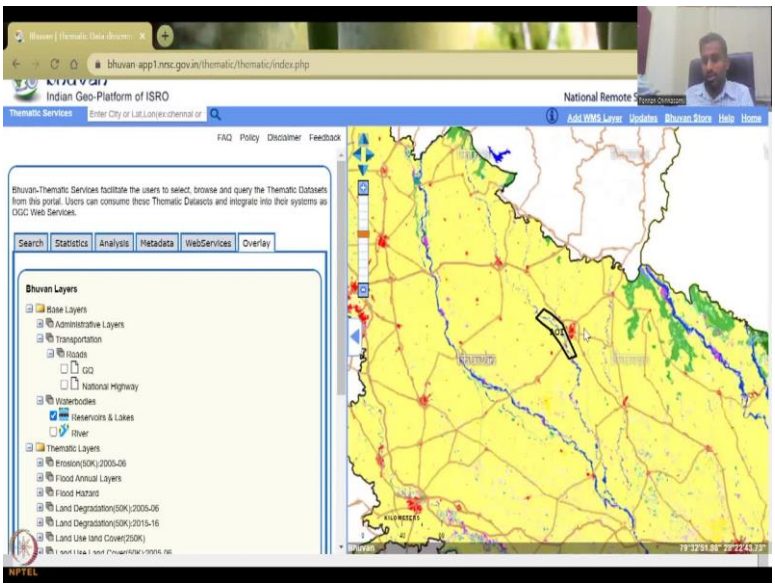
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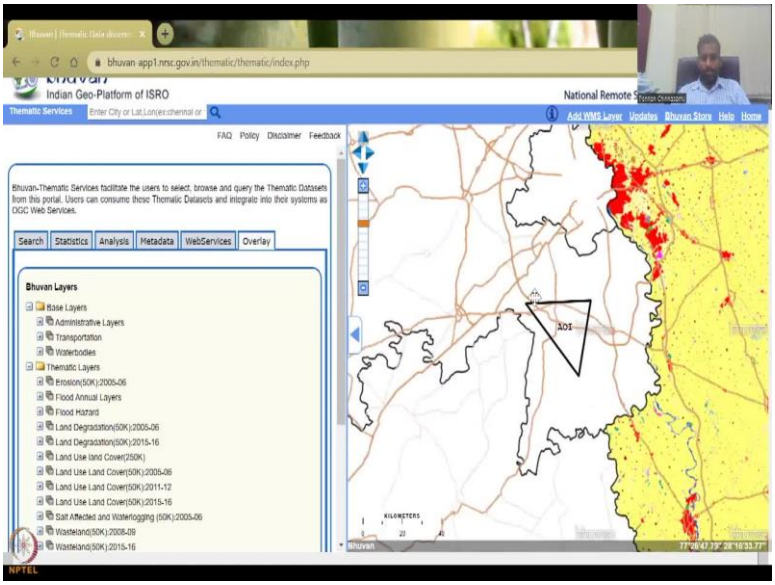
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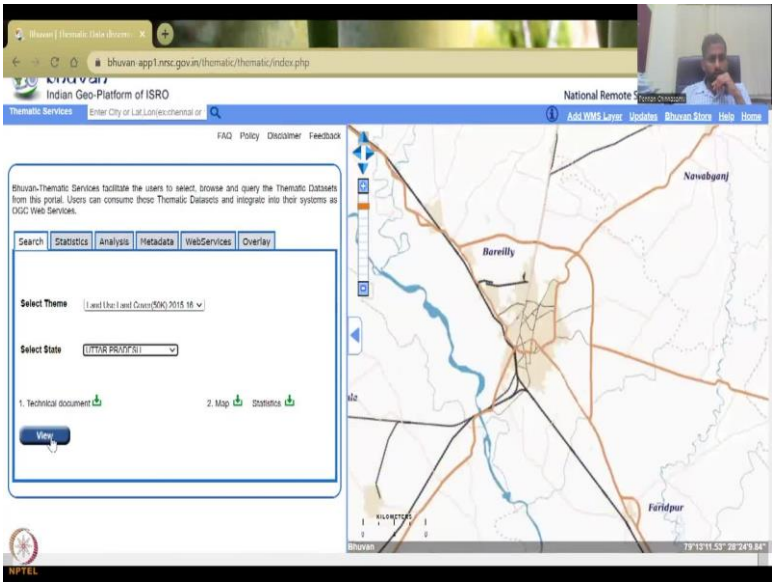
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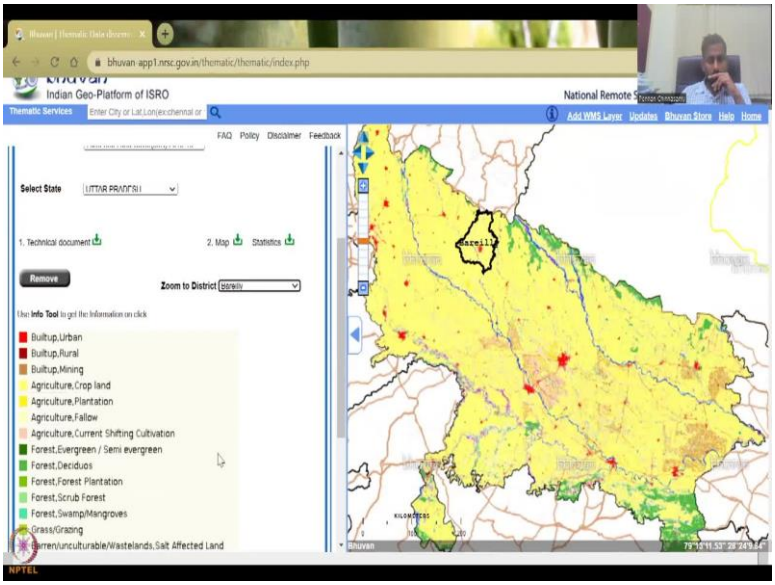
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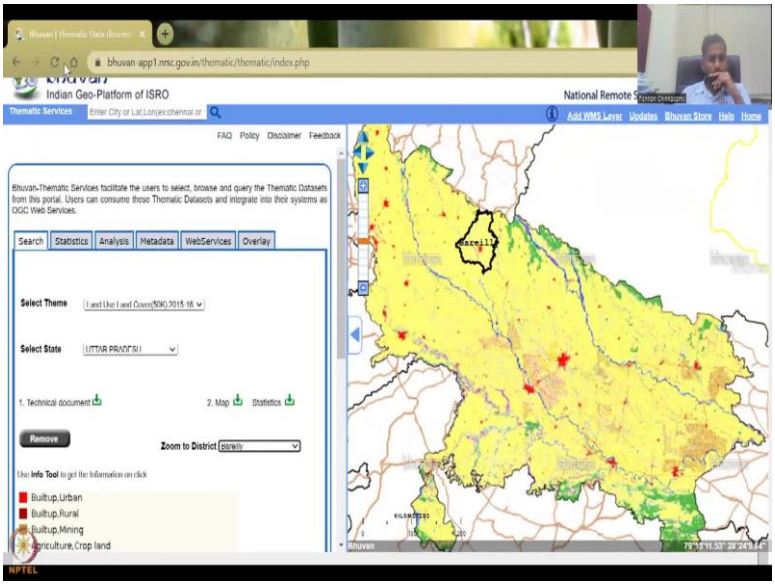
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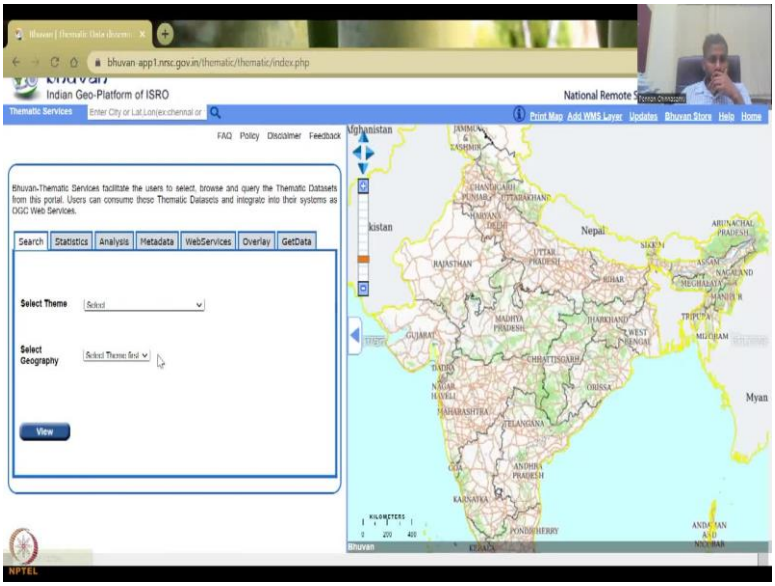
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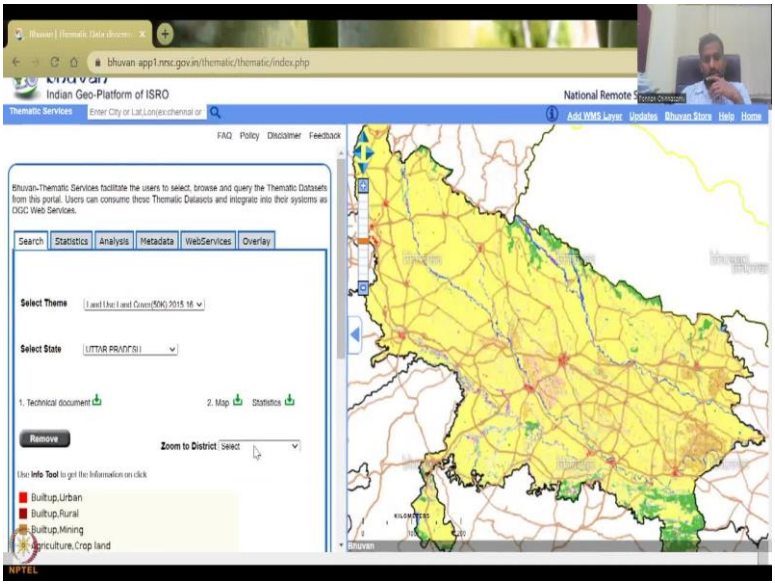
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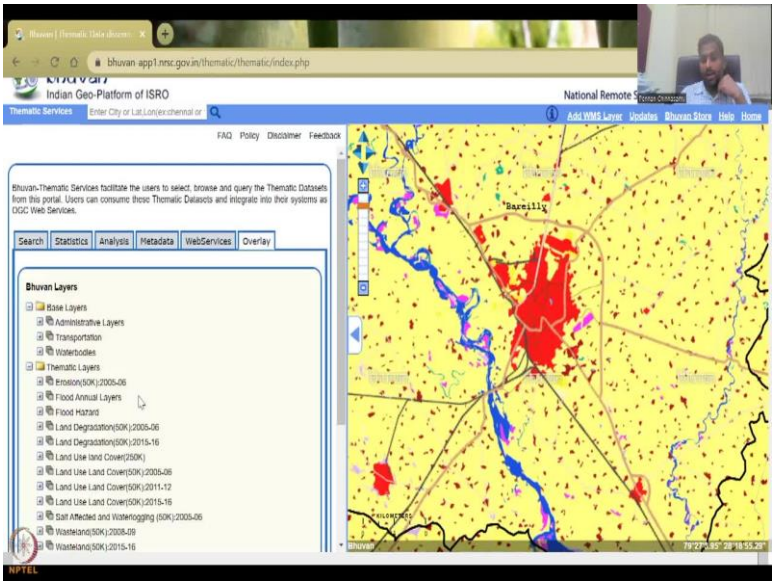
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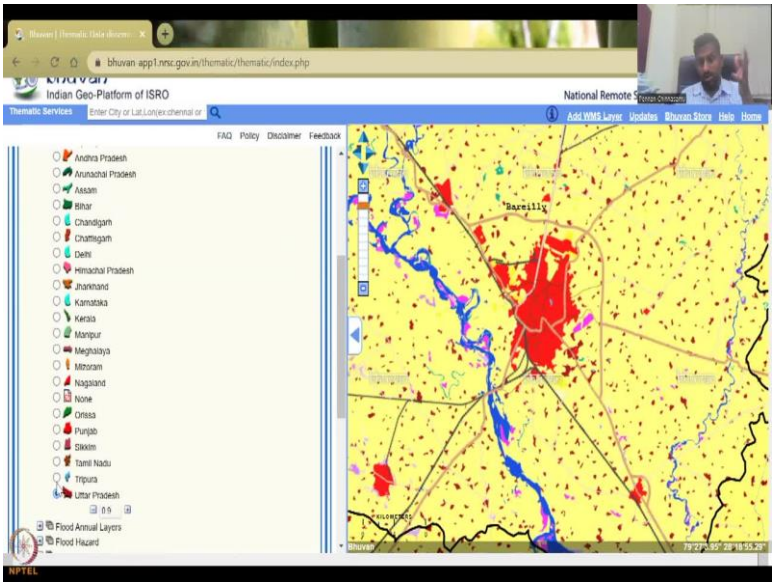
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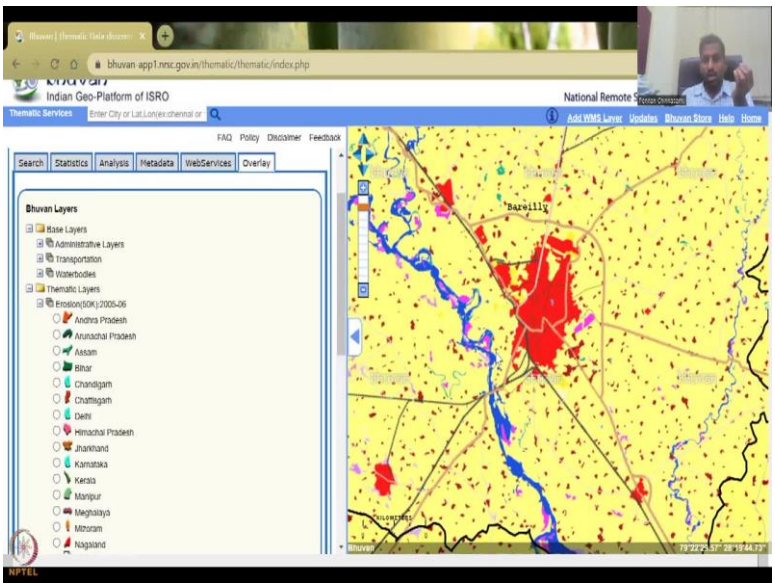
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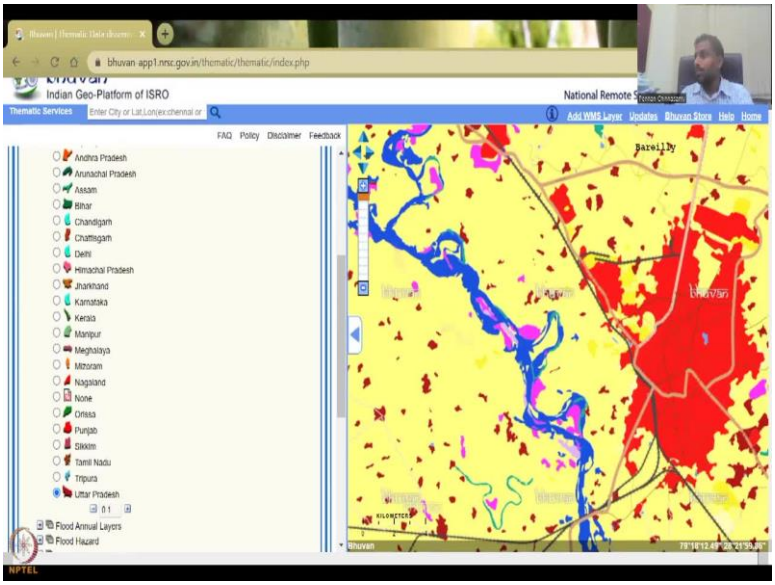
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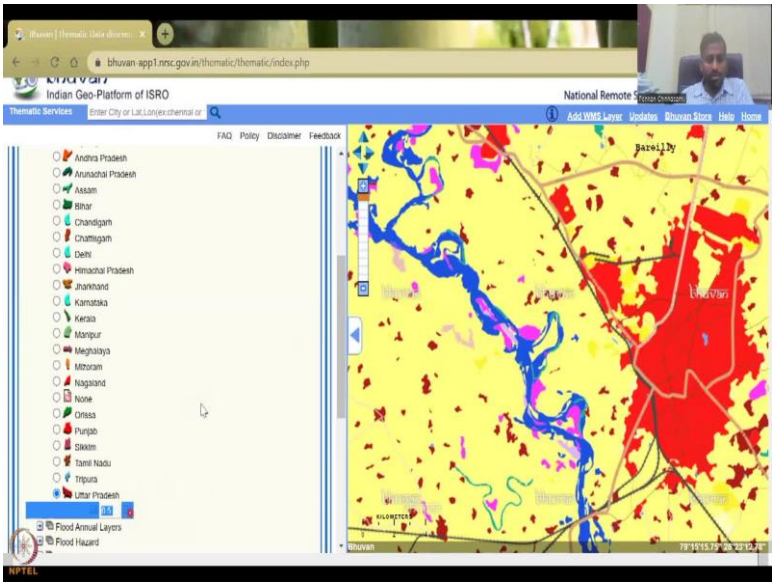
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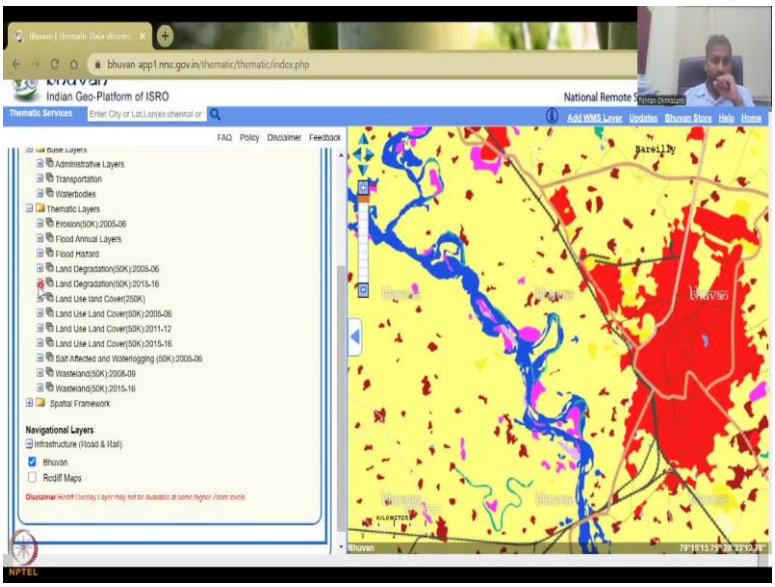
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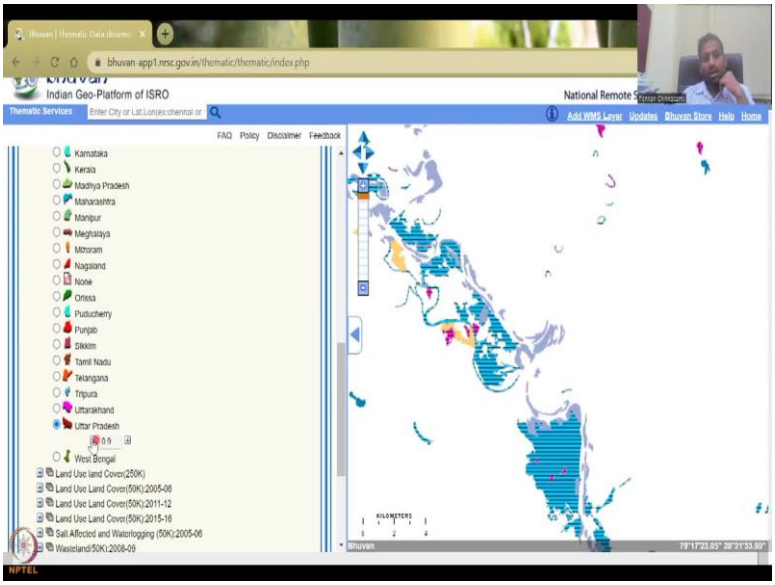
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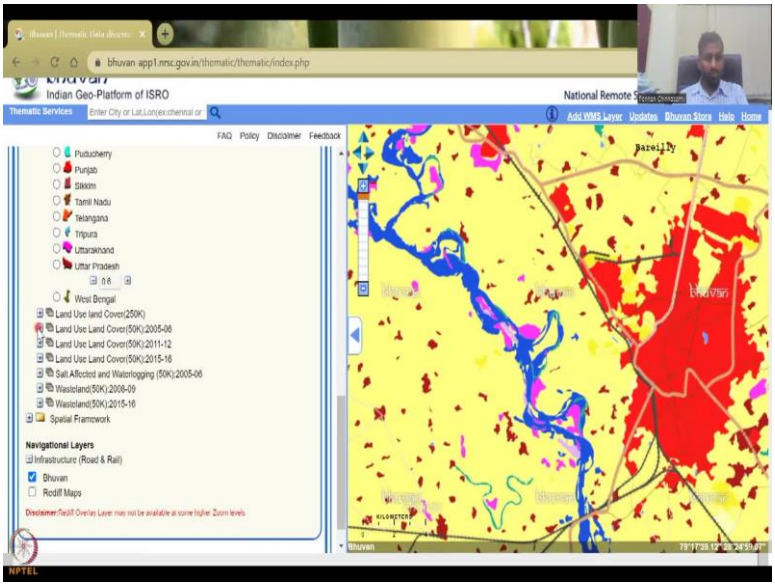
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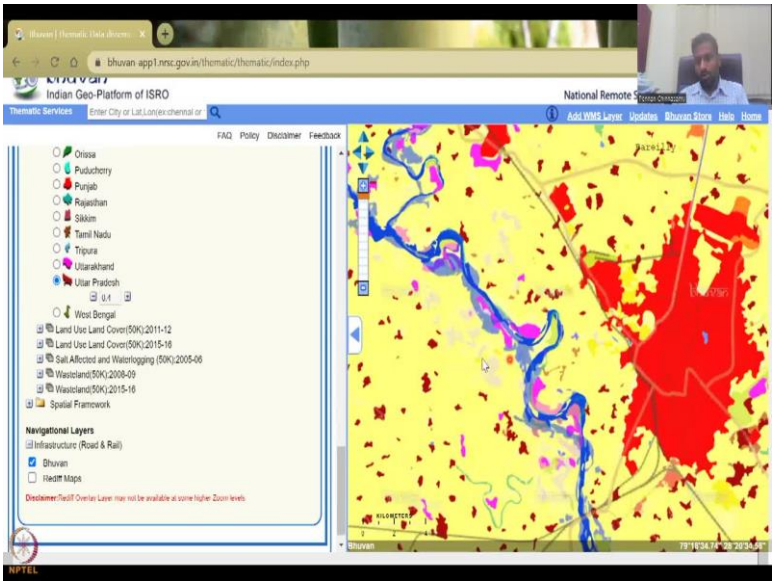
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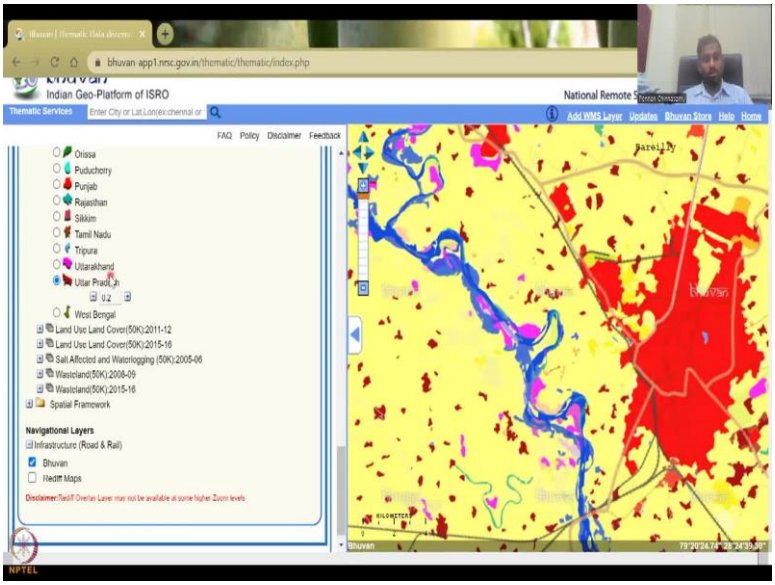
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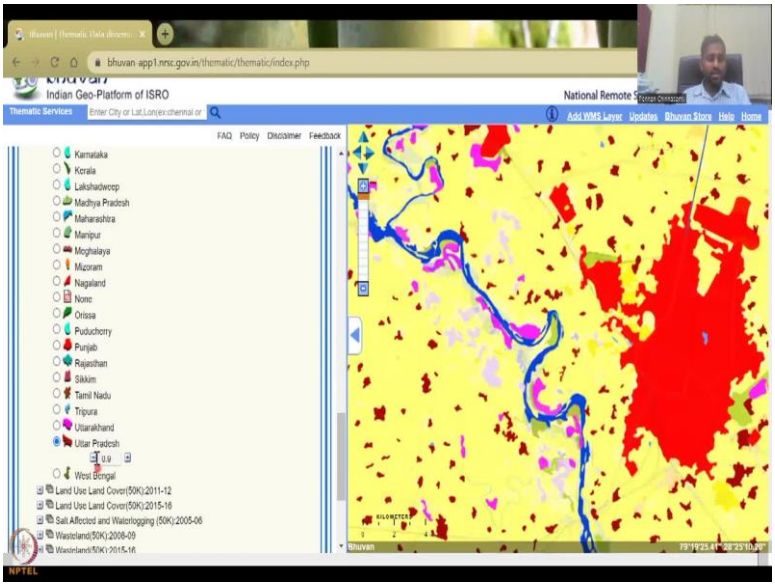
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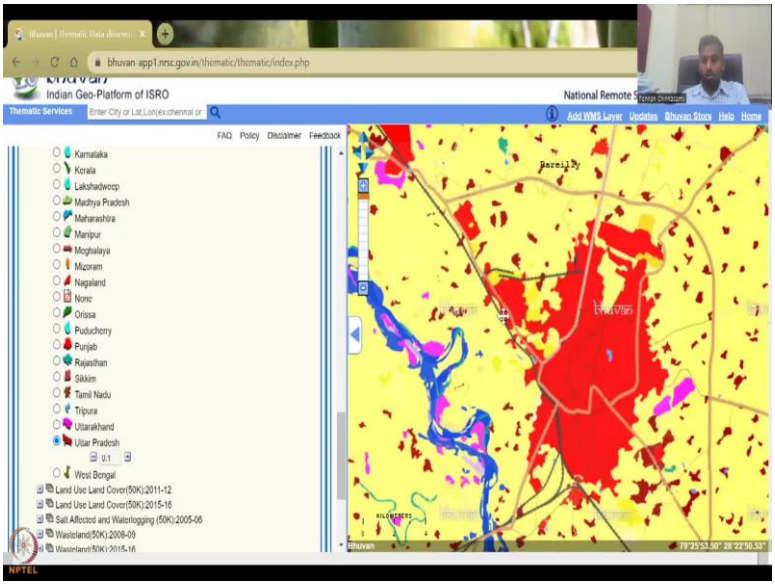
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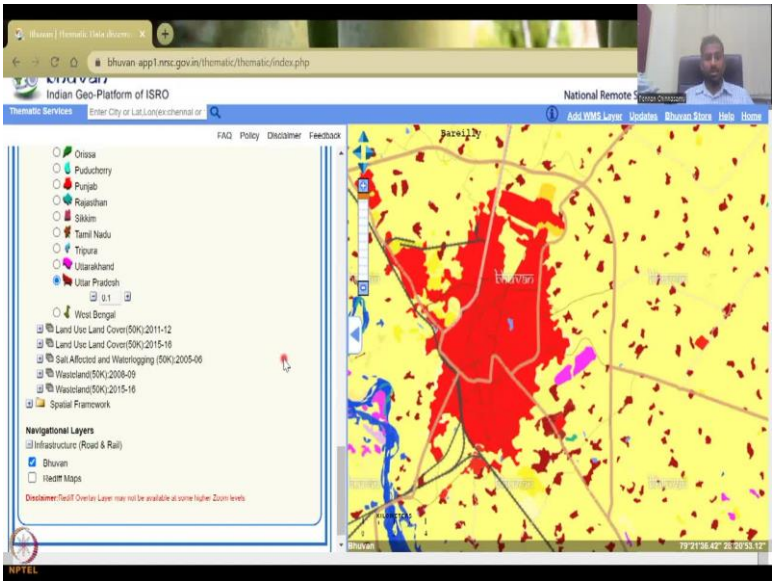
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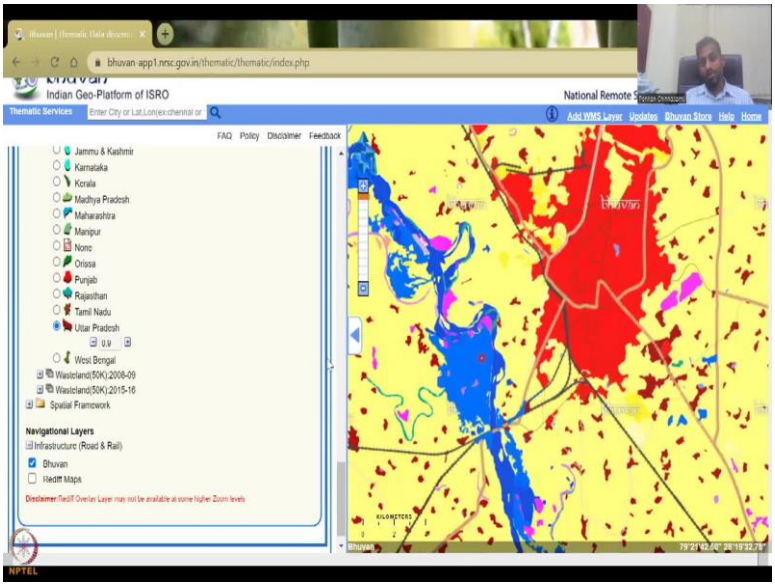
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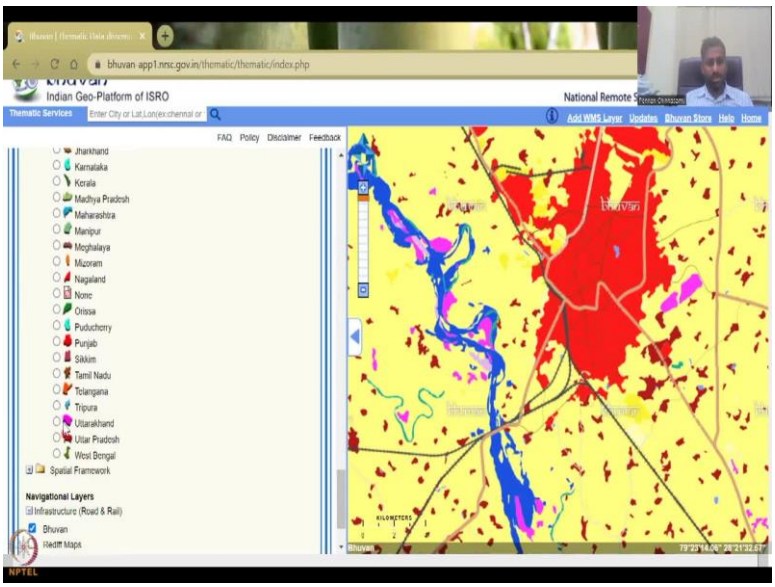
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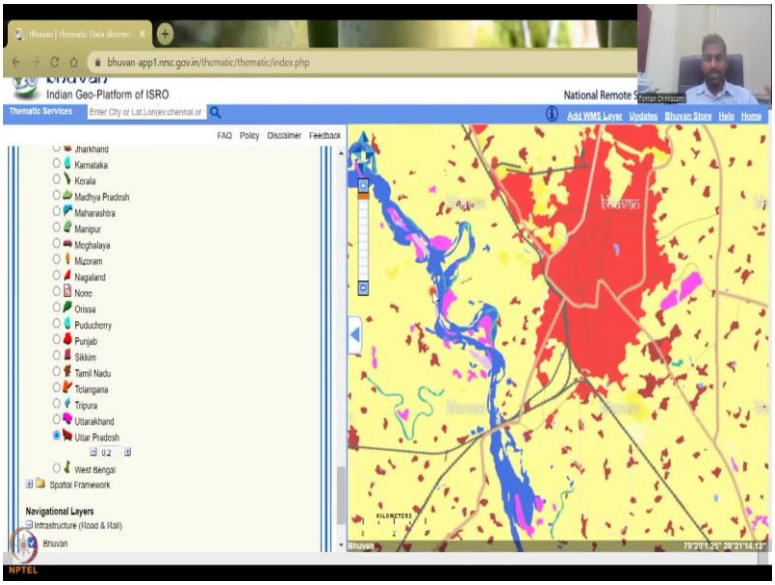
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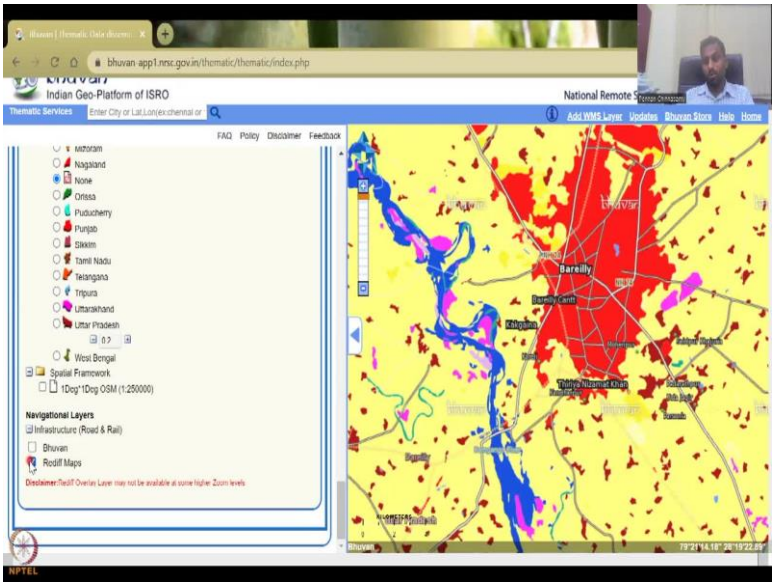
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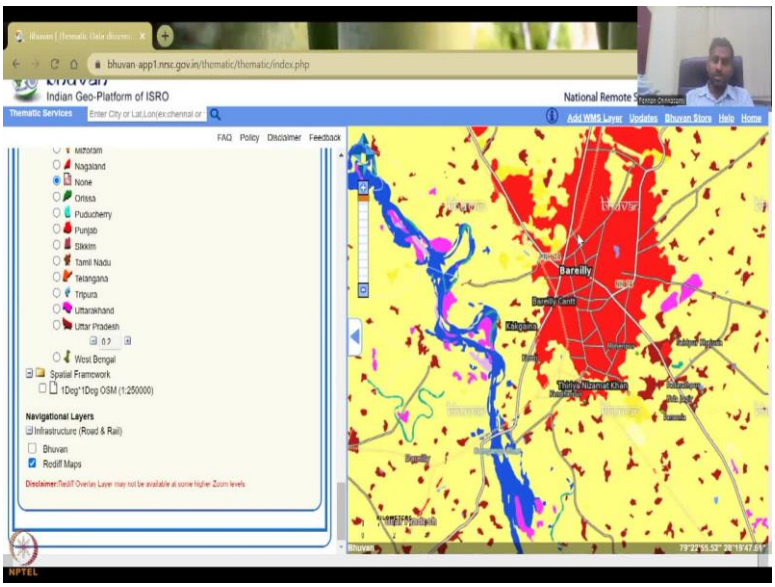
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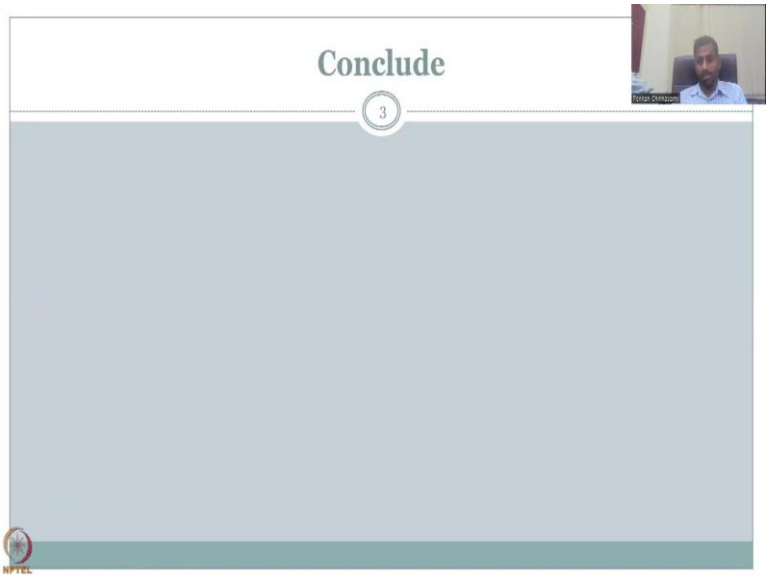

So this is about the statistics, let us do some analysis, we are coming back to Bareilly. And as I said, I do not want the entire Bareilly, maybe I want along the riverbanks so I am going to say draw a y I am just going to click and then you are allowed to click points, I hope you can see that I am going to click points. And then once you do this, it will go like a polygon is going to go up here, then down. When you finish just say double click and it is done.

So then you can click Analyze, let it analyze your area of interest. So, this is what I do. Now, it has come up and it will give you the statistics that you have selected 477 square kilometer. And in that cropland is the highest you could see that very clearly cropland is the highest followed by your water bodies, which is 10 percent. Point rivers and streams, rivers stream canal is 50 square kilometers I purposely did the river canals because that is where Ganges tributaries and river is flowing, we could see where the agriculture happens.

Agriculture normally happens along the banks. So while I am doing this, I also wanted to open the Google Earth Pro. So let me open the Google Earth Pro for you to analyze this Bareilly region. We will quickly see along the region where along the river where the Bareilly is having agriculture, so the spelling was wrong, but now it just picks it up as Google does always. So, you can see that Bareilly is going to zoom in and the river channels are going to come up as and when the internet picks up speed as you can see now, so these are the river channels.

So now if you want to see back and forth, what are these so you can see that this is what was labeled as wasteland wetland in the land use land cover in the data you can see these lands are waste wetland, but as I said, this is more fertile land because water comes along with water

there is alluvial sediments. So these lands are very very pricey and have a lot of water for agriculture. And you can see a lot of agricultural activity happening.

You can go back in time for this area always it is been agriculture. So maybe too much zooming cannot help but 2002 should be good. At least one part of the image is good. Let me go to 2005. Yes. So here you could see that not much meandering has happened. So you can see people farming right on the banks, so they start farming along the banks of the river, because it is very, very fertile. You can see here, these are crops, rows, the rows are giving the particular maybe Paddy was grown on this side, there is nothing wrong.

You can also see how the tractors have laid the area, both the sides, there is good agricultural activity and beautifully the image captures all these aspects. Yes, so now, we are going to go in a bit we will have better high resolution, temporal and spatial locations, you can see that this is being reflected in your initial areas, these are the areas where the pink color is being shown here as scrubland, Gullied ravenous to where the water is moving.

These are mostly the land where it is kind of wasteland not much activity can happen. But along the banks, you can see yellow color, which represents agricultural activity. So you can do a quick analysis for area of interest or for a district, a district is fine, but sometimes you want to do only for a particular area of interest, you can zoom in and do. But make sure you understand the resolution limitations. Colorings, please do not use these kinds of colorings just take if I were you, I will take these in an Excel just type these values in a table and then make your own pie charts or black for agriculture does not look good, it should be green.

So some coloring issues are there. But again, as I said, it is up to you, you are the user, you are going to present it to a committee, you are going to present it for research. So make it beautiful, use an Excel sheet, use a table sheet, copy these values plotted in a software, There is a lot of open source software's that can plot these graphs, then we will go to meta data. Again what is meta data, meta data is the data about the data.

So, you remember that we had gone into the technical document and then we read about this satellite what was used etc. So, you can see that from this metadata also, which is needed for using in your reports, who has done it, it is the Hyderabad remote sensing center, the phone numbers who you can contact what type of data it is metadata, so there is polygons not rasters, so they have made polygons maybe they have converted the raster into polygon and

the polygon has converted calculated the area, the resolutions are given what spheroid and data which is the geo reference coordinate system, GCS we have used is WGS 1984.

This is the same that we have used in our own tutorials also and then the upper left lower left all these things, what data have the use of original source is multi temporal spectral data from resource to which is list 3 sensor so list 3 sensor was used, some rectifications were done which is cleaning up the data most important the source of the data also gives you the time they take the data so they took khareef, monsoon season August to October post monsoon rabi to December March pre monsoon zaid April to May all these are given in the technical document also but here you can quickly take it out.

The metadata stamp is 5 3 2023. So where I did it, so today I am doing it which is 5 3 2023. So it is putting the date and then you have the land use land cover type English is the language used, data identification, overall accuracy is 79 percent to 97 percent like water bodies. So what they are trying to say is the accuracy is okay 80 percent which is still good to do some good mappings and assessments in agricultural areas, water bodies is very, very accurate.

They say it is around 97 percent accurate because water bodies are easier to map. Whereas agriculture as you saw in the Google Earth image, there should be cloud cover there will be some resolution issues all these have to be taken care of, especially in the monsoon time when there is lot of cloud cover because cloud cover will cover the agricultural crops so you will not know what under the cloud unless and otherwise, you do a lot of survey which is expensive.

So where they did it Meraas, Ranchi corporate name Lucknow and Birla institute of technology BITs, remote sensing applications, central Lucknow by the UP state and everything is there. So web services as you see, you have a link to the WMS data, you can create QGIS, ArcGIS and other users, you can use this as an URL. So, basically, when you put this URL in QGIS, it will pull the data into it, we are going to use much, much higher resolution data. So that is why we are not going to go through the QGIS exercise for this.

But there is important overlay. So let us go to the overlay. So, for this particular region, there are multiple datasets that you can overlay. What do you mean by overlay is there is a data and you put a data on top of it. So you are overlaying a data. So let us say for example, we did not know what was administrative layers, there is a lot of noise coming. So let us put a district

boundary. So I am going to zoom out. Yes. So now you can see the district boundary coming up as red line. So Bareilly has a district boundary.

So none I can do solid red is gone, the state is already there UP so you can have it. So Taluk, so within the district, there are multiple Taluk. So if you take this, it goes between 2 Taluk. So on one side there is a Taluk which goes to the right side of the riverbank, and then the left side is another Taluk. So this is the city Bareilly will keep it as the district. So the district boundary will catch Bareilly very well.

So we can do none for now. And then we can take off the administrative layer. So we will just click the plus mark, it will open and then view, whatever choices you have, you can put roads, the national highways, so the national NH 24 is coming, you can see, which is really important, because when you are doing these rural connectivity maps, which is also needed for rural development, this is what you would need, you can remove the other layers that are creating noise, but you can create these national highway maps.

So the GQ is more smaller roles, we see these come out and go, it is not coming up so only some data has been uploaded, and in the water bodies you have reservoirs, rivers. So I am just going to click on the river, the Ganges river should come up. So, you can see the blue line just populating on top of it. So, you see the light blue line that is the Ganges and the tributaries, as I said Bareilly has the tributary of the Ganges, so, this is a lower stream is not populating up, but we can remove it. So this light blue line will go if I remove it, and then there is reservoirs and lakes. So these are basically the small dams that are built across a particular region. So you can map that also. So we can close this, close this. So these are the base layers, we have seen it.

Now. We have seen that there are thematic layers. Now we can see change. So I am just going to go to the AOI and then draw another AOI just for then analyze, it will do to clear it and there is no way to clear it unless otherwise we do a yeah, let me do one thing, I am just going to zoom out, put an AOI here so that it picks it up. And then analyze that analyze in one analyze, then we go to overlay and then we will go to Bareilly, so this is where we were initially Bareilly we are here back again can do that again.

No, population view, we will back to Bareilly. Second. It is easier to quickly do it by refreshing as long as you know the steps. So as I said Bareilly will go and then select this. So we are back at Bareilly and then we will go to overlake. So now we have done the first base

layers, we are going to thematic layers, let us say 2005-2006 how was it eroding and we want to see UP so it is here. Here you do not see the entire district but the entire state will come up and you can see that there are there is some some erosion happening in the water body areas. And then you can, how do you visualize it as you can see by bringing it down to 0, which is opacity, does it overpopulate on top of it etc.

So, the max even goes nine and you do not see much change happening maybe here there is some erosion happening etc. So, this is only going to give you a erosion value, if you have a land degradation happening example, let us go here, this as much as I can go and I am going to reduce it. So, here you could see that let me bring my point. So, here is there is some erosion happening and the color is given in the metadata or the erosion data.

So you have to go back to erosion data, look at what the color means, and then add it. So if you add increase the opacity you can see that this is populating. If I decrease it, it will out same here along the water body there is land erosion, and if you increase, increase the opacity which means it will be on top and it will block the bottom layer then you can see the maximum overlay happening. So now we can go back and then see if we could remove it. Yes. So we have seen the erosion.

Now I am going to show you the flood annual layers, there is only 2 as I said, not all layers are map only 2 are map. So we will close that when the flood hazard also Assam is done. So let us close it. Land degradation 2015. So this is important because this map is 2015. So let us do 2015 and then come back to UP. There it is. So you could see that these are the land degradation parts and let us see, where is the landing let us say maybe it is saying that blue part is degrading land, let us bring down the Opacity and see where it is.

Now, beautifully you could see there is a land use land cover on the bottom and on the top there is the land degradation. So, there is some kind of degradation happening, but you could clearly see that it is happening along the river channels. So, if the rivers are not maintained properly then there is lot of erosion and degradation of land on both sides of the bank. So, you could see here on both sides of the bank of the river there is degradation, these are the high productive agricultural lands.

So for Agricultural Development and rural empowerment, these lands have to be protected so the water resources have to be managed. So I am going to close this as none and then there is also land use land cover so let us do a land use land cover 2005 and 2006. Let us go to UP

and now you will be seeing a population of two datasets. So let us see if I slowly bring it down, you can see that this land was not in the agriculture, you can see that these are not agricultural, but they have been converted to agriculture in 2015 16.

So if I reduce the opacity, the top layer which is the 2011 sorry, 2005 2006. So 10 years before 10 years before the base map, you could see that there is less agricultural land. So all these agricultural land are wasteland, but because of science and technology, some interventions all these have been converted to agricultural land, where you will see more change is the city itself, let us go back and you can see that here they just have an eye here you will see that the city is growing because I am putting 2005 land on top.

So all these were agricultural land, the yellow, yellow, yellow, all these are agricultural land, rural land. But now if you open up the 2015 2016 you can see that it has been converted to the city which is the Bareilly city increase. Like this, you can keep on adding overlay different data. So there is land use land cover 12 2015 16 which is already here. There is salt affected and waterlogging there is not much salt here. So you will not see that but let us add waterlogging that is pretty dominant.

You can see it here, so I am just going to reduce the opacity. So this is the river and wherever the river floods wherever the river expands you will see waterlogging. So now, you can download this map, you can print this map here, just download it, frame it, you will get it up and put none and then you have the wasteland 2008 2009 let us do 2015 2016. It should normally overlap because we already have wasteland in this part. So you have this high wasteland around this area.

So now you see that wasteland has already land use land cover in the 2015 2016 data set, but it is not showing because it was not predominantly map in the 2015 16 data set. So this is it. These are mostly the overlay options. You have a spatial framework if you want. It is not much just reading if you want, you can take it off and then the Bhuvan data if you do not want Bhuvan data you can take it out and then put Rediff maps, which is a roadmaps, which is giving a higher number of attributes, you can see multiple roads here compared to the Bhuvan map. So you can use whichever data you would like to see.

So it says Rediff layer may not be available at some higher zoom levels, you can take it off and visit. This is all about the ISRO LULC dataset, and how you can use it, play with it and download the data. Sometimes when you cannot download the data, you can always geo

reference it, print it and then geo reference it and then use it for your study area. With this I will close here.

In the next lecture we will look into the NASA data set for LULC and how they have done it differently, which is also important to share and copy we want to see how different agencies are mapping so that we can have the best data available. This I stopped here. I conclude today's lecture. I will see you in the next lecture. Thank you.