Groundwater Hydrology and Management
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Indian Institute of Technology, Bombay
Week 10
Lecture 01
Groundwater Data – Aquifer 2D

Hello, everyone. Welcome to NPTEL course on Groundwater Hydrology and Management. This is week 10, lecture 1. In the past weeks, we have been looking at the major concepts of groundwater and then we looked at specific data that we use to understand the concepts of groundwater. And now we are in a stage where we can collect the groundwater data and use it for our understanding.

On that note, this week, we will be focusing on more groundwater data availability, websites, and see how we can use it in our assessments. Since this is a introductory course, we will be showing how to first use this groundwater data. And then in a downloaded fashion, how you download it and use it. And then we will look at how we can put it into a consumption model in week 11.

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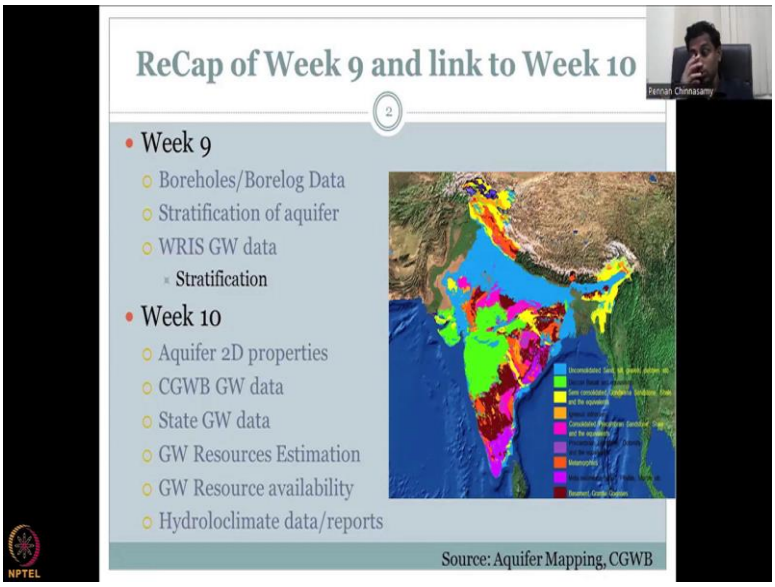

So, first let us do a recap of week 9 and how it is linked to week 10, which is this week. The week 9, we looked at a very important data for understanding groundwater aquifers, and aquifer distances, how it is placed the boundaries etc. We looked at boreholes, boreholes and borelog data. And that is the deep aquifer kind of drilling, where you drill and then you take a core out, a core is a sample, which comes out after drilling and then or while drilling and then

you have layers in the core. That layers were used to stratify, create multiple layers of the aquifer, so that we know how water moves between the layers.

We looked at WRIS data portal, which is the Indian water resource information system. So, it is normally called India WRIS, WRIS standing for water resource information system. Sometimes the website does have some lag, or it has some issues while pulling up the maps. So, do not worry, just revisited often a couple of days, you will get the data, the link is correct. What link I am going to show today is going to be correct. But sometimes you may not have data populating because of the hardware, software maintenance, etc.

So this, we looked at the WRIS groundwater data for stratification. And then the more data in the portal that we will be exploring in week 10. We may not be able to get in depth of each and every data that is stored in this website. However, my duty is to introduce these concepts so that you can slowly build an understanding for these by linking it to the weeks before we had this class. So, in week 10, we will be looking at Aquifer 2D properties.

So, basically a core was giving you a 3 layering, you have at 1 point, how is it layered differently and then 2 points you can take for our 3D visualization. But there are some properties which is 2D that we will be looking at in the aquifer 2D property tab. Then we would slowly look into the most important data that is groundwater level data. And then we will also look at some state data. So, there are central groundwater board data, and then state groundwater board data, which we will be looking at.

So, the fund comes from the central government for water management water resources. That goes to central groundwater board for monitoring groundwater resources. And then we have the state agencies that monitor the state water bodies. Sometimes there is one district with 2 wells monitoring the same water level, whereas 1 is for the state and 1 is the central government water board. So, mostly these data should talk to each other, but they are also standalone. I will go through the examples.

Then we will look at the groundwater resource estimation tab. which talks about how to estimate groundwater resources, the water budgets, we will look at groundwater resource availability, the current availability, the past availability, and some hydro climatic data, we may spill this into week 11, because it is a very important chapter.

So, if there is a weak 11, then we will finish off with a conceptual model which requires all this data. And this helps us in mapping this aquifer boundaries, understanding why these

boundaries are made. And once the understanding for the boundaries are made, you are able to incorporate it in your water management plants.

This year is the UN Water Resources Water Day is given to the groundwater focus. And the team is making the invincible visible. So, whatever you are learning in this course, over this weeks is very important for this year 2022 of which 22nd March is celebrated as the World Water Day and this specific year is devoted to groundwater. So, I am very proud that all of you are taking this course because you are learning something that is not fully taught in classes.

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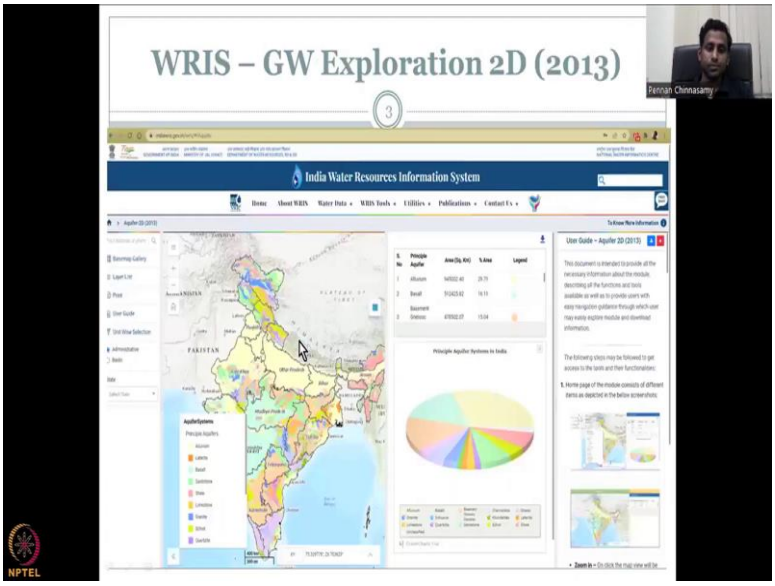

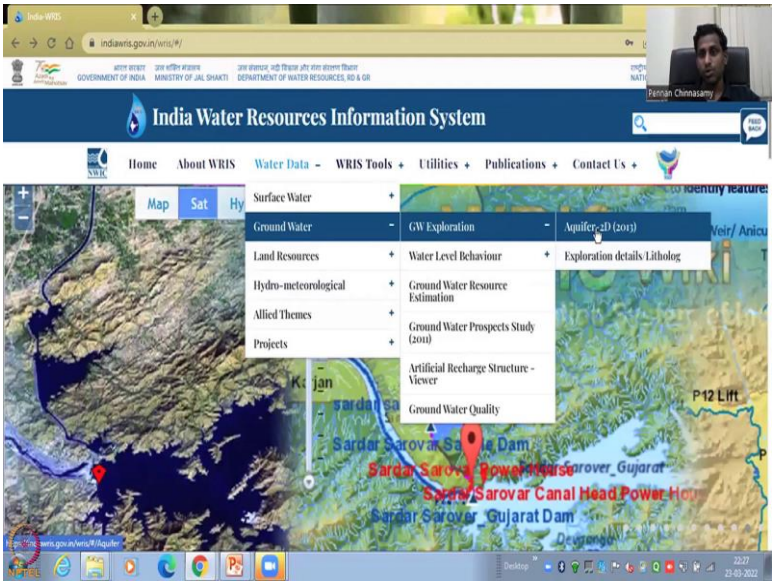

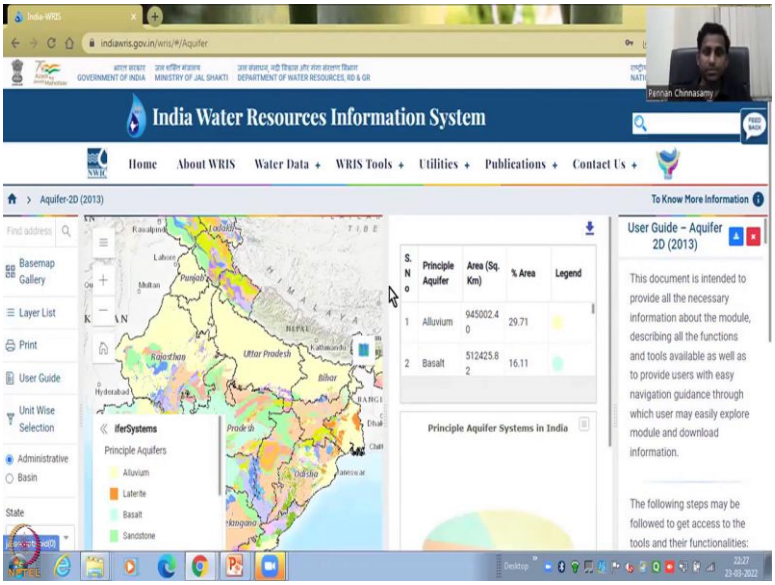

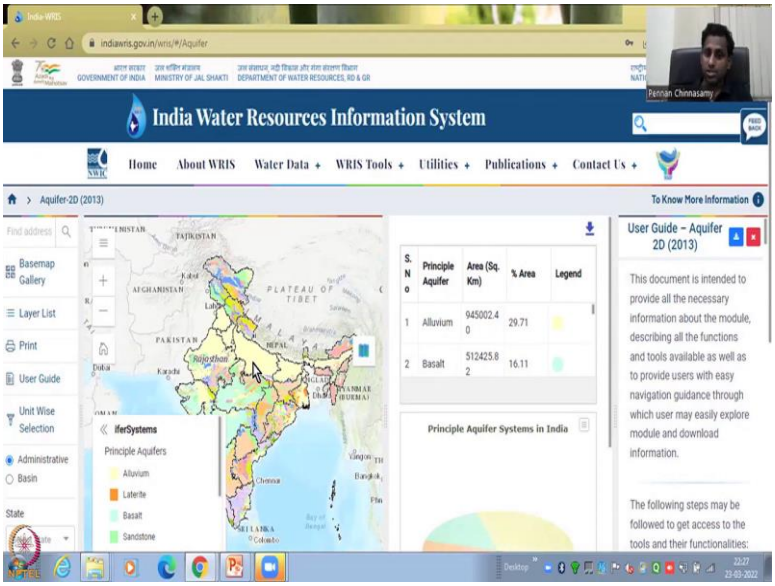

So, this is how the website looks like I will pull up the website to show you quickly. We will be looking at the website which is India WRIS slash Aquifer and this is the Aquifer properties that will come, you will go into this India water resource information system depending on your internet connectivity and the connectivity at the WIRS website there will be some lags. So, please adjust and let me now show you the India WRIS website.

So, what do you see here is the India WIRS website, we are back on there and we go to water data go to groundwater data. So, right so I am not clicking you just have to move your mouse along this tabs and it will populate. So, go to water tab do not click and then come down each one will populate.

If you are taking the rural water resource management course, you will be looking at these other tabs. But since we are looking at groundwater in this course, let us go into groundwater.

And then move right you will go into the exploration details of data logs which we saw in the last week's last class. In this week's class first class, we will look at aquifer 2D.

So, I have clicked it and as I said, depending on your internet speed connectivity, it will take some time, let it populate. Now it has populated. You can move the mouse to the center and then zoom out to show the whole India page. Now you can see it, let us start from the right, the right gives you the manual or what each one is, it gives step by step homepage modules zoom in, zoom out, as I said, you can zoom in, zoom out using your mouse or the default layers, etc.

We will go through all these in class now, and you can print and all these will be updated regularly. What is the base map you want all these things. So, I am going to move this to the side a little bit. See, if you move this to the side, then there is more space for the other contents to come in. So, that is what I did. And I am just moving this so that, the India map can be big.

And you can also keep this to the side if needed, this is places to zoom in, zoom out. And then you could rearrange them back or if you want the table, you can click that, so let us start with the base map. If you click the base map, you get what is behind the aquifer mapping.

So, what this page gives you is the 2D not the depth, the XY plane of the groundwater, what type of aquifers are there? And why are they called, how much area those kind of things.

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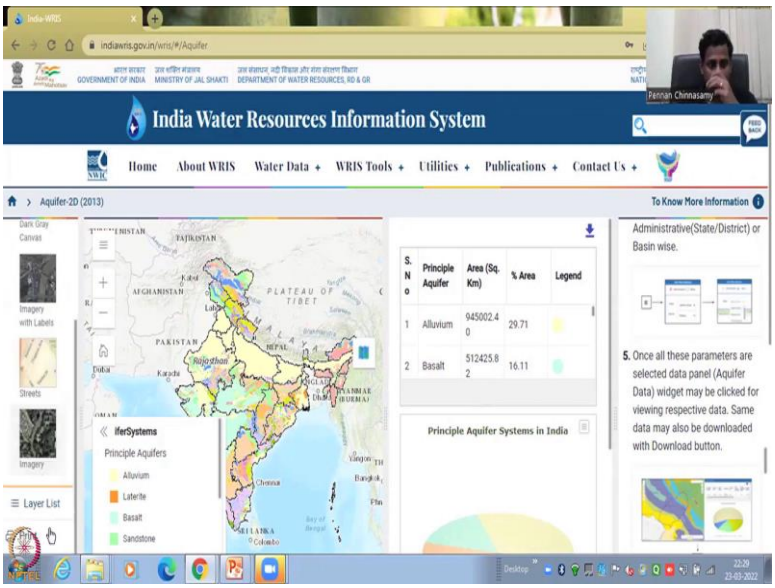

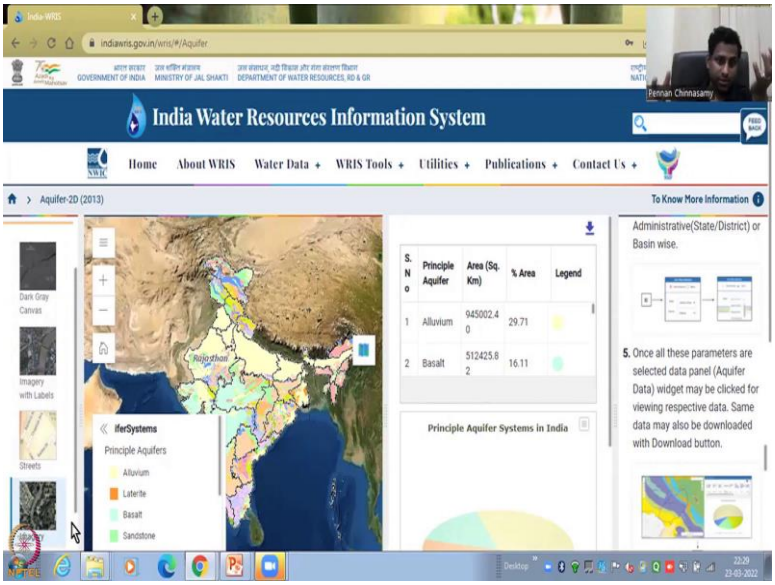
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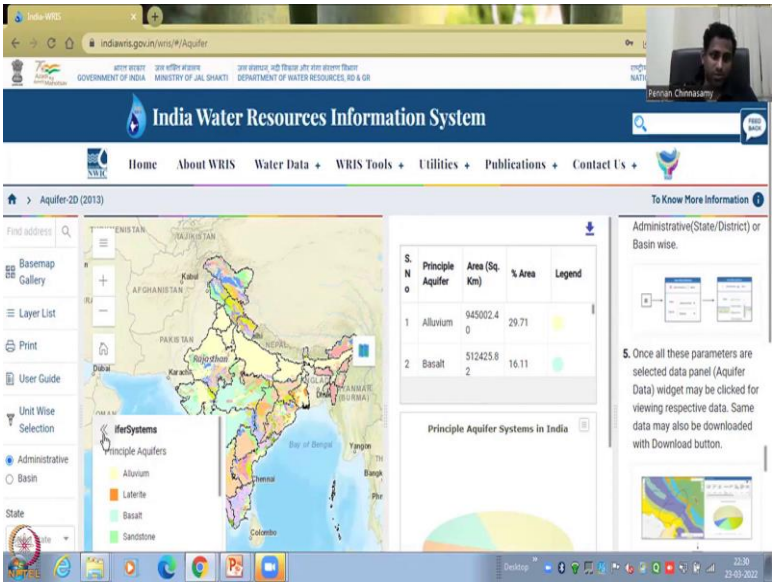
Principle Aquifer Systems in India
Administrative(State/District) or Basin wise.
5. Once all these parameters are selected data panel (Aquifer Data) widget may be clicked for viewing respective data. Same data may also be downloaded with Download button.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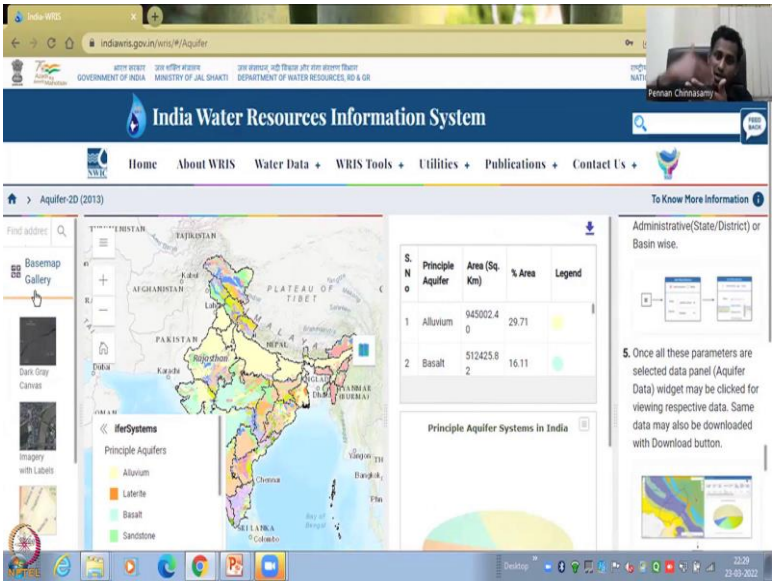
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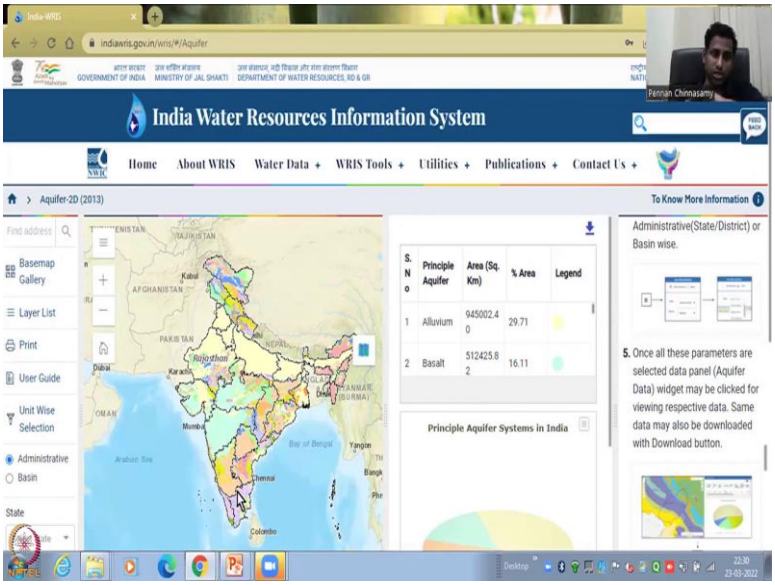

So, for that it is important to understand the base layer underneath layer which shows you the different boundaries. So, the base layer can be dark imagery etc. If you have slow internet always use streets do not use these other layers.

For example, I will show you the imagery it is the real time image from satellites, you can see the green color brown color etc. So, that takes a lot of internet speed. So, for the best thing you can use a street map which is a static map and you can do that so again click on the base map it will become small and then the print user guide, everything is there.

You can create a base invoice map or you can you can create this arrow mark and push the legend to the side. Now you can see the whole of India and or you can do a basin, for example, administrative is your state boundaries or district boundaries.

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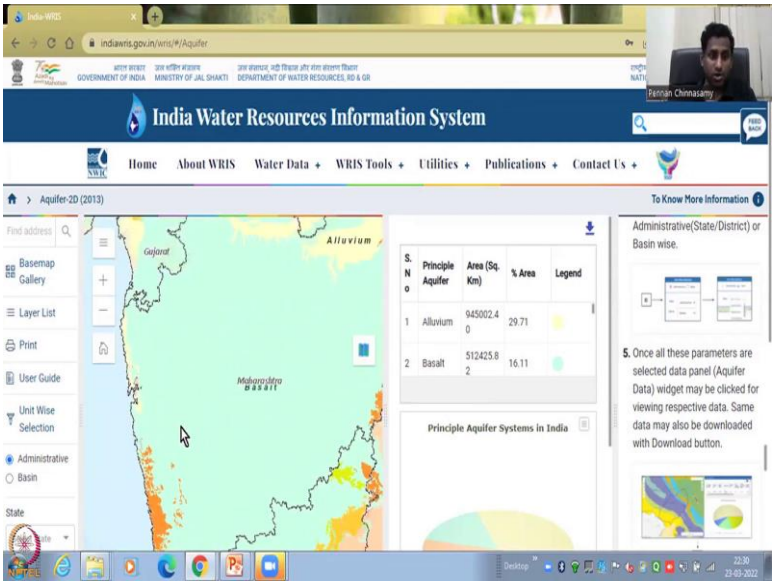

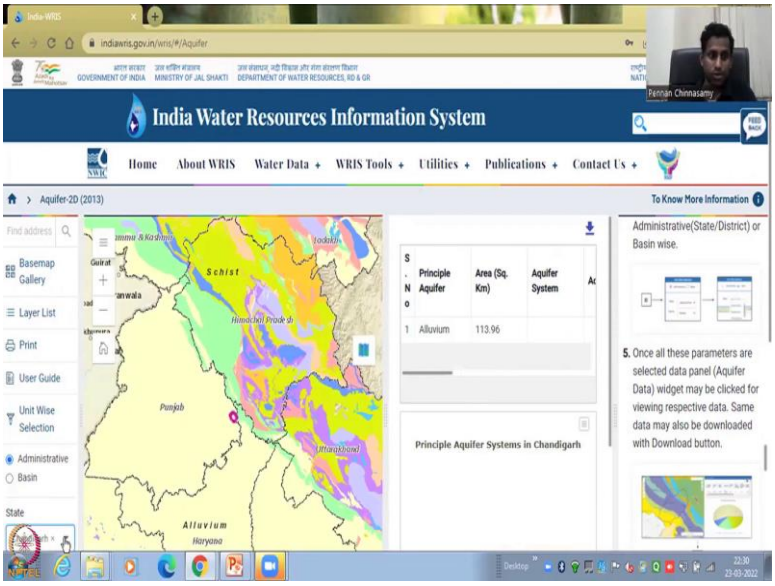

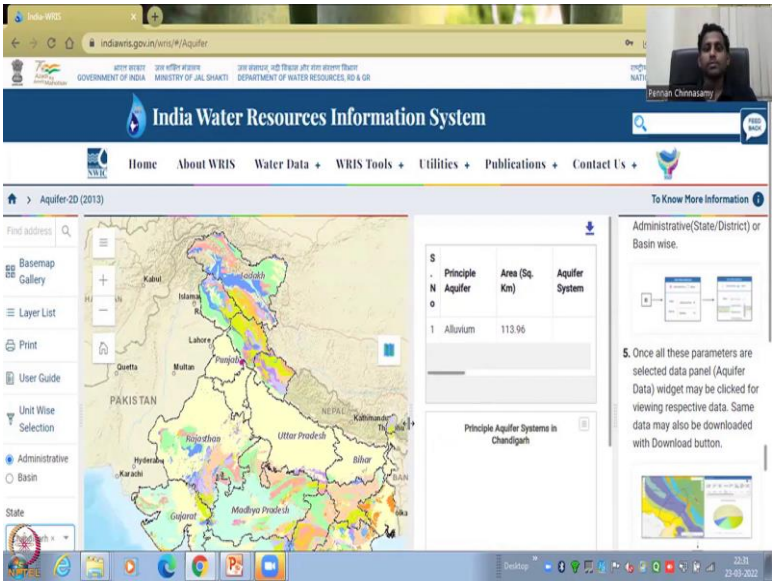

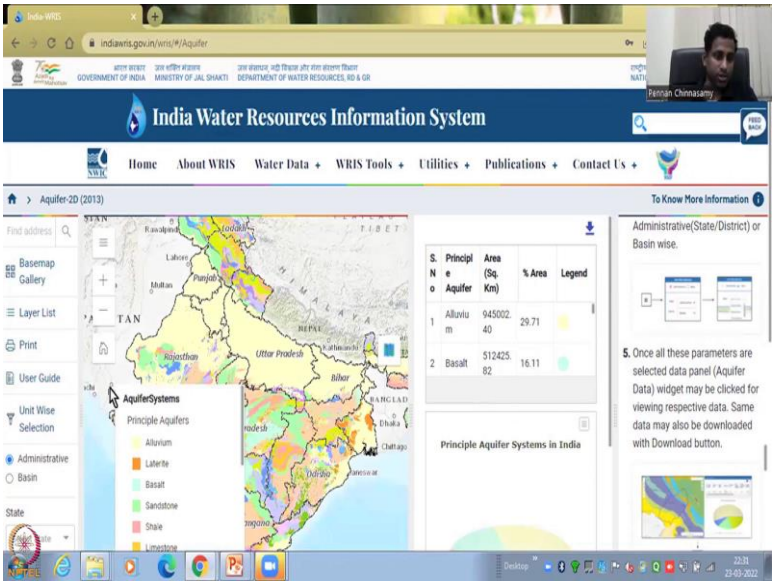

Let me focus on Maharashtra where IIT Bombay is, I am zooming in. So, now it is a state boundary sooner you will see the district boundaries if needed, I will have to turn it on. And then you can select a state if you want to focus on better for example, let us say Chandigarh and the whole map will shift to Chandigarh and this data is also getting populated.

Good. So, let us do back for full India, if you want the full of India, you can just zoom out and if you zoom out, you could see that as this map, the 2D map is getting populated, you will see other data also change. Still, this is Chandigarh because of this, you can click the X mark, it will go off and then this will slowly do to India, now the legend has come back to India and if you go to India scale, this legend would stay.

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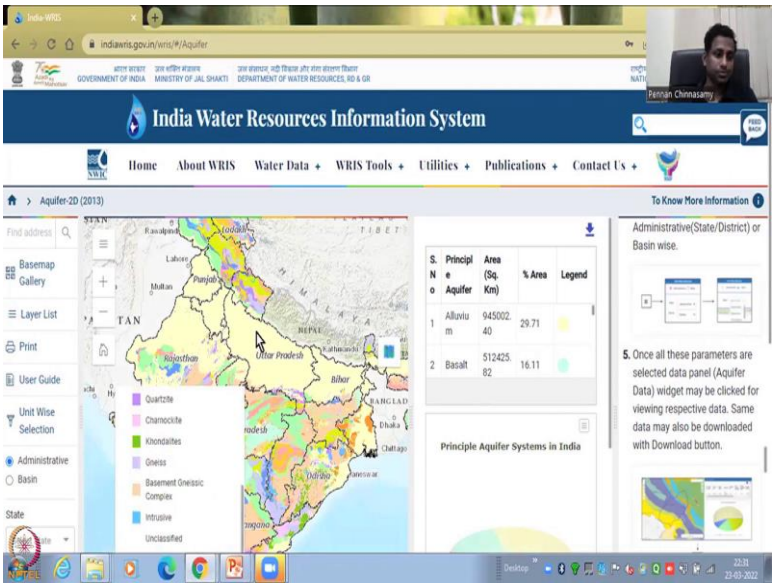

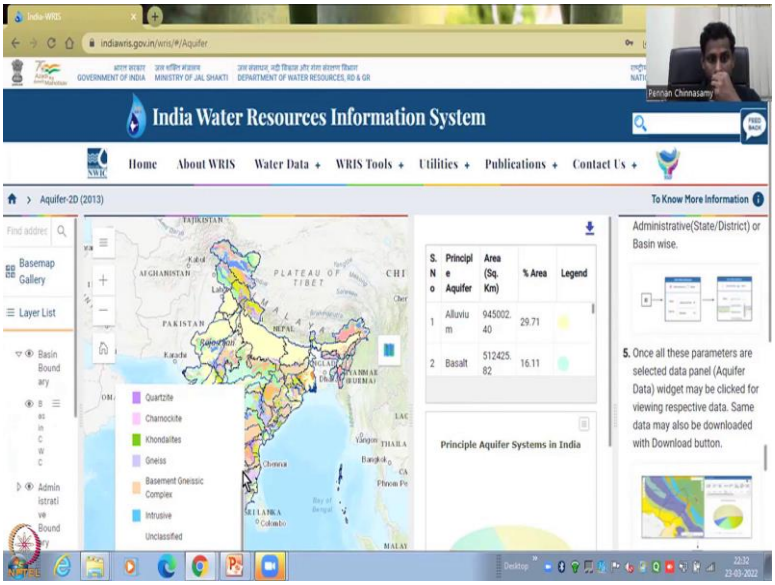
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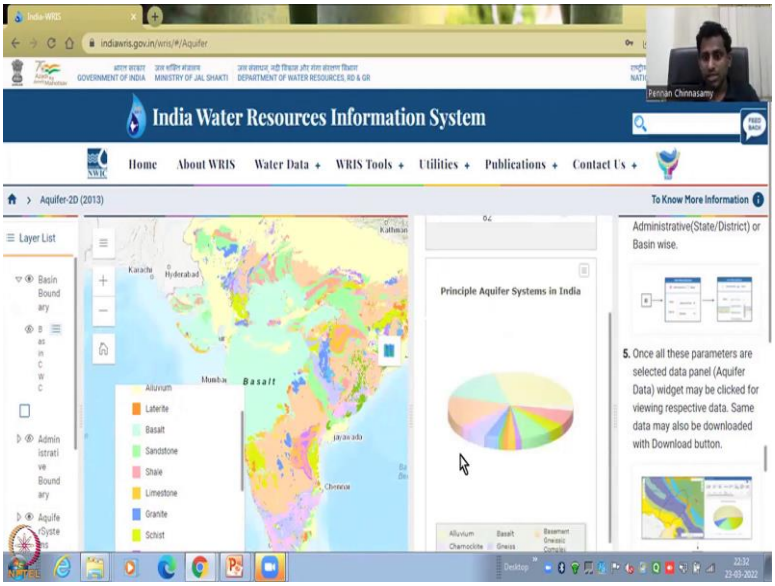
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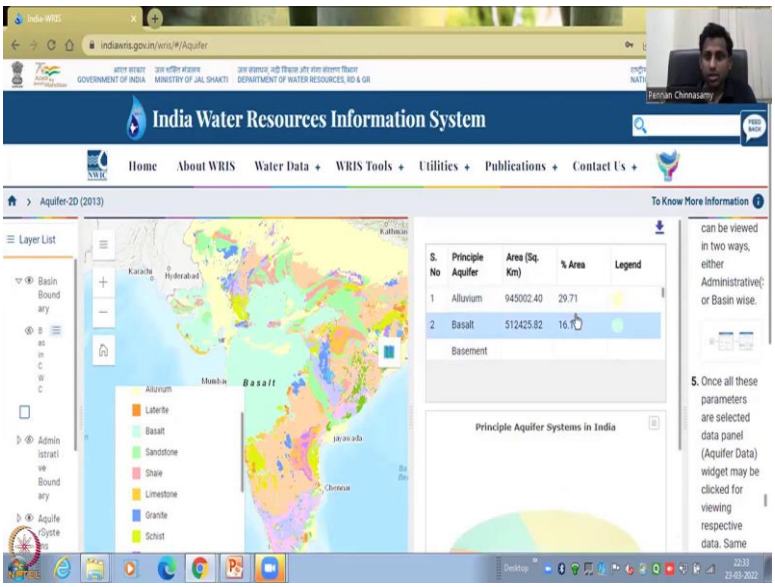
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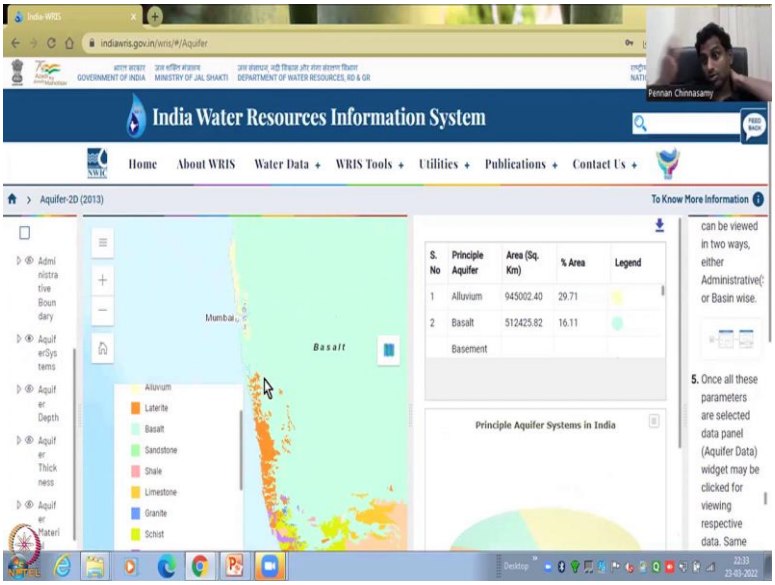

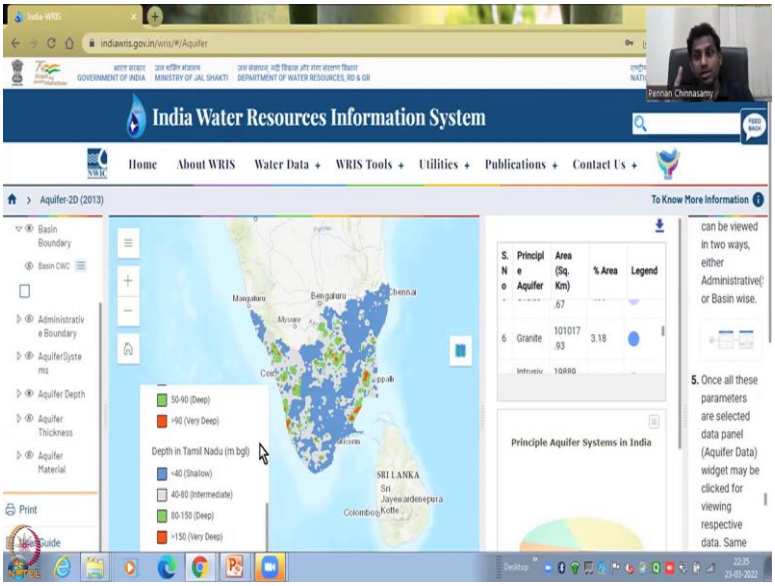

Now, yeah, so now what I am going to do is, I am going to show you the layers which is very important for aquifer 2D mapping, the first is the basin boundary, we have looked at what is the basin and the basin is the watershed etc., etc. And you know that I have taught you in this class that your groundwater need not follow the basin.

So, this is like an eye, an eye which it has a cut which means it is closed. If you want to activate that layer, just click the eye and the basin is going to be activated, now you can see the boundaries as basins. So, if I close this, now, this becomes back to the district or state boundaries and these boundaries can be the basin boundaries can be CWC, which is your Central Water Commission, and different boundaries are there administrative boundaries, aquifer system boundaries.

What I am going to do is, I am going to click this turn off the basin now you can see the basin is gone, administrative I am going to take it off because no point of having watershed and administrative on aquifer, but aquifer system we need so, that is where you can see the different colors of the aquifer and how it is getting populated.

On this side if you see the pie chart is there to show what is the different aquifers present and how much are there and clearly as we explained in class alluvium is high and in the hardrock aquifers is the most. The hardrock can be further divided into basalt, Gneiss complex, Gneiss, Granites, etc.

So, all these would be clubbed together as hardrock aquifers whereas alluvium is around 30 percent in India, the percentage is actually given up, you can see that total percentage is around 30 percent, 29.71. So, I was at 30 percent. The hardrock is 60 percent. So, what you could see here is, I am going down and as you can zoom in, I am going to zoom into let us say Mumbai Maharashtra region, you can see that the blue is the basalt layer and then the orange is the laterite layers.

So, along the Western Ghats you have a particular aquifer and then on the other side you have different aquifers here the numbers are for whole India you can see it is for all the even if you zoom in, it will not change only when you change the boundary at the bottom. Pick a state then it changes. So, what else can you see you can see boundaries you can see the aquifer systems if I close this the legend goes off. The eye, if I close it, I need it so, I am going to take it up, then you can see that is one property.

So, aquifer system what aquifer it is, is one property 2D property the next one is the aquifer depth. So, how deep is the aquifer? Is it shallow, intermediate or very deep? This is done for certain states so you can see that only 4 or 5 states are being done. So, to see it you can zoom out of India and depending on your internet it takes time.

So, society's internet's here it is coming pretty fast you can see Kerala has done Tamil Nadu is done and other reasons but not Maharashtra etc. Let me go to Tamil Nadu but yeah, Tamil Nadu is here and I am going to zoom in to Tamil Nadu you could see that along the coast it is shallow, shallow aquifers, unconfined aquifers, but in most of the key districts and along the dry side of the Western ghats, that is the rain shadow region of the Western ghats, it is pretty deep intermediate to the units are meters below ground water level. So, ground level, so you have the ground and meters below.

So, you have to go in the red 150 at least meters down. That is really really big. And it is not good for an aquifer system. So, understand this that you need to also know the spread of the aquifer on the top 2D but also how deep is do you have to go for the aquifer. All these are taken from your borelogs, data logs, I am going to close this but you can also see like if you can open it there is different depths that you have.

So, for example, if I can open this eye and only keep Tamil Nadu, if I want to see Tamil Nadu, I have to close everything else. And slowly the internet is also going to show you only this but so I am going to close this and then the arrow mark you see you can move up or down, if you close it then you have more space to put these data.

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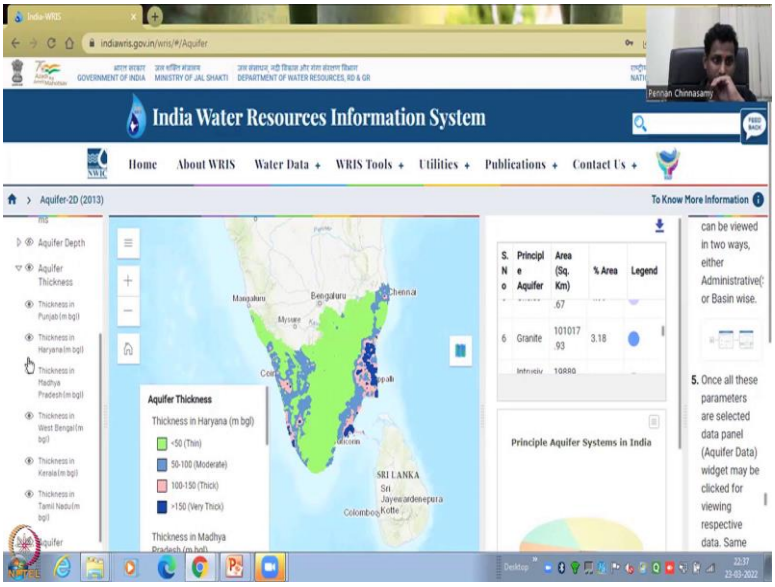

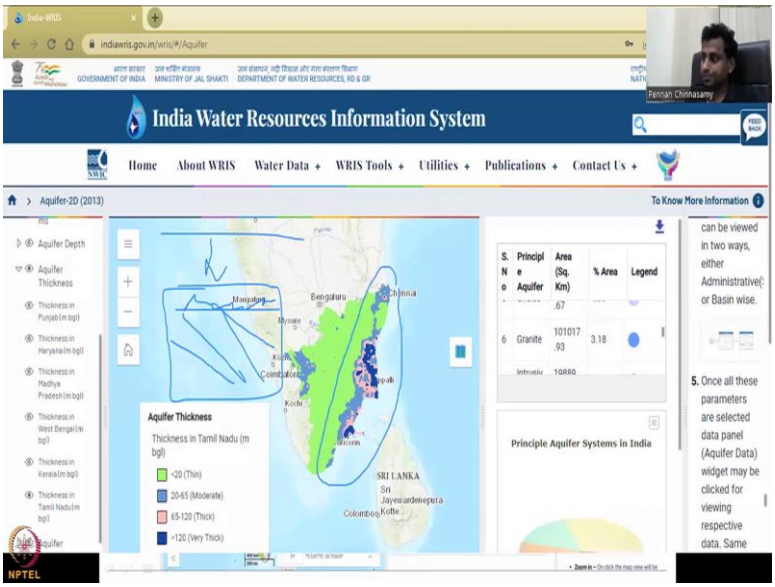

Then come down to the aquifer thickness. So, depth is depth to the aquifer, but how thick is the aquifer in the first water is aquifer depth, but then how thick is it? It could be very shallow, like maybe 5 meters below the ground, but if it is not thick, then the volume is not there. Remember volume is a 3 dimensional. So, I am going to see what are the different states they have done. And let us focus on Tamil Nadu because we have already looked at Tamil Nadu for one study.

So, and if you click it, you can see this arrow a small line moving on the top that is the processing and the internet that is taking time. So, now I have done for Tamil Nadu what you could see is the aquifer thickness is very thin in most parts of Tamil Nadu that is why there is not a groundwater exploitation since the thickness is low lot of pumps are put and water is taken out and the thickness is good then some wells is enough 1 farm can have 1 well and it could suffice but since it is not enough lot of people are putting more more wells to take the water out.

So, the thickness is given by less than 20 meters below the ground 22 to 65, 65 to 20 and 120 if it is 120 think about it, it is big aquifer. And water can be stored thickness, so, you are coming down which is fine. I am just going to draw it for you, see if this is your ground level and you coming down which is your depth to the aquifer and then how thick is the aquifer, if it is very thin that even though you are very shallow easily accessing the water you cannot extract more because the water is only this much, thin, but in Tamil Nadu you could see this is where there is more water. So, all this would have a lot of water and mostly it is because it is alluvial whereas water is being transported by the streams and then the sediments are deposited as alluvial.

So, moving on, now, let us look at the differences why the differences can happen. See, this is not a property that will change because of use the previous one aquifer depth, the depth to go to the aquifer can change. If you take too much water out. If you take too much water out, then what happens you have water depletion, and so your thickness is reduced.

I am sorry the depth reduces, here the thickness of the aquifer which can store water is a stationary property there is some disturbances, you can do compaction, drilling and all those things, but mostly the aquifer thickness is there it is a natural material if water is there or not is a second question.

So, thickness is there. So, what it shows here is this is very thin the groundwater potential is not much even if you put wells even water comes it will not be enough because it is thin, it is a small bank account however, these have really good amount of water and that is because it has a very thick aquifer even though you have to go deep you can get more water out because the aquifer is deep and thick, so, you can justify putting money into accessing this water.

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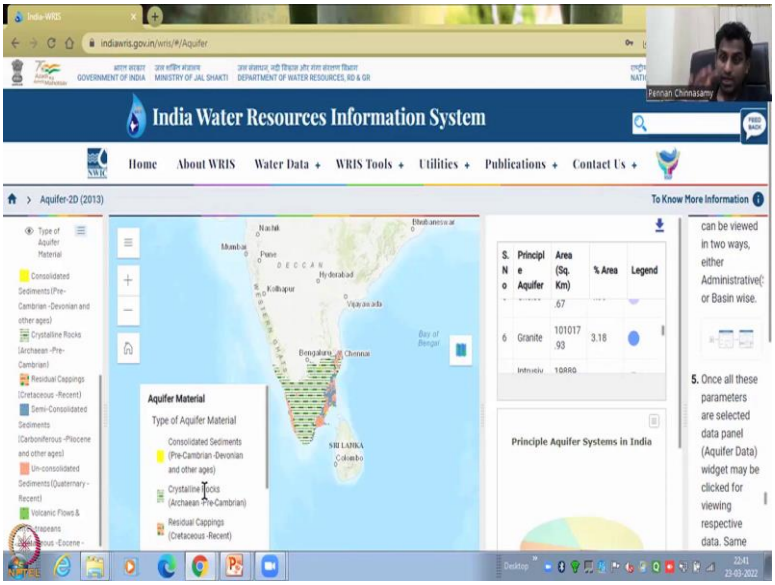
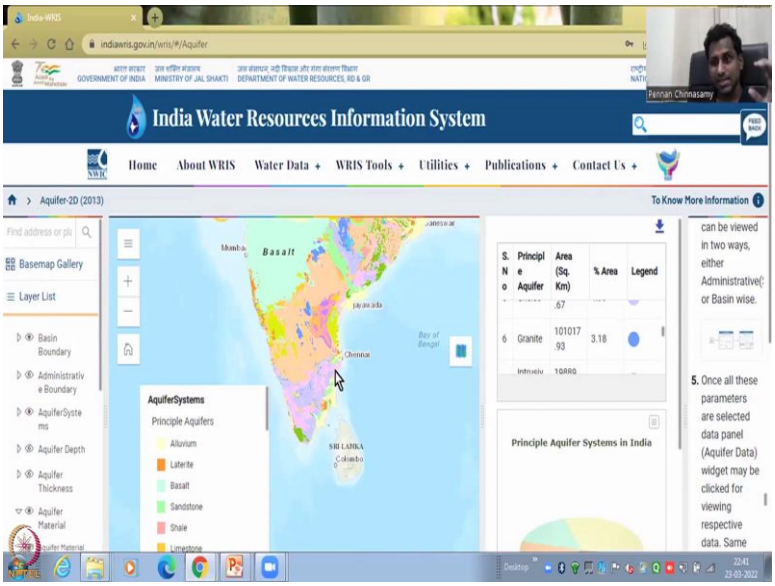
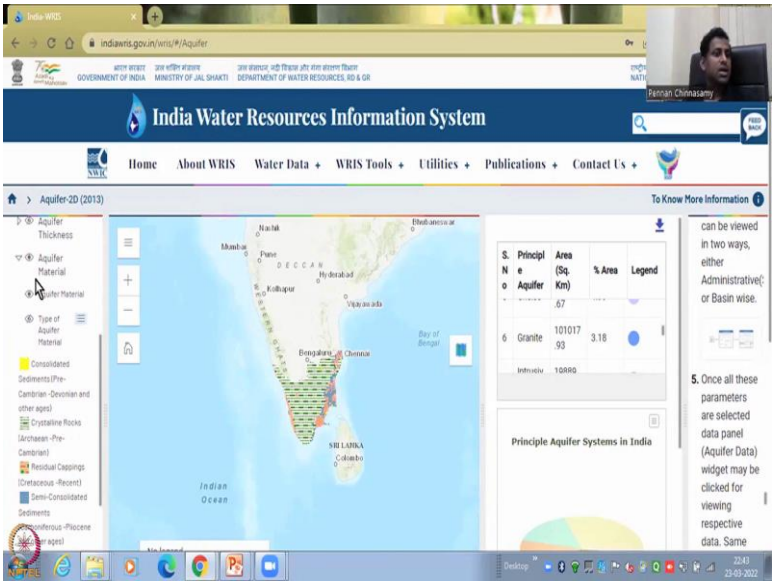
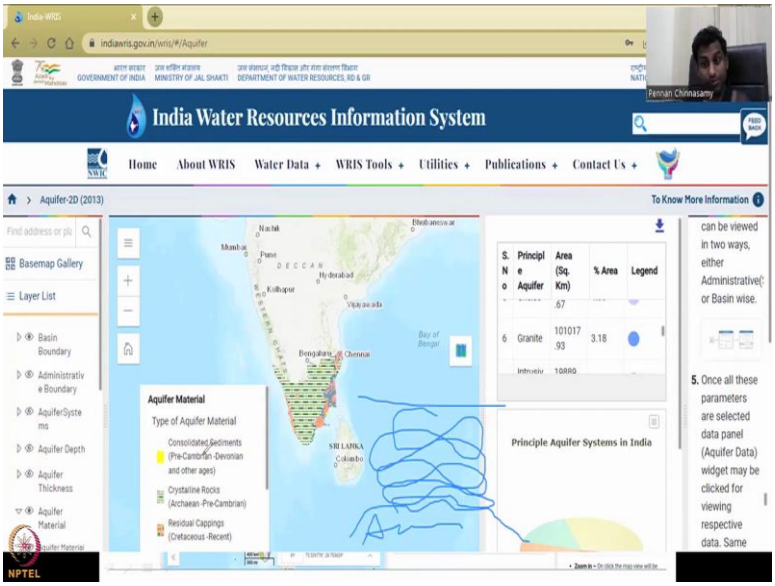








So, I will close this aquifer thickness also there is one more property we need to look at aquifer material and there is aquifer material and click it on and it is populating you could see that there is different materials for the aquifer see by going to stone, here it is the legend. So, the star marks will give you the legend what you see here is the aquifer material which is the not the top material the top is where we saw the Granite the 2D surface you know and here is the old name for the geology name for the aquifer, how much what material was it formed and that actually disintegrates or weathers down into the aquifer type.

So, you have aquifer material and an aquifer type the aquifer material here for example is in this region you have crystalline rocks, now, the crystalline rocks would weather break down and then become hard rock aquifers. So, if I turn on the aquifer system, see I am going to turn

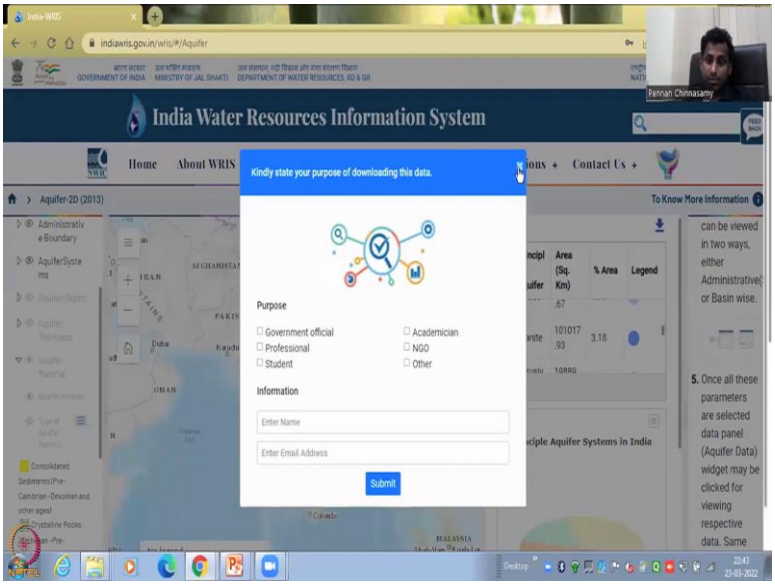
it on and what is happening here this is basalt. So, Basalt is the aquifer system where is the type of rock the type of rock present in the aquifer is your aquifer material.

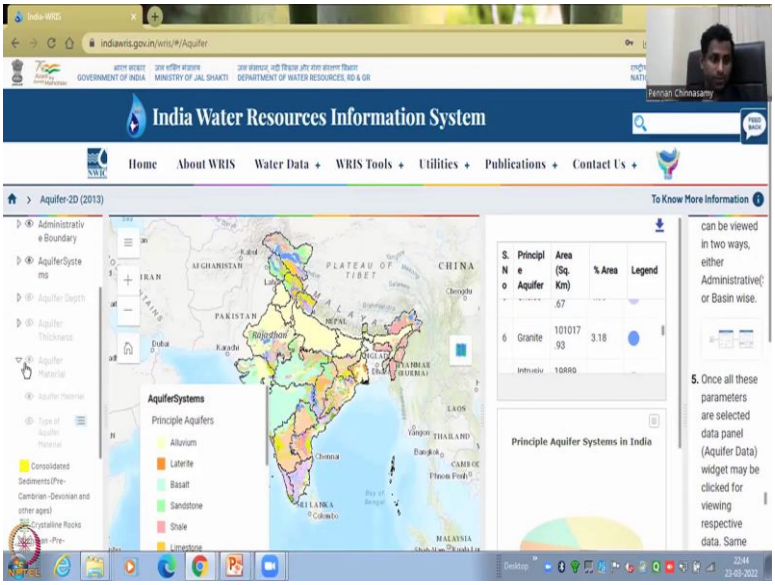
So, that is a difference between aquifer systems and aquifer materials, it might be slightly confusing to understand that Basalt is also a material. It is a rock however, the rock came from a geologic setting and that geology setting is the aquifer material. So, you have an aquifer material, it is the parent material it starts to weather, it starts to break down and then another material is formed. So, this is called the parent material and then the other material which is the recent material is where water stores. Let me draw a quick diagram for you.

For example, you have. Yeah, so, this is your ground and this is the parent material. So, here for example, crystalline rocks the crystalline rocks would be weathering to form a aquifer type and that aquifer type is basalt in this region. Basalt and laterites we saw the Tamil Nadu. So, I hope I am clear this is aquifer material as older older material very very deep, very very deep like geology, and then these are your aquifer types.

So, today we have seen the aquifer material, and type of aquifer materials are these, so you have seen 1,2,3,4,5 only for some states, they have given it not for all states. So, if I zoom out to the whole of India, you could see that not all states actually it is trying to get it but it is not there, the internet also has a lot of data.

(Refer Slide Time: 24:24)

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Aquifer Depth
Aquifer Thickness
Aquifer Material
Consolidated Sediments (Pre-Cambrian -Devonian and other ages)
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PAKISTAN
IRAN
CHINA
PLATEAU OF TIBET
NEPAL
Rajasthan
Karachi
Dubai
MYANMAR (BURMA)
LAOS
THAILAND
Yangon
Bangkok
Chennai
CAMBODIA
Phnom Penh
SRI LANKA
Colombo
MALAYSIA
AquiferSystems
Principle Aquifers
Alluvium
Laterite
Basalt
Sandstone
Shale
Limestone
S. No
Principle Aquifer
Area (Sq. Km)
% Area
Legend
6
Granite
101017.93
3.18
Principle Aquifer Systems in India
can be viewed in two ways, either Administrative or Basin wise.
5. Once all these parameters are selected data panel (Aquifer Data) widget may be clicked for viewing respective data. Same
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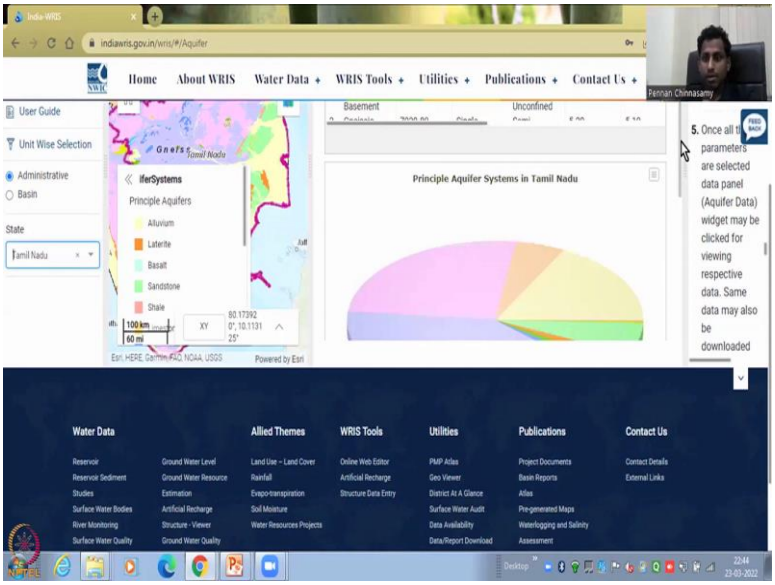
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Principle Aquifers
Alluvium
Laterite
Basalt
Sandstone
Shale
100 km
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Esri, HERE, Garmin, FAO, NOAA, USGS
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5. Once all these parameters are selected data panel (Aquifer Data) widget may be clicked for viewing respective data. Same data may also be downloaded
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Reservoir Sediment Studies
Surface Water Bodies
River Monitoring
Surface Water Quality
Ground Water Level
Ground Water Resource Estimation
Artificial Recharge Structure - Viewer
Ground Water Quality
Allied Themes
Land Use – Land Cover
Rainfall
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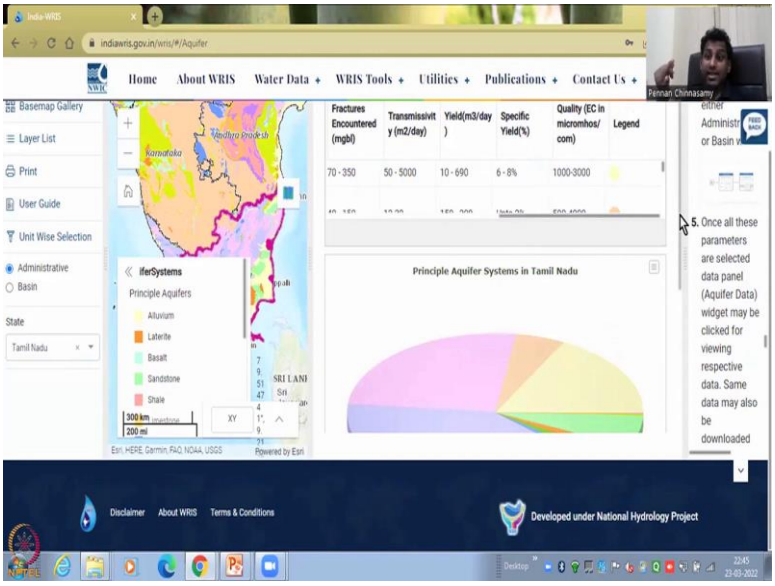
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State
Tamil Nadu
Karnataka
Andhra Pradesh
SRI LANKA
Principle Aquifers
Alluvium
Laterite
Basalt
Sandstone
Shale
300 km
200 mi
Esri, HERE, Garmin, FAO, NOAA, USGS
Powered by Esri
Fractures Encountered (mgbl)
Transmissivity (m2/day)
Yield(m3/day)
Specific Yield(%)
Quality (EC in micromhos/com)
Legend
70 - 350
50 - 5000
10 - 690
6 - 8%
1000-3000
Principle Aquifer Systems in Tamil Nadu
either Administrative or Basin wise.
5. Once all these parameters are selected data panel (Aquifer Data) widget may be clicked for viewing respective data. Same data may also be downloaded
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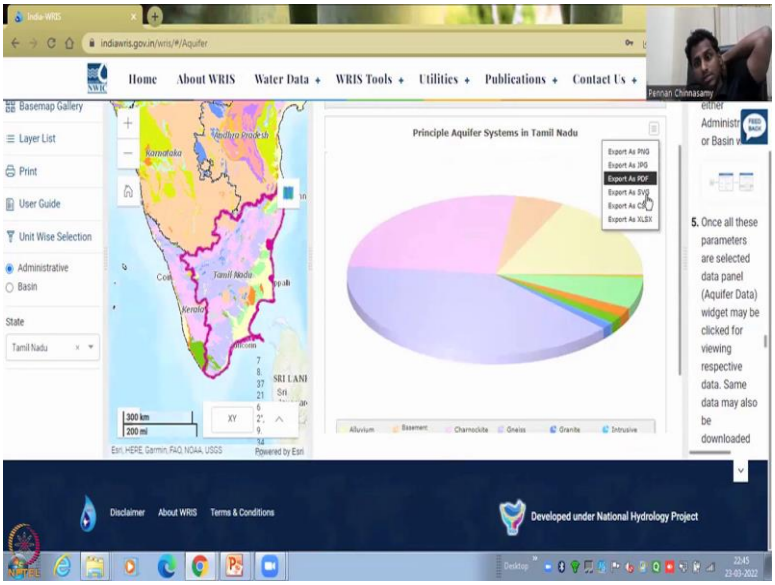

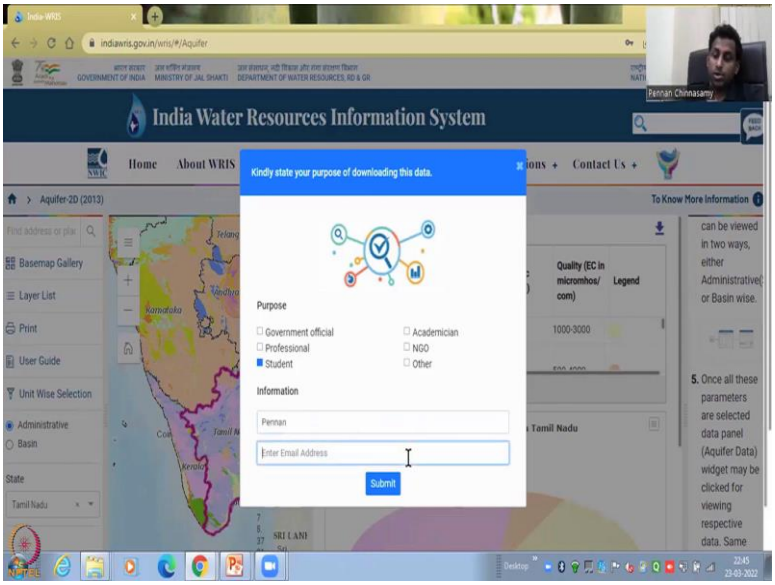

So, with this, I think I have covered the aquifer 2D data that is available, you could download this data as a chart. As I said, when you download it, for example, this data I need, let me first turn this on. So, that we can have some data here. So, if things do not switch on, sometimes just refresh it, it will come up. Now, I am going to push this to the side.

And I want to show you that this is the data I want to take the principle aquifer systems in India, if you want only once a state as I told you go to unit wise selection click it select the state you want and then take it, let us say I am going to do Tamil Nadu. Slowly give it time and it has come up.

So, Tamil Nadu and click this button to go down. So, Tamil Nadu has been selected you see that pink line and this has been also updated Alluvium is you have a thickness you have other

data see for all India these data did not come, why? Because all India these explorations have not been done only for some states it has been done.

And this is where you have the physical property specifically we have covered yield transmissivity we cover fracture encountered similar some advanced things are their thickness we did advertise we did aquifer system, we did all these we have done. So, the legend is given. So, for the coloring, let me close this. So, you can see the coloring and that that is given the legend here. And the shape is given the pie chart, you can download this pie chart as APG and CSV, CSV, you do not get a chart, but you get columns.

So, that you can make different graphs or input it into the model that we are going to show the next class. And you can download this, it will ask you any of these just give, for example, most of your students, you can put student, put your name, let us say Pennan, put your email and then submit it will download.

Good. So, you do not have to have an account. But be careful what details you give as in your student and other things. They want to know how many students are using it. So, that is why we approach correctly. Giving your details correct your details correctly. And you have any other questions you can go down here to the manual and look at how to download the data what is aquifer depth, what is aquifer material.

So, I am not reproducing these into my slides. Because all the data is given here. All the writing is given here. You can also download all of this as a manual by clicking here. You can click it will open as a PDF like a book, you can use the book it is free open source, see it is in PDF book.

Good. I think we have covered the aquifer to the tab the others User Guide print you can also print the page what page you want, I would recommend you to download it and then print it from your system rather than printing a page like this because then you will have control of what you want to show not all the details.

So, with this I would like to conclude today's lecture where we looked at WRIS data for aquifer 2D properties, especially the XY properties on the surface act for type and then also the aquifer depth material.

How do you zoom into a particular state if you look in here you can also zoom in more as in when you zoom in the names also will come, the names of the special materials or aquifer

type whatever you have chosen and some background information of your districts Coimbattor, Nayveli, Vellipuram, Muthupet, Karaikal, Pondicherry, you know Chennai all these names will come Tiruvannamalai etc. So, how do you want to export it as the layout or the map and you want to export as an image all these has been given the Export tab or print tab.

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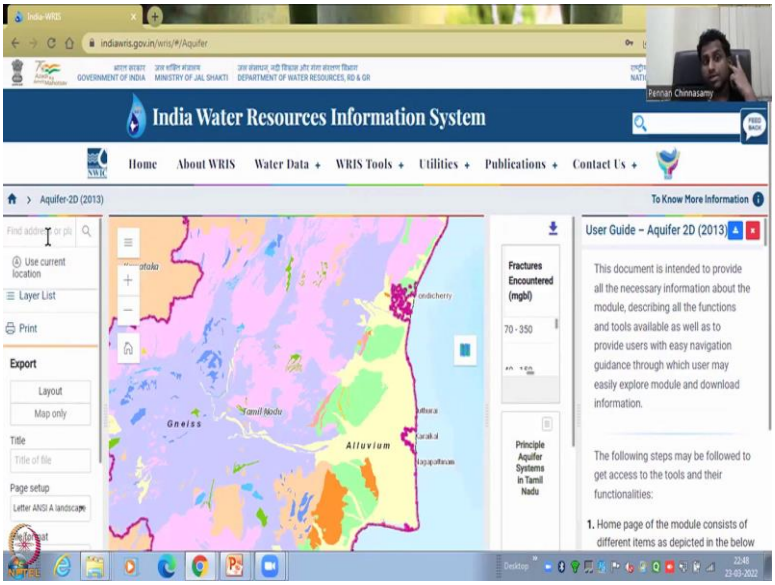

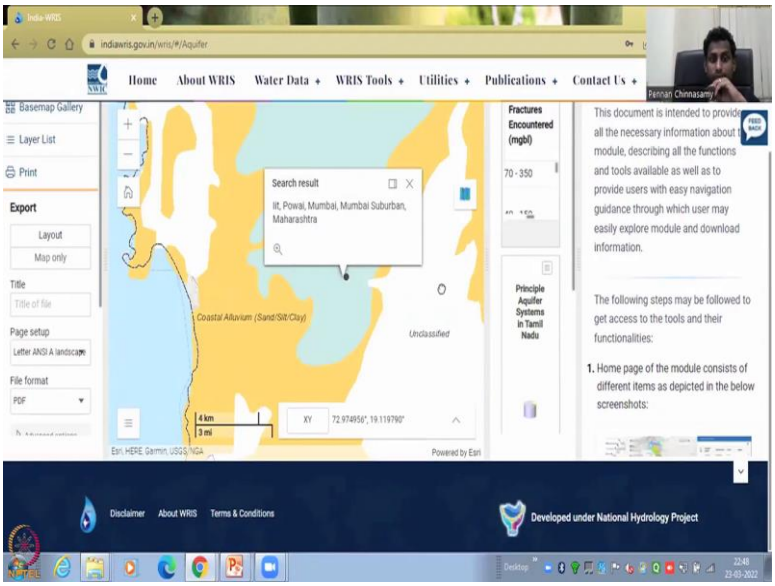

You can also put an address here to choose a location for example, you can put IIT if it searches yes it does IIT Powai. So, it will go to where I am taking this lecture now and it zooms in too much. So, you have to zoom out a little bit to see where it is and you can see here it is Mumbai Maharashtra.

Be very careful it is a very sensitive so slowly move it see if you move one the other things will move and now you can see that, this is IIT Bombay, it has this type of rock. So, anyone who is going to ask you these details, you can quickly go to this website and give them the details about this aquifer and our properties. With this I would like to stop today's class I will meet you in the next class. Thank you.