Groundwater Hydrology and Management
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Lecture - 44 Groundwater Data - Lithologs

Hello everyone, welcome to Groundwater Hydrology and Management, week 9 lecture 4. In this week we have been looking at data for stratification of the aquifer, basically looking at how layerings happen, what data do you collect and how to manage it. We have looked at in the last class how manually we can connect the layers and make a stratigraphy or also use softwares that can be done, basically giving you the names of the software which you are welcome to use.

It is important to now know where to get the data to input into the software, so we started by defining where and how to get the borelogs the stratigraphy data, layering data and then we looked at where and how you can make connections between the layers, thereby making a fence diagram and stratification aquifer and we looked at how to collect data in and put it into a model and what type of models are available.

These are field data, so how do you use someone else's data or like government's data how do you use, that is what we will be looking at in the first part of today's lecture.

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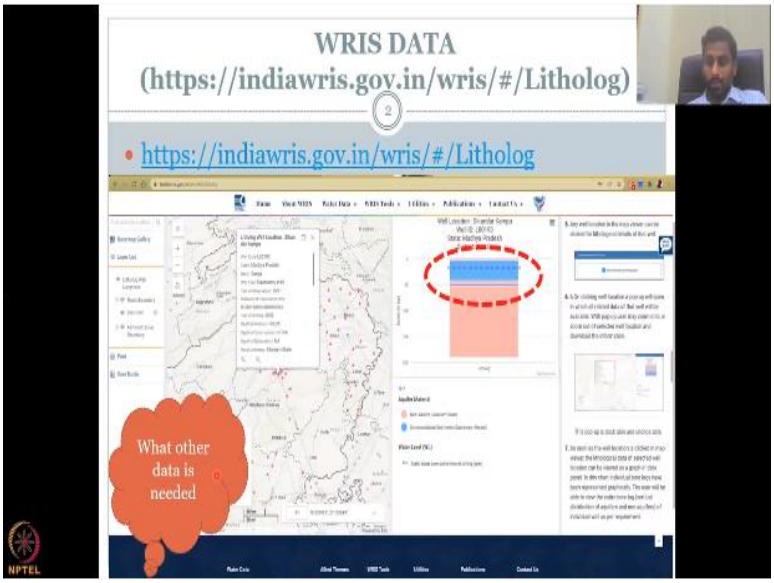

So, this website you see here post most of the water related data, it is an Indian government data and most of the data here or all of the data here are owned by government of India and are people who have added data to the database. So, the link is given here, you are welcome to go to the link and see how this website behave. In the next class I will go through some of these websites, today I would like to stress on how this website is created and what data you can take.

Here when you go into this India WRIS website along with the litholog full link I have given you the link in the slide. You will be taken to this page and then you can zoom in and zoom out and click on the locations depending on your internet speed it will take time, so do not push the model, do not worry if it is taking too long because there is a lot of data and it might take time.

Once you have the data you can download and use it in the software that I mentioned, you will need to create an account to download the data, so please go to this website in today's lecture and slowly start downloading the data before that start the account and play with the website as in what is each button, so that you will be ready in the next lecture when I teach you will also have an account to look at and practice within or how I do.

So, if you go to this website with the litholog, I will just first tell about what is the litholog data, you will be shown a map, a map of some red points, the red locations are where the sample has been taken, the borelog has been taken, the borehole has been made. When you click it, it will be blinking for some time and then you will get this litholog, so now you can see how many layers are there in this litholog, dominant layer is only two which is your non aquifer alluvium shale and then your unconsolidated sediments quaternary descent.

So, almost they give you an edge and also tell you what kind of aquifer it is, more details on that could be just you can search for the names that they are given and you will get it since this is not a geology course I would not jump into all the major sediments and quaternary those kind of things but for now you can understand that it is two distinct layers and then there is a unconsolidated layer and a non aquifer.

See the non aquifer could be labeled as different terms in different books but here you could see the water bearing or where the water is storing in the groundwater through spaces is given by the blue color, the dashed line is called the static water level at the time of drilling well, so when they drilled you can see the well location is Sikandar Kampu, well ID is given, state Madhya Pradesh, district Gwalior.

When they drilled it, the first water they hit which is called the static water because it is called static because it is not being pumped, so it is a stable static water, you drill the hole and then the first time you hit it you record the water level. I hope you remember this is what I taught in the previous two lectures back, where you make a sheet and then by drilling you can know where the water level is then record water level.

So, this is the first water and the only water here because there is no other line which shows an impervious layer and water and it is the dashed line as a static water table, water level, so once they put it at the time of pumping that is the level and what is it, it is almost around 10 meter, 10 meters below the surface they got water, so this is the meters and this is the litholog.

There are some instructions here on how to use the website and because it is a new addition to the website and then you have on this side the map where the location is, it says exploratory well, observation well, piezometer well, others. Exploration as I said it is not for water level monitoring it is just to take the lithologs. So, these are the wells by CGWB or by the state government where they have made the well, you put it in take the water level, take the type of material and that is it, you go ahead to the next location.

The observation well is a well where the water level is being monitored, that is why it is in blue color. Piezometer well is a well which has a piezometer, it is like a meter which they put inside the well, it monitors the groundwater every day or month depending on the time interval, whereas your observation well they monitor four times in a year.

So, now you see the three different types of wells where exploration is just for the logs litholog what kind of rock, what kind of aquifer, observation well is for the water levels

which is done by CGWB mostly for four times a year and then your piezometer well which is having an instrument at the deep aquifer.

So, if you ask me what is the deep aquifer well, then it will be the piezometer well because you cannot put a meter in and then take the level every four months, it is too deep, so what they do they put a transmitter or a data log which logs the data, they put it inside and then they take it every year or every two, three years once because the battery life is large they take it and then download the data and put it back in.

They can also make a system where it relays the data but depending on the depth it may, may not relay the data, you will have to take it out, put it in your system to download the data and then put it back in. So, what you see here is one litholog data, so the idea is you collect more and then make the statigraphy using the handmade model which I showed in class or the softwares.

When you take it, it will be like an excel sheet or a text sheet where how you would like to take but you can also note it down in pen and paper, it is what it says from 0 to 10 around 1 meter you have is very thin soil, that is our top soil and then you have the blue layer from 2 meters to 30 meters and then the 50 meters line there is one other one and after that everything is the non-aquifer, so with this we would finish the aquifer litholog data and how you use the data.

But be careful on understanding the static level, it is not the water level actual because it is not being pumped, whereas most of these observation wells record what is being pumped, so it will be fluctuating a lot, whereas this well it will not fluctuate depending on the aquifer, if it is an alluvial aquifer it will fluctuate, but if it is a normal hard rock aquifer it would not fluctuate much because it is an observation well, it is kind of shielded away.

So, now we finish the litholog, the stratigraphy etcetera but now we are going to jump into kind of wrapping up this course, we need to understand what other data is needed and where is it available, that is what we will be looking at in the next two, three lectures, what other data is needed for understanding groundwater and where to get it.

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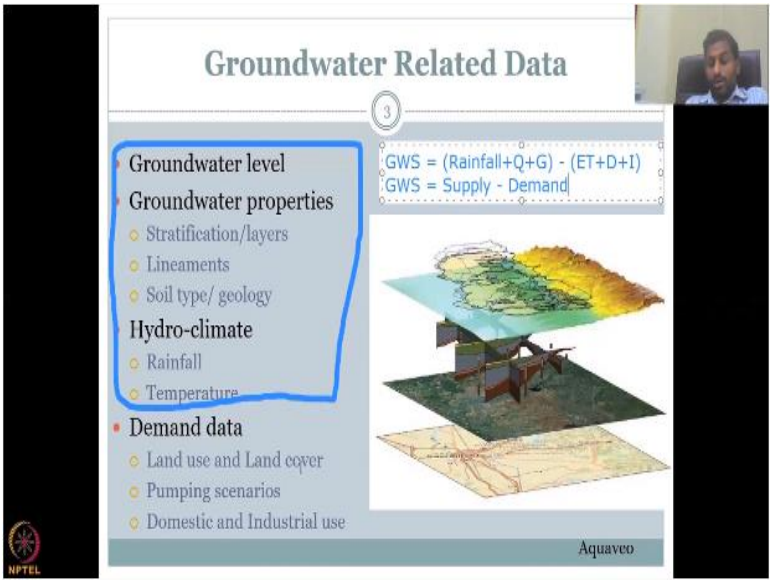

So, if you look at this diagram, you could see that there is multiple data sets that you need to understand groundwater, starting from your roadmap of where the location is and then the land use, land cover, how is the land covered in terms of the green land, is it like crops and etcetera, and then you have your fence diagram, basically your borelog how the log is made.

And then you have your raw material, I am going from bottom to up just to show all the layers, because when you start this is the easiest to get, you can easily get the major material of the rock because that is already available for us. Whereas, if we go down further and further you have different, different data sets.

So, let us look at it as hierarchy, the first and foremost thing is the groundwater level, you need groundwater level to understand the dynamics, how it is being pumped and how the water level fluctuates. For that there is multiple agencies that collect data, we will get to those agencies soon.

Then we need the groundwater properties which is starting from the aquifer properties, do we have the layering, how many layers are there and what are the layers, do we have the lineaments or the geological uncertain areas and lines where water would just pass

through. So, these are both geological terms which actually help to quantify the aquifer thickness and or how much water is stored in the aquifer.

Then you need your soil type and geology which is very important, all these data mostly you will get at a large scale, it is up to you to kind of focus it down to your study and find more data from local environments. Hydro climate and rainfall, which is including your rainfall, temperature, humidity, wind speed all these climatic parameters which help to explain the hydrology is very important.

Those you can get from many sources because these are more easier to get, there is lot of climate models, global circulation models and or a lot of data sets from satellites that can easily capture the rainfall, temperature and other things. The most difficult of this would be your underground parameters including your stratification layers, how many layers are there and most important your groundwater.

So, these are all on the supply side, how much water comes, how much water is stored and how much water is available for your groundwater use, these are called your supply side in your budgets, water budgets. Remember the water budgets we discussed that. What is more important along with the supply side how much water groundwater I have is your demand estimates.

Because your supply is shrinking because someone is taking the water out, it is not just shrinking because water converts to base flow and then goes into the rivers, it is shrinking because or coming down, the ground water level is coming down because there is lot of demand and the demand can be estimated using your land use land cover because if I know there is a lot of agriculture, if there is a lot of forest and trees, plants there is some water movement, some water being taken up, so that you can find out using the land use land cover data.

The pumping scenarios gives how much water is being pumped out of the aquifer, basically you would ask for metering, metering of pumps and or some data that gives you how much water has been found for example, your irrigation database, if you know how much crops are grown in an area and you know the per crop water requirement you could

easily calculate the pumping volume. So, this is a demand that has been occurred you need to take that.

So, let us write the equation here quickly, you have del s or change in storage or you want groundwater storage equal to your supply minus demand, this is the net groundwater available, the groundwater storage, how much is available is nothing but your supply versus minus demand according to your hydrological water balance that I explained earlier in the first, first classes.

And the supply is given by these parameters which is rainfall plus Q in Q out plus your G your water recharge and then you have a minus of ET, ET is your evapotranspiration how much water is lost during the pumping and your pumping scenarios minus actually a bracket, this is supply minus demand is your plus domestic and industrial.

So, you could see how this water balance has evolved, which is nothing but your GWS storage your supply minus demand. So, you need to get all the supply data intact and then subtract it from the demand to get this data. When you get the land use land cover again you have satellites and other things that you can get data, I will actually present this in the next week, we will go each bullet and then we will collect the data and we will establish a conceptual model to show how this groundwater depletion scenario is happening.

Then we look at pumping scenarios how do you estimate a pumping scenario and then we also compare the domestic versus industrial use, domestic you can estimate using your population and then the LPCD rate how much water they would consume and your industrial use is very, very difficult to estimate, we do not know how much they use, agriculture is the biggest demand, however we can easily estimate it using your satellites and other data that is available.

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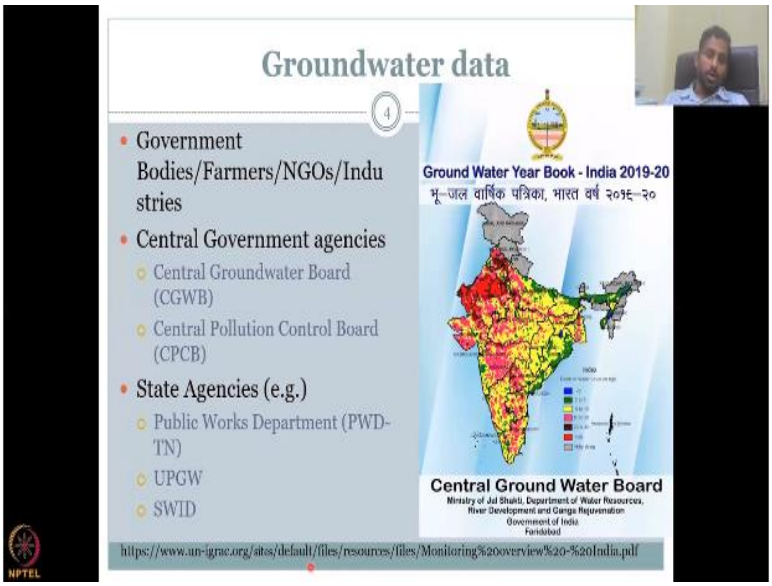

So, moving on then we have groundwater data which is coming from level data, where do you get the groundwater level data and all these remnants and everything you get it from government bodies, farmers, NGOs and industries. So, the industries would be inclusive of your water industries and your agencies that supply water, bottling industries they might have some groundwater data.

Because they consume a lot of groundwater but mostly your government bodies have a lot of these data, agencies I am saying as followed by your farmers which because farmers eventually should have but it is expensive and they are kind of not sure if they will be billed for water say they do not monitor the groundwater, so farmers data is available and NGOs are the people who work on the ground with the farmers they have some data.

The Central Groundwater agencies include, so I am going to break which are these agencies that I am talking about, the government agencies include Central Groundwater Board which is the instituted government body by India to monitor groundwaters across India, they are the central body under the ministry of Jal Shakti department of Water Resources and River Development and Ganga Regeneration Government of India with an office in Delhi.

Almost every year they would release a book like this called the Groundwater Yearbook in India and it will have every single state mapped with the water level fluctuation and most of the data is shown as a net value for example, for one year what is the net, if you want the actual data I will show you how to get the actual data in the coming classes.

The next board which is important is the Central Pollution Control Board, also called as CPCB, see the CPCB is mandate to control pollution and monitor the pollution, because as the name suggests it is for controlling, how do you control without monitoring, so that is why they have lot of monitoring networks.

So, when they monitor the surface pollution, land pollution they eventually have to monitor the groundwater for pollution because they can move inside and that is why they will also have some records, at least water quality only they do, so they will have good lab facilities where you can collect the data and put it. Eventually they also had some groundwater data which you could all take it up from this website that I will be showing in the next class called WRIS website.

Then you have the State Agencies for example, the Public Works Department in Tamil Nadu, the UP government's Groundwater Board UPGW and SWID, so all these boards at different agencies support with a budget to monitor groundwater, they have a capacity for example, scientists in Central Groundwater Board and consultants that work across with these bodies, they monitor the data, they write reports and books and it is published like for example, this book is published, open source anyone can take it and read it.

Initially the data was not available for free, you had to pay for the data, nowadays most of the data is available for free, there are some sensitive data you cannot take, so they will label it saying yes we have a monitoring well but we will not give the data it is sensitive data and along with this there are other agencies that I have given you here on the bottom which have lot of groundwater data UN-IGRAC and also your other international bodies that are interested in groundwater conservation in India, they also collect some data which is available through their different websites and portals.

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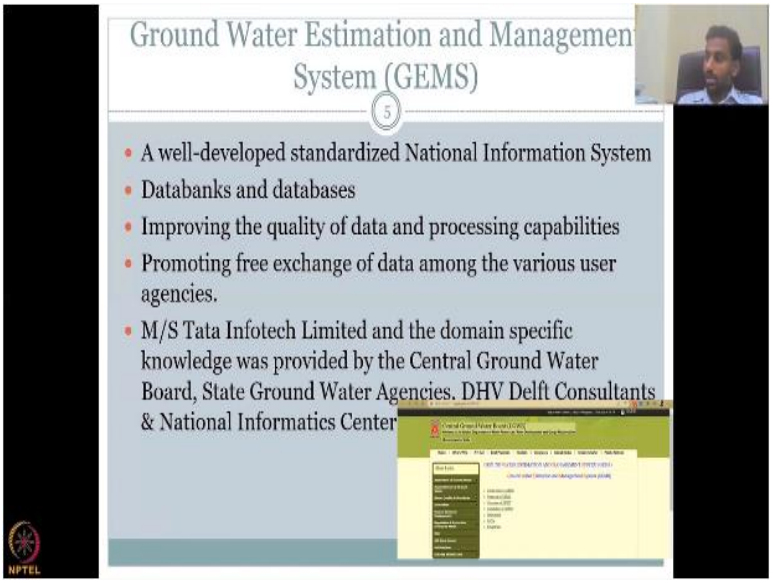

So, what is the government of India done for this all this data that I mentioned is they have created a web page or an application called Groundwater Estimation and Management System. So, this was developed for helping to understand groundwater with the data they have and also some advisories using their advisory team which is made up of eminent people and industries across the world.

For example, UN GEMS it is a well developed standardized national information system database, the link is given here on the top you could see if you zoom in to the slide you can see it here or just type GEMS groundwater India you will get it and it has given you all the instructions on how to download, how to set it up, faqs, etcetera.

So, this data is all hosted into this information system but running this as I said there are multiple systems, running this would take its own learning curve and because we just have three more weeks I will be focusing on just collecting the data for you, there are YouTube tutorials on how to use these websites please go and check it on YouTube you will learn how to use it.

What GEM has is a lot of data banks and databases, which is needed for hosting the data, see not every state government would have a big server and store all the data, so it is better that government India was having this website and from the website they collected

all the data that they need and kept it in a data bank and database which is available for free for public.

It improves the quality of data and processing capabilities because you, your computer or your hardware may not be suitable for collecting and running these samples, so they have given you an information system which can help in making these trend estimates the degree of deviation from groundwater, static line and your depletion scenario, all these things you can take.

It is aimed at promoting free exchange of data among the uses of various agencies, when I say various agencies it includes the government and public private also but most importantly between the government agencies like agriculture, irrigation, forests, climate change, Jal Shakti mission, domestic water demand, water ministry, Ganges rejuvenation, Jal Jeevan all these all these missions can have different data and now they have one common place where they can put the data and encourage exchange of data among the users.

It was done by as I said MS TATA Infotech Limited where TATA has put a lot of their staff on government projects for building these infrastructures, IT infrastructures I mean and domain specific knowledge, see the IT has built a good IT system where if you put data the recommendations can come, however you also need some technical background which is given by the Central Groundwater Board, key scientist, state groundwater agencies like your PWD, DHV Delft consultants these are consultants from Netherlands and the National Informatics Center which is more on GIS and data analytics. So, all these work well together as a system and you can download and use it all the instructions are given in this website.

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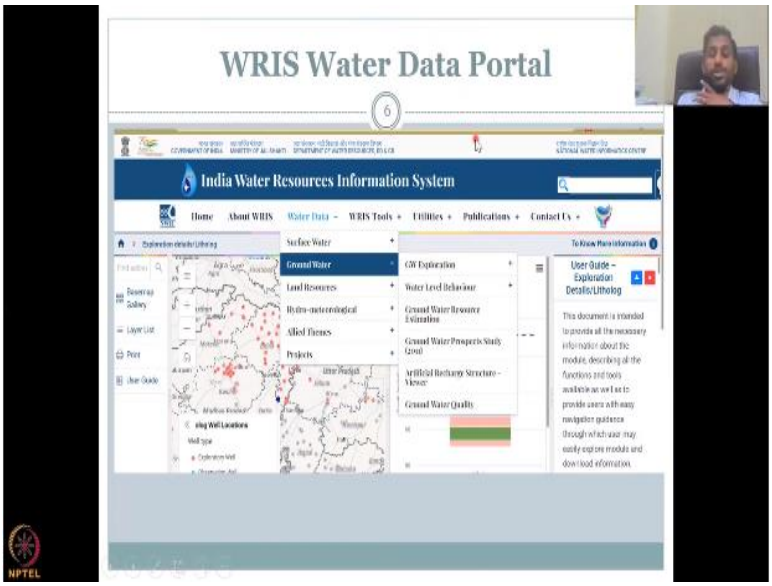

Moving on from next class on we would go into each and every part of the groundwater, so if you see here in the WRIS website which I shared in the litholog also, I will be going through each of these bullets to show what it happens and how the data is being shown because some students may not get it when they open it, it may not open properly, you may close it and say it is not opening so there is a process on how to do it I will lively show it on this platform, so that you could use it for your information. Make sure to create a link so that you can download and use the data, thank you I will see you in the next class.