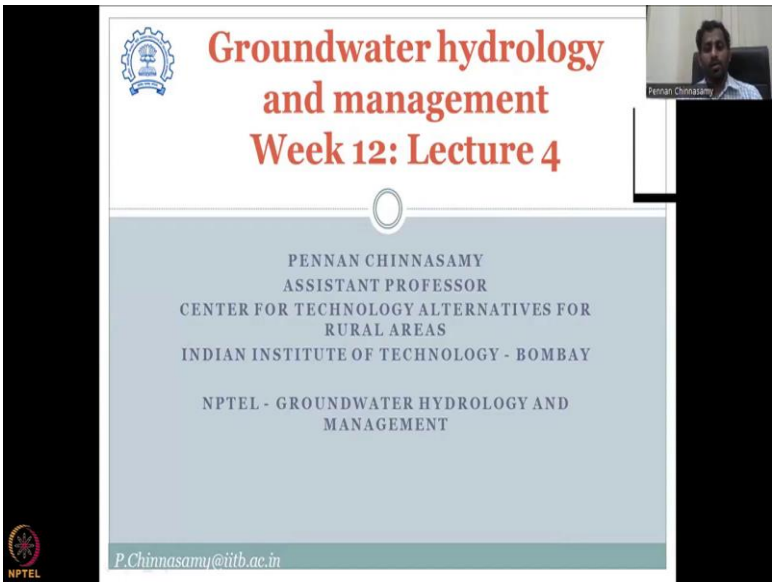
Groundwater Hydrology and Management
Professor. Pennan Chinnasamy
Centre for Technology Alternatives for Rural Areas
Indian Institute of Technology, Bombay
Week - 12 Lecture 4
GW Reports from CGWB

(Refer Slide Time: 00:16)



Hello everyone, welcome to NPTEL course on Groundwater Hydrology and Management. This is week 12 lecture 4. The last lecture, we looked at one particular remote sensing data that can be used for understanding long term, 20 years of groundwater approximately number of depletion rates and across the world, throughout the planet, and at monthly intervals. So you see a lot of data. I am using for this data, because it has been a very useful data for a lot of regions.

However, especially in India, there are some limitations on using it. So, that is where we could look at beyond the data and merging the data to have a single cohesive data for groundwater management, because not all data can be taken from remote sensing, as we have seen the resolutions and the size. Similarly, you cannot take all from the observation data, which has its own limitations.

Measuring the deep groundwater aquifers is very expensive, you are not going to put a tape inside and measure, think about 300 meters 400 meters groundwater touching, how do you put a reel, you do not have that reel which goes in touches the water and it comes out. Remember, we talked about how to measure groundwater levels. So here, this part of the

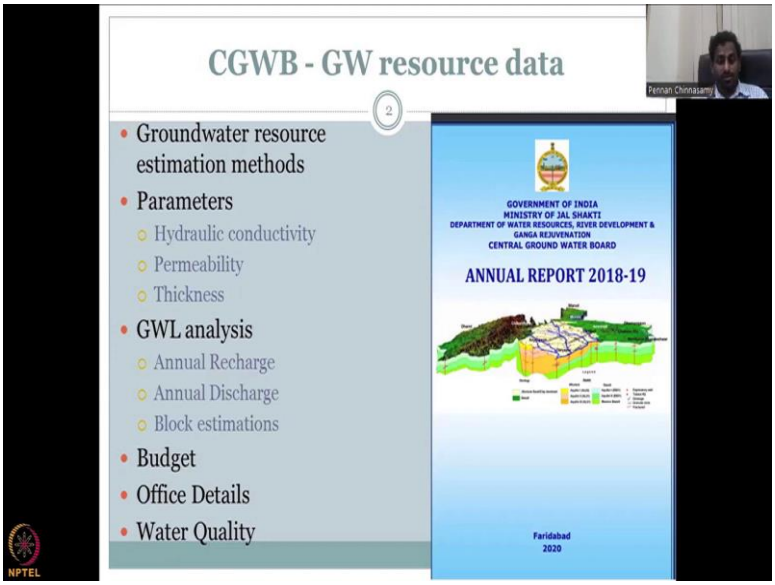
lecture series, we are looking at how to collect these data and set it up in a final timescale model and then run for your analysis etcetera.

So, we have looked at the key data that from the water balance, what data is available, and then we have looked at different vendors for the data as WRIS, CWC, IMD, CGWB and other data centers. We have also looked at certain specific data that can be used for local scale like state agencies, SWAT PWD from Tamil Nadu, etcetera.

And we have also looked at multiple stakeholder data from NGOs and publications. The NGO and publication data is not peer reviewed, as I mentioned, and they are not going to be liable for any found, finding authoritative finding that comes out which means it is not a government record. And also, when you cite it and use it in your research, you can use it but some, potentially someone may say it is not a government data, it is not a government record.

So for that aspect, it is also important to find what government reports have. So initially, we talked about CGWB as a government level groundwater monitoring level agency. In today's lecture, we will be looking at their reports, what do they do with the data, there can be so much done by collecting the data and running some analysis. So, we can see how they prepare these reports and make it available for the public.

(Refer Slide Time: 03:37)



Since this is the only agency in India that looks at groundwater, CGWB, the central agency, I am saying they do have a mandate to give annual reports. Sometimes the annual reports are not on the exact year and there is some delay. However, they do get the data and produce these kinds of delay in reports. It is a very in depth report, it is a lot of data, a lot of

technology, techniques, methods, and now analysis done in the report and we can go through the basics.

So, in today's lecture, I will showcase you how you could access these reports and what does it mean what does it mean the differences So, when you see a report like this, it will be saying Faridabad or Delhi depending on where the report is released. So, the place is not as important but be careful. There are state central groundwater board offices that do reports also.

So, you have an annual report for entire India and you have reports for West Bengal, Gujarat, Rajasthan alone and both of them may be similar in terms of the content or may not be because of the in depth, state level latencies that mean. For example, this report would take all the water levels in Gujarat and make a trend analysis is ground water going up or low. Whereas the Central Groundwater Board, Gujarat report, just the Gujarat report may have extra data focusing on Gujarat because that cannot be done in the central Indian report because it would be too volume, too much big volume.

So, they will give you the initial findings and those who are interested in go to the state level agencies and collect the data and report. So, it is a report which tells about the different methods on estimation of groundwater resources, including the groundwater level methods, the GC methods, other methods that are widely used across India for understanding the groundwater levels and fluctuations.

It also gives you the borehole litholog data that they have collected, we have gone through in class, what is the borehole, how do you collect data and an interlock, etcetera. But what CGWB does is, they also take it to the labs, they have a chemical lab with CPCW, CPCB central pollution control board, and they have other private agencies where they could test these values and get record.

So, because they have monitoring wells, and they have exploration wells, where they dig and assess the aquifer thickness, permeability, hydraulic conductivity, etc, by by taking samples and taking it to the labs. So, this report can serve as a hydraulic conductivity database for your regions. Remember, I used to trees and sherry for the entire planet, if you know the rock if you know a soil type, you can assess the hydraulic conductivity, but it is a big range, there is a big range that trees and sherry has given.

Now, this certain one water board data would be anywhere in between that range. So, now you have your fine tuning your range, so that you could address these differences in the in your reports and research. So, then, what you do is you have groundwater level analysis as I said, the key data that they collect on long term is the groundwater level.

The other data maybe one time collection, the exploration wells rainfall is collected from IMD. So, what CGWB collects is samples which are sent to lab and some properties are measured including the water quality, but most important the frequency in which water level instructed is the highest in CGWB the other data compared to other data that CGWB collects.

So, what do they do with the groundwater level? They analyze the annual recharge for a basin or for India or even for a state district boundaries. How much recharge has happened? So, the pre monsoon level groundwater level before the monsoon and then after the monsoon it rises up. So, that is being captured by the post monsoon water levels that is why they have seasonal groundwater levels pre monsoon, post monsoon, winter and you have somewhere around spring you have one what level.

So, kind of seasonal, and the season is enough to capture the recharge because pre monsoon to post monsoon is the recharge and post monsoon the water levels deplete to pre monsoon. So, if you have 2 years, let us say 2012 and 2013, 2012 pre monsoon which is August is taken as a lower level and then from there you have a high level in the pre monsoon we can take as May for the month of May 2012. And then August is the post Monsoon 2012.

So, now I can estimate the recharge, but the discharge how the groundwater goes down, I have to go to the next year, next May. So, from August 2012 to May 2013. How the water level comes down is the discharge. That is why you do not follow a calendar year for hydrology investments.

You only follow a hydrological calendar or water calendar. A water calendar is when you have rainfall the day 1 starts and then 365 days later, you have all the seasons coming in. So, normally in countries like Western countries, they have a water calendar and the water calendar starts in the month of the monsoon. So, for example, if it says in June in Maharashtra, we call June 1 as the calendar start or June 6 when the rainfall comes as it the calendar start.

So, now how to estimate annual recharge, which they do for you and the annual discharge is done. And the same is done for every block, the smallest they do is block the largest they do

is for India. So, if you do the block level estimation, and you find that your recharge is more than the discharge, then you are positive net groundwater positive. However, your discharge if it is lower than your recharge, then you are net groundwater negative.

So, then we saw the percentages, if you are using 0 to 50 percent, you are safe and those kinds of things we saw, 70 90 percent is which is still net promoter positive is critical. The over exploitation, above 100 is over exploitation, that is the concern and most regions in India are going through that phase because of higher pumping for groundwater for agriculture and higher pumping because of technological interface.

They also do budgets. Budgets on how many wells are there exploration. What are the maintenance costs for that? And also, what are the explorations they do? What are the science they bring? All these research has a budget. So, they discuss the budget and office details, which means where do you go and collect data. For example, these books may have historic data also, which is reference inside the book you will not find because of the volume. As I said, you do not find all the data.

So, what you do in those kinds of scenarios is you go to the office, you approach the office and see if they give the data for you. And the point is you need to buy the data, whichever you discuss with them by email or you go in person and say I would like to have this data. What do you think about sharing the data with us? And what is the what is the sensitivity is on the data where I could use where I cannot use these data, for example, we do not know what the sensitives are. And it is better not to ask them. Why is it sensitive, just as if the data can be shared, and then use the data. Not all data is available for public or academic reasons.

So, those office details are very important where you can go ask them about the different procedures, the scientists are very good, we have different scientists levels in CGWB, I remember when I was student also, I used to communicate with the CGWB office in Chennai, in Basant Nagar, and they are very, very helpful, they would teach the concept, etc, because they are also always interested and they are happy to see people who like to work on groundwater as a student.

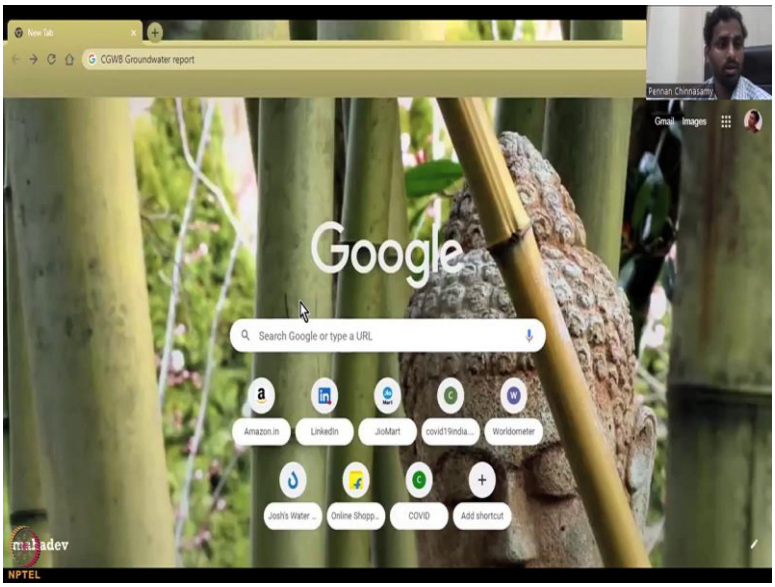
So, coming back and all the other data that is available is water quality data from these groundwater reports which are also very, very handy when it comes to understanding the groundwater change.

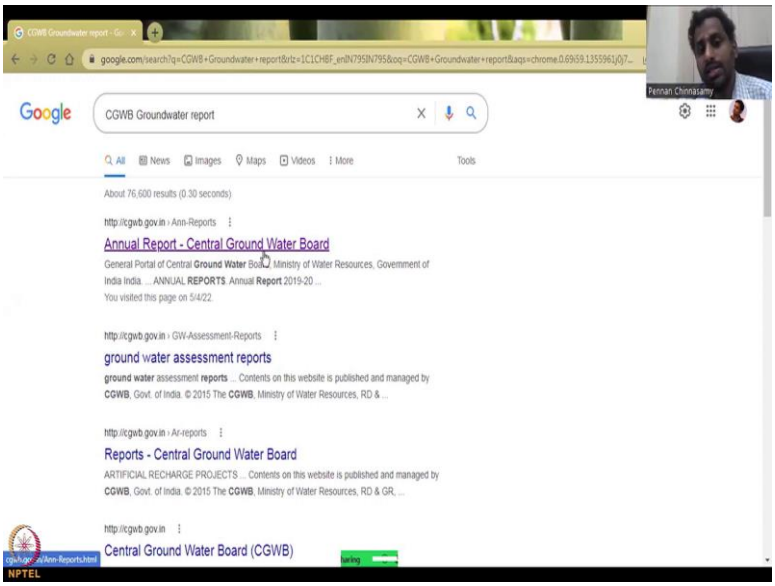
(Refer Slide Time: 13:27)

So, the normal reports are kept in this kind of an archive we will go through this and you could see that 2005-2006, there was a report 2006-7, 7-8, 8-9, 9-10, 11-12, 13-14, 15-16, 17-18, 19-20, so all the reports are here except the 2021, maybe the COVID issues they were working on it and the data was not collected sample, etc because of travels restrictions. But however, we have all the data for the last 15 to so years.

And we will be looking at the some of the reports and what they have in this coming session. So, let me share the screen on how to find this link. You can go to the link but I always teach you how to google it because sometimes the link changes. I cannot give you a link and expect it to be there for the next 5-10 years, so I would I would support more on teaching you how to find it so that you can also check it later.

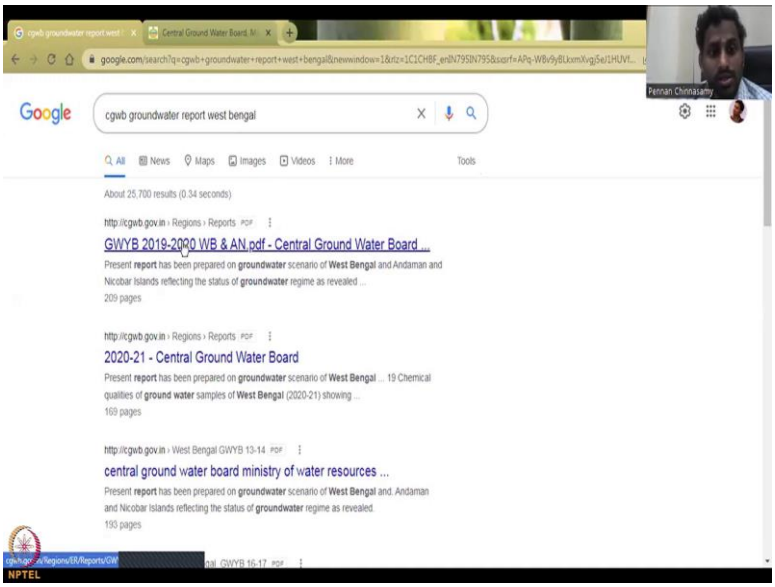
(Refer Slide Time: 14:37)

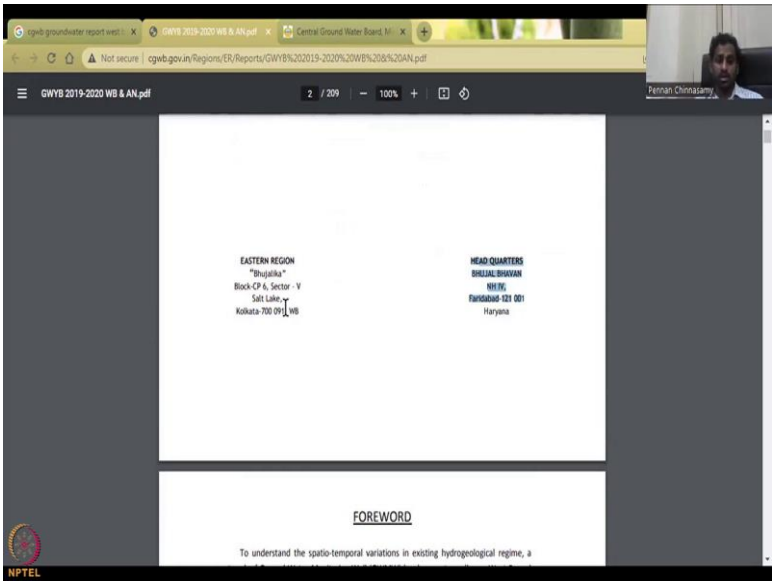


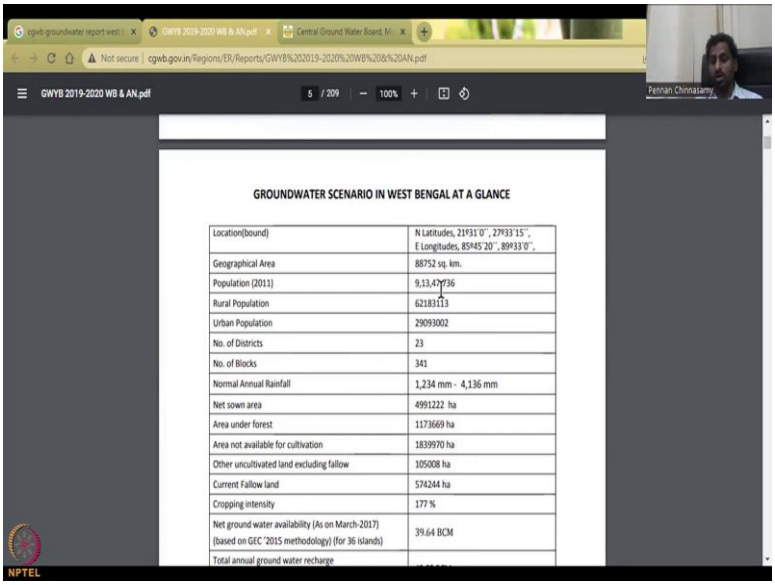


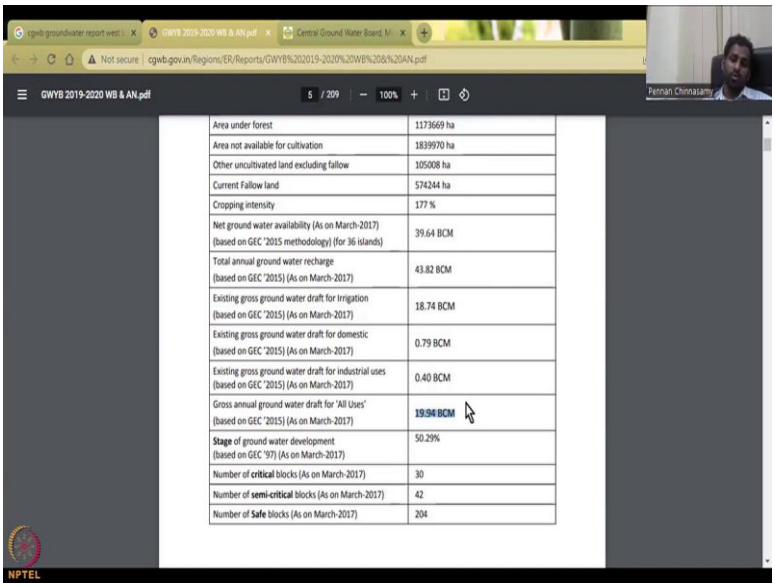
So, now my new tab is visible and what I put is CGWB groundwater report. And I click OK. So, type CGWB one word report in Google. So, that is what I type in Google and you will get all these links. The first link is what is necessary, so I will just click it annual reports and go to report.

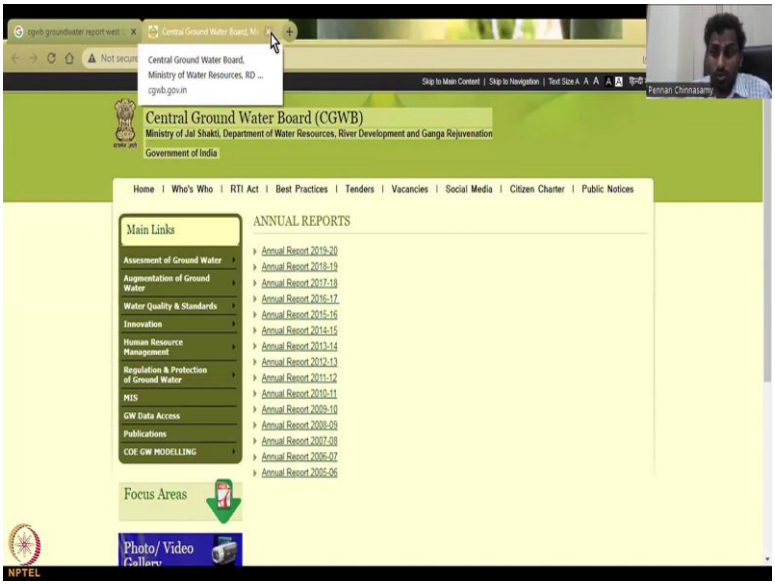
(Refer Slide Time: 15:02)











And, I will also show you that you can say let us say, West Bengal. See you can have a region report. I will just click on this to show you that report also. Just one example, then we will go back to the national board. So, while this is downloading, it is ready to download, you can see that, see groundwater year book they call it as a year book and it is 2019-2020 West Bengal, WB stands for West Bengal and AN is Andaman and Nicobar Islands.

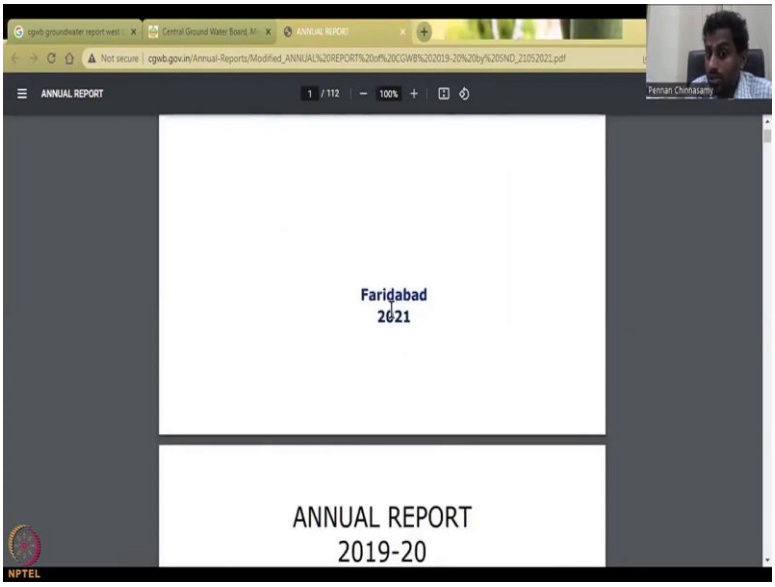
So, what is this like every region has a regional office and that office is mandated to monitor groundwater in certain locations. So, this says West Bengal office has to monitor West Bengal plus Andaman Nicobar Islands maybe the size of the state also plays a role. Because Maharashtra is bigger, much bigger than the West Bengal size and I would assume that West Bengal office is as big as Maharashtra Supreme Court. Two states in one office.

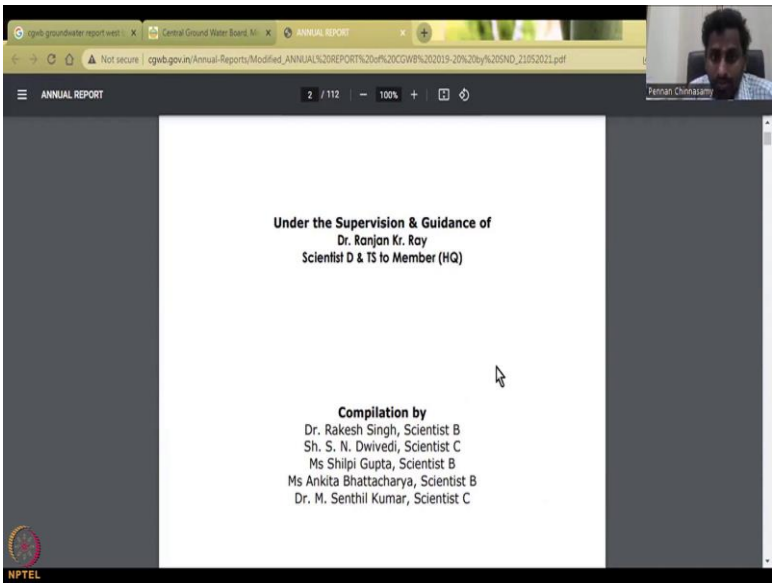
So, you could see here that the year book is done. And then the Eastern Region Headquarters, as I said, the whole headquarters is in Delhi, whereas the region headquarters is in Kolkata, all these you have, you have a foreword telling what it is. And then as a small budget of the groundwater water budget, so the net annual rainfall, net zone area, cropping recharge stage stage of the element is only 15 percent. So, this is the water budget.

How much water total recharge is 43.82 billion cubic meter, net groundwater availability is 39 point 64 billion cubic meter, and the use is only 19.94 billion cubic meter, which is approximately 50 percent 50.29. So somewhere, you see that the availability and the draft is still, you get only 50 percent use in West Bengal.

So, the critical blocks and immutable blocks, as a state, maybe 50 percent small, but when you go to certain locations, there is more commodities, that is what this data is showing, and that is how the Andaman and Nicobar also, but again, as I said, let us focus on one national report. And then you would kind of look at the state report for data as and when you need it. So, when you type in the first thing that comes to CGWB annual reports.

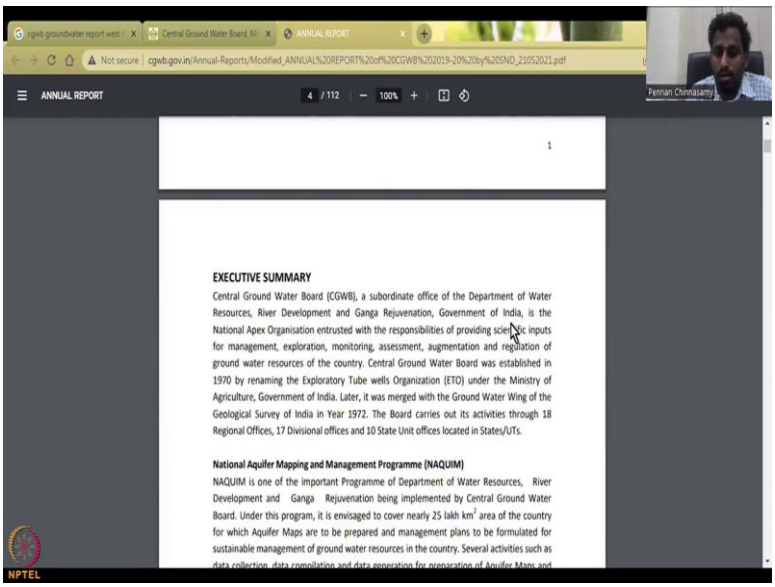
(Refer Slide Time: 17:56)

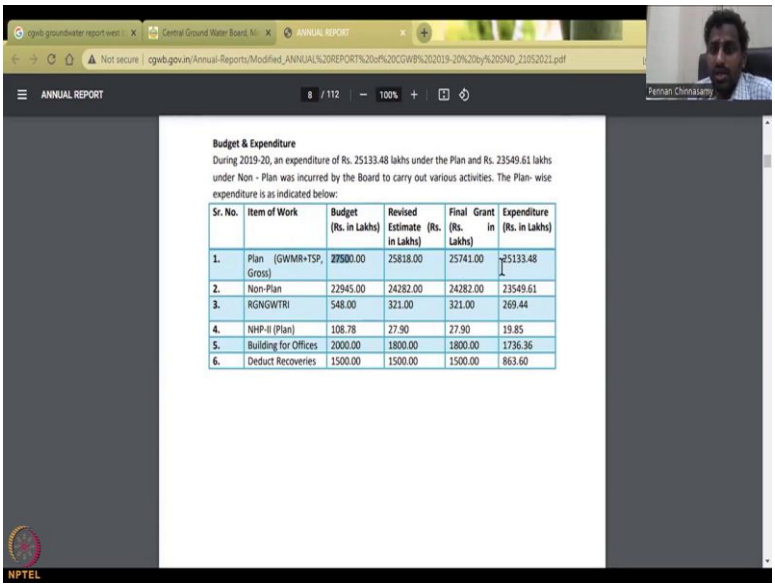


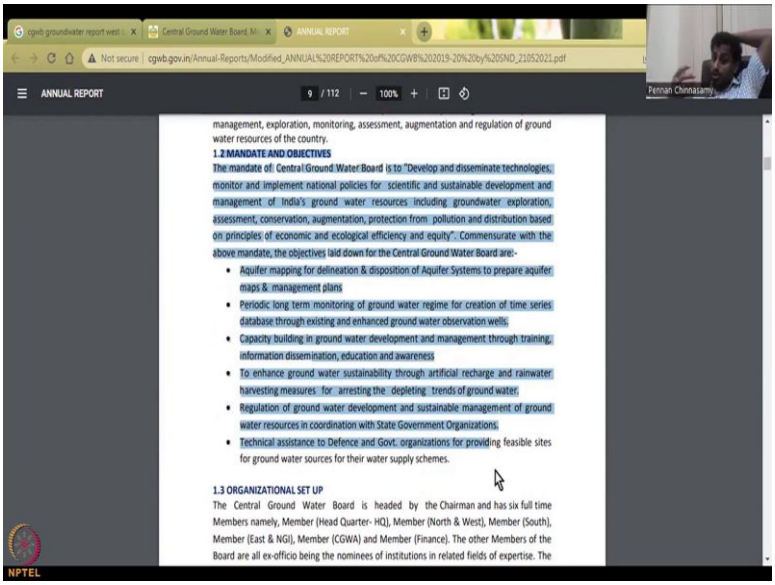


I will take the latest one which is the 2019-2020 data and you can see that this report was done in 2021. So, one year it takes for them to release the data. So they collect data for 2019 2020 but it takes one year to make this report and then they release it. So under supervision, who did it to scientists, as I said scientists starting from C to G, scientists G is kind of a high level, so, what we have here, the young scientists who are working on it very very helpful they will be if you go and approach them.

(Refer Slide Time: 18:37)







So, the executive summary and average abstract will be very helpful to look at these kinds of reports because you can get through all of it in one go. The first thing I would like to start here is the budget. What do they use the budget for how much in lakh rupees, in lakhs. So, this is around lakhs, do 27500 lakhs, so that is approximately 275 crores.

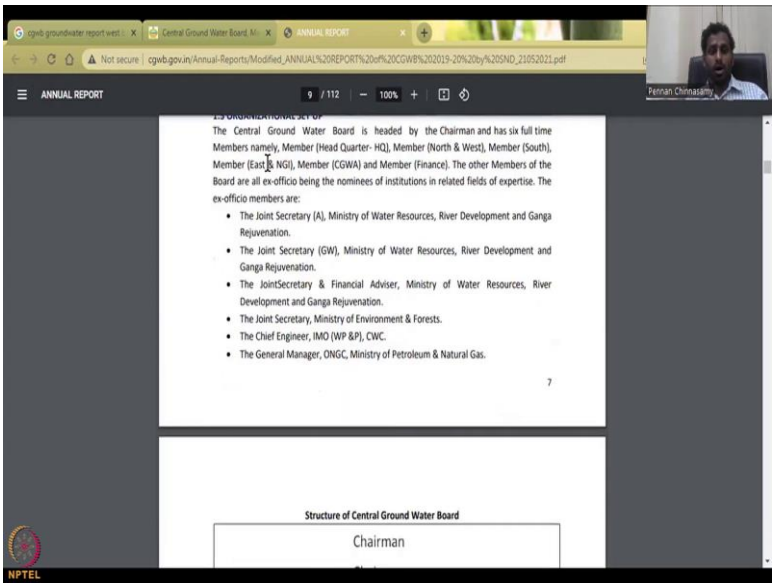
So, you have to certify crores spent on that year and then revise estimate expenditure. So, you see how much budget was given how much final grant was given and how much was used. And then, non plan all these things, building officers, recoveries NHP is the national hydrology plan, which is their mapping the aquifers and size and all those kinds of things. So you can see how the budgets are broken up and how they are used.

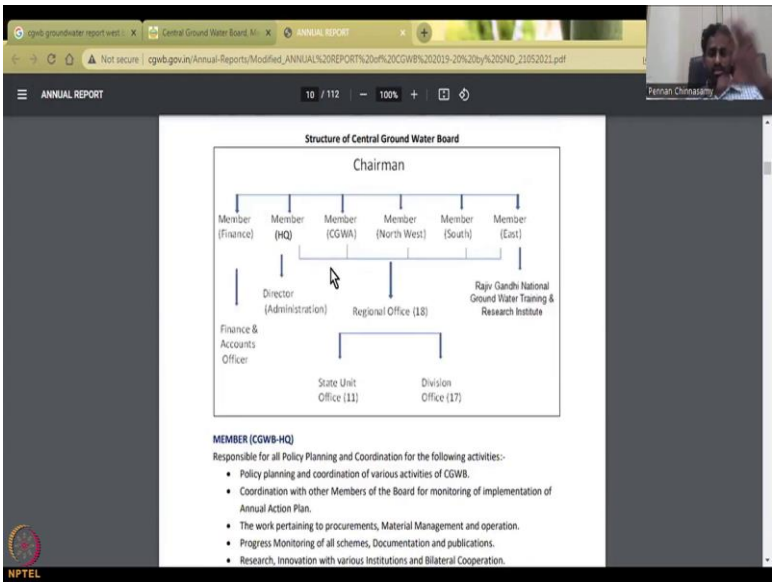
And then some mandates about CGWB what are their objectives, you can find everything. So as I said, please go through these reports before you approach the central groundwater board

because board of central groundwater say give data for this location. They just say go to WRI's website because now everything is online. I remember when I was a student as I said, there was no WRI's website.

So, the data sometimes was available on the central groundwater board, but the location was not available, it will be like district this is when, so how do you map it. So, that was a difficulty and CGWB helped in those kinds of locations, but now everything is shared. So, be careful, be knowledgeable, do your homework before you go there. And as for the right data.

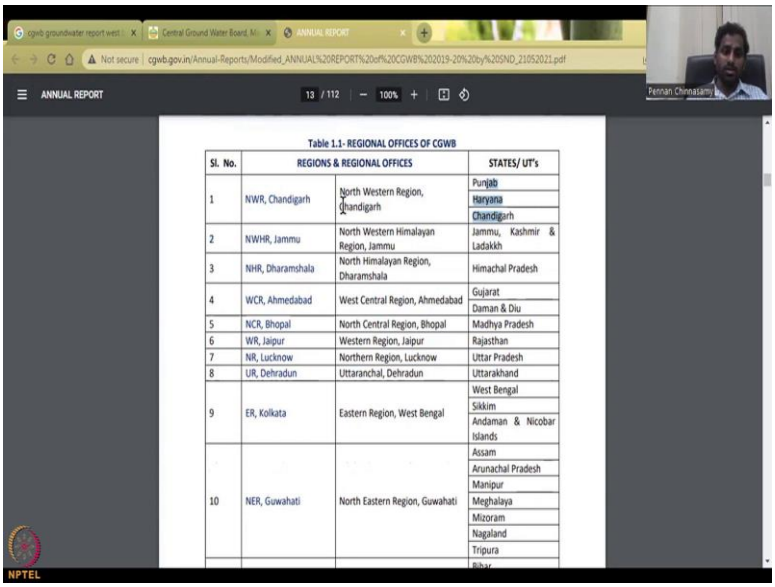
(Refer Slide Time: 20:31)

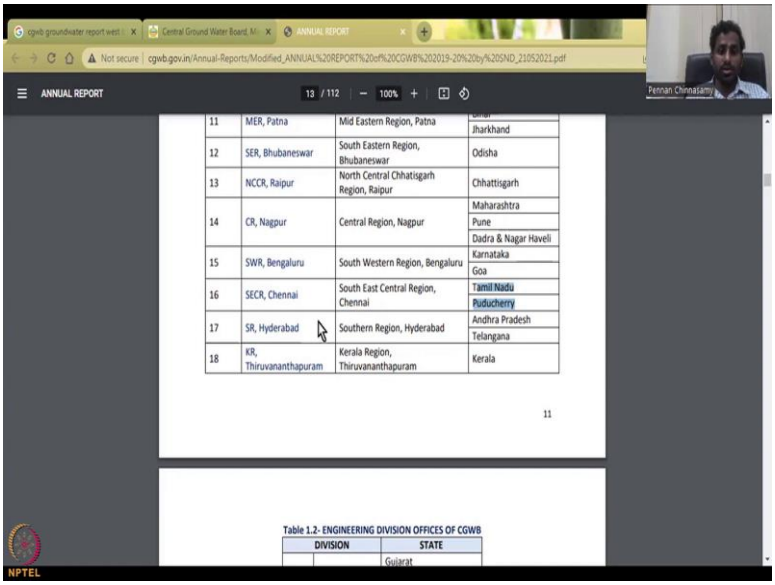




Organization set up. How the hierarchy is set up all these things, as I said, there are scientists and then officers, division managers, etc. Which is again not needed for us.

(Refer Slide Time: 20:45)

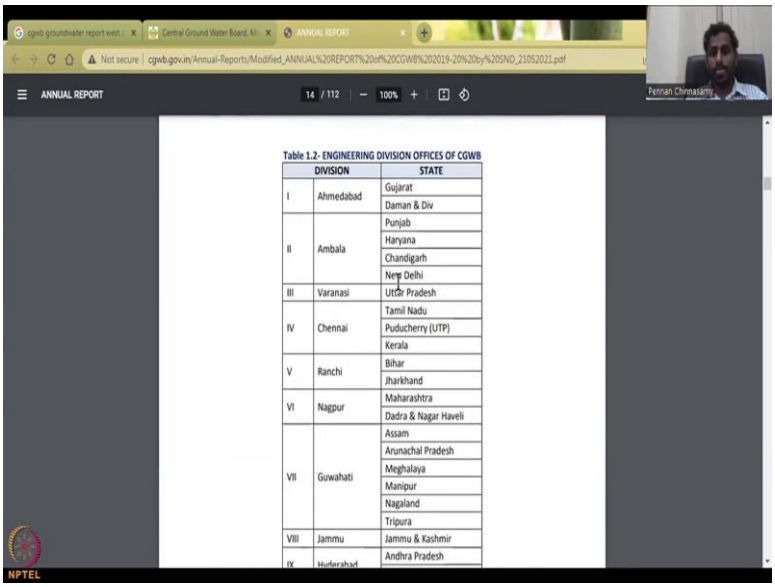


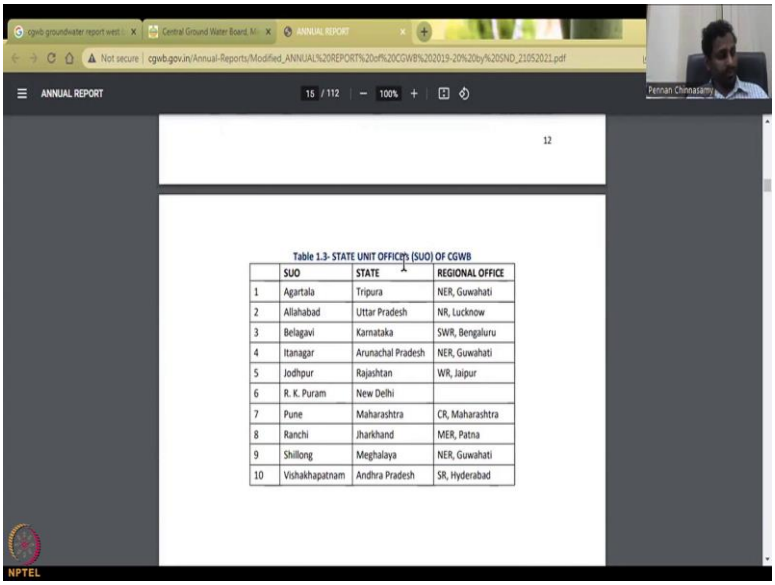


And here is the regional offices. So, always go to the regional office, it may not be called as directly CGWB Chandigarh, it is North Western Region, Chandigarh, CGWB. And what are they responsible for. So, there is a North Western Region in Chandigarh responsible for Punjab, Haryana and Chandigarh and then there is a North western Himalayan region, Jammu Kashmir and Ladakh.

The Chennai which when I used to go they would take care of Tamil Nadu and Puducherry, Pondicherry is small, so, Puducherry in Tamil Nadu would have been mixed together and then let us look at Nagpur goes with Maharashtra and Maharashtra includes Pune and Dadra and Nagra Haveli and so, you call up see only some states just by themselves Odisha for example, Uttarakhand and those kind of things.

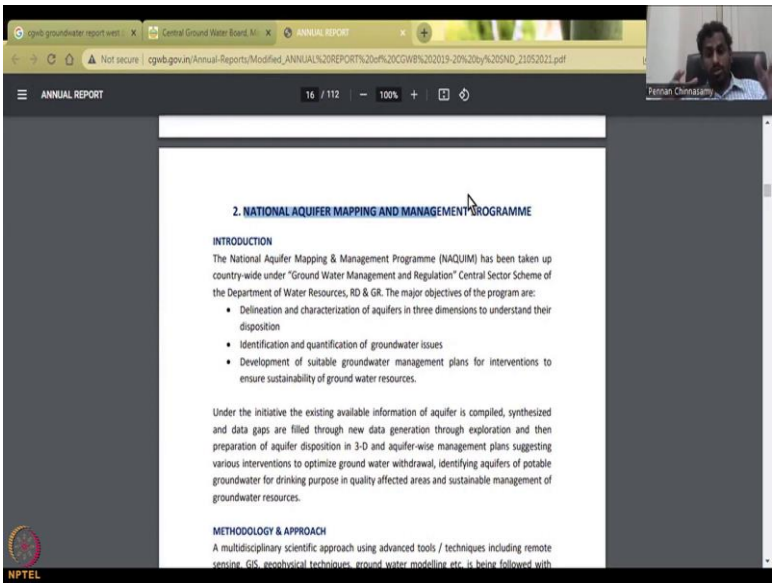
(Refer Slide Time: 21:37)

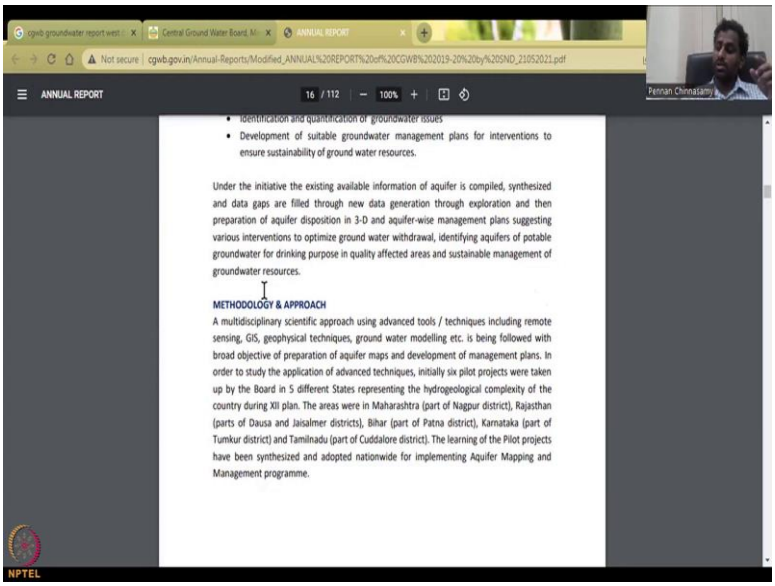




And then, there are engineering divisions you can go and see where engineering divisions are kept, state unit officers, etcetera.

(Refer Slide Time: 21:51)

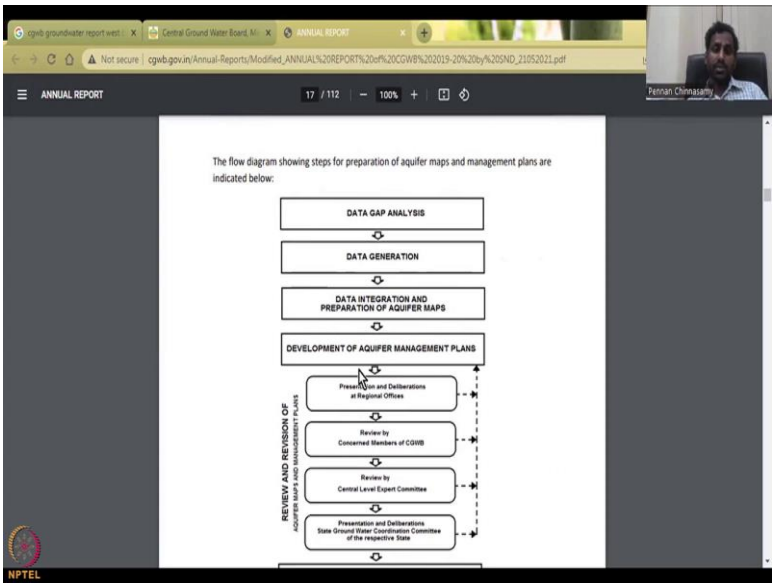


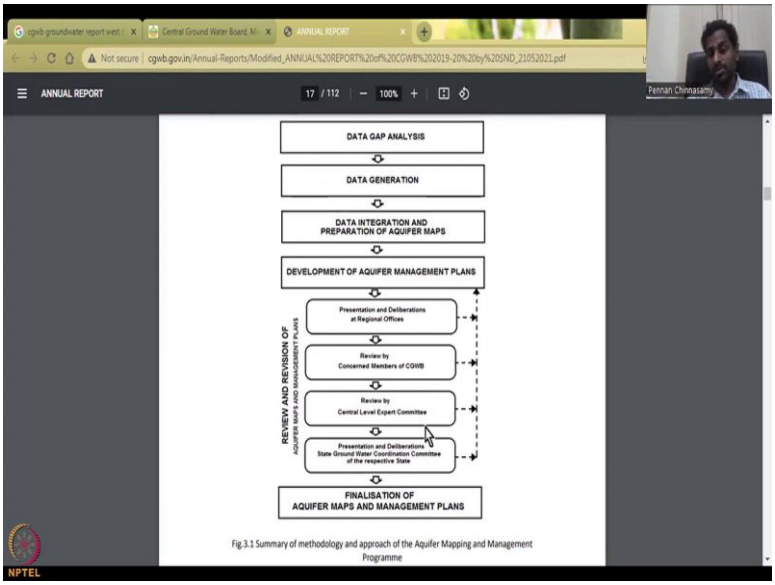


So, they also give a forward on what are the managing, what are they applying the data, what are the manpower use for. For example, the National Aquifer Mapping Plan is a big plan that have been started and going through the lot of budget where they map the aquifer boundaries in India. So when you go to this report, you can find those types of methodologies how they do.

So, for example, when we go to WIR's website, you see the boundaries, but you do not see the method in which the data was collected and this is the report which gives you that information.

(Refer Slide Time: 22:30)

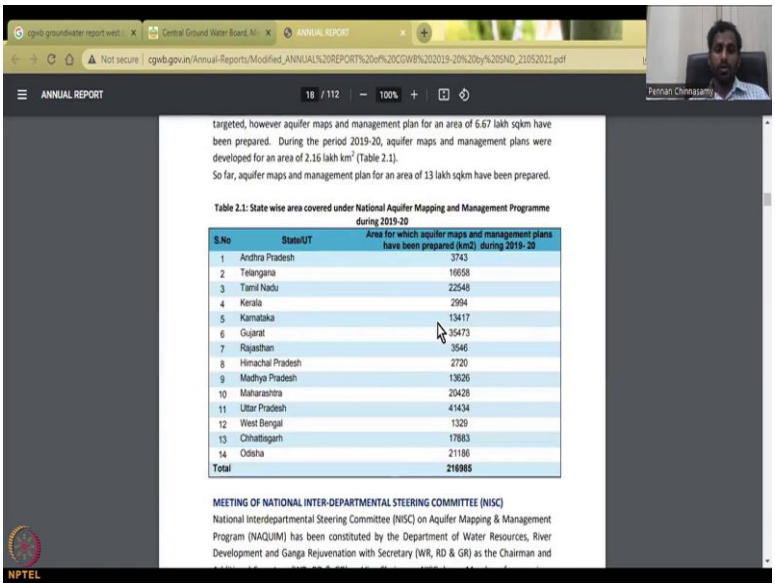


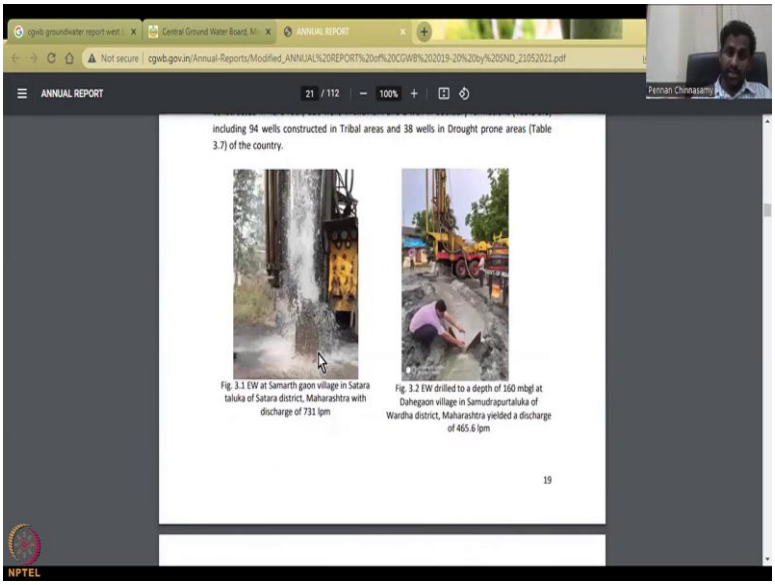


So for example, the flowchart is given. Data gap analysis the floor for aquifer maps and management plans are given. So, when they get the aquifer any any type of requirements, research or monitoring requirements, they will go through these flowcharts to first assess what is data gap analysis, generate data integration, data preparation for maps, and then each aquifer once it is mapped, has a management plan. So, that has been made.

And then presentation at regional offices review by members review by central level expert committees where for example, IT professors would sit and go through and then finalization of aquifer maps and plans. So it is a very scientifically well focused flowchart, which tells where is the gap, what data do we have to generate or print and then they do this mapping.

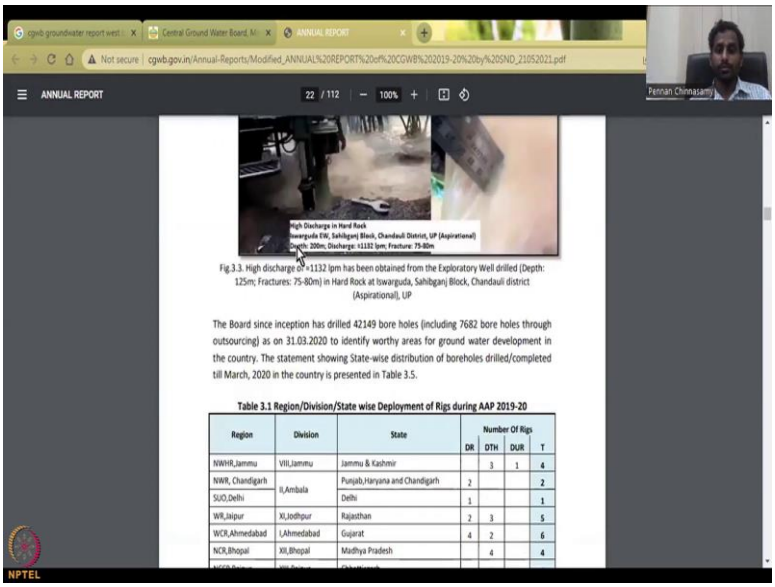
(Refer Slide Time: 23:23)

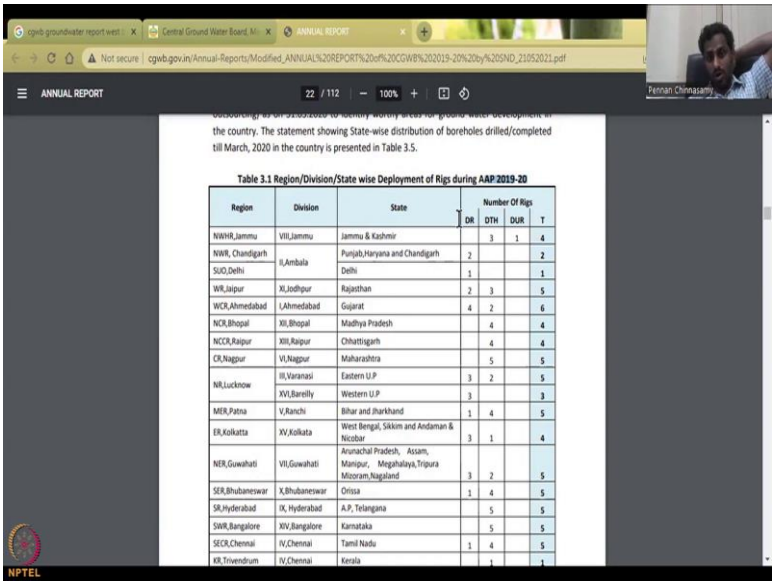


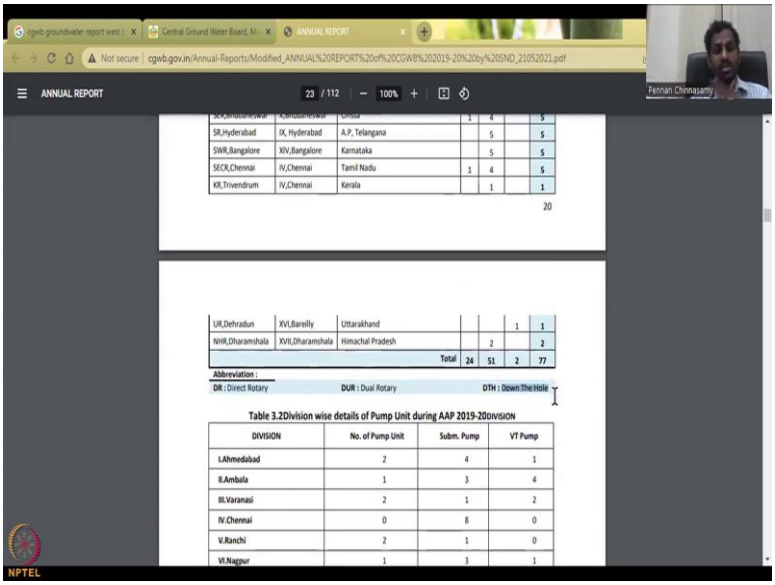


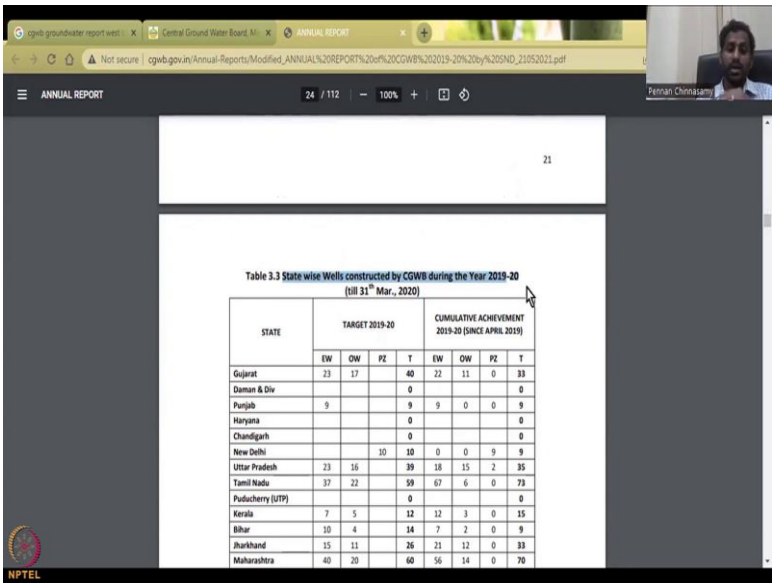
So, this is how much area has been mapped all these different plans and data on these will be there. So these are the groundwater exploration. As I said, you see the big driller that comes in, it drills inside takes samples at each and every depth that they want. And then it says like 160 meters below ground water level in Wardha district, Maharashtra yielded a discharge of 46.5, 46, 465.6 liters per minute. There is a lot of water. So, what they do is? They measure the yield. Also they measure the samples, take the samples on what type of hydraulic conductivity is there, those kind of things.

(Refer Slide Time: 24:07)







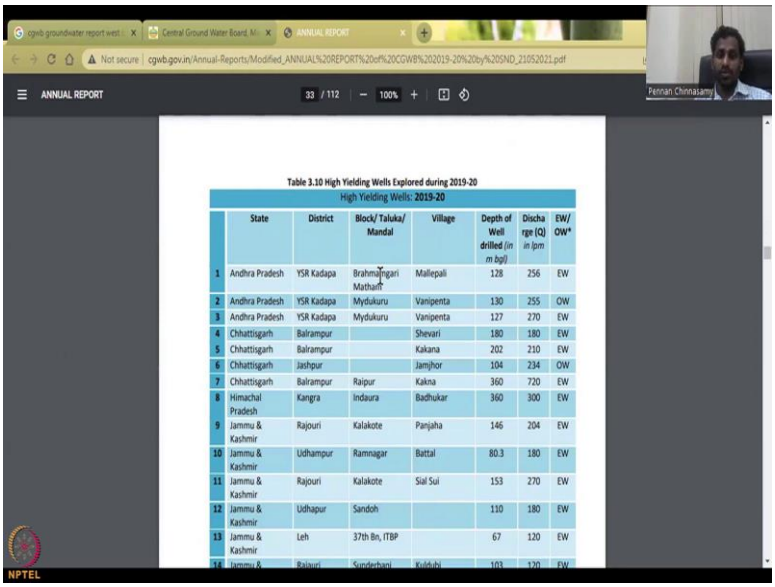


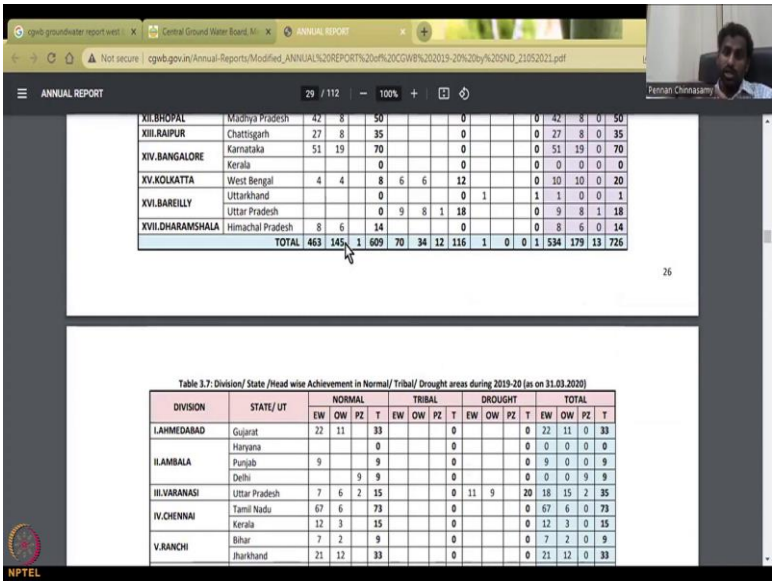
High discharge rocks, and then how many rigs they did, how many samples they collected this rig samples this deep drilling samples, how many did they go and all these small, abbreviations are given normally in the text. So, if you go through the text or here it is direct rotary, dual rotary, down the whole methods. Every single method is actually captured and then they show where the total number of drills have been done.

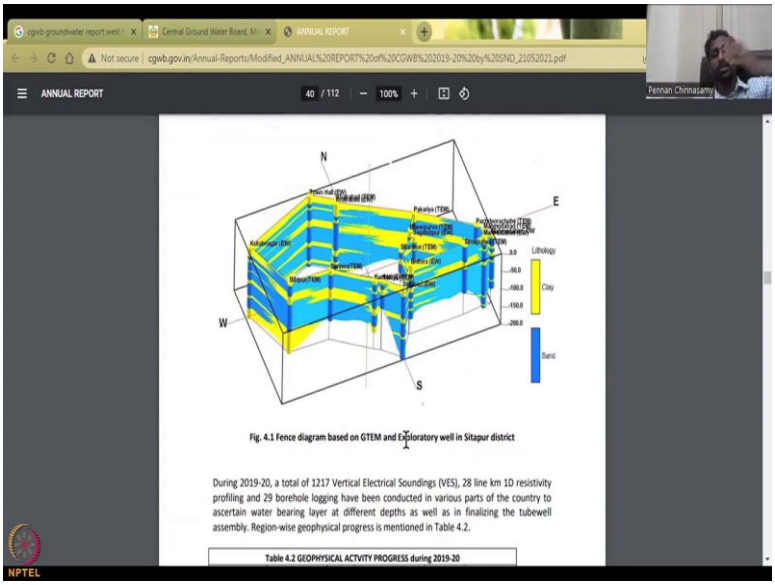
So for example, you will see 6 drills are done in Gujarat for sure because there is more data that is needed, more depletions going on. So, they would like to see more data to understand why the depletion is going on. And then in the where they have to measure the yield discharge. And here is the statewise well constructed in 2019-2020. As I said, they do have us but maybe it is not enough. And all these wells, most of them are open wells or dug wells. And the parameters which go in the deep aquifers are very limited.

For example, as here Gujarat you do not see any parameters. And we know that Gujarat is facing a lot of groundwater issues. Punjab, for example, has deep deep groundwater issues, but there is no parameters. So, here is where they do put some budgets for the next year to have more wells in for monitoring. Then in the district wise, how many wells have been constructed, those kinds of things. So, I will skip the wells.

(Refer Slide Time: 25:51)







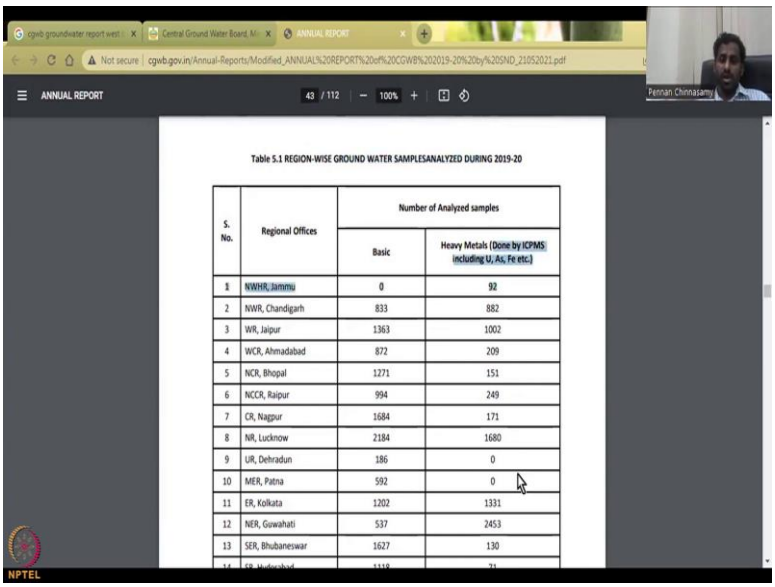
Now, let us look at the data. Yes, so here is where they have some high yeilding aquifers, they have identified drill discharge, and they also say if it is, EW or open well. So these, these are very interesting to understand why they have these selection. And is it an expertly well, or observation well.

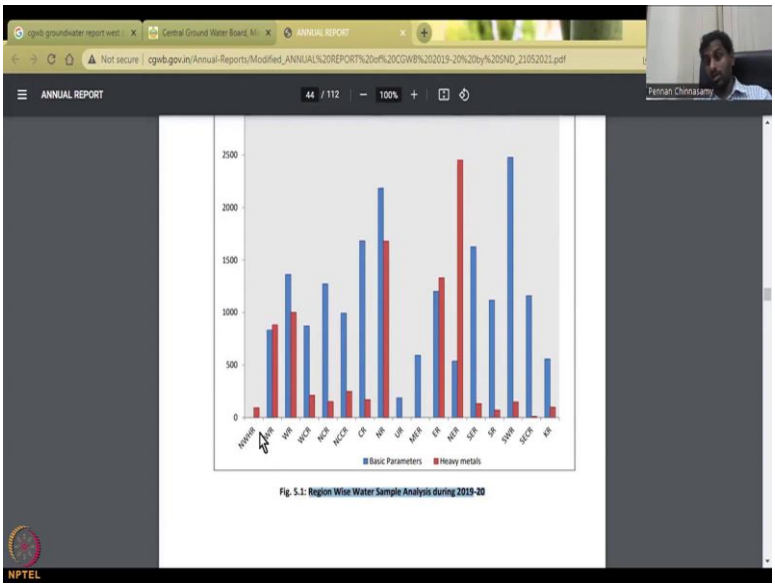
For example, all these wells that you see here, that they plan to put are either EW, which is exploratory one year, one time, they will take a sample and take the yield or they have open well, open well is always been monitor. So, you see that there is lots of exploration wells, they want to put down rather than open wells and parameters. I would say that to be more adaptive towards getting more data, but let us see.

So, here, they have also measured some resistivity on seeing how much resistance is there for drilling, drilling and all these things, they have constructed a 3D map which we have seen in class. Fence diagram, where they have the little logs, go logs, and then they use a software to connect the lithology and only two layers that are in the file lab, clay and sand.

So, as I said, the exploratory wells are taken and these EW wells, you can see EW they are in the bracket are then linked to each other to a lithography, stratigraphy techniques, and then this kind of fence diagrams are made to show how the aquifer thickness. So, again, all these have been discussed in class. So, please go ahead and look at it.

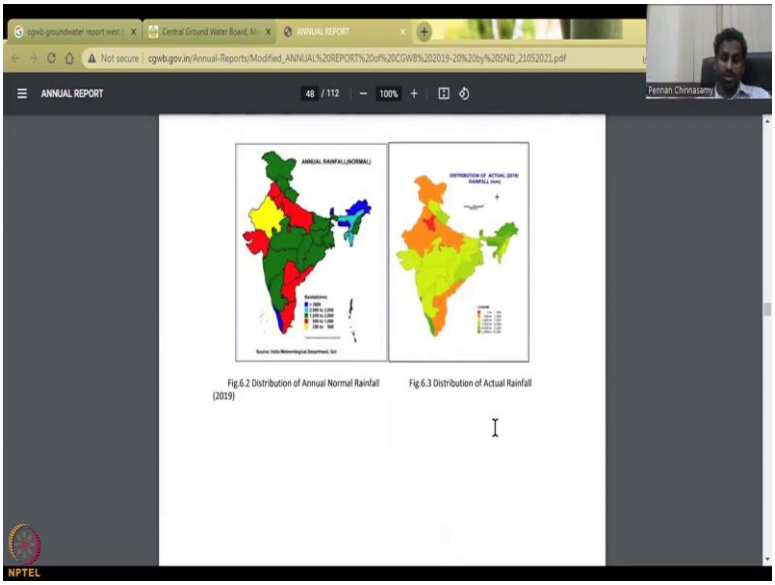
(Refer Slide Time: 27:38)

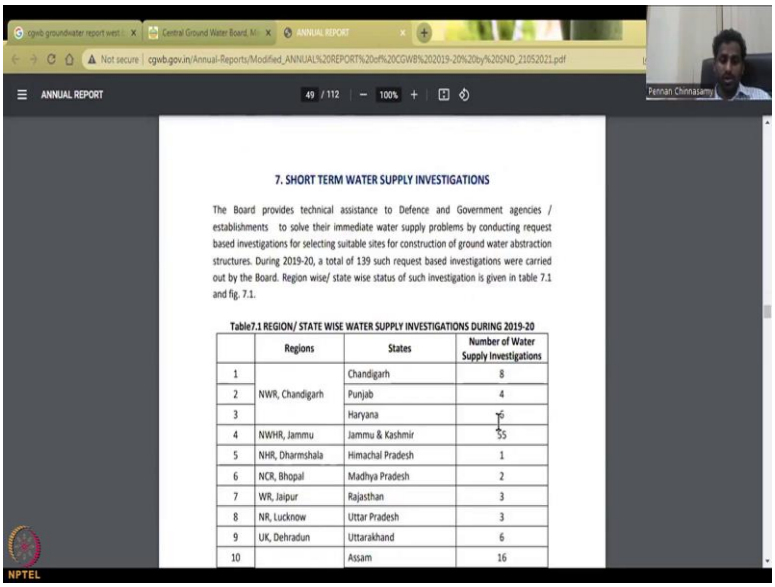




And then, they also talk about the water qualities analyzed, and then how much of them have heavy metals, those kinds of things. Now, we get into the data region wise water sample analysis, the region, so here they break India into regions, central region, northern region, southern region, southeast region, those kinds of things. And all these region what is included in the region is already given on the top in the book.

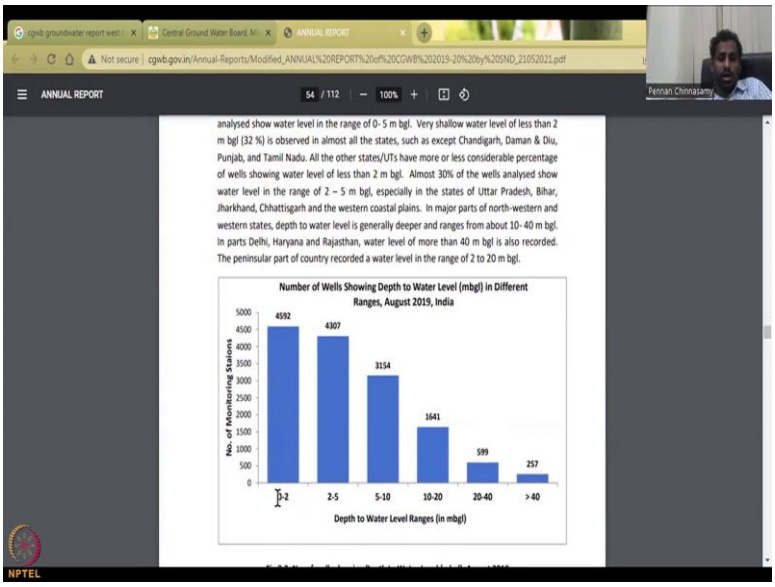
(Refer Slide Time: 28:13)





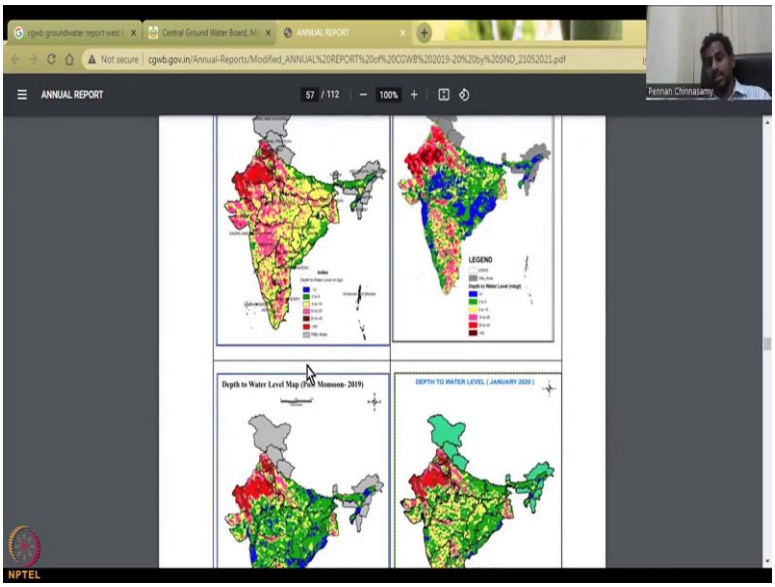
So, some more data is collected on evapo-transpiration rainfall, you can see it on rainfall is there and then distribution of actual rainfall 2019, which is basically taken from IMD records because it is government. And, then water supplies schemes. So, now, we come to the groundwater monitoring.

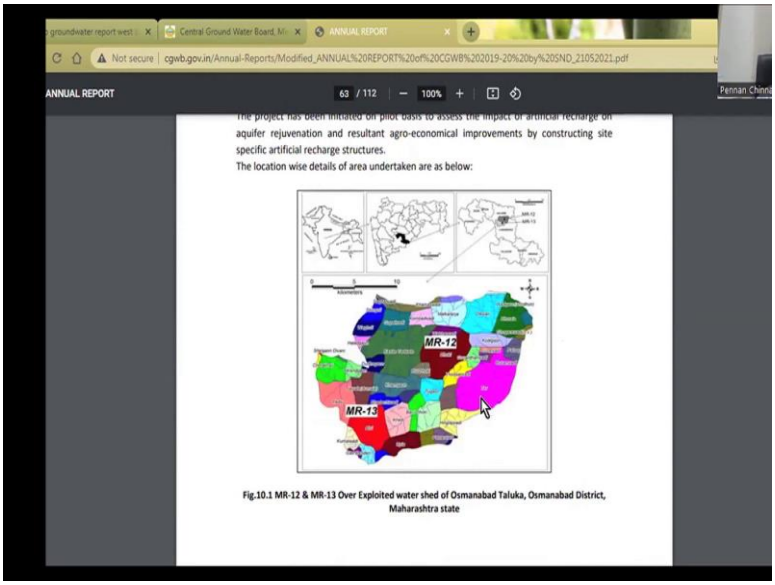
(Refer Slide Time: 28:33)



Number of wells in different ranges between August the number of stations and what is the depth of the well. For example, the total wells around 50,000, and then how much of them are 0 to 2 meters below the ground those kinds of different statistics they have given.

(Refer Slide Time: 28:53)





This is the important map which I would like to show the four maps, the four seasons that they collect. So, depth water level pre monsoon, depth water level peak of monsoon and then depth water level post monsoon. So, sometimes, May August, October, I will say that is for four months and the depth to what level January. The pre monsoon and post monsoon depends on the monsoon calendar and also depends on the need for data.

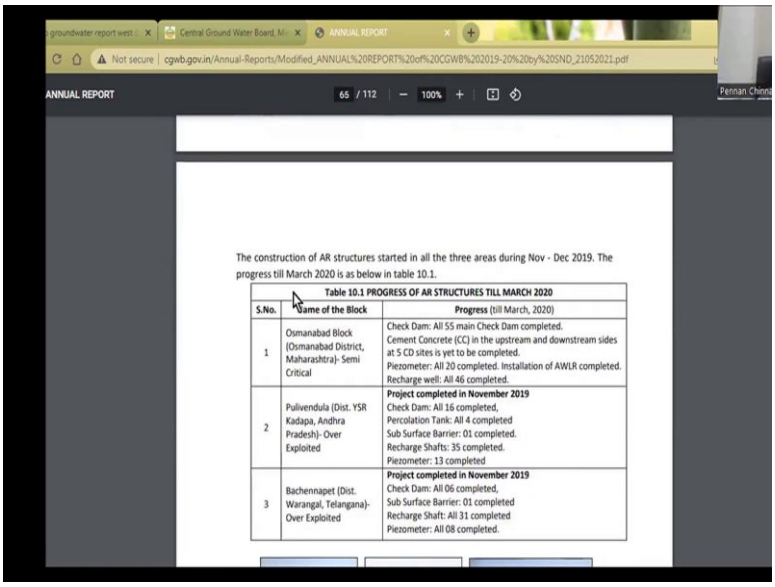
So, here you see when you see the least water you see the least water in the pre monsoon season. If you look closely, you can see all of them are red or yellow, which means the depth from the top to the water level is at least 5 to 10, yellows is 5-10 meters and red is greater than 40 meters. So, this is the pre monsoon.

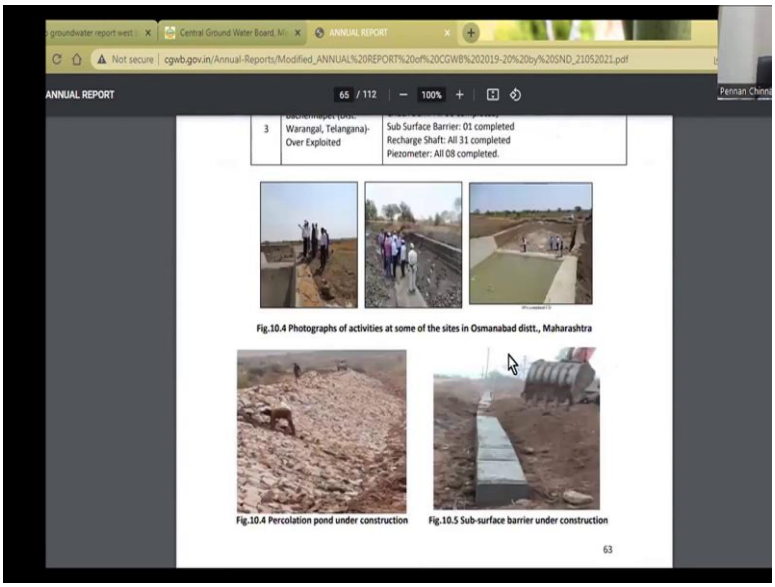
So, let us put a calendar to this for Maharashtra this could be the May month and then you have August, August is the peak of the monsoon season because June the monsoon starts it picks up in July and August will be the peak so you could see July August peak has influenced the good rainfall on the western region. So, the water level is only 2 meters depth, so here initially it was 5 to 10 meters. But now the water recharge has helped the water level to bring up. However, this region is getting not much help, because a monsoon does not help in that particular month, August.

Then we have the post monsoon season where the some rainfall does go up north, and you will see more green color happening here. Green color means that water level is 2 to 5 meters, which is almost 6. And then, in January after the monsoon is done, the post monsoon period is gone. Now the rabbi season is there where crops are grown using the groundwater, you see again, the blocks are turning into yellow and then red eventually. So, the progression is yellow is kind of still safe, but then from yellow to pink and red is really really concerning. And that is where these water levels are going ahead.

So from here, they have done all these recharge estimates a lot of data on mapping, some particular exploitation studies are given in the book as I said you can take the Maharashtra book you will get a full record of all the studies in the annual groundwater book we only take some snippets some studies from here and there.

(Refer Slide Time: 31:20)





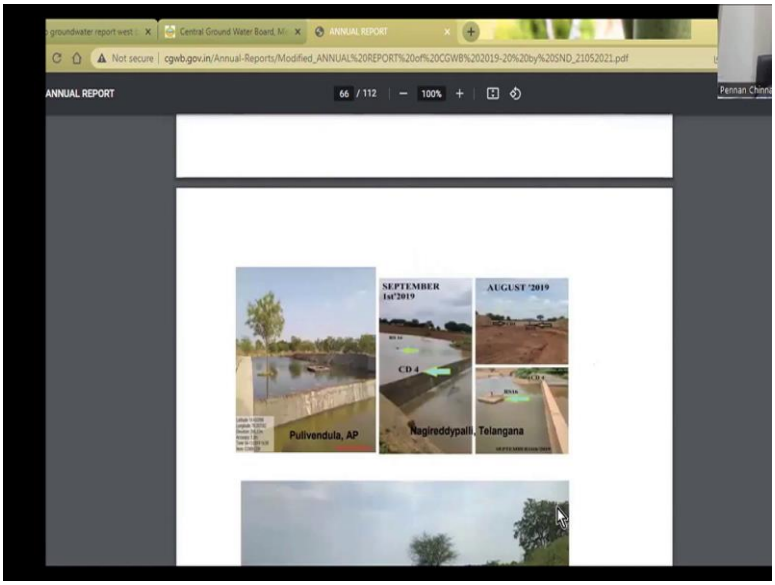
3	Warangal, Telangana)-Over Exploited	Sub Surface Barrier: 01 completed Recharge Shaft: All 31 completed Piezometer: All 08 completed.

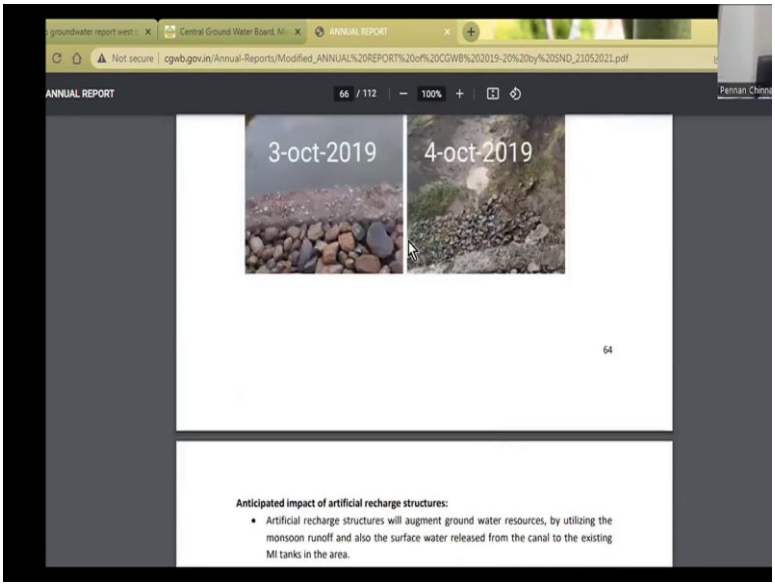
Fig.10.4 Photographs of activities at some of the sites in Osmanabad distt., Maharashtra

Fig.10.4 Percolation pond under construction

Fig.10.5 Sub-surface barrier under construction

63





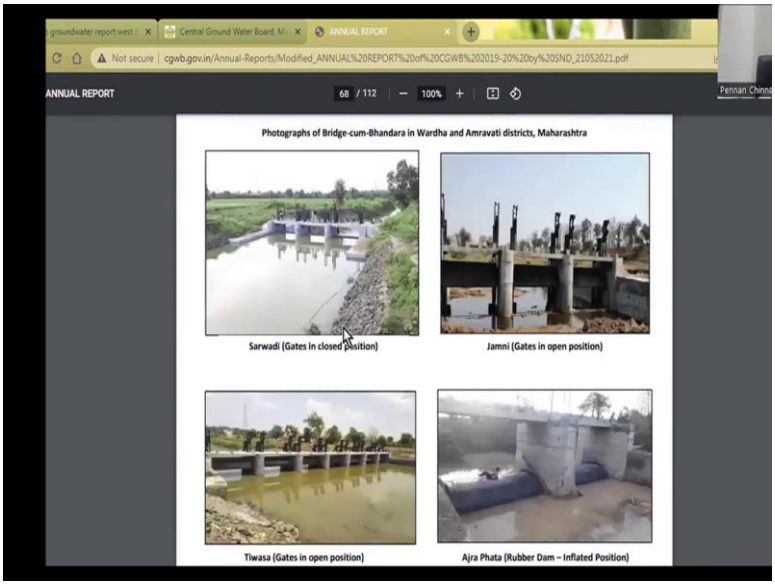
64

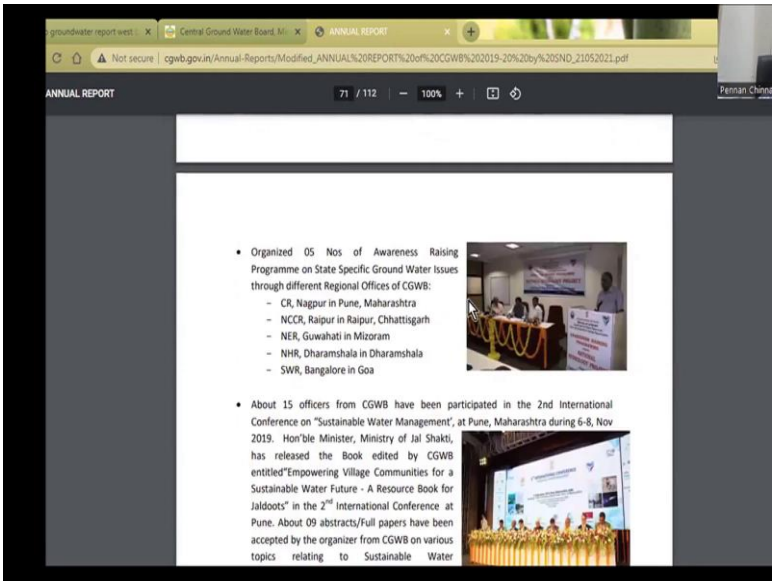
Anticipated impact of artificial recharge structures:

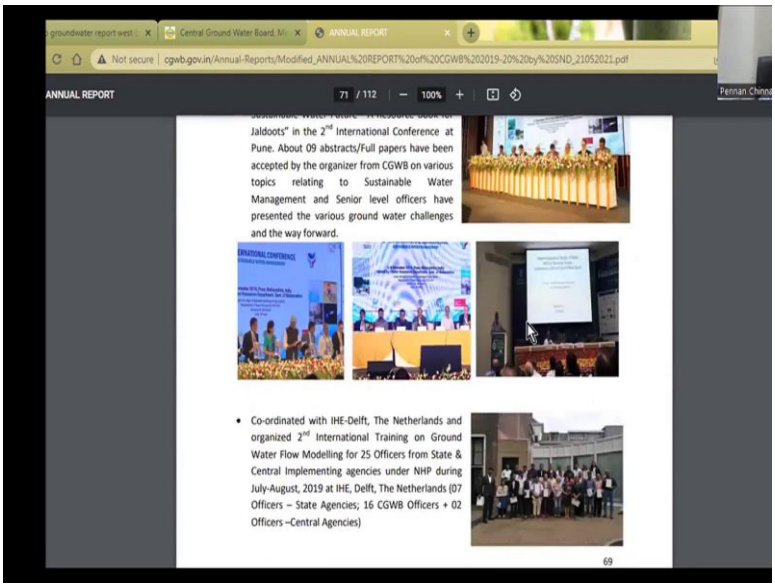
- Artificial recharge structures will augment ground water resources, by utilizing the monsoon runoff and also the surface water released from the canal to the existing MI tanks in the area.

So, here they have done some artificial recharge structures here which we also looked at in class, they have taken photographs of some artificial recharge structures along Maharashtra percolation ponds, subsurface barrier for addressing the flow, check dams have been constructed and repose, leaky dams everything that we discuss in class mostly are shown here.

(Refer Slide Time: 31:43)

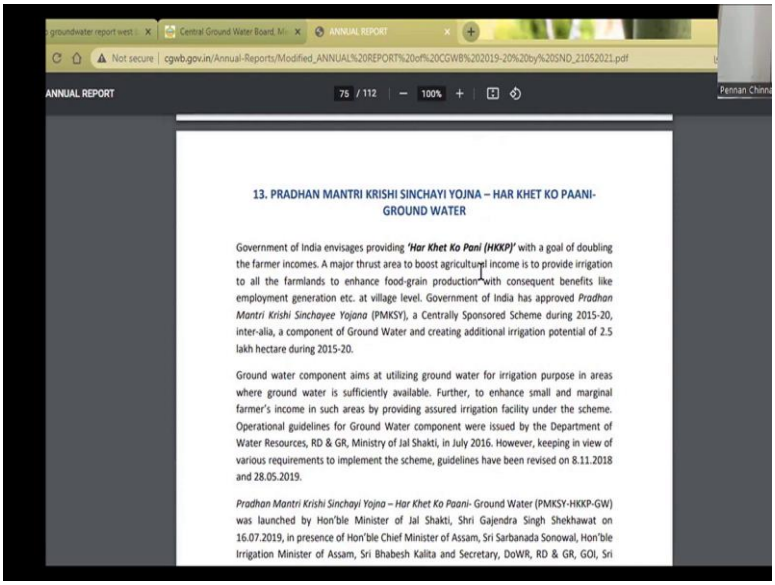






And the gates of the dams are the least the water and then some events that they did for water, groundwater news and authority will be showcased. So most importantly, the data is here, the trends are analyzed at a national level.

(Refer Slide Time: 24:07)



groundwater report west | Central Ground Water Board, Mi | ANNUAL REPORT

Not secure | cgwb.gov.in/Annual-Reports/Modified_ANNUAL%20REPORT%20of%20CGWB%202019-20%20by%20SND_21052021.pdf

ANNUAL REPORT 75 / 112 100%

Pradhan Mantri Krishi Sinchayi Yojna – Har Khet Ko Paani- Ground Water (PMKSY-HKKP-GW) was launched by Hon'ble Minister of Jal Shakti, Shri Gajendra Singh Shekhawat on 16.07.2019, in presence of Hon'ble Chief Minister of Assam, Sri Sarbanada Sonowal, Hon'ble Irrigation Minister of Assam, Sri Bhabesh Kalita and Secretary, DoWR, RD & GR, GOI, Sri Upendra Prasad Singh as shown below in Fig.13.1.

1. Sri Gajendra Singh Shekhawat, Hon'ble Minister of Jal Shakti, 2. Sri Sarbanada Sonawal, Hon'ble Chief Minister of Assam 3. Sri Bhabesh Kalita, Hon'ble Irrigation Minister, Assam, 4. Sri Upendra Prasad Singh, Secretary, DoWR, RD & GR, GOI 5. Sri Snajay Lohia, Principal Secretary to CM Assam

Fig.13.1 Launch of PMKSY-HKKP-GW

73

Fig.13.1 Launch of PMKSY-HKKP-GW

groundwater report west | Central Ground Water Board, Mi | ANNUAL REPORT

Not secure | cgwb.gov.in/Annual-Reports/Modified_ANNUAL%20REPORT%20of%20CGWB%202019-20%20by%20SND_21052021.pdf

ANNUAL REPORT 79 / 112 100%

Interaction by Sh. K.C.Naik, Chairman,CGWB and Sh. Sunil Kumar, Member (RGI), CGWB with the trainees ofILTC

Map reading and Well Inventory during ILTC Field trip to Jagdalpur Area, Chattishgarh State

77

groundwater report west | Central Ground Water Board, Mi | ANNUAL REPORT

Not secure | cgwb.gov.in/Annual-Reports/Modified_ANNUAL%20REPORT%20of%20CGWB%202019-20%20by%20SND_21052021.pdf

ANNUAL REPORT 112 / 112 100%

Rule 377 in Lok Sabha of Ministry of Jal Shakti.

5. Matter Related to Special mention in Rajya Sabha

CGWB has furnished Suitable replies for framing the replies to List of Points raised by Committee on Petition, Rajya Sabha on"Petition Praying for Development of Capacity to Make Real Time Forecasting of Floods so as to Issue Timely Warning to The Affected People"Ministry of Jal Shakti.

6. Replies to Parliament Questions

CGWB has furnished suitable replies for framing the replies to Parliament Questions of Ministry of Jal Shakti, Ministry of Environment, Forests & Climate Change, Ministry of Health & Family Welfare, Ministry of Agriculture and Farmers Welfare, Ministry of Rural Development and Ministry of Urban Development and Ministry of Drinking Water Supply & Sanitation and number of other ministries and State Legislative Assemblies of various states.

7. VIP references/PMO references

CGWB has satisfactorily furnished replies to about 39 References received from PMO and 54 VIP references received through Ministry of Jal Shakti.

110

And you could also see that you have this “Har Khet Ko Pani”, which they want to double the farmers income by having more grain per water drop. So, this is kind of helping the farmers work with available water in a very conservative, conservative way. So, you can see that they have been having meetings, a lot on this and discussions, books released all these things.

So from here, we can go to some more sophisticated books and research outcomes. So, then meetings and where a talk of the scientists give talks to public, NGOs and other activities, all these are captured. Again, it does have a lot, but my point is, more importantly, the data and where to access the data is given.

So, the reports are very exhaustive. One class, I assume is not enough, but I hope you could go through it and build some knowledge on it, it is not technical, the technical terms are already discussed in class with us, what do you see here is very applied sense of this research that we did this I will stop today's class. Thank you.