Ground Water Hydrology
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Module No # 01
Lecture No # 04
Ground Water : Literature / Data / Internet Sources

Welcome to this fourth lecture on the first chapter of introduction and this is the last lecture of this chapter and the in this lecture we will be focusing on the various literature sources the data sources as well as internet sources which are related to ground water and now let us come to the various sources. As we all know so this ground water it is a forms one of the major component of fresh water.

So therefore right from the beginning of the human society there have been attempts to estimate our document or even present so the various phenomena related to ground water and it is always this ground water is in combination with surface water. So therefore so there have been various right from the human beginning of the human history so there have been attempts and many of them are even now so there is existing.

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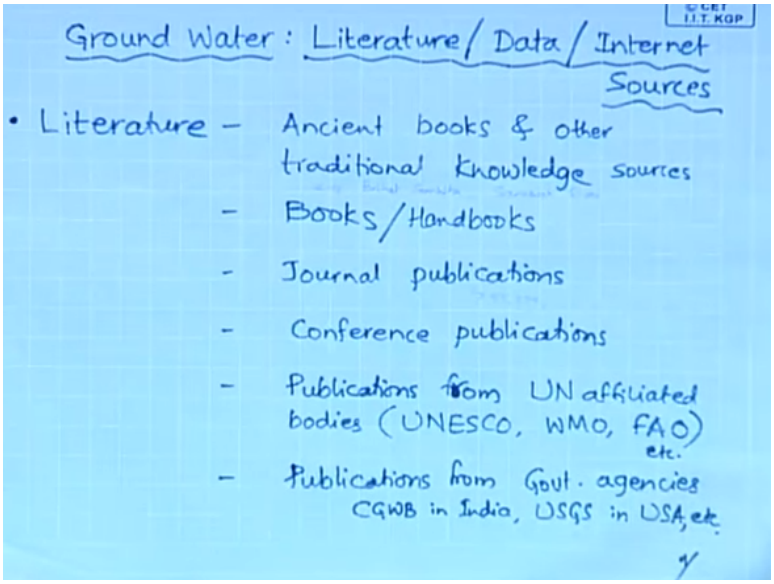

And let us come to first let us come to the various literature that are available in this on ground water. Firstly it is I would like to start with the oldest one chronologically it is the ancient books

and other traditional knowledge sources so these are essentially in all the regions where the the human civilization starts.

Say for example all the river valley civilizations whether it is Indus river valley civilization in the present India and Pakistan or whether it is the Mesopotamian river valley civilization in Iraq or it is the Nile river valley civilization in Egypt. So wherever this river valley civilization started so along with that so there the document of the ground water related phenomena as well as the ground water related structures and all those things started.

So here we can mention so in the Indian context we can mention the BRHAT SAMHITA written by VARAHAMIHIRA and of course the original Sanskrit text it has been translated and many commentaries have been written because and here so because the property of Sanskrit language in which maximum meaning is conveyed in minimum letters and words and sentences.

So there is lot of room for interpretation so many interpretations also have been written and coming to this and also another example I can give is the Saraswati River in the India which was earlier it is believed to be tributary of Indus and presently is believed to be it is as unseen tributary of river ganga joining as a third that is underground stream along with Yamuna in the city of Allahabad.

So here so and there have been the problem with this traditional as well as ancient sources many of them are under documented or undocumented but still there are many proofs say for example the entire Rajasthan the entire state of Rajasthan. So the present day in the middle of Rajasthan so there is what is presently known as Ganga River this one hatchment.

So there is an ample groundwater reserve available and even now so there have been many studies by few studies by the space application center Ahmedabad of Indian Space Research Organization. So they had they are trying to bridge the gap between this undocumented or under documented ancient sources and I am sure this is the same case with whether is Mesopotamian River valley civilization in the present day Iraq or Nile valley civilization in the present day.

Egypt or even other the Chinese Ancient river valley civilizations or even the other this one like the Israel and so on now let us come to the other sources other than the ancient books in

traditional last one. So it is the books and the hand books and there have been many books and hand books on ground water written almost in the past say 150 to 200 years either as a part of the water resources or hydrology or hydraulics books or exclusively as a part of ground water.

And also there have been many handbooks which contain not necessarily on ground water other phenomena such as hand book of hydrology the handbook of hydraulics or handbook of say water resources and all this so they also contribute a very large amount of literature of this one.

Next is it is the journal publications and it has been mentioned that in past 15 years or so there have been many journals related to hydrology, hydraulics or water resources ground water and so in these journals or water sources economics in these journals more than say 55,000 of 55,000 articles they may be full length paper they may be discussions or they may be other case studies.

So they have been published and it constitutes say even a large source of literature and now let us come to the other publication which is the conference publications and it has been in the past say 100 years also. Large number of conferences have been organized by water related issues or hydrology and hydraulics and water resources economics ground water and so these publications conducted by organized by various national as well as internal bodies.

So they also present a large source of for literature next it comes to the publications from the united nation affiliated bodies. So here so there is what is called the UN water which consist of say 28 united nations bodies and out of them three important ones I would like to list here which is the UNESCO United Nation Economics this education sorry educational scientific cultural organization headquartered in Paris France.

The world meteorological organization WNO the food and Agricultural organization that is and headquarters head quartered in a Rome Italy. So this are some of the 3 or 3 main UN organizations in which constitutes a 28 united nation bodies constituting collectively what is known as UN water also next it is the publications from government agencies.

And in this case the governments depending upon their technical capabilities and the developed countries such as USA or may European countries at Japan the former Soviet Union present Russia as well as the council of Independent states as well as the ground water board central

ground water board in India. So these publication so they may be in the form of hand out or there may be in the form of books or they may be in the form of the Maps or they may be in the form of tables or charts or the predictions.

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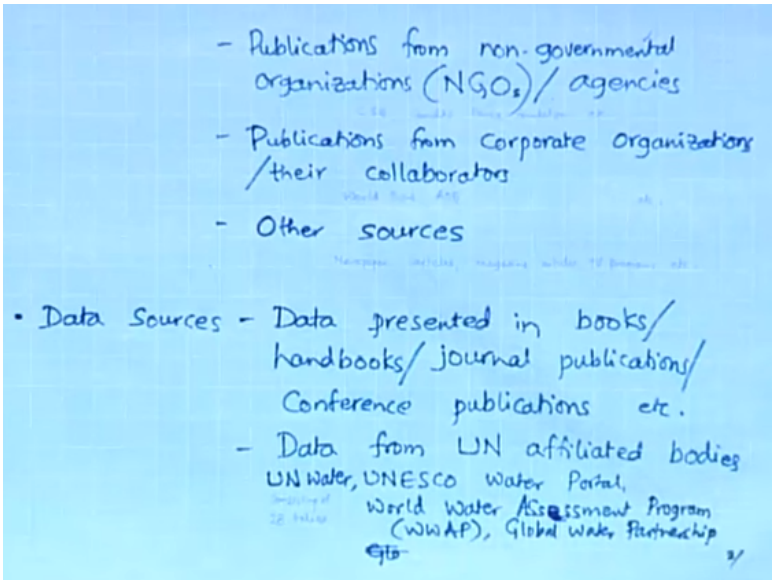

So all this they also constitute a important form of literature pertaining to ground water next let me list here the publication from non-governmental organization as well as the agencies in addition to the governmental organizations so there have been many non- governmental organizations involved in the water sector.

So they have brought out their own publications they may be again books or they may be guidelines or they may be other resources for conserving other handouts or manuals to conserve ground water to conserve surface water in conjunction ground water and in this I would like to mention so in the Indian context I would like to mention the center for science and environment in New Delhi as well as the Gandhi Peace Foundation.

So as well as this so there are many other bodies which work in the area of water so their publications their books handouts their other maps and these are also various and coming to next is the publication by corporate organizations and their collaborators. So here I would like to mentioned the publications brought out by this world bank, Asian development bank as well as other financial institutes or corporate bodies which are involved in this funding various projects related to water resources ground water hydrology, hydraulics and so on.

And so they also from a very important source of ground water and lastly I would like to mention here all of the sources even the simple this newspaper article pertaining to say ground water or ground water engine in conjunction with surface water and other this one so the magazine or articles as well as the popular science articles and as well as the popular TV programs such as the discovery channel the programs which are aired on the discovery channel and other such educational TV programs.

So they also form a very important source of literature pertaining to ground water and added to this is the recent impact of climate change and also which as a resulted in the constitution of bodies such as the inter-governmental panel on climate change. So they also they have brought out many publications case study scenarios future case study scenarios. So all this form and important sources of literature available on ground water.

So and as we all we should be aware that these literature pertain to the ground water which is below the surface of earth and obviously so the as I am reminding right from lecture 1. So there are more in so ground water represents the invisible or say less visible domain of water resources so there more room for uncertainty and then more room for say error and there is more room for speculation and all this.

Therefore so all this literature which is available which is mentioned which I have mentioned here should be taken with the pinch of salt of course they have to be verified so their authenticity their applicability as well their usefulness need to be verified using the basic the basic principles of science engineering and technology and so we should always bear in mind that.

So these ground water resources the literature on ground water so it should be relevant it should give the useful information and it should also be willing to stand the test of time in the limited time horizon at least. Now let us come to the various data sources which are available on ground water so in this as I mentioned in the literature which I mentioning few minutes back in all these literature.

So there is a there are large amount of data roses which is available in the form of say graphs, maps as well as tables and monogram's and other this one and here in this case so there we

should also I would also like to mention here some of the traditional knowledge bases which may be undocumented or under documented say for example in the Indian context.

So there is a popular belief that the water from ganga in the north is going to join the waters from the south Indian rivers or the rivers in the other regions of India such as in the west and as well as in the south. So of course there is a need to scientifically verify this these kinds of popular belief but at the same time so there is no harm in studying in initiating studies which there is a possibility if that they may solve they may provide to be a good source of data for addressing the quality as well as quantity issues in ground water.

So here coming to the data sources the data presented in books the data presented in handbooks as I mentioned so there are various handbooks which are published on ground water or hydrology hydraulics as well as the data presented in general and here we should also remember that the data does not essentially mean the numerical data it may also include the data presented in the form of graphs in the form of charts or in the form of maps.

In addition to the statistical or numerical data as well as the data published in the presented and published in the conference publications impose or seminar and all this so they constitute the major sources of data available on groundwater. Next it is the data presented or data which is available from the UN affiliated bodies as a mentioning it is the UN water consisting of 28 UN bodies out of them few that is I have already mentioned about say UNESCO, the meteorological organization, the food and agricultural organization.

You may wonder why this food and agriculture organization is also such a major is one because so water goes hand in hand with food. So and for growing food so the water is the major requirement and so therefore the food and agriculture and agriculture represents major consumer of water resources. So therefore food and agriculture organization so they have evolved their own methods for estimating the water which is available at present as well as estimating water in this one in the immediate future.

So therefore and added to that so there are say the UNESCO it has a special portal on water and in this UNESCO water portal. So the discharges of the various discharges and maximum discharge the minimum discharge the annual maximum discharge annual minimum discharge as

well as monthly average discharge for vary for all the rivers in the world so they have been presented in tabular form.

And so they include the largest river in the world in terms of discharge that is the amazon river in south American continent which is the most water rich continent in the world. As well as the river which are aware which are flowing through the deserts in Africa or in say few rivers such as Nile river and so they have been also presented in this UNESCO the discharges of selected rivers.

And so there are other data like such as the world water assessment program the international hydrology program that is IHP the world water assessment program which is WWAP the global water partnership which is the partnership between UN bodies such as world meteorological organization UNESCO as well as other world food and agricultural organization.

So all this so they constitute they have presented the data related to ground water in general as well as ground water and surface water in ground water in particular groundwater and surface water in general in the form of various maps, chart that is a numerical or statistical data as well as graphs and so the constitute major is one and here I would like to mention the inter-governmental panel on Climate change.

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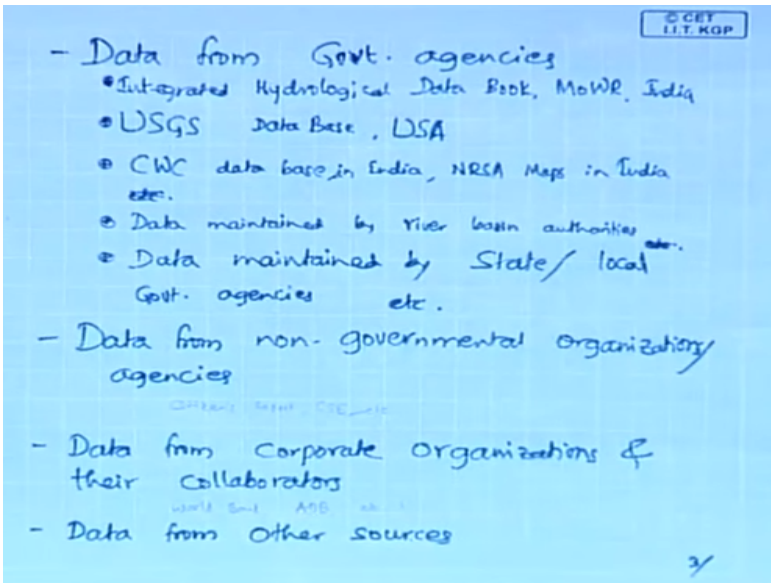

And coming to other data which is available so here I would like to mention the data which has been published by the various government agencies say like in the Indian context the ministry of water sources. So they have published the data pertaining to the non-classified rivers unfortunately so the Indian government is always associated with water conflicts with neighbors earlier it was Bangladesh and presently it is also with Pakistan in terms of this one.

So therefore for the non-classified rivers of India so the data pertaining to ground water as well as the ground water and surface water is published in what is known as integrated hydrological data book which can be easily purchased or even it can be downloaded that one. And in case of US it is the USGS database. So this USGS database so it is a one of the very extensive database which pertains to the the rainfall or precipitation as well as it pertains to run off so here in terms of this rainfall.

So all the 48 contiguous states of US mainland so they have been this divided into say various metrological zones and as well as small regions so depending upon the attitude of the region the distance from coast as well as other features so at this USGS database pertaining to precipitation as well as the USGS database pertaining to the runoff in which all the rivers have been classified into the different basins and each river as been given an eight digit code.

The first 2 digit representing the base in third and fourth digit representing the sub basin the fifth and sixth digit representing the mini basin or the small basin and the seventh and 8 digit representing the micro basin or the smallest basin which is also known as hydrological unit. So like this every river tributary as been given a numerical code and then accordingly.

So then data has been the data pertaining to the surface as well surface water and ground water in that basin has been presented in the Indian context it is the CWC database in India which consists of the various gauging stations. So these gauging stations have been divided into the gauging stations which provide the data on simply gauge as well as discharge which are essentially surface water data and there are few gauging stations which are also provide data in terms of gauge discharge then sedimentation and water quality.

As well as the NRSA the National Remote Sensing Agency maps published in India so like that so there have been other the data maintained and published by the river basic authority such as

the bhakra BS management port the Bhrahmaputra port the other the Narmada control authority and this one and in case of say USA it is the St. Johns water district in Florida and even in many other European as well as the Asian agencies there have been many agencies which maintain data related to river Basin.

And obviously they also maintain the ground water related data so in that particular basin and added to in addition to this the data maintained by state and local government agencies. Some of the state as well as local government agencies in developing countries like India the developed countries such as USA as well as Europe, Japan and other countries. So they have they have maintained a very good data here again in the form of statistical data graphs maps charts and all this.

So depending on this one they have very good monitoring network so their data is also one of the next is the data from say non-governmental organizations or agencies. So in this case in the Indian context I would like to mention the citizen report brought out by the center for science and environment.

So far we brought out the that the data book on the 5 citizenship report on environment state of environment especially the fifth citizens report it contains one source which is essentially the statistical data pertaining to say other environmental related issues which in water in general and ground water is also very important.

So and of course there are other non-governmental agencies working in the water sector so they have also brought out many they also published collected and published data from their various studies. And next is the data from the corporate or corporate organization and their water bodies. So here I would like to mention the world bank the Asian development bank as well as other funding agencies which have funded various water resources as well as ground water related program.

So the surface and ground water interaction an all this so this the data published from these also constitute. And next is the data from other sources so here in this case the data from other sources it could be even say simple school textbook or it could be from a TV us program the popular science program or it could be from any other sources such as newspaper or it could be

even from a this popular science friction books or so they also have presented a large amount of data pertaining around groundwater.

So these are some of the data sources which are available in this groundwater and now let us come to the last part related to the ground water data which is the internet data sources as it is evident now. So the internet found a large amount of data source which is essentially which is a online library. So earlier used to be the actual libraries wherein the data in the form of books or even say other databases so it was physically stored and it was being accessed by various.

These days it is the internet which is the basically the information super highway so in this so there are large amount of data source and here i would like to mention the online libraries the online databases man maintained by the publishing the general publishing houses as well as various or professional organizations their websites online libraries databases and so on.

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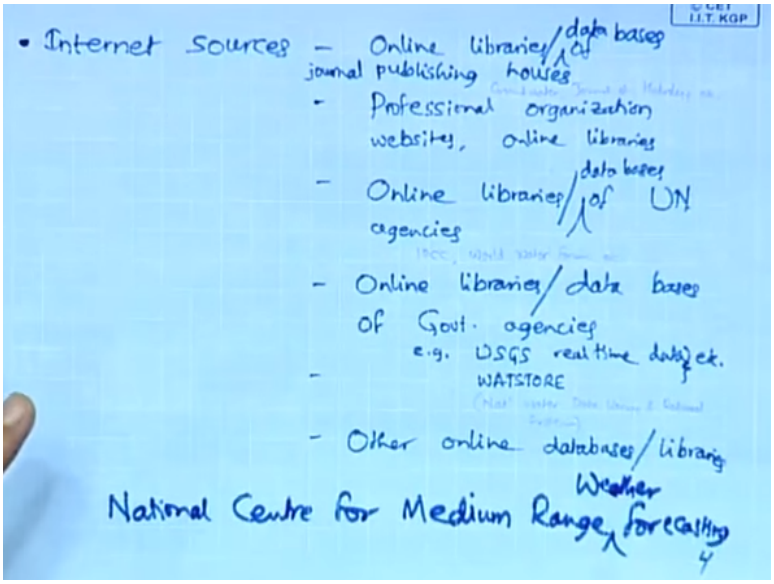

So here so it is this is a vast source and this most of the data which has been which is available in the either as a literature or as a data source is also available in these days as a source on internet. And of course due to their commercial as on so it may not be available fully but at least significant amount of that is available in the form of data source.

Here in the general publishing houses I would like to mention here say few of the two of the most important journals related to ground water that is the ground water journal as well as the journal of hydrology and this journals.

So they have as per the ground water journal so that maintains a large amount of database and online library so which can be accessed by doing the simple internet search and so it contains the information about the books the journal articles the databases as well as other sources and so on. So which is very much useful especially in the areas especially in places where we may not find the physical sources of ground water related literature or data.

And also this the UN agencies so they have also maintained and they are maintaining the libraries as well as database I was mentioning the UN water consisting of sat 28 united nation bodies or agencies in this case the recent the IPCC publications the inter-governmental panel on climate change the world water forum its data. The stock home water and other this one so this also consist of vast amount of internet sources.

Next is the online libraries the databases of government agencies some of the government agencies especially in US and other developed they maintain a large amount of database on the studies and so here I would like to mention the USGS real time database and in which we can get the data pertaining to the discharge of this in the river in surface water bodies such as rivers as well as the water table data in the observation networks and the data stations or gauging stations.

And so there is here I would like to mention also about this what store it is the national water data storage and the tribal system for USA like that there are other online databases libraries which constitutes a large amount of data which is available online. So coming to this the internet a well as the data source and in the Indian context it is the here the national center for medium range forecasting weather forecasting.

So this is a center pertaining to this one here it the weather forecasting is done based on this weather so depending upon the that is the ground water abstraction making suitable assumptions in the surface water this one. So there is a possibility there is a very good chance we can do a reasonable estimate of the ground water availability the depth of groundwater and as well as other this one and there are also other.

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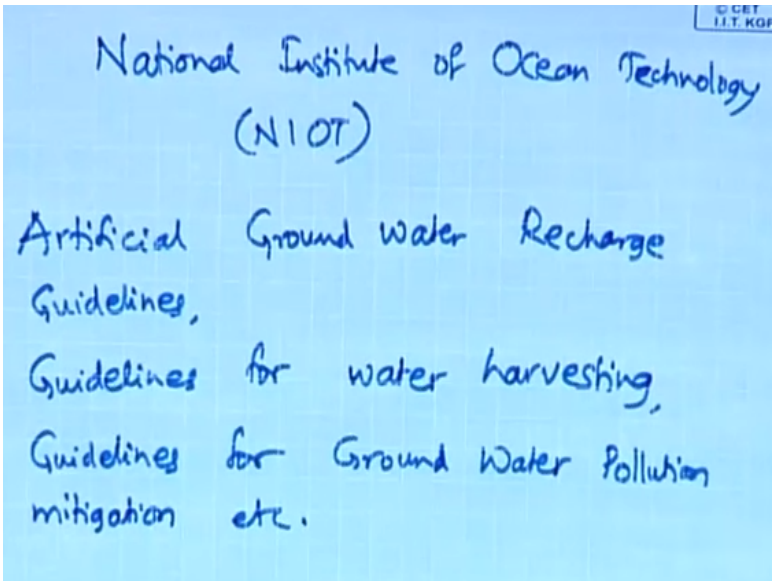

Say like in India there is what is called the National Institute of Ocean Technology NIOT in Chennai. So they have done a very useful study on this desalination of sea water so as to provide fresh water and they have done a very god study on the fresh water sea water interface and so it provides a very good this one because it is mentioned that so this in spite of all studies of this all the studies as literature as well as data which is available on ground water which constitutes as major sources of fresh water.

So still there is a need that because of the adverse impacts of climate change and global warming so that water resources the fresh water resources are getting repeated quantitatively as well as they are getting polluted quantitatively. So therefore this the study on the this fresh water sea water interface as well as the study on desalination and using and generating fresh water which obviously which is being done in nature in the form of hydrological cycle.

So through evaporation and then so the storage of atmospheric moisture which has evaporated from the surface water bodies into the clouds and subsequent condensation and precipitation so here so this desalination represents the artificial way of this one that is the artificial replication of the natural hydrological or water cycle.

So and also it is said that in the world more than say 50% global population it is estimated a somewhat a sum of the exact estimate is around 60% of the global population lives in a region in a region closed to the cost which is a within say 100 kilo meters of the coast. So therefore so they have been attempts in the middle east as well as India in say USA as well as other regions on the others that is the desalination aspect as well as producing fresh water.

So they it also represents a large amount of data pertaining this this one and added to that so there have been say the artificial so this is the ground water recharge guide lines. And guidelines for water harvesting say guidelines for a ground water pollution litigation etc. So such guidelines have been published by various government agencies as well as various non-governmental agencies and other professional the organization.

So these guidelines so they are based on that case studies which are existing which are pertaining to ground water and so these also present a large amount of very useful information as to how to address the issues of the ground water decrease in quantity as well as quantity.

And also there have been this other this other sources on ground water and many times so there was many undocumented or under documented this literature pertaining to ground water and many experts on ground water. So they have formed their own sources on literature or data and many of these sources and literature. So they are also available the online and when so these form some additional sources of ground water.

So essentially so our objective this through this chapter one which is on introduction in this we discussed about the back ground. We discussed about the historical background we discussed about the ground water utilization we discussed about the ground water its position or its status in the hydrological cycle we also discussed the groundwater budget which is based on the mass conservation principles we discussed the groundwater level fluctuations and environmental influence.

And lastly we discussed about the various literature data as well as the internet source or resources which are available related to ground water. So this completes the first chapter on introduction and in the next chapter we will discuss on the occurrence as well as moment of

ground water. So thank you and so we will in the next the second chapter the next lecture will be on the second chapter on say ground water occurrence and moment thank you