**Rural Water Resources Management**
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**Week 01-Lecture 01**
**Course Introduction and Schedule**

Hello everyone. Welcome to this course on NPTEL which is focusing on Rural Water Resources Management. This is the very first course on Rural Water Resource Management and especially for India because there are a lot of need statements for managing water resources in India especially.

So, I am Professor Pennan Chinnasamy from Center for Technology alternatives for rural areas located in Indian Institute of Technology, Bombay. It is a very unique department only focusing on rural areas and finding new technologies and science for better application in poorer regions. So, the first week of the lecture would happen from today. And the first lecture would be on trying to sensitize the topic; why this topic is needed and what would be covered in the 12 weeks from now.

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I would be using a lot of my personal experiences as a hydrologist for which I would like to go into my personal introduction. I have graduate degrees, double masters in physics which has helped me a lot to understand the physics behind water management, and my PhD was focusing on surface water, groundwater and hydrology of both these two systems and interactions between them.

Also, I looked into nutrient dynamics microclimate and to map all these I know GIS and remote sensing. Sometimes a good understanding of hydrology will be used for running hydrological models and where there is no data. And if you would like to see different scenarios, hydrological models are used.

In this course, we will be focusing most on what I did for my PhD in hydrology for water management. My research profile after my PhD I moved in as a post-doctoral fellow for Ashoka Trust for Research in Ecology and Environment in Bangalore. Then I was a researcher for International Water Management student in Sri Lanka, where I focused on groundwater, remote sensing and water budgets, which we will be covering through these lectures.

Now, also, I looked at a lot of climate change scenarios and adaptation and mitigation to change. These are really, really important terms, at least in the current scenario in India, where climatic change extremes are happening, and we need to know how to adapt, mitigate it preserve and conserve the water resources. Then I was as a Senior Researcher in Nanyang Technological University, Singapore, where I did some flood prediction models and also ran some climate change scenarios.

And currently also I am the visiting scientist with N.M Sadhguru Foundation in Dahod, Gujarat and also visiting professor in University of Oulu, Finland. This is a general overview of my personal curriculum or CV. And what I have come across to teach in this rural water resource management.

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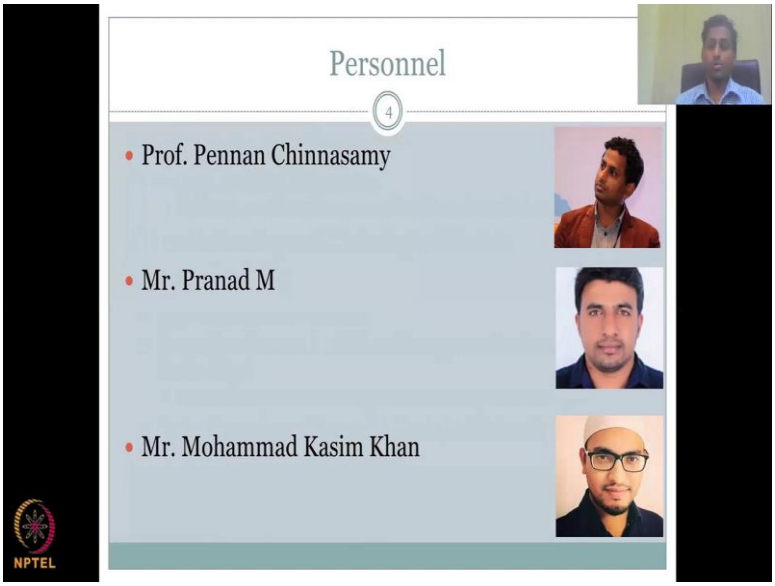

From my introduction I would like to also introduce my team is that we will be guiding you through the course. They would also be on the communication through the networks that have been given to you. The first TA will be Mister Pranad, who is also my PhD student and he has a policy, social science background. And he is also a hydrologist at GIS remote sensing processing. His research is on Lake restorations from rural lakes in India.

The second TA would be Mister. Muhammad Kasim Khan. He is a technocrat, he is more into IT. And since we are getting a lot of data for rural water management, his research area focuses on how to manage these water resources using big data, IOT and ICT tools. Some of them you would come across these lectures, but most importantly these two people or TAs will be helping you throughout the course.

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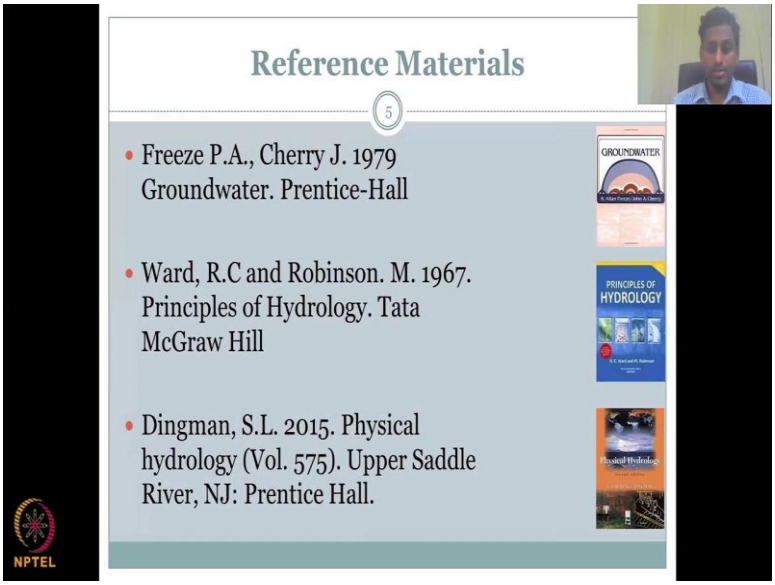


Yeah other things which are much more important than the lectures and the TAs will be the books and I will be following most of these books in the lectures and give you the citations where I will be using them. The first book would be the Groundwater book from Freeze P and Cherry, Freeze is pretty well-known person, first of all for groundwater, where this book has been used as the dominant resource for everything regarding groundwater.

And since this course focuses on rural water resource management, groundwater is key, groundwater management is key for the course. So, we will be going through this book a lot. Next book would be Principles of Hydrology, we will be using this book to understand some methodological principles and how these react in the field can be taken up by Physical hydrology from Dingman, most of the information I have taken and put in the lectures. So, if

you do not have access to the books, you could still follow through the lectures for your homeworks, for your and other aspects in exams and etc.

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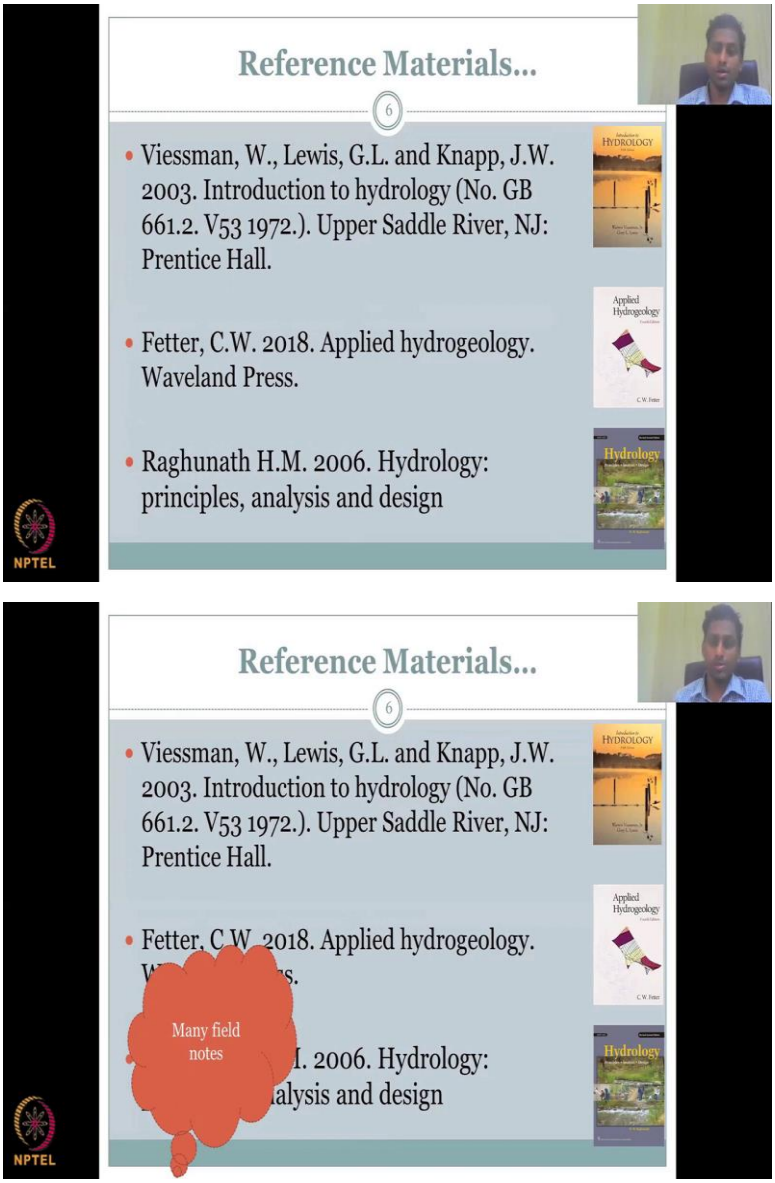


We will also be using Introduction hydrology, all these are kind of introduction or one on one courses for hydrology, water resource management. And then little bit of groundwater aspects would come from books like applied hydrogeology. So, these books are pretty well known across international forums. Coming to the Indian hydrology and lot of Indian material, I have used Doctor Raghunath's book; Hydrology: Principles, analysis and design.

So, this book has been widely cited and it has a lot of information on the local Indian region, about hydrology, the water budgets, what kind of systems have been used in India, the traditional methods and a lot of equations for engineers to estimate the hydrological

components. Along with this, I will also be sharing information from my field notes, again, as I showed in my personal introduction, even though I am hydrologist in modeling in GIS person, I have done more work on the ground.

So, a lot of field experiences, field loads from my work in the rural region and also work from NGOs would be used here, because a lot of the work from NGOs non-governmental organizations do not end up as books and papers, either they do not have time or it is not a mandate for them to write these. So, these end up as documents and these documents I would be using or documentary videos etc. So, these materials I would be using across the lectures, so that you can understand from a ground person, the NGOs work on the ground, how they manage these water resources.

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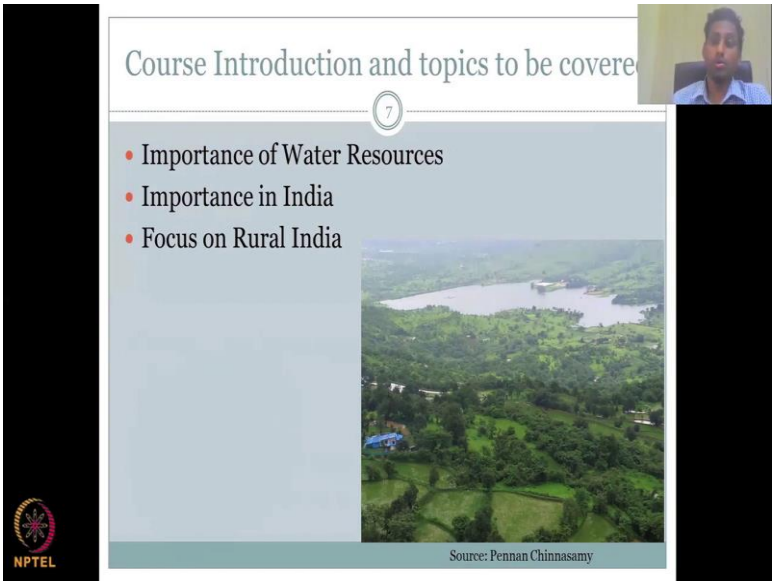


So, let us move to the course introduction in topics to be covered. As I said, why is this course important? It is because the importance foot on water resources, water has been and is the most important source for the living organisms. The reasons why people go in search of water  is because it is the driving force. So, it is a very important source and especially for rural regions, where livelihoods are dependent on water. For urban cities maybe it is not it is only for domestic use, but when you go to rural regions, water resources are key for livelihoods also.

The importance in India we will be covering this and this is where this course is very important. India is still an agrarian nation, which means most of the livelihood is either directly or indirectly related to agriculture. And since agriculture happens in rural villages, most of it we are looking at how to manage rural water resources. As I said the focus will be

mostly on rural India and some examples would come from like rainwater harvesting, might come from cities and other perspectives. But most of these lectures would be for rural water management.

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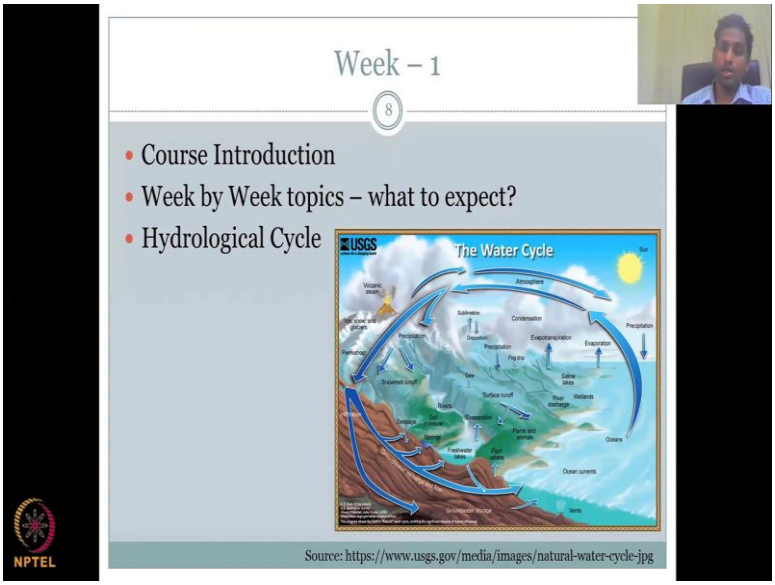


This, I would like to go into what we will be covering per week. And in the first week, we will be looking at the course introduction which is going through. Then week by week topics, this builds the interest, why to understand or go through these lectures and what to expect at the end of the lectures.

So, I will be breaking up the lectures into modules and each module will be explained today in this lecture. And you could build that expectation on what to expect, also what notes you need to refer. Most importantly, we will be looking into the hydrological cycle. This is the key for understanding rural water management that we will be covering that in the first week lectures.

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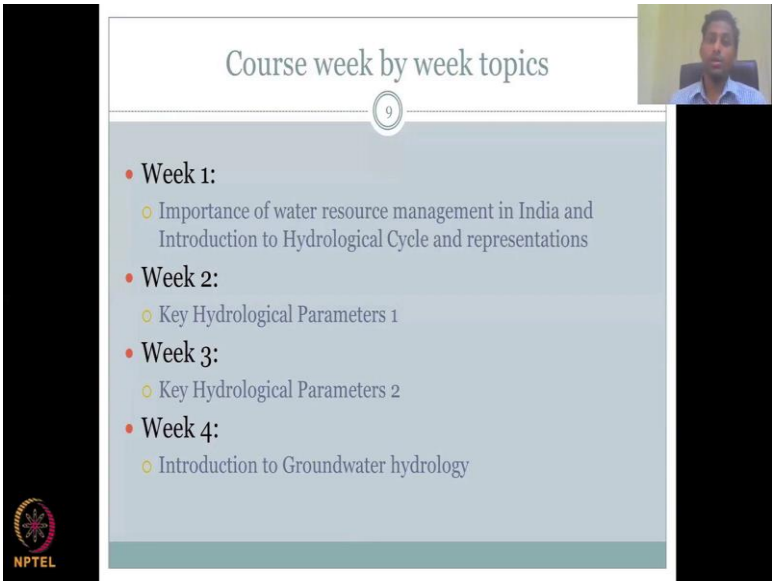


So, as promised, we would look at what you could expect for the weeks to come. Week 1 would be discussing about importance of water resource management in India, which is why do we need to have water resource management in India in scenarios both in urban and rural setting. Why is the importance much more needed now, especially in climate change scenarios?

Then, we will go into the introduction of the hydrological cycle, which is the base for understanding the water resources in any region, be it urban or rural region, we need to understand the hydrological cycle and how they are represented. So, this would be gone through the detail in week 1. Please understand that there are multiple components in the hydrological cycle what makes the hydrology, but we would only focus on the most important ones due to the length of the course, and what is important for rural water management in India.

I have divided based on the need for rural water management and also based on the course structure, I have divided the next two weeks for debating and discussing the key hydrological parameters. So, we would have a set of 5 to 6 parameters in week 1 and then in week 3, we would go into more on the hydrological parameters, the more important ones the first week or the second week, we would go through some basic hydrological parameters which would lead into the secondary or more important hydrological parameters in week 3.

Week 4 would go into introduction to groundwater hydrology. So, this is a little bit different from the hydrological cycle. The hydrological cycle would encompass the entire hydrology at a given location, not only the groundwater, but when we zoom into the groundwater

hydrology we would get into much more complex components which may not be represented in the overall hydrological cycle. One of the things is like infiltration, percolation, etc.

Why this is important to understand is because it gives a more better understanding of rural water management, most of rural India is still dependent on groundwater for irrigation. So, it is very important to understand the groundwater hydrology for the rural setting. So, hydrology is the movement of water, the study of the movement of water and the first couple of weeks we would be looking at the overall hydrological cycle. And then we will be focusing very, very narrowing down to the rural scale and that is where groundwater hydrology becomes important, which will be covered in week 4.

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Moving on, once we introduce the ground water hydrology in week 4, we will also introduce the multiple variables, parameters in the hydrological cycle. And then from there we would discuss in detail some ground water components. This is important again to understand how you want to know rural water resource management because if you do not understand which components are key or bigger storage components in the cycle, then your efforts in water resource management would go, the benefits would go somewhere else not to the local area that you want to focus. So, it is very important to understand the groundwater components.

Moving on we would also look at some of the surface water hydrology components. So, those who know hydrology or water resources, there are two types of water resources; one, two major types so, one is your surface water which you could see on top of the surface, dams, lakes, rivers, streams, etc. And the other component is the groundwater cycle where it goes under the ground and lot of complex processes happen.

So, week 6 would lead it to the surface water hydrology components, because we would also want to touch upon some of the basic hydrological components for surface water hydrology. But most as I said, most importantly, we would look into groundwater. The water mass balance equation with the rural focus. So, this is like a budget, water mass balance equation would give you the budget on how water comes into the rural system. What are the key drivers that bring the water into the system?

The second is how water is extracted or taken up by the system; multiple activities, farming, livelihoods etc. And the next components would look at what is remaining in the system. So, that you could preserve water in the rural setting. So, a water mass balance is kind of a budget to show how much water comes in, how much is used and how much remains. If you go on a negative budget or if you overspend, then what happens is you will be taking water from the already stored water resources which is going to deplete your long-term water sustainability. So, that is what we will be discussing in week 7.

In week 8, we would be looking at rural water management issues. So, what are the current issues? What are the more key issues to water management in India? And we would look at more specifically data challenges, observation, records, etc., etc. So, that we could understand if we need to better, where do we need to focus more? So, that is where we will be doing a lot of insights in week 8.

If you look at it, we are starting from the introduction of the hydrological cycle then going into the components. Once you know the components then you are fitting them into a water mass balance equation budget. Once the budget is prepared you are better to understand the rural water management issues.

The data challenges are also discussed because it is as and more important, once you know the budgets, the water budgets and the key components for rural water management. What are the data that you have to actually conduct these management activities? So, that is where we get into some of the data challenges for rural India and look at how observation records are being made.

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Then we would also go into rural water resource management structures. So, how are these infrastructures built? What are their lifelong achievements? What are the pros and cons in most rural water management infrastructures that are used in India now? So, I have divided it into two components.

In week 9 you would be looking at engineer rural water resource management infrastructures, which are some examples like dams, check dams, where you need to engineer or bring some concrete structures into practice. So, that is what you would be discussing in week 9, engineer options, engineered solutions for rural water management.

In week 10 you would be looking at a rural water resource management infrastructure nature based. So, what is the difference between these two weeks is you would be looking at an engineer perspective and where a lot of money has to be spent, big, big projects are being made in engineering. Whereas in nature based solutions, it is along with nature, how do you bring already existing traditional knowledge and lessons from nature to preserve water in a rural setting?

Also, how do you look at these two approaches from a centralized version which is a top down approach we call, where you have a big massive structure catering to many people or multiple smaller structures catering to multiple people. So, this is where you would be discussing in detail, both engineered and nature-based solutions. The nature-based solutions are very important nowadays, because engineered solutions have become more expensive, very costly to manage also, so once it is expensive to create and also expensive to manage. And land is being very, very less.

So, slowly nature-based solutions coming up. We will jump into some of these, introduce some of these topics and concepts in the lecture. In week 11, we would be looking at some case studies for rural water resource management. As I said, I will bring some case studies from my field experience, I have been in better position to explain what has happened in the field, why did not the project go by the different outcomes and results came up.

So, some of the, some of my case studies would be discussed, but more importantly case studies from non-government organizations, extension networks, government agencies would be discussed. So, these would give you a bird's eye view of how some people have used a science to understand resource water management and have been successful.

Also, to understand week 9 and 10, the basic difference would be also engineered is more on the engineering cycle whereas nature-based solutions would be scientific cycle. So, both of these will be discussed as solutions, options for solutions in week 11. There is not one right way, it depends on where you are on the rural setting. So, you would see a mix of engineer and nature-based solutions in the week 11.

In week 12, for those who are very interested to take up these understanding from this course and solve the rural water problems in your area or your nearby areas, I will be going through some databases that would help you, put you on the track to first estimate the rural water budgets and from the rural water budgets, you would understand the hydrological cycle. And once you understand the hydrological cycle, you would be in a better position to come to week 9 and 10 to see what kind of solutions can you give.

So, everything starts with the database to understand if there is a problem, there is a water resource problem in rural India. And from there, what understanding, what are the analysis you want to do, is being done through the hydrological models, algorithms or budgets and those understanding and information you would convert into a solution which are being covered in week 9 to 11.

So, with this, I would stop the first lecture and all the details for the courses, the documents and everything have been shared with you. The TA details are also there for communication. So, we would take up the next course looking at the hydrological cycle coming soon. Thank you.