Rural Water Resource Management
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Week 02, Lecture 01
Key Hydrological Parameters for Rural India (Part 1)

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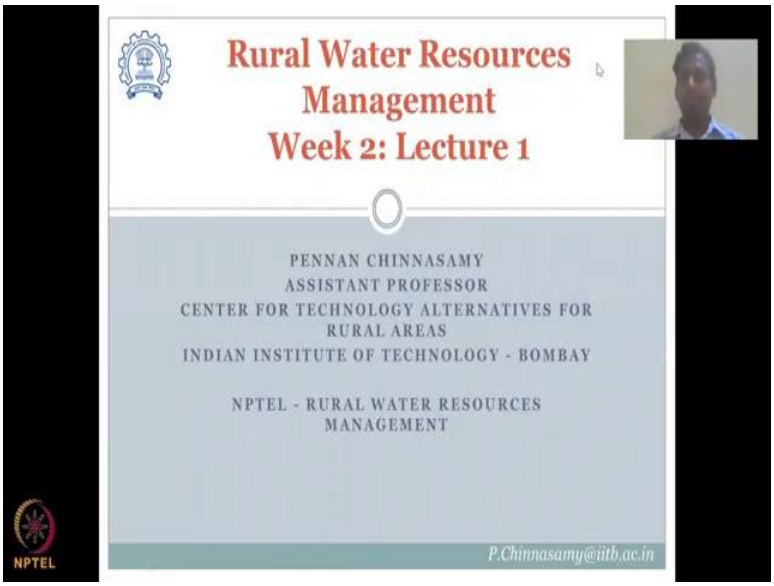

Hello everyone, welcome back to NPTEL course on Rural Water Resource Management. This is professor Pennan Chinnasamy from IIT Bombay. We would continue the second week lectures from now on.

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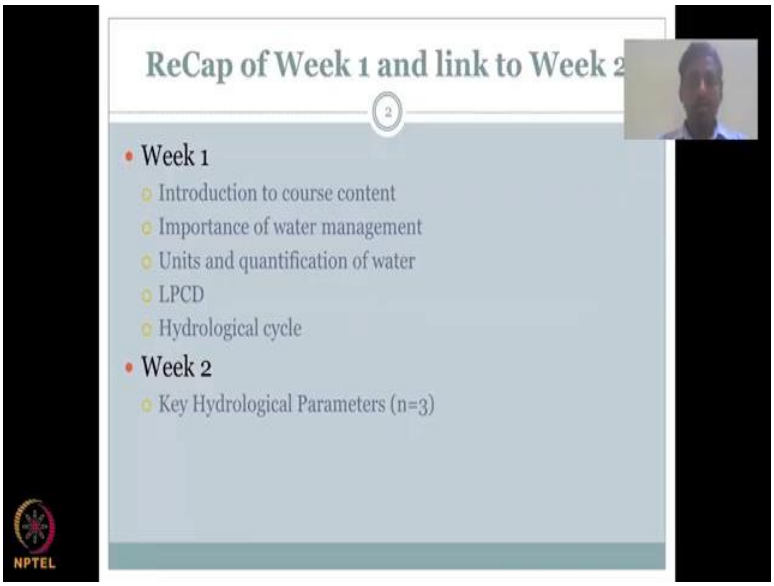

Before we go to the second week, where we get into more of the aspects, let us do a recap of week one. So, and how week one whatever we covered, going to be linked to week two we will discuss today. In week one we looked at five lectures on which I have spread across on introduction to the course content, importance of water resource management.

And we also talked about how in the global scale water resources very scarce. In particular we also looked upon freshwater availability and how rural regions are being more stressed. We looked upon different countries and how they treated water in terms of what livelihood options they have. For example, developing nations put more water on industry, whereas under developed developing nations such as India put water mostly on agriculture.

So, there is a big divide and we looked at all the scales of importance of water management and different studies and how they looked at water stress. Now, after that we went into units and quantification of water resources. As I said, since we were using the British system for a long period, still some of the British system is being used and also the SI units are being used.

So, it is always careful on the user to have both the units understandable and or a book or ready access to conversion of these units. Then we looked into LPCD. So, it trickled down to the rural water management and how water is being given to Indian rural regions for agriculture, which is the dominant consumer of water. And then we looked at domestic water, then industry water.

For the domestic water we looked at LPCD which is Liters Per Capita Per Day, how much water do we consume per person per day. And what we found out is that the rate the government has prescribed is around 40 to 70 LPCD rural areas, whereas it is 150 to 200 in urban areas. So, given the context of how much water is available in the world, and how are the units for different water resource management given.

We then went into depth on the hydrological cycle. We looked upon the hydrological cycle in a broad overview and saw how these parameters are linked to each other. In the week two, we will look at three key parameters in detail. This is very important to understand why I am going to pick or why we are going to pick of the parameters and the hydrological cycle.

We will be picking only three for this week and we will go into analyzing why this parameter is important for rural water resource management. How do you measure and monitor them? And what are the different ways to conserve them. So, for this week, we will do three and another three for the week three. So, then we will have six parameters that we have identified.

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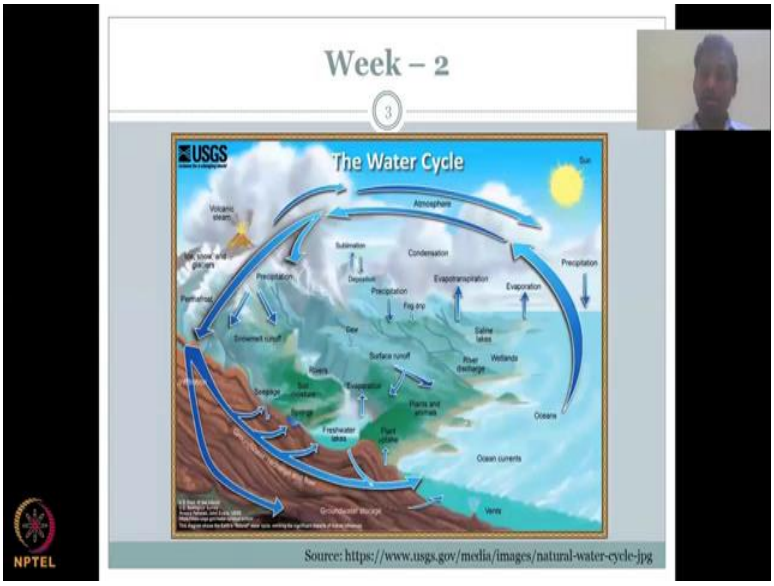

Let us quickly look into the cycle again. As I said, the key dominant resource is water, but it does not start or end the cycle with the sun. The sun's radiations is the key driver for all these processes. Be it evaporation for which you need warmth on the sun, heat from the sun, be it your transpiration where plants conduct photosynthesis and chlorophyll, through chlorophyll they

produce food, and for that they use the water resources and transpire. So, for that sunlight is pretty, pretty important.

There are some processes which may not require sun's energy, however, for the cycle to continue in a loop, we do need the sun. So, we started from the atmosphere and then we went into precipitation cycles, we looked at the different precipitation available in the world and as I said we are still using the USGS Water Cycle diagram because it has been well cited and also used in many government reports.

So, we identified all the precipitation multiple pathways, then we came from rainfall into freshwater storage and rivers, streams, lakes, et cetera. Then we also looked at ground water, water recharged and came in. Finally, the water moved into the oceans. Once the water is the oceans there is plenty of opportunities for evaporation and which is driven by the sun.

Some of the water which goes into the soil is being able to be taken up by plants and animals and that actually give it back to this process of taking of taking water would end by giving water vapor back into the atmosphere through transpiration. So, once these water vapor molecules are cooled down, they began to condense and form clouds. So, what happens here is you have movement of water vapor up and then once it condenses, coalesces, then precipitation happens.

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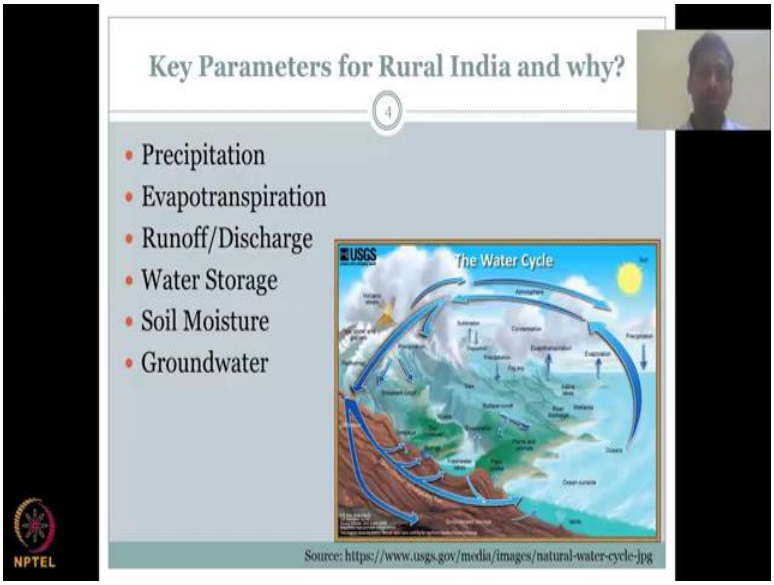

So, let us look at the key parameters for rural India. First one of course is your precipitation. This is the input to the system. Please understand we will go through only 6 right here and we have identified them based on the literature and where more studies are being done, more ground work have been done for water. So, precipitation is the key because that is the key resources, water resource that comes into your system, into your cycle.

Then once the precipitation occurs and converts to runoff, rural livelihood stakeholders they have the water, so what do they do, most important livelihood is this water. so they would apply the precipitation water which in turn converts into evapotranspiration. So, that is the second key point, precipitation is the input to the system whereas evapotranspiration is the loss to the system. Then we also looked at runoff at discharge.

So, we will be going to be looking at runoff and discharge. These are the three key parameters that we will be looking at this week. So, evapotranspiration is a loss to the system because it is taken up by the plants, whereas runoff and discharge is the remaining water that is available for converting it back into the stream, rivers, ocean, lakes, et cetera.

So, we will go through these three parameters. So you see how it is tied, precipitation is the incoming water resource into your system, whereas evapotranspiration, runoff, discharge are the losses. For the following week, we would also look at water storage components. So, some of the water would be store, you could see here the fresh water is being stored and then it goes into oceans, plants, et cetera.

So, we will look into some other water storage components. For example, water can also be stored in the human body or in the plants, in the animals, but we will not look into that, we will look into higher scale water storage. And we will also look into soil moisture, other than the living things and constructed dams, check dams, et cetera.

We will look into how water is being stored in the soil and after that how water moves down from the and again stored in the groundwater. So, these are these six have parameters that we will look into, out of these 6 parameters the key input system precipitation, whereas evapotranspiration and runoff are the key losses from the system. And then key storage in the system would be water storage, soil moisture, and groundwater.

If you look at how I have divided the lectures for this week, we will be looking at the input and losses to the system. But as the next week we will be focusing on them storage. Storage is very important for rural India because once your precipitation stops, you still need to continue to grow the crop or finish off the growing period of the crop for which your precipitation is not available, runoff and discharge may have left the system.

So, the only waters remaining would be your storage, soil moisture and groundwater. So, if we understand this logic it will be better to conserve the water.

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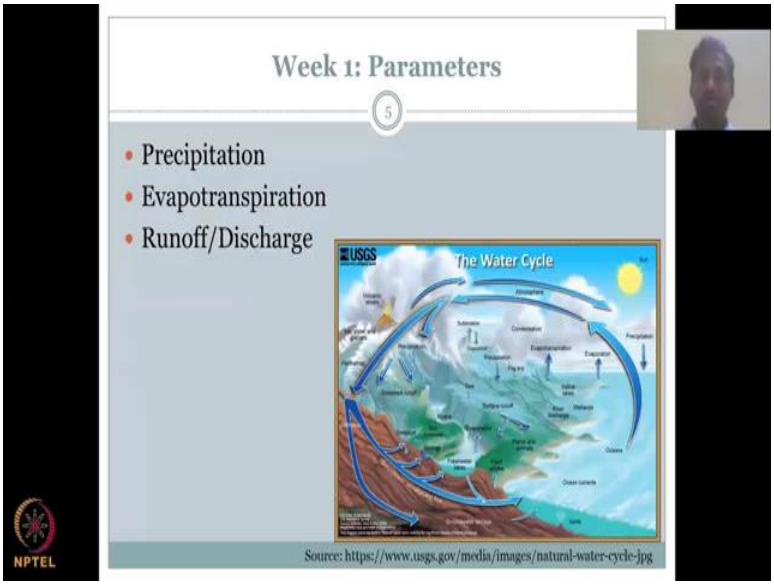

Let us come to the week one parameters, as I said we will do precipitation, leading into evapotranspiration, runoff and discharge. Please understand runoff and discharge are (())(11:34) two parts, runoff would be the water that is precipitation, excess rainfall, it is converted into runoff. So, once rain hits the land it starts as a runoff process, it runs off the surface, so it called runoff, whereas discharge is where it comes into a stream and then flows as discharged.

Sometimes discharge can come from a different river into a system, like for here if you have your unit of analysis as this land where you want to see soil moisture, et cetera, water can still come in through your system. The input, so at that point your discharge can become your input along with your precipitation. We will go through these parameters in detail.

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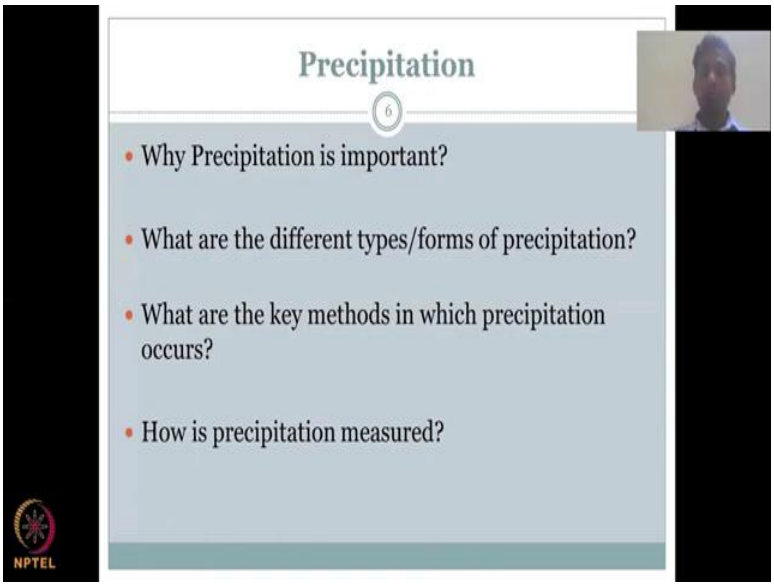

So, let us start with precipitation. Why precipitation is important? Precipitation is the key source where we could not control till date, how much precipitation can occer. we do not have a control over it, neither do we predict exactly the amount of rainfall. So, it is very-very important to understand the process, rainfall markers and how the government agencies, NGOs and networks collect data on rainfall.

It is also important to understand that since nature is very complex in precipitation process, we need to understand document how much water we actually capture through precipitation. And from that we can do the rural water resource management activities. If we do not know the precipitation, there is no point of doing a rural water resource management activity.

Let us take for example, if you are going to construct a dam and say that I am going to store water for the rural development unless there is precipitation, unless this runoff, which is again precipitation converting into runoff, you cannot use the water. So, it is very important to understand why, how much precipitation occurs and it is the key input to the system.

So there is only two types of farming that people do, one is the Rabi season and the Kharif season, whereas Kharif is your monsoon rainfall dependent agriculture and your Rabi season is the non-monsoon party. Even in the non-monsoon part please understand that the precipitation which occurs in the monsoon is what is being used, we will go into this in detail.

We will also look at the different types and forms of precipitation. So, in the previous slide we showed the water cycle, and there are multiple forms and types of precipitation, but for rural India there are only a few which are very-very important. Thus stressing two parts, rural and Indian because rural means you can also have one in Africa, where they do a different type of precipitation, they do have a different type of precipitation.

So, this course would be focusing mostly on Indian rural context, in that too mostly arid, semi-arid regions, not in the too much north, where we have snow and glaciers, and snowmelt, et cetera. Once we understand the types of precipitation, we will then go further into the key methods in which precipitation occurs.

Remember, precipitation has different methods in which it occurs. Magnitudes may change, now you will be seeing many cyclones happening, which is also of disturbance and precipitation following up, when you also see a lot of droughts. And sometimes other precipitation events happening, like in a dry-dry area or a very hot region you will see ice rain falling, which is called hail or even snow falling, once in 20 years, once to 30 years.

So, it is also important that you know the different types of precipitation and what are the key methods in which precipitation occur. On top of this we also said precipitation is the important source that brings water for agriculture in India. In different countries precipitation may not be the important source because somewhere else it rains and the water is connected through rivers and stream networks so the country can do agriculture.

So, it is mostly channel based or dam-based agriculture or irrigation, in those countries, for example, in the African countries which are fed by the Nile River, you may not worry about rainfall, precipitation in your region. However, in India, most of the administrative units have their own discharge networks, but most importantly, the rainfall should occur.

So, the other aspect I wanted to mention here is the importance of precipitation because India is an agrarian nation as I said; there is a lot of importance for agriculture, which is going to be driven by precipitation. We are also not a country where we import too much water for agriculture and or domestic use. So, that is why precipitation ranks high.

Understanding precipitation ranks high for rural water management. So, given the importance, given the types and the methods in which precipitation occur. We will also look into how to measure precipitation, for this there will be some exercises also on how to measure precipitation in terms of units and then convert it into volume.

You had remembered from the last week's lecture, we mentioned precipitation and other parameters in the hydrological cycle, mostly are measured as a thickness, which is one dimensional, to convert it into a volume which is three dimensional, you would multiply it by the area across which it occurs. So, we will go into that part also on documenting, monitoring the water rainfall data and little bit conversions into volumes.

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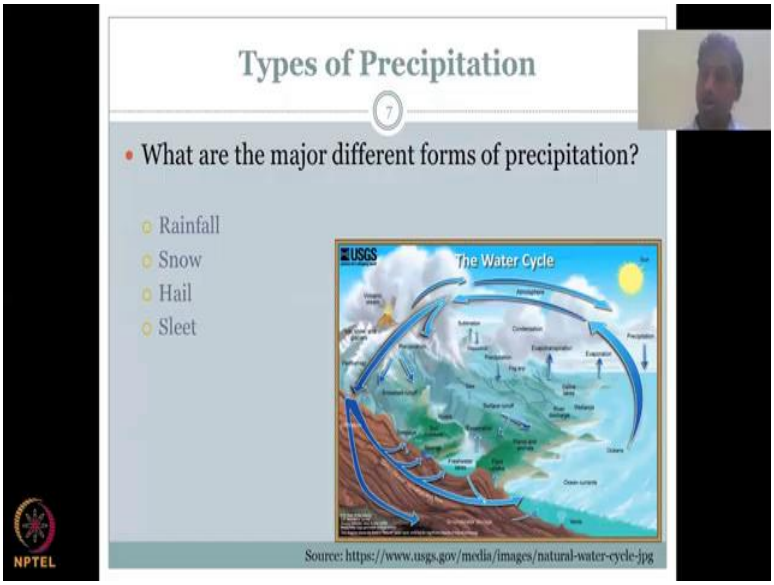

Let us get into the types. What are the most important types of precipitation? What are the major different types of precipitation? We do have rainfall and that can be high rainfall, drizzle, very slow rainfall, all of it is included in the precipitation. So, when we say rainfall measurements it includes your higher rainfall events, slow rainfall events, and the drizzles, et cetera.

Somewhere dew is also considered in the rainfall because when you measure overnight, you may not know if it is a rainfall or is it a dew deformation in your rain instrument or rain gauge, rain measurement instrument. Then we have snow. Why would snow be important? As I mentioned the hydrological cycle, let us get back to the hydrological cycle.

There are some regions in India where it is channel based irrigation or water which comes from the mountains as snowmelt, snowmelt runoff is then converted into freshwater resources into rivers, lakes, et cetera. And then finally dammed and then given us, channelized into irrigation networks. Sometimes you do not have channels, but along the riverbanks people will use it, take the water and use it for agriculture.

Can we have an example for this? I think where we would have snow and which region would get most of the snow melt in India, slow snow melt converted it river, et cetera. Correct. The Ganges; so the Ganga River, even though it is a river, if you go up not it is formed and lot of water does come from snowmelt. It is a trans-boundary river in nature which means it goes beyond India.

So, we do have multiple sources for the river Ganges and the most important would be from the snowmelt from the Himalayan region. So, what happens that water converts into liquid, or the snow converts into liquid through snowmelt, and then comes down as runoff and mixes with the rivers and oceans, before it gets into the oceans in the Bay of Bengal, what does happen?

Along the Ganges floodplains, riverbeds water is being relocated to the groundwater or farmers take access of it for irrigation. So, that is why snow is also an important part in your hydrological cycle if we are looking at the Ganges region. So, Ganges is such a big basin, and it is one of the biggest basins in terms of people around 1 billion people are directly or indirectly connected to the basin for livelihoods.

So which is one person per seven people in the world, so if the world's population 7 billion, approximately 1 billion is supported by the Ganges. So, it is a huge basin. And to understand that the water comes from snow, it is important. The other methods as I said is hail and sleet which are forms of frozen rainfall, which occurs mostly in the north.

So to wrap it up, we will be looking at rainfall measurement alone, not much of snow, because by the time snowfall converts into river, discharge and runoff, you are only measuring runoff. So, that is where in the precipitation slides coming up in the next lecture, we will be looking into the rainfall measurements of precipitation and we would discuss about how rainfall converts into runoff and runoff measurements.

So, yes, it is rainfall event, but measured at different locations and coming back we are going to go very small in scale or small in size so that is where snow would have already converted to runoff, so we do not take measurements for snow; hail, sleet we will not take. So, of these parameters the key parameter for our discussions here on would be rainfall, precipitation in the form of rainfall.

So, all the advisories are the farmers get through IMD, which is the government agency for weather climate data, et cetera is in the form of rainfall. So, they get rainfall advisories, the floods, droughts, most of them is in rainfall terms, so farmers do not get a snowfall related advisory. So, they would mostly get a rainfall advisory.

So, this is the amount of rain going to come, you can either sow your crops or do not sow your crops. So, that is where we will also stick with looking at rainfall.

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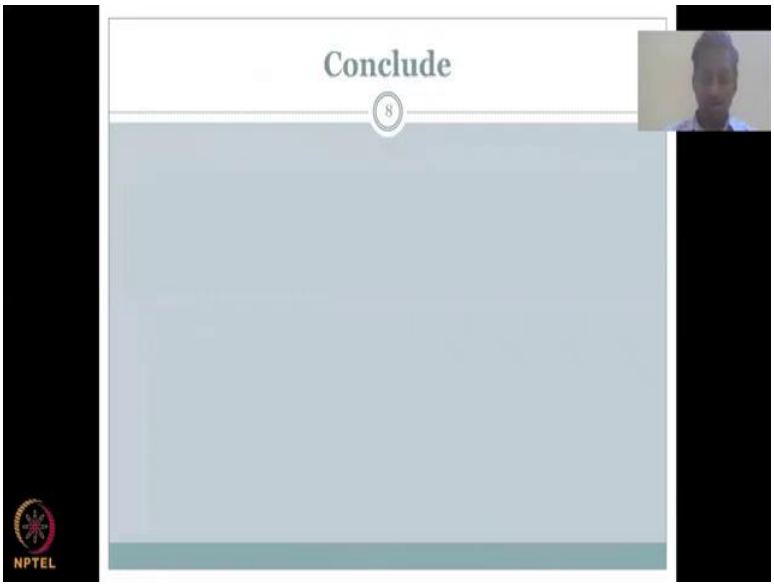

With this we would conclude and get ready for looking into deeper aspects of rainfall, precipitation, et cetera. If possible, please go through the books that have been prescribed and look into aware in India, there would be tremendous amount of rainfall and how it is being measured. I would see in the next class. Thank you.