Availability and Management of Groundwater Resources

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Lecture - 02
Hydrological Cycle, Need for Conservation of Groundwater Resources (Continued)

Welcome to you all in the NPTEL lecture on the subject topic groundwater resource availability and its management. Here we will discuss about the two important issues related to the groundwater resources a very important resource for the survival of the man. First is the availability of the water resources and second is its management. So, now we have already learnt about the importance of the groundwater resources, its distribution on the earth's surface in the very first lecture of part 1 of the lecture topic.

In this lecture we will discuss about some of the salient parameters related to the hydrological cycle.

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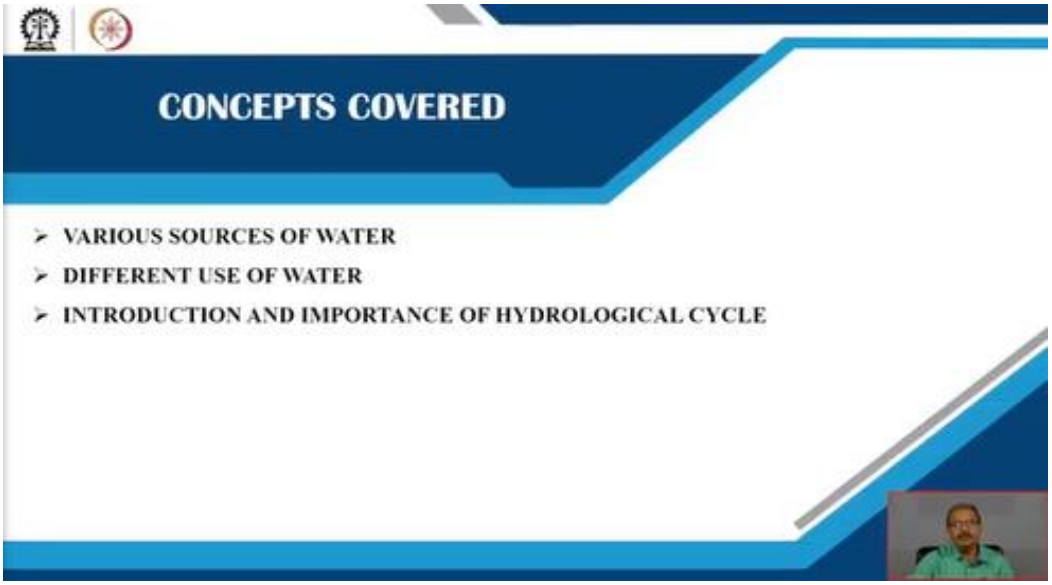

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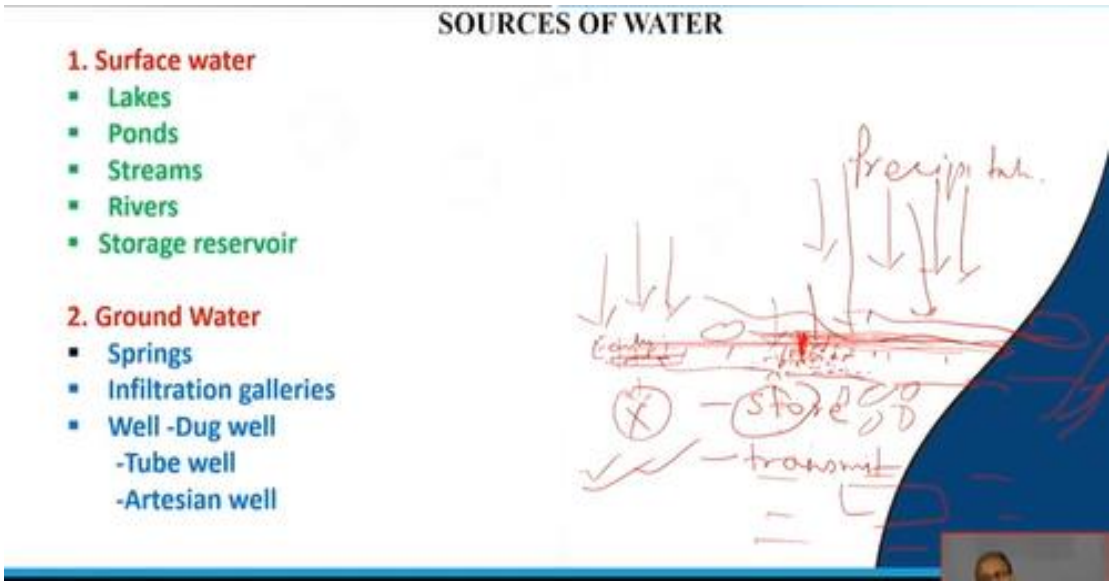

So, here what is happening in the earth's surface suppose earth surface we are getting plenty of water precipitated water on the earth's surface. So, this total rainwater is not moving down to the earth's surface because within the earth's surface we are having several types of rocks. So, so many rocks are available and in these rocks some of the selective rocks are having the ability to store the water, first to store the water and second to transmit the water.

So, all the rocks which are underneath a surface are not having the ability to store the water and to transmit the water. Only very few rocks underneath the earth's surface are having the characteristics for its storage of the groundwater resource or the movement of the groundwater resource from one rock to another rock. So, now we in the very first lecture we have discussed that out of the total water resources present on the earth's surface in lecture 1 we have part 1 we have discussed.

Now we are discussing the part 2 of the lecture 1. So, in that very lecture we have already discussed that out of the total water resources 97% of the water is the sea and oceans water that is the saline water that is the water which cannot be used by human being. Only 3% of the total water resources were having the fresh water resources. Just if you will see the previous lecture part 1 of the lecture 1 there, we had already discussed this thing.

Now the point is in this lecture we are discussing how the ground resources is remaining inside the earth. So, here in the very first lecture we had also seen that primarily or importantly we are having the two different types of water sources that is first the groundwater sources and second is the surface water sources. So, surface water sources we are knowing; the water which are remaining in the lakes, which are remaining in the ponds, which are remaining in the streams, rivers or some storage reservoir. These all are on the surface of the earth so these are called as the surface water resources. Groundwater resource generally remains within the dug well within having tube well within some artesian well or some infiltration galleries are there in which the groundwater remains. And we had always seen also at several places we are getting some springs and these springs are also emanating just the underneath the groundwater resource only.

So, these are the two important sources of water on the surface of the earth. Second thing we have discussed that the surface water remains on the surface. So, river flows on the earth's surface only, river flow we are also having the pond on this earth surface. So, some lakes, ponds your rivers so these all are we are getting on the surface of the earth. So, these are the surface of the earth surface.

But on the earth's surface only we are getting the precipitation also we are getting here. So, this precipitated water will ultimately move there. This precipitated water will ultimately comes down where it will try to move inside the earth. Why? Because here the area is totally dry. So, this area is totally dry so it will first try to come inside towards the gravity. So, this process is having some term and the term is infiltration.

This term is infiltration because here we are getting the soil layer here. So, this infiltration plays very important role for transferring the precipitated water to infiltrated water. So, now this first drop of the rain which enters through the surface of the earth in the first layer of the soil. So, these are the layer of the soil inside the earth and then we are getting some rocks inside the earth. So, first we are getting some layers of the soil having different characteristics and then the rocks.

So, what is happening? We have I already told you that groundwater remains in certain rocks. So, it remains in certain rocks. So, if the groundwater remains in certain rocks, then also, I had

mentioned that time that this rock is not remaining at every place. It is not remaining that is why at some places we are having the plenty of groundwater. But at some places we are having no groundwater inside the surface.

Suppose your house is there and your neighbour house is there. In your house you may get the water while having the tube well or in any dug well but your neighbour is not getting the water. Why? because beneath your house the rocks are having the ability for the storage of this infiltrated water. Your house is that the place where inside some rocks are available and these rocks are having the ability for the storage of the pure water. So, these rocks are having the ability for storage of the water that is why you are having plenty of water through your dug well or through your tube well. But point is your neighbour is just there. And the neighbour he will think that while in our house through the well or dug well or tube well we are not getting the water. The point is that the area beneath it is having also rocks but these rocks are of some different characteristics.

It is not having the potential to store the water as well as it has no characteristics to transmit the water whatever it has from one place to another place. So, think over it that precipitated water will definitely enter towards the earth's surface because of the gravity it will move definitely inter. But what is happening after the saturation of this layer means the layer the level of the soil in which the precipitated water is entering after few minutes of the rain or after few hours of the rain the area will become totally saturated.

Then what is happening? It will not allow water further towards the rock in which the groundwater will store, no it will not allow. Then what will happen? This surface water will then follow the topography because water always flows from the top to bottom. So, it follows the topography and that is why the precipitated water has also become the source of the river water surface water.

So, we have discussed this thing in the first part of the lecture also lecture 1 that only and only recharge source and that which are source of water on the surface of the earth is your precipitated water. Precipitation rainfall is the only source through which we are getting water on our planet.

So, this is the only source. Now condition depends where the groundwater will be more, where the ground will be less. Condition will depend on the basis of the available geology of the area.

Geology means the study of rocks, the different characteristics of the incoming precipitated water towards the rocks. So, the total scientific study will then only suggest you whether the area for which you wish to have the information about the availability of the water resource is sufficient or not. We cannot predict we can only do some study and through the study because concept is clear.

Crisis of groundwater is from place to place; the reason is that every place we are not having plenty of groundwater. Now why? Maybe, that the recharge source that is the precipitation is not sufficient enough in that very area because if the precipitation will not enough then definitely it will not move inside the earth. If it will not move inside the earth, it will not reach too large that is rock in which is having the ability to store the water. So, these whole things are there.

You can see these all things are responsible for the ability of the groundwater resources in any area. haphazardly we cannot say that at this place we get water, at this place we do not get water, no. Everything depends on the detail your scientific concepts scientific studies. But the point is very clear that this precipitated water will first saturate this layer where it will fall. If you will if it this water will enter just inside the earth because definitely it will interface because this is dry this is wet.

So, the water will try to move down and once it will become saturated then what will happen. Once it will become saturated, this layer will become saturated then the precipitated water will not enter to beneath this layer meaning this place. Why? Because this has already become saturated. Then what will happen? This surplus water will move and follow the topography then what will happen this surplus water will ultimately join to some river or lakes or ponds.

So, this will join surplus amount of the rain water precipitated water, rain fall water this will ultimately join to some rivers and then it will flow as per the current of the river. So, somewhere else then what has happened? The rainfall has taken place in the area say x this area name is x

here the rainfall is plenty, sufficient amount of rainfall is there. But what has happened? Not a single rock is are available here which is having the ability to store the water or transmit the water.

Then what will happen? This surface amount of water will enter first but it will not move down, why? Because this rock is not having the ability to store the water. This is hard rock unable to store no space. Then what will happen? This water will also move inside the earth's surface and ultimately also this water will rise to the river bed. Every river is having some rocks underneath it that is why we are getting sand on the bank of the river.

Why? Because of the weathering and erosion of the river beds means river bedrocks the sand comes; it brakes and then it comes near to the bank of the river. So, what we have seen? The precipitated water is definitely very good source for the recharging of the groundwater underneath the earth's surface if the rock is having the ability to store the water and the ability to transmit the water from one rock to another rock.

But when we are getting not a good quality of rocks, good quality of rocks means will fail in the two different aspects that is the storage and the transmission of the water. Then what will happen? The surface water which will enter that will enter inside the earth but that will not go beyond. What will happen? It will again follow the topography inside and then it will move and ultimately it will join to the your some river bed.

So, this is happening generally in the case of the availability of the groundwater resources. That is why we are having the different, different situations of the availability of the groundwater resources in a same place, same area, same district, same blocks. But the availability of the groundwater resources will vary from place to place. This is the reeason why we are having so many crisis data we are seeing on some media reports also about the scarcity of the groundwater resources.

The concept is that if the rainfall is the sufficient then it does not mean that the place where the rainfall is sufficient will have the good amount of availability of the groundwater resource also. It does not mean; it also does not mean that if the place is having good amount of precipitation

and the rocks suppose one rock is having the availability to store the water but that rock is not having the availability to transmit the water.

Then again, the chance for the availability of the groundwater resources is very poor there. It may hold for a certain time say example is clay is a type of if you will see the textural characteristics of the soil clay silt sand. So, in the clay is there it is having a very good amount of availability to store the water. But it will not have the availability to transmit the water not sufficiently it is transferring.

So, what is happening? It can store water for a year for two years for five years but after that what will happen. Since it is not having the ability to transmit the water then what will happen. It will not receive water from any other rock and it will not transfer water from one rock to another rock. So, the storage will gradually decrease. So, what will happen? Gradually the well will dry become dry the bore well will become dry.

So, that is why the important point is that this groundwater resources what we are getting inside a surface is following certain cycle and the cycle is very, very important and this cycle is known as the hydrological cycle.

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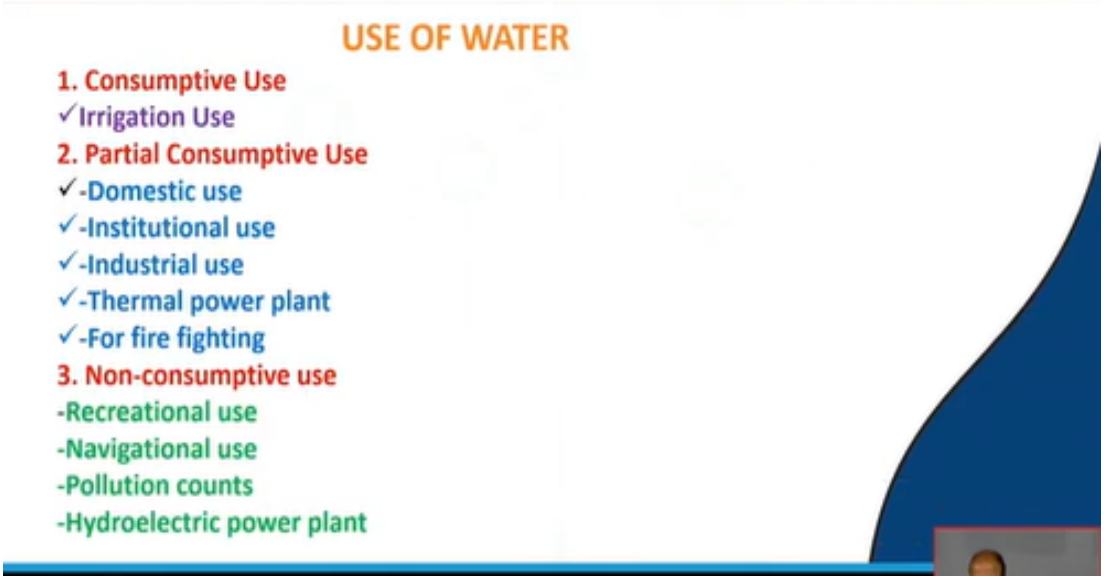

So, this hydrological cycle is having the total discussion about the availability of the water we have seen two important types source that is the surface water and groundwater. And if you will see the use of the water there are several uses, importantly the irrigational use, domestic use, institutional use, industrial use. So, every place we are having some uses, without water we cannot survive.

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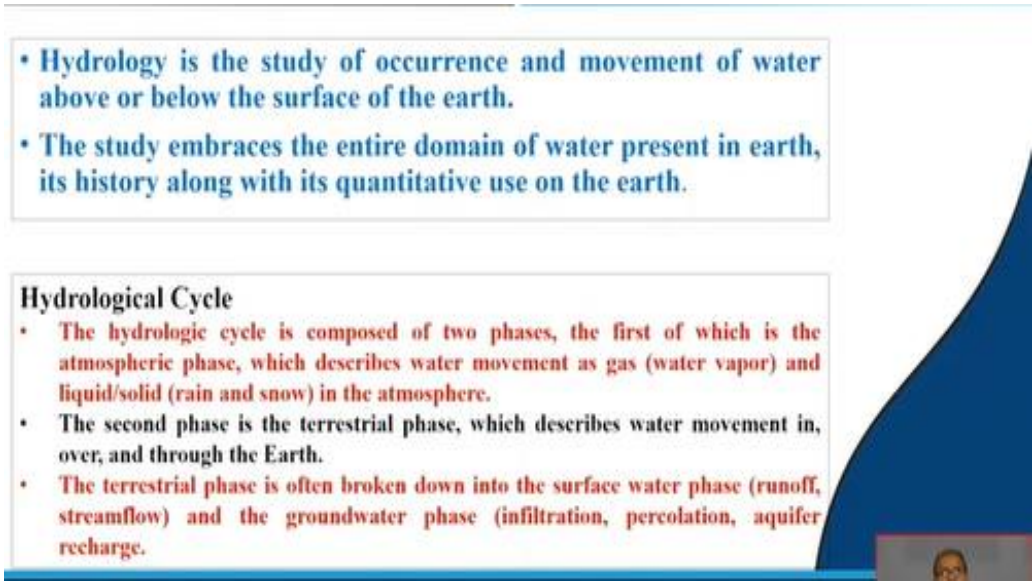

And this whole thing is discussed under a purview of one scientific your terminology that is the hydrology. The branch of geology in which we are discussing about the study of occurrence and movement of water above below the surface is known as hydrology. So, this is a very important subject in terms of the availability and management of the groundwater resources and in the subject if you will see inside, I have discussed the hydrological cycle a very important cycle where you cannot able to define its beginning or its end.

That is, it is a hydrological cycle is composed of two different phases. This cycle is composed of two different phases. The first phase is the atmospheric phase which describes the groundwater movement as a gas, gas means such a water vapour and liquid and solid in the form of rain and snow in the atmosphere that is why the first phase is the atmospheric phase in which we are getting the water vapour also, the rain also in the terms of liquid and the snow also in the terms of solid. So, this cycle which is a very important cycle hydrological cycle this hydrological cycle is responsible for the availability and the management of the groundwater resources. This

hydrological cycle is composed of two different phases the first phase is the atmospheric phase and in this atmospheric phase it describes about the water movement as a gas, liquid and solid in terms of water vapour, rain and snow respectively.

So, this is a very important cycle. Second phase of this hydrological cycle is the terrestrial phase. First was the atmospheric phase second is the terrestrial phase which describes the water movement in over and through the earth's surface inside the earth's surface over the surface and through the surface. So, this is the terrestrial phase. Combining both the atmospheric phase and terrestrial phase we get the hydrological cycle.

And in the hydrological cycle we will discuss some terminology very important terminology because that this whole terminology what we are seeing on runoff, infiltration then percolation then evapotranspiration, transpiration, evaporation. These whole terminology within the hydrological cycle are very important for the understanding of the concept of availability and management of groundwater resources.

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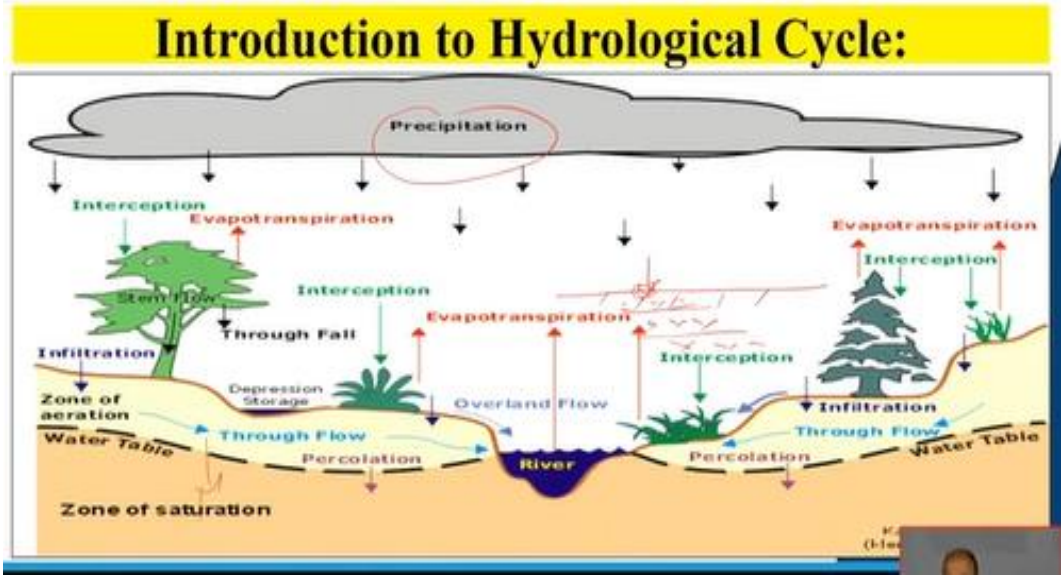

So, just a description of this hydrological cycle what we have discussed till now we have understood till now that this cycle is responsible for the management of the groundwater resources for the availability of the ground resources. We have seen that precipitation is the only

source so this precipitation if you will see this precipitation is the only source from here only. The water is coming toward the surface and then what we are seeing this is just the earth surface.

What we are seeing here? On the surface we are having the tree, we are having some small plants, then some tall buildings are also remaining here tall building, tall trees. So, this precipitated water is coming towards your ground surface toward the surface. So, this is coming. Now the total quantity of precipitated water is not reaching to the earth surface. See here again some disturbances are there.

The question is why we are getting the groundwater problem that is why I have chosen the subject very vibrant subject availability and management of grammatical resources. First, we should understand why we are not having the groundwater resources at the place where we are interested to study. So, first we should know whether the place where we wish to study about the availability of the groundwater resource which type of characteristics should be there.

Then we can come to the conclusion that here at this place we can get the groundwater and sufficient amount. So, this whole conclusion can only come when you will understand the concept how the groundwater is just remaining in certain rocks at any place. So, this precipitation we have already understood this one that precipitation is the only source of the recharging on the earth's surface that is getting the groundwater on the surface.

But here you will see this precipitation total quantity of this precipitation is not reaching to the surface. What is happening? Some tall trees, tall buildings they are just restricting the fewer quantity of precipitated water at the top surface of the area at the crown cover of the plants at the top concrete structure of your tall buildings. So, this amount is having reduced while it is coming to the ground surface.

So, see already fewer quantity of precipitated water has reduced while reaching to the surface. Now again see a very interesting point here because first we should think over the terminology then we will come to the conclusion why we are getting the groundwater amount in sufficient amount, why we are having the water stressed areas at the same place at a fewer distance say at

fewer distance we are having the water stress area at other place we are having the water plant area.

So, this whole concept is here. So, we have understood that precipitated water total quantity of the precipitated water is not reaching to the surface this we have understood. Now reason also we got that tall trees and tall buildings they are just intercepting and then fewer quantities are being reduced and fewer then it reaches to the surface. Now again the evaporation and transpiration the two terminologies are here evaporation, transpiration.

Evaporation means the water which is again going back to the atmosphere. This water precipitated water has raised to the surface in some depression storage it remains there. But because of the continuous solar intensity heat this water again moves in the atmosphere in a gaseous way and then the terminology is called as evaporation. So, here evaporation is there also this is a loss from the earth's surface. This is the lost water from the earth surface.

So, this water is not going down towards the surface rather it is again moving up to the earth's surface. So, it is going back to the atmosphere. Now what is happening? Transpiration. Transpiration is also there; transpiration means the water the amount of rain water because rain water is the only amount. So, amount of water which is going back to the atmosphere from the stomatal opening of any leaf surface of any plant.

So, two terminology we have understood first is the evaporation when the water moves back to the atmosphere after getting heat evaporation and second water going back to the atmosphere from the surface of the leaf through the stomatal happening of any plant that is transpiration. So, these two evaporation and transpiration cumulatively termed as evapotranspiration which is the amount of water which is again going back to the atmosphere and which is again forming the clouds and then we are getting the rain.

So, this cycle continues throughout. So, what is happening? In this cycle the another important terminology is the infiltration means the movement of water rain water from the top surface earth surface to the bottom first layer of the soil. So, first layer of the soil say if this is the surface so

from this is the precipitated water and these are the soil layer this is one soil layer this is another soil layer this is another soil so, different types of soil layer we are getting inside that.

So, movement of rain water this is the rain water from earth's surface to inside the soil layer is called as infiltration, it is called as infiltration. But the from the first layer because since it was dry it was just the water drop came down it is infiltrated means it is infiltration process takes place but this movement of in filtered water beneath the soil layer just beneath there again the water is here so this is called as percolation.

So, once the water moves from the atmosphere to the in the first layer of the soil it is infiltrated water and from the first layer of the soil to the bottom layer of the soil at the same place it is called as percolated water. So, these are few terminologies which is very interesting in the case of your hydrological cycle.

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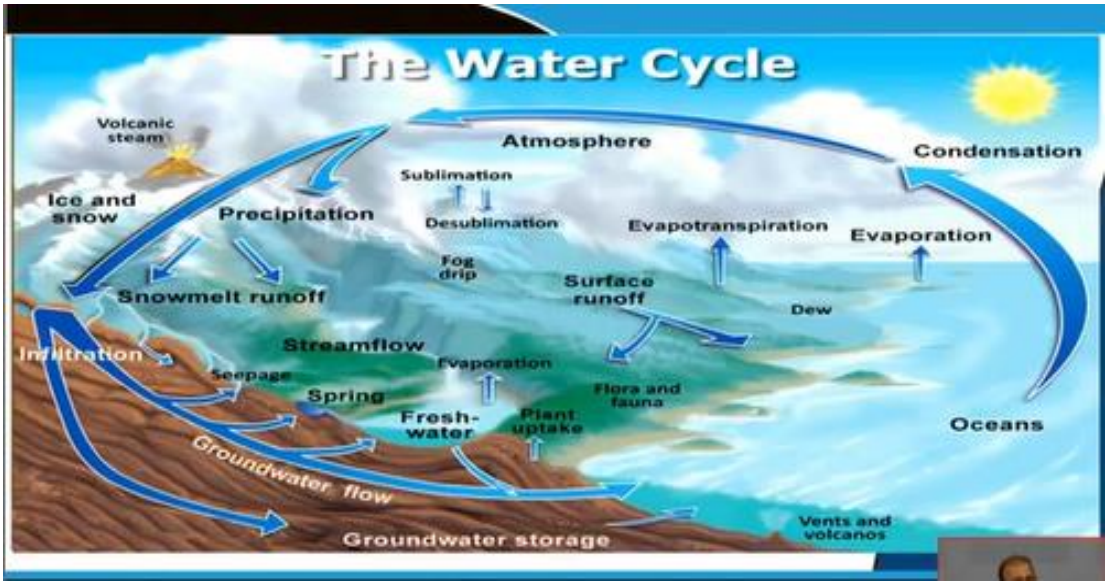

Here we can see the water cycle involves the exchange of energy which leads to temperature changes. So, this is very important the one important cycle which we have discussed in the previous slides.

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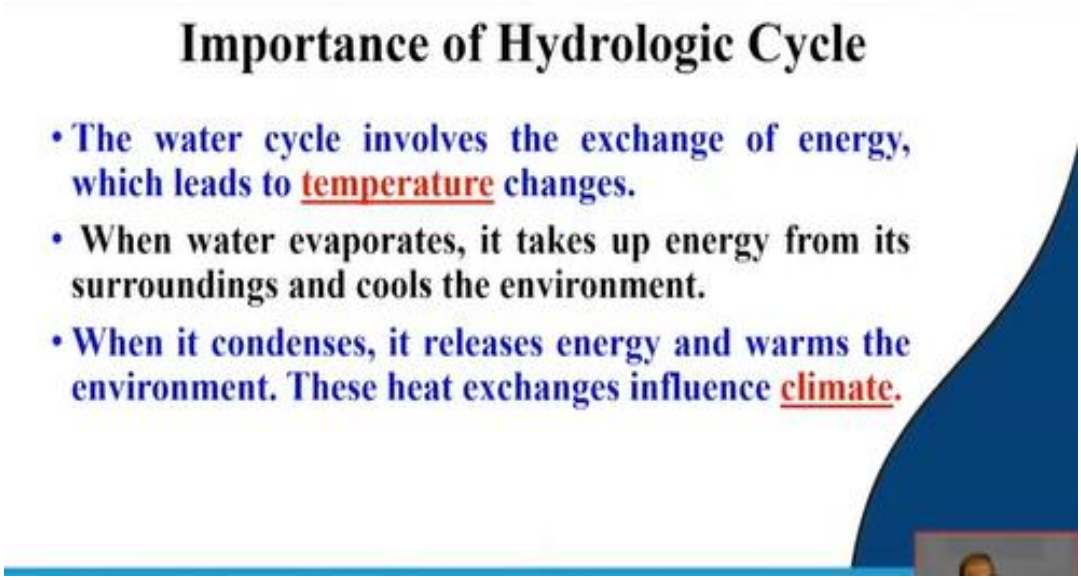

The point is that water cycle this cycle hydrological cycle what is happening? These are happening because of the exchange of energy. Why? This leads to temperature changes. So, when water evaporates it takes up energy from its surrounding and it cools the environment. But when it condenses, I told you this evaporation and transpiration both the process ultimately forms the cloud and then again, we can we are getting the rain.

So, when it condenses it release energy and warms the environment these heat exchanges influence the climate. This is all about the lecture on the specific topic. Thank you very much.