Availability and Management of Groundwater Resources

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Lecture – 31
Estimation of Subsurface Runoff, Types of Wells, Well Hydraulics (Continued)

Welcome you all; in the part two of the module 7 estimation of subsurface run off types of wells and well hydraulics. So, we have discussed in the part one; about the detailed concept of the runoff.

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And we have seen that the runoff is basically the surplus rain water amount which is not going down to the earth surface for recharging of the aquifer rather it moves towards the topography of the surface and ultimately joins the river channel. So, we have considered this amount of the precipitation as a runoff in the previous part. Now we have also seen that the precipitated water which infiltrated down to the earth's surface just tries to saturate the underneath soil layer.

And then this amount of water which remains in the soil zone or vadose zone; it moves laterally and ultimately reaches to the stream channel which we have discussed as a subsurface runoff. So, runoff and subsurface runoff we have seen in your previous part one lecture. We have also seen one word or one term that is base flow which is a very important term. This base flow is nothing but this is the groundwater flow.

And this groundwater flow just enriches the amount of the water of the stream channel. So, we have seen the runoff cycle also in the previous part. Now we will discuss about certain factors which are just affecting the runoff amount in any land area. Now what are the different factors which are affecting the runoff?

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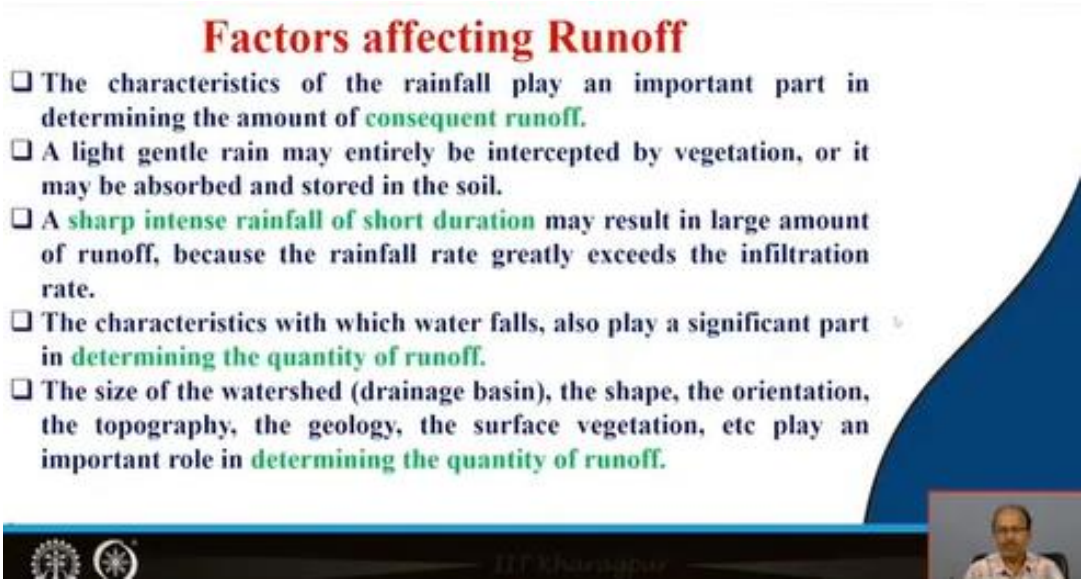

So, one by one we will discuss the factors also. The characteristics of the rainfall play an important part in determining the amount of the consequent runoff. So, the characteristics of rainfall is very important. Suppose at one area you are receiving a very little amount of water as rainfall so runoff will be of different types. Whereas in another area small duration but intense rain is there so the runoff will be something different.

So, this totally depending on the types of the characteristics of the rainfall. So, and this will decide about runoff. Now a light gentle rain may entirely be intercepted by vegetation or it may be absorbed and stored in the soil only. So, very little contribution again you run off. But a sharp intense rainfall of salt duration may result in; large amount of run out, why? Because the rainfall rate greatly exceeds the infiltration rate.

So, it is just exceeding rainfall rate is just exceeding the infiltration rate. The characteristics with which water falls also play a very important role in determining the quantity of the runoff. So, this characteristic is also very important. The size of the watershed, means any drainage area; any

drainage basin, its shape the orientation, the topography of the watershed, the geology, the subsurface, vegetation these all play very important role in determining the quantity of runoff.

So, we have seen that the size of the watershed, the shape it is; what is the shape of the watershed, then orientation, then the topography; then geology; then the surface vegetations these whole factors play an important role in determining the quantity of the rainfall of certain areas.

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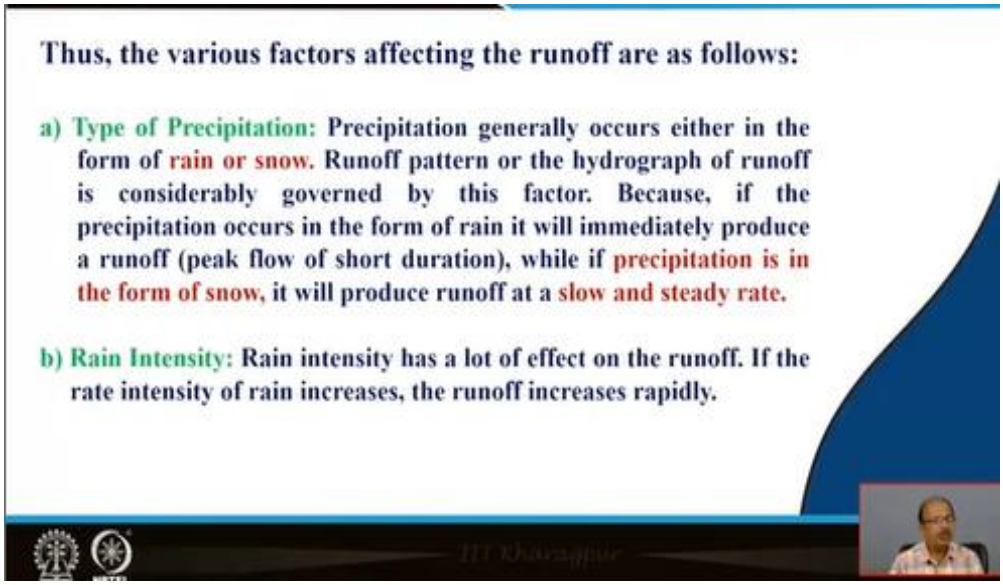

Now the first factor is the type of precipitation. So, how does the type of precipitation affected runoff? So, precipitation generally occurs either in the form of rain or in the form of snow. So, these two different two different forms we are getting. Runoff pattern or the hydrograph of runoff. Hydrography is a graph in which through which we are just showing your discharge versus time we are just a graph we are telling it as a hydrograph we will discuss it in later portion.

So, runoff pattern or the hydrograph of runoff which is considerably covered by this factor. This factor means what? Means the precipitated factor. Why? Because precipitation only occur in the form of rain so it will immediately produce a runoff. While precipitation will occur in the form of snow, it will produce runoff at a slow and steady rate. It will produce runoff definitely but this will be slow and very in steady rate.

So, generally in the form of rain it is producing runoff and in the form of snow it is also producing runoff but in a very slow steady rate. So, this is very important factor; this type of precipitation is whether in the form of rain or whether in the form or snow. In the form of rain, the pressure runoff will be more in the form of snow the runoff will be slow. Now rain intensity in second factor it is also very important factor, rain intensity.

So, what is happening? Rain intensity has a lot of effect on the runoff. We are seeing it if the rain intensity of; if the rain intensity increases what will happen? The runoff will increase. So, if the rain intensity will increase definitely the layers of the soil underneath the layer of the soil will become saturated firstly and once the saturated this layer will become saturated. So, now the rain water is not infiltrating down; percolating down.

Rather it is just following the topography and reaching to the any stream channel. So, rain intensity has a lot of effect on the runoff.

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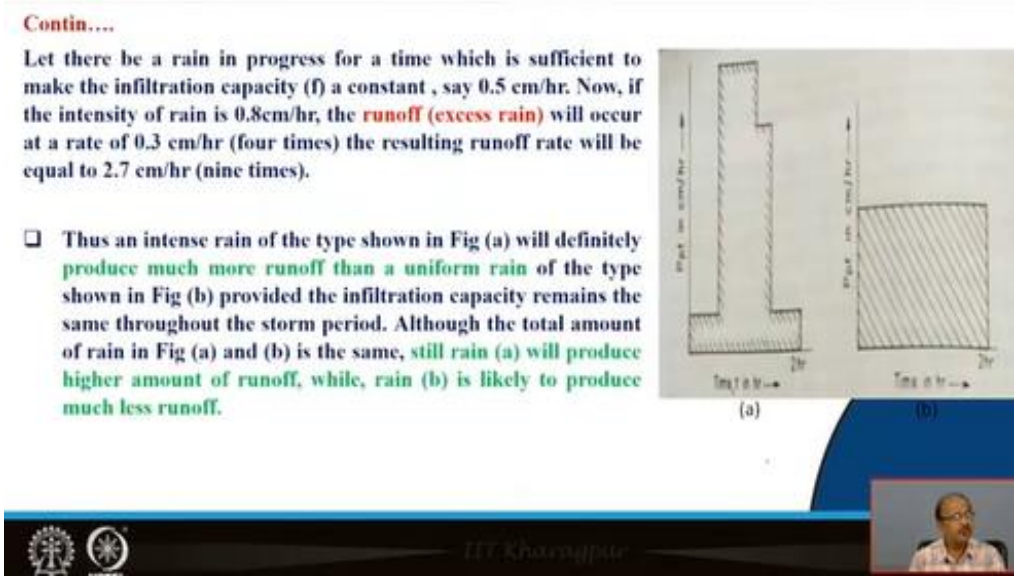

Now third factor in this only just I am continuing some more point that let there be a rain in progress for a time. So, this is your precipitation in centimeter per hour and this is the time in hour. So, in this case what we are seeing that there will be a rain in progress for a time which is sufficient to make the infiltration capacity denoted by f a constant say 0.5 centimeter per hour. So, this just example has been shown here so 0.5 centimeter per hour.

Now if the intensity of rain is 0.8 centimeter your per hour, then what is happening? The runoff means excess rain which is not going down rather it moves through a topography will occur at a rate of 0.3 centimeter per hour that is the four times. The resulting runoff rate will be equal to 2.7 centimeter per hour that is the 9 times.

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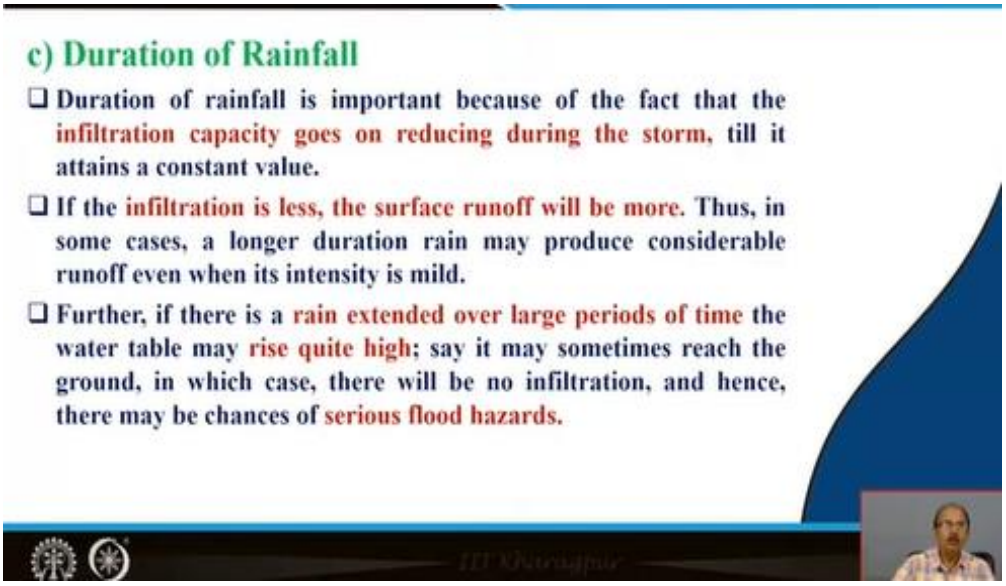

Now the third factor is the duration of rainfall; this is also contracting the runoff. So, duration of rainfall is important, why? Because of the fact that infiltration capacities goes on reducing during the storm. So, what is happening? Just we have seen also that the; as the rain starts first, they are in water will try to satisfy the underneath soil layer. So, the this will be such this is underneath soil here becomes saturated then it will not allow water to move down further.

So, what will happen? The runoff will generate and this runoff will flow as per the topography of the land surface. So, if the duration of the rainfall will be more; what will happen the infiltration capacity will decrease further. So, it will decrease and then the generated runoff will move smoothly and will join to the river channel. So, this happens because of the longer duration of the rainfall. If the infiltration is less downward then what will happen? Surface runoff will be more.

So, this layer underneath soil layer has become saturated. Now it will not so rain water will from the earth surface rainwater will not enter into the soil layer subsoil layer. So, what is happening?

So, if the infiltration will become less then definitely the surface runoff became more. So, in some cases a longer duration rain may produce considerable runoff even when its intensity is mild. So, it happens somewhere we have seen also and the runoff if the rain is for longer duration.

So, considerable runoff will be generated even when its intensity is very mild. Further if there is a rain in standard over large periods of time longer duration if the rain is standard for longer duration the water table may rise quite high. So, what will happen? This is the water table of the formation of an aquifer. So, here what is happening? So, if the rain will be for longer duration definitely the your infiltration will stops here means this layer has become saturated.

So, this water will reach and it will join to the prevailing your water table. So, during the longer duration of rainfall this water table may rise high and it may sometimes reach the ground also because rain is for longer duration. So, from here the water table has reached up to here and then it may reach to the ground surface this is the ground surface. So, it usually happens then when there is a extended rain over large periods of time.

The water table may rise quite high and sometimes it reaches to the ground. In such a case there will be no infiltration; then infiltration will be low infiltration will be here and then what happens? There will be a chance to generate serious flood hazards. So, this is just enhancing the cases of the serious plus flood hazards. So, this because of this at some places probably you have seen that during the longer use of rain the flood has come.

Why? Because of this only because it will just rise the water table longer duration will rise the water table. This rise of water table will may reach to the ground surface and then you can see the water table has reached to the ground surface then what will happen the water will flow on the earth's surface and then the serious blood hazards will come. So, this is because of the longer duration of rainfall.

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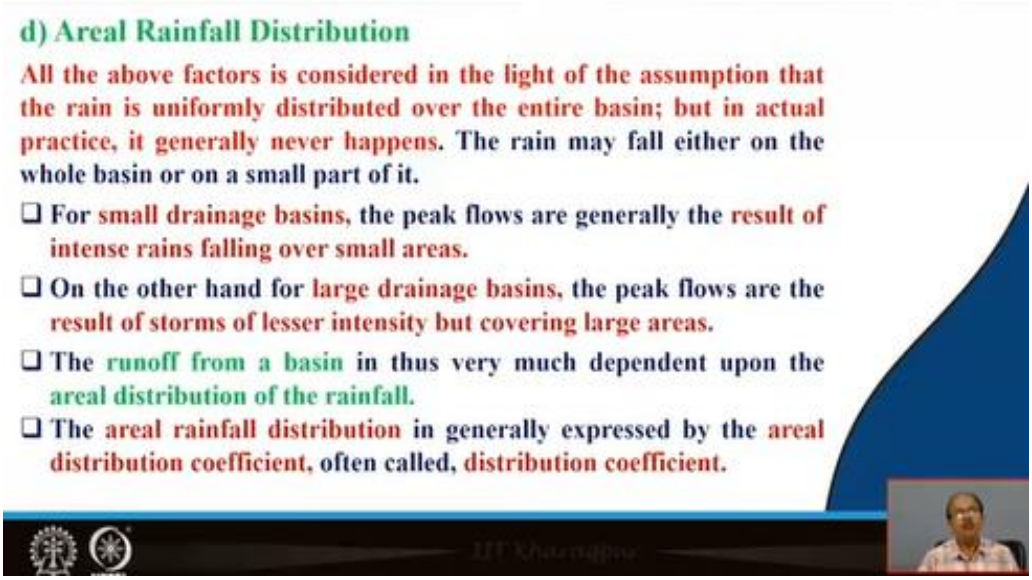

So, now the next factor is the areal rainfall distribution here. What we have seen is the factors just before this one; that all the factors which we have considered in the light of these assumption that the rain is uniformly distributed over the entire basin. That the rain is informally distributed over the entire basin area. But in actual practice even nowadays also, we are seeing it generally never happens. The rain may fall either on the whole basin or it may fall only a small part of it.

Today also we are seeing such types of conditions that rain is falling to a certain portion of the area and in the just adjoining areas there is no rain during that period. So, this is happening we are all have become aware about this also. So, for small drainage basins suppose a small drainage basin is there so the peak flows are generally the result of intense rains falling over small areas. So, for your peak flow means the maximum flow generally we have seen also the maximum flows are being contributed by runoff.

So, the peak flows are the result of intense rains which fall over very small areas. But on the other hand, you can see for large drainage machine; what is happening? The peak flows are the results of storms of lesser intensity but covering large areas. So, because intensity may be lesser but it is covering to larger portion of the area. So, the runoff from a basin is very much dependent upon the areal distribution of the rainfall.

So, for any basin if we are calculating the runoff so, it is depending upon the areal distribution of the rainfall and it is generally expressed by areal distribution coefficient which occasionally, we are telling it as a distribution coefficient. Generally, we are telling it as in hydrological terms it is termed as the distribution coefficient. So, it is a very important factor we are we have seen that at one portion of the area is having good amount of rainfall whereas in other adjoining areas there is no rainfall.

So, this where there will be good amount of rainfall in small drainage basin. So, this is if the peak flows are remaining in the small drainage basins definitely this is the result of intense range rain falling over small area. But on the other hand, for last day is we are seeing the peak flows are the results of lesser intensity but covering large areas. So, this distribution coefficient is very important for fine and it is affecting the runoff also.

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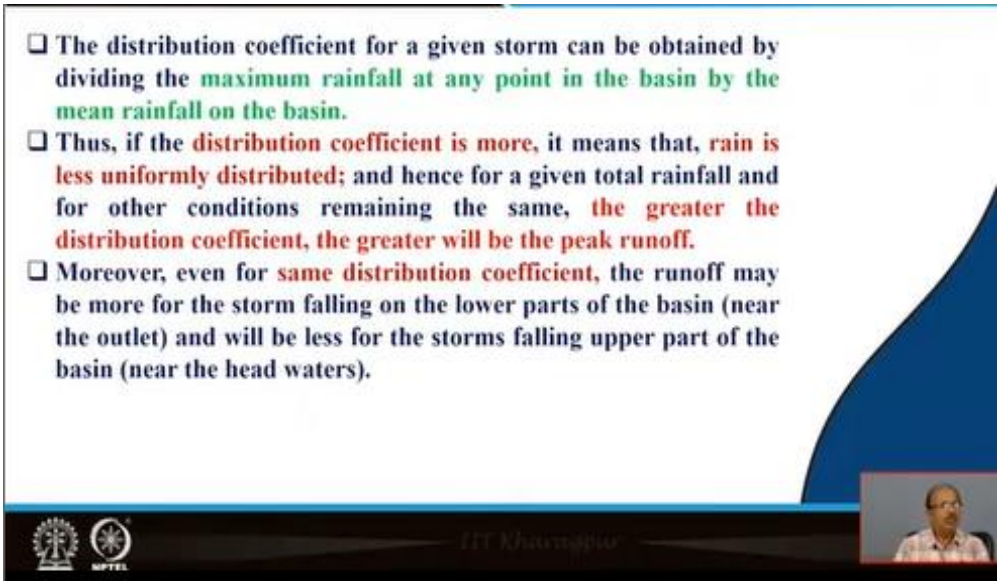

This distribution coefficient for a given storm can be obtained by dividing the maximum rainfall at any point in the basin by the mean rainfall on the basin. So, whatever basin is there basin area is there water set area is there and just the maximum rainfall at any point in the basin is divided by the mean rainfall on the basin. So, then we are concluding the distribution coefficient and if the distribution coefficient is more, it means that rain is less uniformly distributed.

And hence for a given total rainfall and other conditions remaining the same the greater the distribution coefficient the greater will be the peak runoff. So, this is the general concept that the greater will be the distribution coefficient the greater will be the peak runoff. Moreover, even for same distribution coefficient, also the runoff may be more for the storm falling on the lower parts of the basin. That is lower part of the basin will where?

Near the outlet and it will be less for the storms falling upper part of the basin which is known as the head waters. So, at the upstream side and downstream side your distribution coefficient will vary and because even for the same distribution coefficient the runoff will vary in the two different sector that is near the head as well as near the outlet. So, this is important factor.

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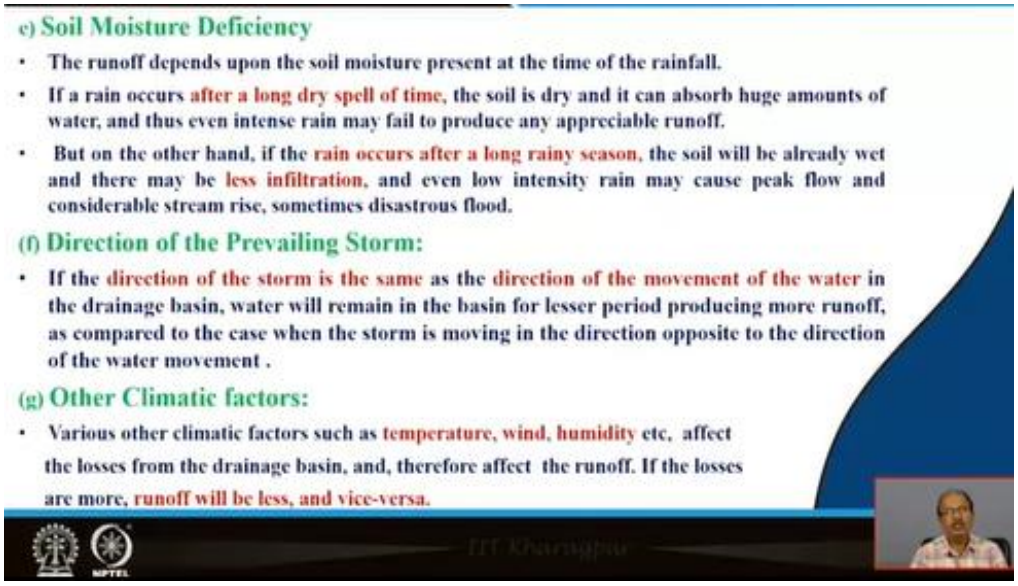

Then next is the important factor which is affecting this is the soil moisture deficiency. So, the runoff soil moisture deficiency. So, what we have seen that; we have seen that the runoff is generating more when the underneath your soil layer will become saturated. If this is the earth's surface; so underneath the soil layer is this one. So, if it will saturate in a lesser period definitely the more amount of runoff will start and it will automatically reach to the river channel.

So, soil moisture deficiency also plays a very important role. The runoff depends upon the soil moisture present at the time of the rainfall because at the time of the rainfall that is important. We have seen in the runoff cycle also when the monsoon when the summer season ends and the

monsoon starts the condition of the soil also remains dry. Even the water in some of the aquifer will the water level goes down, level of the water remains at a deeper depth so what will happen?

As soon as the monsoon starts what is happening? Rain water infiltrates down to the oil layer. Why? Because total soil layer was dried at during that period. So, those soil layer tries to become saturated first because it has to play two different role. First to send water to the underneath aquifer and second to send water to the bed of the steam channel. And thirdly when the soil will become saturated then only the runoff will generate because then the rain water will not be accepted to go down.

So, in all sense the runoff is depending on the soil moisture deficiency. The runoff plays a very important role; it depends upon the soil moisture present at the time of the rainfall. If a rain occurs after a long dry spell of time; what we are seeing after the summer the monsoon is reaching. The soil is remaining dry and it can absorb huge amounts of water. It will in the first rainwater rain day you can see it is accepting a large amount of water.

The subsoil layer is accepting a large huge amount of water and even intense rain may fail to produce any applicable runoff. So, this is usually being noticed during the rainfall. But on the other hand, if the rain occurs after a long rainy season after a long rainy season say during the monsoon season you can see if rain is occurring so what is happening? The soil has already become saturated, it is already wet.

So, there will be less infiltration, infiltration will be negligible and even low intensity rain may cause peak flow. Because inside the water will not move then what will happen? This will just turn into the runoff water and then it causes the peak flow and considerable steam rise in the river level; the level of the water in the river will also exceed and sometimes the disaster flood comes and because of this we have seen that the disastrous flood is coming.

So, this is just the; if you will see the basic, basic is very clear that the flood is coming because the rain occurring. And after a long rainy season of the rain what will happen? It is the infiltration will come near about zero and once the infiltration is becoming near about zero then what is happening

the surplus water is ultimately reaching to the earth's surface it is reaching to your stream channel and the underneath base flow also contributing water to the bed of the river channel.

And if this will occur; it will cause the peak flow and considerable rise in the layer of the river water and ultimately it just turn into the disaster flood. So, this is because of the soil this is because of the surplus runoff because of the intense rainfall for long duration. So, this is very important factor soil moisture deficiency. Now, next factor is that direction of the prevailing storm, which is the direction.

If the direction of the storm is the same as the direction of the movement of water in the drainage basin, then what will happen? Water will remain in the basin for lesser period because the water will move again. In the basin it will remain for lesser period producing more runoff as compared to the case when the storm is moving in the direction opposite to the direction of the water movement. So, this is direction of the prevailing storm is also a very important factor.

We usually notice this thing also, that if the direction of the storm is the same as the direction of the movement of water. Then in the drainage basin the water will remain in the basin for longer period producing more runoff as compared to the case when the storm is moving in the direction opposite to the direction of water movement. So, this is an important factor that is an direction of prevailing storm.

Now next is the other climatic factors, what are the other climatic factors which are very important role in your effect; runoff generation of runoff. So, other climatic factors such as temperature, wind, humidity, these also affect the losses from the drainage basin. These are generally affecting through the losses from the drainage basin and therefore affecting a runoff. If the losses are more definitely runoff will be less and vice versa.

So, if the loss will be more the runoff will be less because water will go to the atmosphere. So, less water will remain on the earth's surface. And if the less water will remain so definitely the runoff will be less. Because some of the water will infiltrate down and ultimately reaches the aquifer and vice versa will be there. If the losses will be less runoff will be more. So, these are the few factors

which are playing a very important role in the generation of the runoff. So, with this thank you to you all.