agMOOCs

Basic aspects of Rainfall and their application in crop production

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In the last class we were discussing about the characteristic future of atmosphere and its related weather and climate. In this class today we like to discuss some of the important weather elements, because these are borne from the atmosphere. Let us discuss something on our rainfall. Why I say our rainfall without water there is no life? So rainfall is very very important. You know already what is hydrological cycle? Water gets evaporated from the ocean surface, all water bodies, it also gets transferred through a plant system goes as evapotranspiration and stays in the atmosphere as water vapour.

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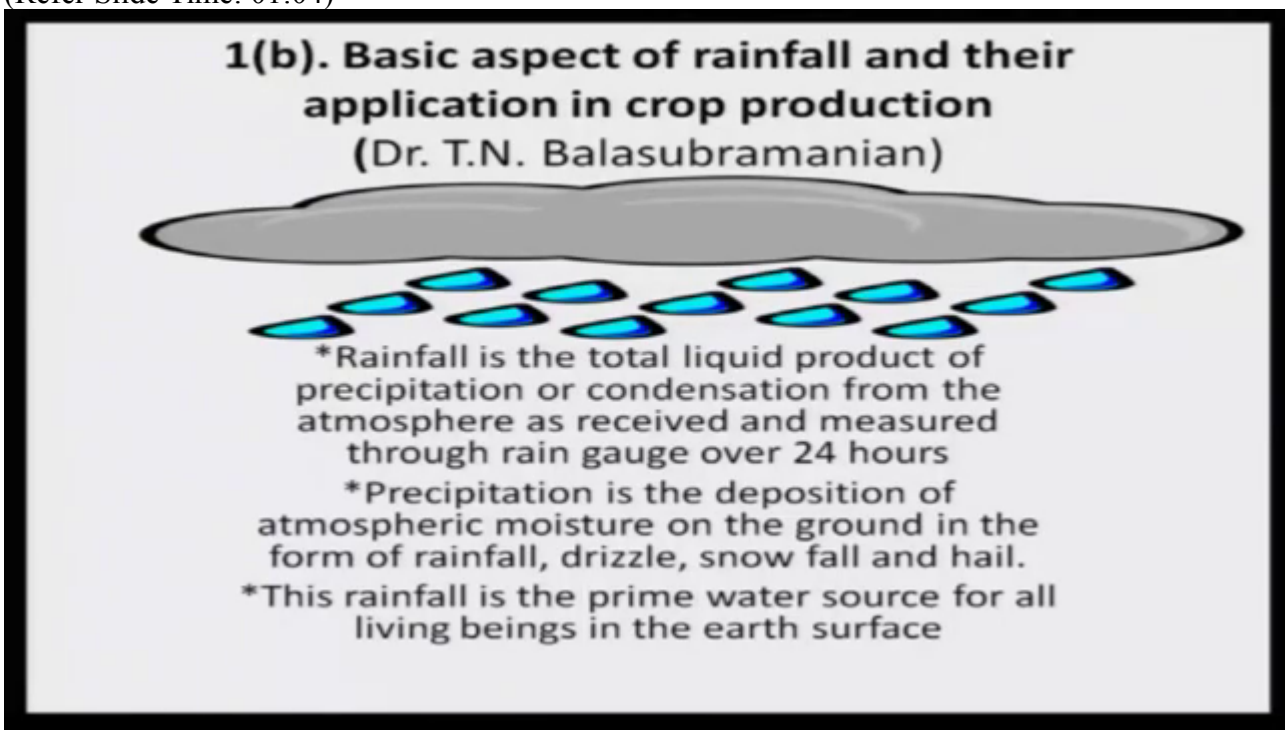

Normally they live in the atmosphere up to 10 days for a single water vapor molecule, they stay for 10 days then gets condensed and falls as precipitation. So one among the precipitation is our rainfall, so one among the precipitation is our rainfall, other than that you know drizzle, you have snow, you have sleet and hail also. These are all some forms of precipitation. In temperate countries you get snow, in tropical situation you get rainfall because of the lapse rate that is being operated at the lower part of the atmosphere. Without rainfall there is no life in the earth. That is already understood. Normally rainfall is being reported for the past 24 hours. For example, today the rainfall is being recorded by 8:30 AM it is said to be 20 millimetre means in the past 24 hours there was a rainfall up to this quantity. This is a very very important.

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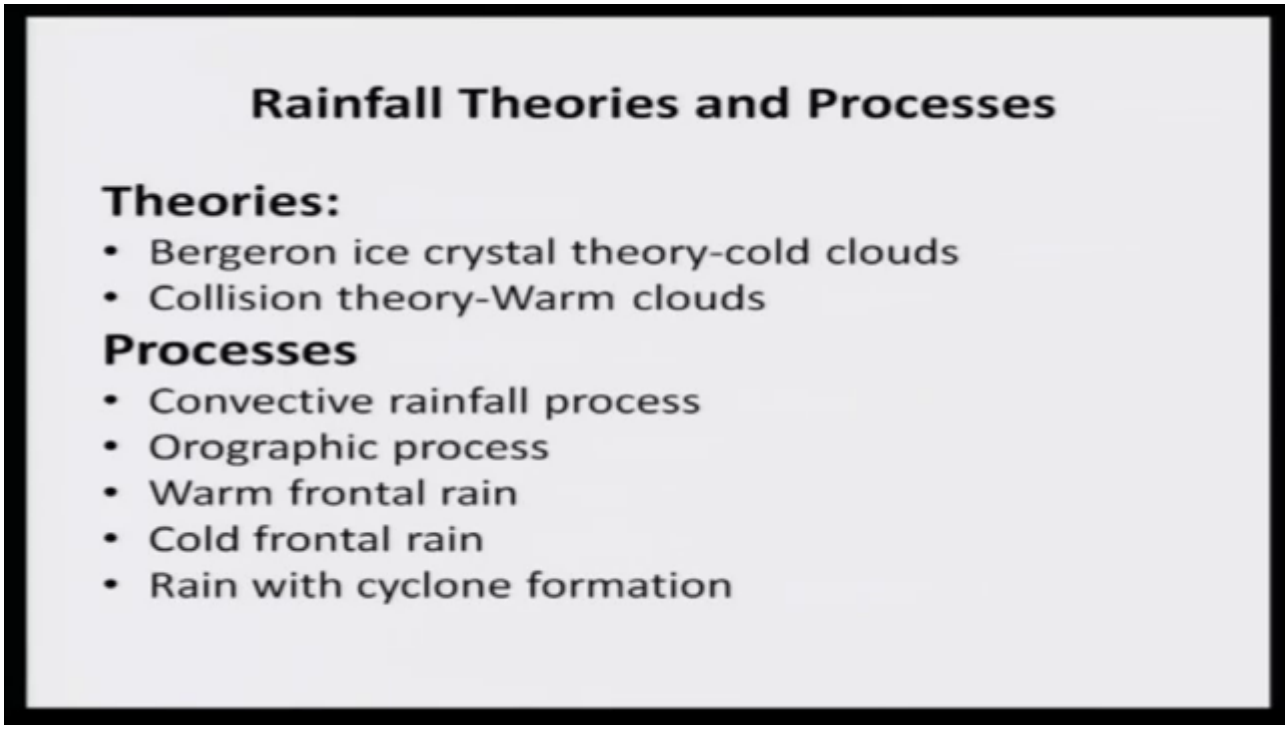

Next we move to some theories. I say rainfall. You must understand some basic aspects of rainfall. Rainfall is from both warm clouds as well as your clouds. Accordingly it is being different made two authors. One is the rainfall from cold clouds. This is a proposed-based. This theory is proposed by Bergeron. He is from Norway. He has proposed Bergeron ice crystal theory for cold clouds. And another one is collision theory proposed by Brown from Australia. This is for warm clouds. Let me say symbol about your Bergeron ice crystal theory.

There is a cloud, the temperature goes below zero degree centigrade, all water gets freezed into ice crystals except to certain portion we call it as supercooled water. It stays as a super cooled water not as a ice crystals. If you examined the saturation vapor pressure between these two ice crystal and this supercooled water. The pressure is more with supercooled water as compared to your ice crystals. What happens? There is a sublimation process, physical process, sudden change from (inaudible 00:03:56) on stage the vapor goes as a ice crystal and falls over the existing ice crystals and because of the weight and the gravitational force it comes as your rainfall. This is for cold clouds.

In respect of the warm clouds the process is coalescence and the pollution proposed by Brown of Australia. Wherein the temperature does not go below seven degrees centigrade, some warmness is there. Here small cloud droplets gets collided and becoming the crystal particle of the cloud because of the thickness of the clouds and the presence of abundant moisture in the cloud there is always vertical agitation, the bottom goes to the top, top comes towards, its like a missionary process. By that the rain cloud droplets becomes very bigger and the falls as rainfall at a later stage with your gravitational force as well as (inaudible 00:05:08). These are all some theories proposed you must understand.

Now I'm coming to the process, theory is something different from the process. What are those process? For every season the rain occurs through different process. For example

during summer there was – there is convective process, because of the solar radiation, the land gets heated, the air above the land also gets heated, it loses a density and it gets ascent goes to the atmosphere and through adiabatic cooling process you get rainfall, Another the process is orographic rainfall process. These occurs during monsoon season especially during (inaudible 00:05:56) the monsoon season of India. Wherein the trade winds they travels over ocean, take enough of moisture and then this warm and moist water here, the heats on mountain as a result the air up and through adiabatic cooling you get a rainfall.

There is warm frontal rainfall also. This occurs during cold weather period. Therein already there is cold air mass exists, warm air mass come from somewhere and sits over the cold air mass and grows like that over addition by addition and you get rainfall. In the case of the cold frontal rainfall what happens is, the already the warm airs sits over the cold air mass because of natural phenomenon the cold air mass sits away leaving the warm air mass in the agitation mode, in addition the cold air mass pushes the warm air upper side and through adiabatic cooling you get the rainfall.

And the another one is rain with cyclonic, this is very very common during northeast monsoon season of India. There is a dense, extensive air mass in the atmosphere which has conversing effect, energy conversing. This moves up towards the atmosphere and through adiabatic cooling again you get rainfall. Cyclone process is something different. You get that suddenly deposition in the atmospheric pressure. Suppose there is a 980 millibar of your portion yet suddenly there is a drop in the atmospheric pressure 978, 975 then you get this process of rainfall. This is very very importance. So these are all process and it varies with season, somebody's say that is there any rule that same rainfall process occurs throughout the year? I think it is not so. It gets varied with season.

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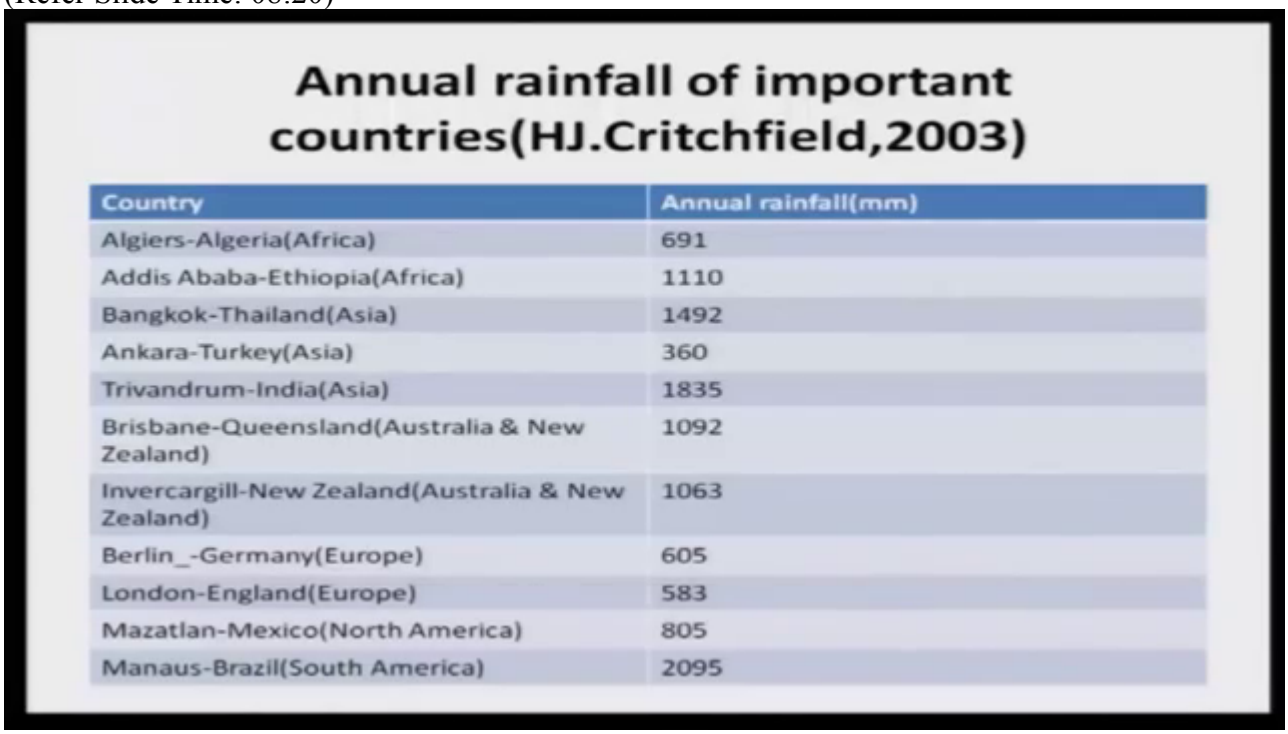

Then coming to the annual rainfall of important countries, this is very very important to understand the spatial and temporal dimension of the rainfall. This is very important. I can say because of the geographical position upon in a particular area that I say latitude and longitude the climate or weather also gets changed.

Now you see in the case of your Turkey, Asia the minimal rainfall 360 millimetre and the maximum could be seen in the South America bottommost layer it is around 3000 millimetre. Where is 360, where is 2, 3000 millimetre. Similarly if you take India as a case, in Jaisalmer, the annual rainfall is 100 millimetre annually, 100 millimeter. So how do you express? So rainfall gets varied. The process also gets varied. The theories also get varied. The spatial and the temporal dimension also gets varied.

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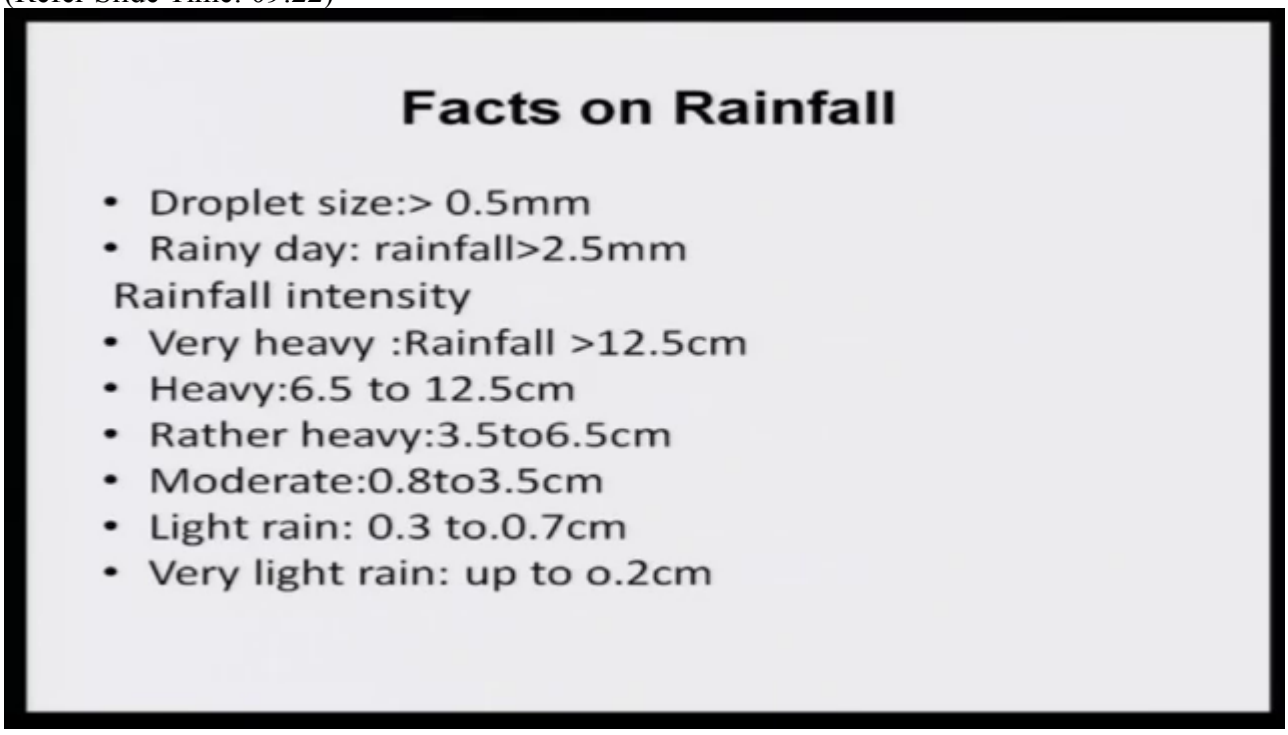

Now some facts I want to say about rainfall. What would be the size of the rainfall? The droplet size must be more than 0.5 millimetre. People will must understand how to call a day as a rainy day or a dry day. If the rainfall is more than 2.5 millimetre then we call this a rainfall day otherwise the rainfall is a lesser than 2.5 millimetre means it gets evaporated. I'll say evaporation, because daily a minimum of 3 millimetre is being goes as evaporation. So lesser than rainfall 2.5 millimetre does not make a day as a rainfall day.

Then coming to the intensity of the rainfall this is also very very embed. Here you can see light rain, there are two subtypes; light rain, very light rain and one moderate and the three heavy; rather heavy, heavy and very heavy. This is again based on what is a scale. Is it per hour or per day or you can say that you can call it as per day or per day, when rain starts and the completes by one hour in a particular day then you can say it is a one hour scale or in a day it goes on drizzling, drizzling, drizzling then you call it's a per day. If the rainfall is more 12.5 centimetre that is 125 millimetre then we call it as a very heavy rainfall. Heavy means the classification is here 6.5 to 12.3 centimetre, rather heavy.

Then moderate, these are always moderation is very very important, moderate rainfall. Here I like to say one thing. In the case of European countries the rainfall is 2 mm per day. If you country like India the rainfall is 20 mm per day. See this is due to some variations. In the temperate condition the rainfall process is mainly due to cold frontal rain or frontal rain, but respect of our Indian condition you have cyclonic storm, you have orographic rain, that's why rainfall quantity gets varied.

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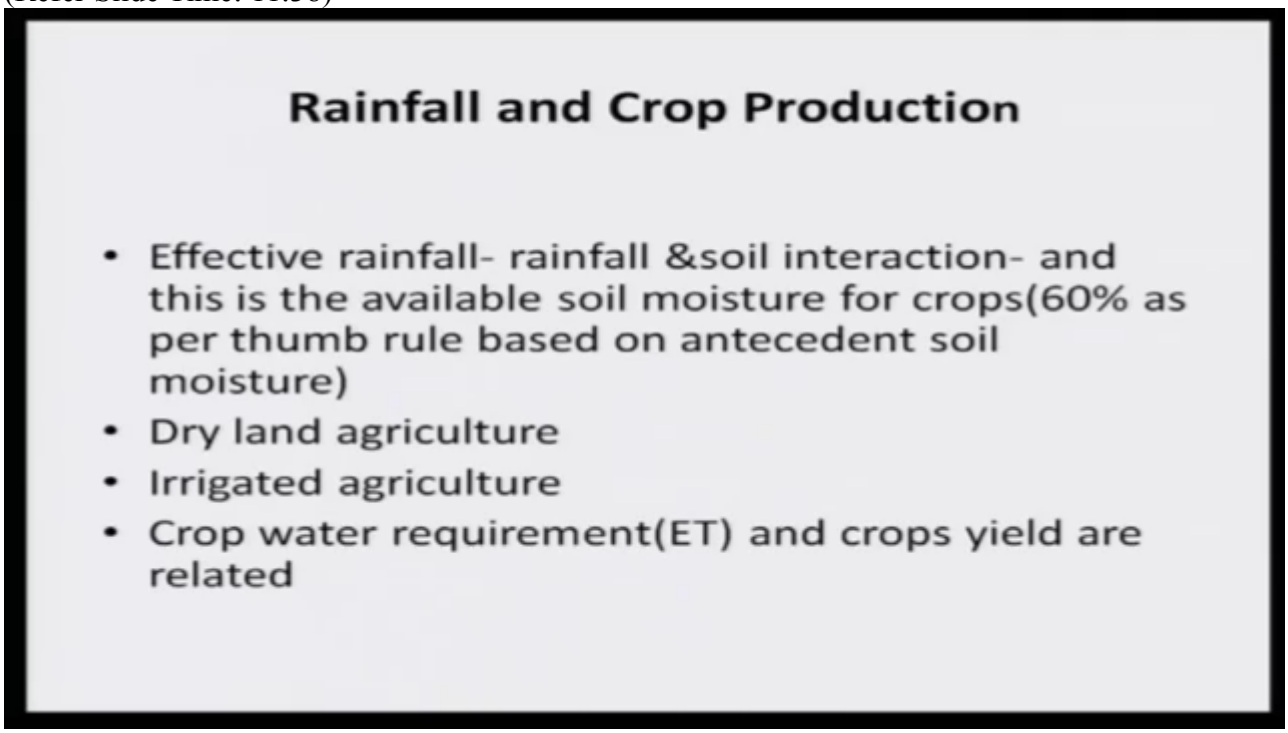

Then why rainfall is very important to crops, not only to crops but also to all human, cattle and everything, every life. We call in agriculture crop protection, effective rainfall. This is nothing but the amount of moisture or the amount of rainfall that gets infiltrated into the soil profile and stored as soil moisture. This soil moisture is going to used by the crop as evapotranspiration for its growth and the multiplication and also giving yield. So the effective rainfall is very very important. We say that 60% of the rainfall received to be the effective rainfall in the case of not considering the antecedent soil moisture. Suppose today's rainfall is 100 millimetre the effective rainfall is 60 millimetre.

In the case of the drain and agriculture the entire crop production depends upon rainfall. If you take here for example India, 44% of total annual production comes from the dry land agriculture, thus indicating the importance of rainfall for dry land agriculture whether it may be in India or Australia or any other country. The other important aspect of rainfall is irrigated agriculture. Whenever rain falls on your land, the water goes inside the soil profile as infiltration and heat reaches the deeper layer and getting stored as a groundwater, that groundwater is being used for your irrigated agriculture, so irrigated agriculture is very, very important because the reduction -- risk reduction is very very important as compared to dry land agriculture. Then crop water requirement. This is very very important. You have you are food requirement per day calories 2,200 to 2,500 calories per day your requirement. Like that plant also, crop also requires water for his growth that is being a discussed in the next slide.

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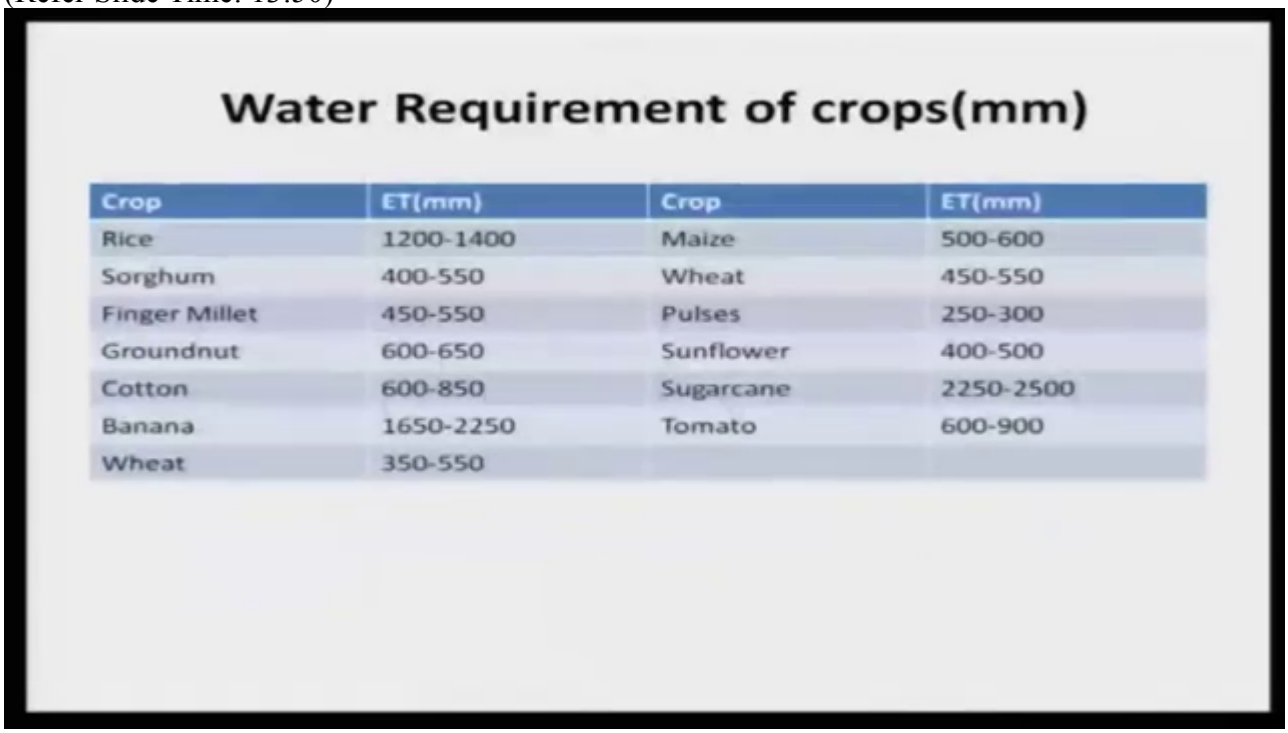

Now you can see, I have taken the rice crop, it's evapotranspiration. The water loss from the soil goes as 1,200 to 1,400 millimetre either as a evaporation or like your e transpiration through the plant process. So we have given different example for this crop, every crop is given, tropical crops are given, You kindly see all those things. So here one interesting point is, whenever the evapotranspiration is more the yield also would be more. For example, you see rice, the evapotranspiration goes up to 1400 millimetre and the yield is five tons per hectare. If you come to pulses on the right side, its ET is 250 to 300 millimetre, the yield also 200 to 300 kg per hectare. So in the absence of the ET, the yield also will be getting reduced indicating that rainfall is mostly required for crop production, if you want to sustain or increase your grain yield from the crops.

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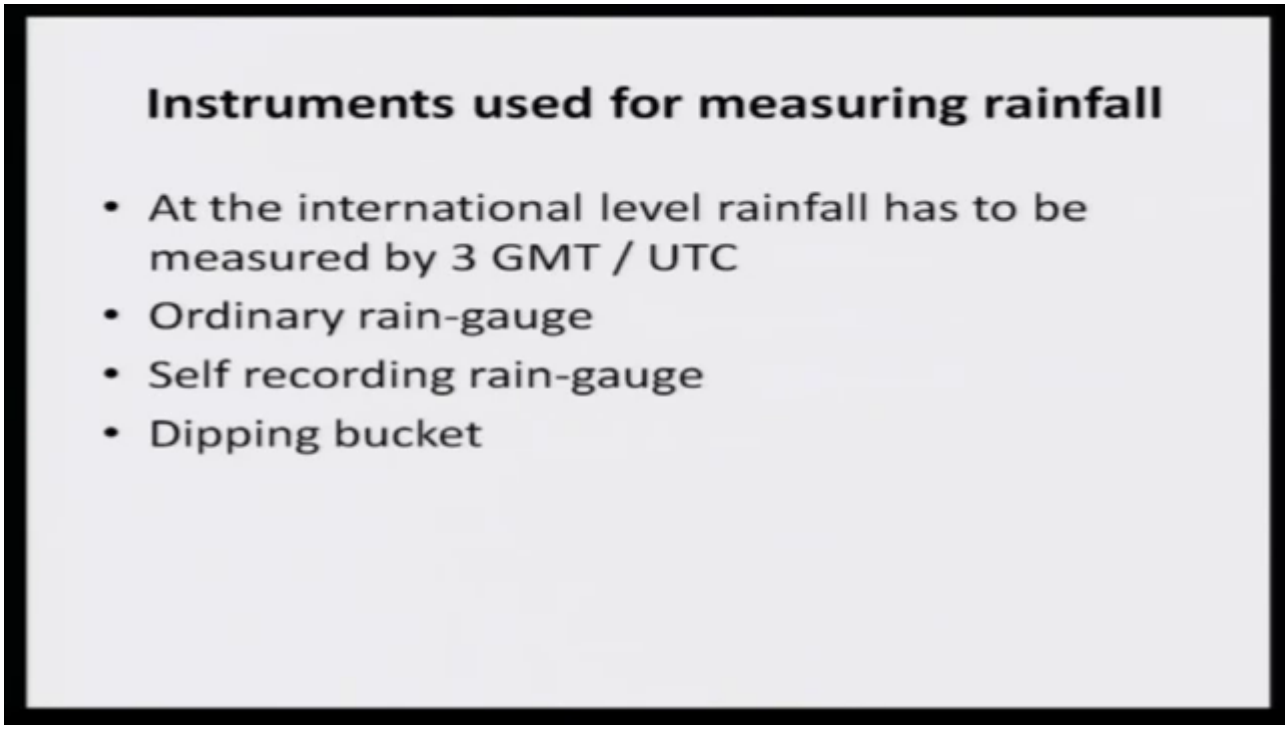

Now let me say what are the instruments let us use to measure the rainfall. Internationally the rain is to be measured by 3 GMT. For India plus 5.30 hours it becomes 8:30 a.m. in the morning. So for having an international comparison we have to record rainfall by 3:00 GMT in all the countries. There is one ordinary rain-gauge, it is asked to be manage it by manually and only the self recording rain gauge. It is being operated by through battery or like a clock then dipping like this is automatic sensor equipments being fitted with your automatic weather station. So these are the some things that I like to discuss on the rainfall for today's class. Thank you very much.