Water management
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Lecture No 20
Irrigation Methods and their Suitability

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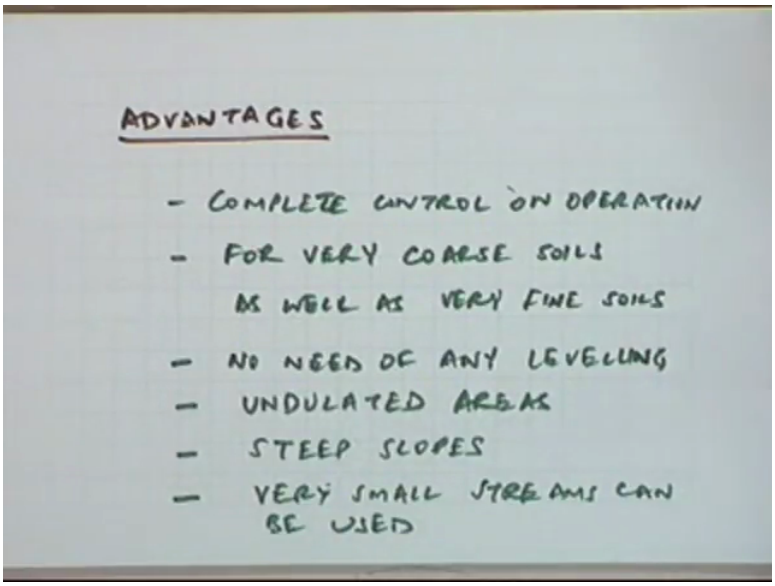

In the last lecture we were looking at the sprinkler irrigation system and we were discussing what are the various possible advantages of this system? Or what is a suitability of this system where it can be used in comparison to the other methods which we have discussed so far, what are the conditions where is having much better suitability and we had looked at some of these aspects, we had said that since this method we have complete control on the operations, we can even go to the extent of applying any level of irrigation and that gives us additional advantage.

We had also mentioned that it can be used for very coarse soils as well as very fine soils because in this particular case the application has over the surface is sprinkled over the surface, the water is coming in the form of rainfall as the natural rainfall occurs, so from that angle the other difficulties which we have encountered so far because of the fact that water moves from one end the upstream end of the field to the downstream end which is typically the case of all the methods where the gravity is used for the flow of water, so this method has that advantage then we do not need any levelling, so this can be used for the areas where the areas are undulated.

All the areas which having which are having lots of undulations where the other method the conventional method cannot be used you can make use of the sprinkler irrigation method. Then the other areas where this slopes are very steep again the advantages because of the fact that here you can control the rate of application to an extend that they will not be any run-off generation. In all the previous conventional methods we could not irrigate those areas which were having slopes, excessive slopes because of the reason that we were trying to restrict the slopes to that level where the erosion problems should not be getting activated.

So once erosion problem gets activated because of the fact that the surface run-off gets generated or because of the fact that you are trying to move a sheet of water or some stream of water over the surface of the land whereas in this case the application is over the land in the form of something looking like natural rainfall the drops of water which are falling directly onto the surface and that rate of application is controllable, so you can always control the rate of application to such an extent that there is no run-off generation. That is the reason that steep slopes can be now you can even have cultivation on those areas which are having steeper slopes. Again that is beside the point that what type of crops you can grow there? What type of… whether you can have only orchids or some other crops that suitability has to be accounted for?

The other advantage is that even very small stream can be used, earlier we had felt that if the stream size if the rate at which the water can be applied has to be constrained with respect to the type of soil where you are applying that water, so that now you have to very much bothered about that, if you have a smaller stream size if the rate at which the water is available that is low you can run the system in such a manner you might be able to use the same availability on an area which is smaller because you are you are using the water through pipes systems.

So now instead of having a bigger extend covered in that case you will need higher discharge. You can cover smaller areas where the discharge requirement will be lower and you can you can use that lower availability of discharge is available in such systems. Besides these major advantages which are because of the fact that the way we are applying de the irrigation, the way the whole thing is formulated and the way you are making the water released from the nozzle head of the what we call them as the nozzles.

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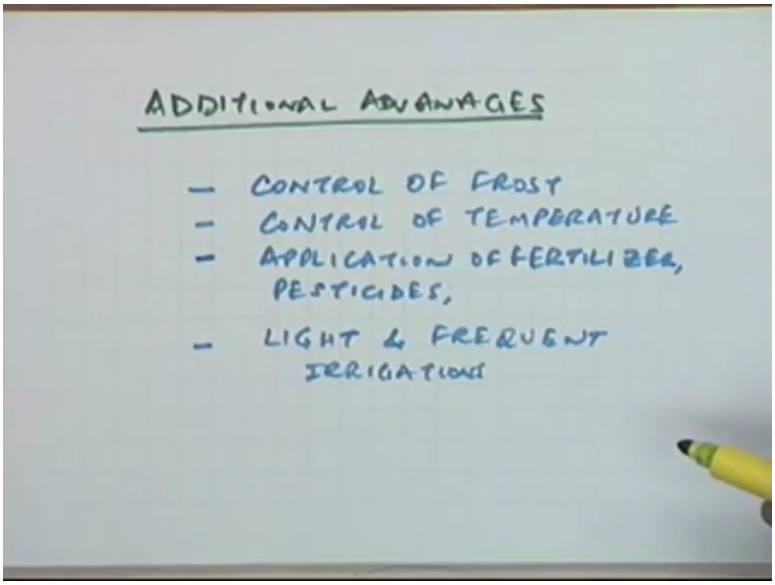

There are some additional advantages which approve as by products, now these advantages are there because of the fact that the way we are using this system, the way we have assembled the whole system. These advantages…let us have a look at some of these additional advantages which are there because of the way you are supplying water, these advantages are you can now control frost to certain extent there are some areas where the frost formation is quite active, now if you use the sprinkle water you use the sprinkler system, you can avoid the frost formation because once the water is sprinkled over the area where the frost…and the timing has to be suitable.

In this case the timing can be within your you can irrigate the area whenever you want and most of the time the irrigation is done during the night time because of the fact that during the night times the wind effect is minimum. So that is that is the general tendency in the case of sprinkler irrigation system wherever the winds are quite predominant during the daytime, the choice of the night is quite an obvious one but for frost control you can you can fix your timing in such a manner that you irrigate the areas just during the time when the frost can be active and that frost formation can be stopped.

You can also use this system for control of temperature, this can be either the temperature of the soil or in some cases the temperature of the canopy also, the plant itself. It has been seen that some crops they behave preferably to the controlled temperatures, if the temperature… now when you are sprinkling the water over the plant, the plant will get wet and it will have it will change its temperature in comparison to the other system when you are when you are supplying the water over the land surface the plant is not getting wet, so in those areas where

the temperature of the plant goes very high this system can bring down the temperature to a lower level.

Even you can afford to depends if they are the temperature requirements are such that you can artificially also you can make the temperature of the water at the intended level and then you can supply the water. So that control is possible in these systems because of the fact that water which you are sending it through a system that are other units which are essential units which we will discuss later for example the unit like filter unit is there because of the fact that you want the water quite free from most of the impurities which have a tendency to get clogged into the pipe system. Since this pipe system you are trying to use over a very long period, the life of the pipe has to be look into and you for that matter it becomes essential in all these sprinkler systems filter unit has become an essential units.

The other additional advantages which you can think of is the application of fertiliser or even pesticides. Any search requirement whether it is pesticides or whether it is fertilisers or whether it is weedicides all these things can be sent through the same system, you can mix the fertiliser with water and applied onto the system without having any additional labour requirement and for that you can have additional unit which is called the fertiliser tank which can be attached to the system in the beginning of the where you are having the pump whether pumping is being done, so close to that there is a fertiliser unit which can be made use of. In this particular system that becomes additional advantage that now you can have an application of the fertiliser through the system along with the water.

It will have an impact of having a uniform vision of the fertiliser in other case when you are doing it besides the reactivity of irrigation water then you will have to do with additional labour requirement and the uniformity of the application might not be as good as you can get with the along with the system but only thing is that when you are using the fertiliser you have to be slightly careful that after the use of the fertiliser because these things can react with the material of the pipes and it can damage the pipe system, so you have to ensure that after the application of the fertiliser is over you must run the system for quite sufficient time so that all the traces of the fertiliser or the pesticides can be removed from the network and it is not remaining inside so that it can have detrimental effect.

Then the we have already discussed this aspect that light and frequent irrigations are possible in the system and this in turn helps us in some situations example if you have some soil where the crusting is a problem and in that case if you use the conventional method you will

find because of the crust formation germination might not be very good, so in that situation where the crust formation can be a problem this type of system will be very effective where it will not end up in having the soil crust it up and thereby it can help in proper germination of the plants.

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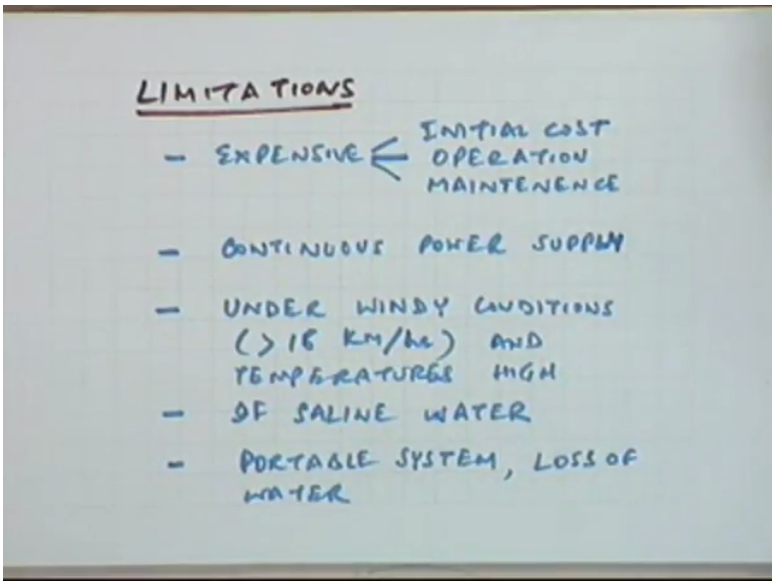

Now it is not true that there are only advantages of the system there are some limitations also, let us have a look at what are the possible limitations because everything has 2 sides of the story, there are some good points there are some point which are which are restrictive point in the sense that they are either making the thing unaffordable there can be economic reason, there can be reasons of distribution. Let us look at in this particular system when you are using a sprinkler system, the basic limitation is that the system can be very expensive and when you say expensive there are many aspects one is the initial cost, initial cost itself is quite excessive in comparison to the other methods you have to invest a lot then the operation cost, operation cost also is more than what you are incur in the other methods and maintenance also.

The maintenance will be the wear and tear of the system there will be some parts which will be which will need replacement and since the initial cost itself is large anything which has a big initial cost and mechanical parts the maintenance cost will obviously be quite reasonable or reasonably excessive in comparison to what you do in the other conventional methods, so the expense is one of the major limitations but at the same time let me say that in country like ours where it has been felt that this system has a good potential in terms of saving the resource, the water resource which is becoming more and more scarce.

Government is even helping the farmers by providing some subsidies in procuring the equipments, so is a question of whether you feel sincerely that yes the thing has a potential than the resources can be catered to the subsidies are being provided to all those farmers who feel that they are not in the position to invest that much money. They are been given loans which they can repay back, those things are their decisions, their policy matters which can be…a decision can be taken on those matters provided they are convinced that yes these methods they have the potential and they have the advantages which are worth exploiting.

Other limitations are that you need continuous power supply, now since your whole system is dependent on the availability of water under pressure you need to run the pump. Either you have to use the electric supply or you can use the diesel sets, so in any case some source of supply has to be…the power has to be available which can be made use of and this looking at the availability of electric supply in our country again the efforts are on to make our the make the electric power supply available all over the country within let us say next 5 years they are trying to do their best to get the required demand fulfilled. Right now we are having a lot of deficit and even the privatisation is step towards that, so I think this situation the power supply situation will improve and this will effect this sector also.

Then under windy conditions let us say conditions when the wind velocity is more than 15 kilometres per hour and when the temperatures are high you will find that when you will use this system under these conditions are distribution efficiency as well as application efficiency they will drastically reduce because of the fact that there will be losses on account of the wind conditions as well as on account of the evaporation. When the temperatures are high the evaporation loss will increase, when the wind conditions are high the spray losses will increase.

So if you have these type of conditions prevailing in the area of your interest then you might find that this method again the efficiencies will be low, the suitability of the method will still be there but the basic aim at with which you are trying to save the water, if that is the basic aim then it is not worth it but if the aim is to make use of the other conditions which are not suitable for the methods of surface irrigation, methods where which are using the gravity flow then this method might still be used.

In case if you are having saline water, if you are using saline water it has been found that the leaf burning can be excessive when you spray the saline water over the surface of the or the canopy of the plants then the leaf burning can be a problem, so this method should be avoided

if you have the available water is saline in nature. The other limitation is that when you are using portable system, loss of water can be there. We have not yet discussed what type of systems can be possible and the sprinkling method.

When you using a sprinkler system there can be many different setups, you can have a fix systems, you can have a portable system we will come to that shop when you are using portable systems what it means is that you will be using a very small number of pipes which are the laterals on which you have installed your sprinkler heads, those pipes will be removed from one place and they will be taken to the next place they will be again attached to the mainline or the sub-main and the system will be run again, so when you are moving the detachable components from one place to another place when you are ending one process and going to the next one there can be some loss of water because all those pipes which are filled with water that will be that will go waste that water.

There will be some other losses when you are opening and the system was not on at that time but still they loss of water will be there. Since your, if you are using this method to save the water any loss will be additional loss, so this though the order of magnitude is not much because when you are closing the system you are not the transition is there for a small period when you will be having because it will take some time for the pressure to build up. Similarly when we are closing system it will take some time when the pressure will fall down and come to the lowest level, so that will be the time where your water will be getting wasted. Okay with that we have had a look at what the sprinkler system has to offer.

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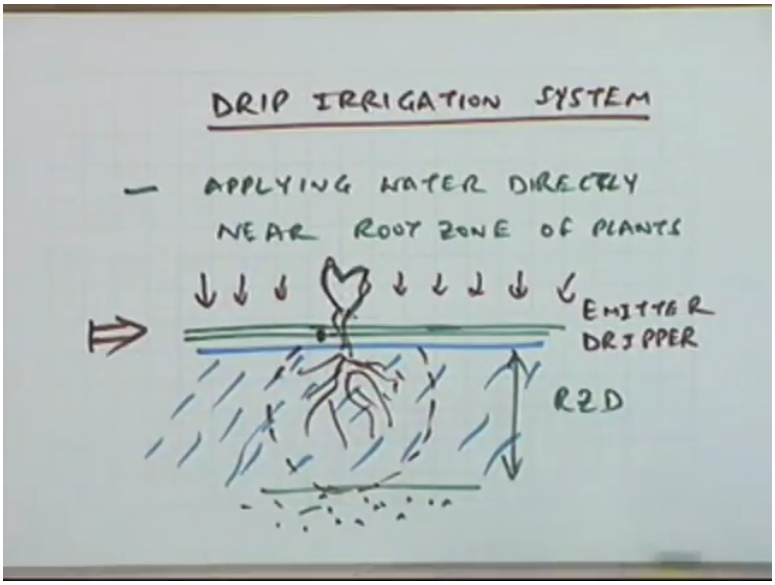

We will go onto the next system the last one which we have and the method which we are going to discuss and this is known as drip irrigation system. In this particular system the main characteristics of this systems is that we are applying water directly near the root zone. If you look at the system which we have been discussing so far that we are having a plant where it has its root system, we have looked into that. Now this, this plant we also know that it has some root zone depth and here in most of the methods, all the methods which we have practically what we have discussed so far, we are wetting this total area.

This total area is being wetted to cater to the requirements of the plants but we also know that the effective zone out of this total zone and 1 extent is the root zone depth that we have the vertical extent, we have already discussed that no water is being used which is available in the soil beyond the root zone depth, so if there is some water availability here in this particular zone it is not going to be affecting the growth of this plant because its root system is not capable of extracting this moisture but we have not looked at what is the extent of the moisture extraction in the other 2 dimensions in the horizontal dimensions, so if you try to locate that we might find that this might be the this zone which is supplying moisture to the root system.

Even if the water is available here it might not be made use of by the plant by the root system of this plant which means that there is no point in wetting this area if we can, if we can avoid wetting this area, the growth of this plant is not going to be affected at all. So with that with that knowledge and to implement that knowledge, the drip irrigation system has been evolved basic idea of drip irrigation system is to it to the requirement of this particular plant and provide the moisture in that zone only which is directly supplying moisture to the plant. If this has to be achieved then what are the what are the various requirements? The 1st requirement is that since this is the small area, if you will if you will try to wet this area at a large rate at a rate which is large enough if the moisture supply…because the way you have to supply the moisture is one we have seen supply the moisture at this end from here the water is supplied at this level, it moves on to this level and wets the whole area on the way.

When it moves as a sheet there is some infiltration taking place and depending on how much time are water had stayed on the top of the surface, it has wetted the area and you have try to restrict that wetness of do our up to a just beyond the root zone depth that was what our surface irrigation methods were and this sprinkler irrigation methods what we have said is that instead of supplying the water from this end, we will supply the water from the top and

let the water be sprinkled over the whole area but in that method also we could not restrict the water only to come onto this this surface or this zone even the water was being sprinkled over to the other areas where the crop root system might not be making use of that water, so this will be effectively it will be going to the atmosphere through evaporation, it will be lost through to the atmosphere through evaporation.

Now if we have to restrict the application relate to this zone we have to have some advice which will make the water available in this region, so that has been done by having a pipeline going over the land ground surface and then having an opening here somewhere a small opening. Now this opening is nothing but is a device, it can be either opening in the pipe or it can be a small device which is taking some water from the pipe and then making it a drip over to the surface.

This device is called there are different names given to it, some people call it dripper some people call it emitter. Let me write here, it can be either emitter or it can be a dripper basically that is what has brought this name drip irrigation because this devices such that the water almost trickle-down it drips as a leaking tap drips, so the rate of application is something of that order of magnitude because of the fact that if you try to apply the water at a higher rate it might blow over the surface, it might go to the other areas and depending on how much is the infiltration rate if you apply the water at a rate which is higher than the infiltration rate it will it will have a tendency to flow over the surface.

So with that reason the rate of application is controlled by providing these drippers and in case you feel that the requirement is more than…one dripper is not sufficient to take care of this requirement what is being supplied or what is needed to be supplied to this zone you can use more than one drippers that is not a problem, so that process of irrigation when you are catering to the individual plant is the drip irrigation system though they are the advanced version where it is not necessary that you will be using the each individual plant only, it can be a row of plants which you are catering to, so the mechanism but the philosophy remains the same the mechanism can be different people are using this method for crops which are not only the orchard crops, they are vegetable crops are being irrigated using the drip irrigation system.

Let us try to look at having understood the arrangement, now in this case also before I go to the other aspects the arrangement of layout is similar to the sprinkler irrigation system. You will have…the only difference is there in this case you are using PVC pipe which are flexible

pipes which you can take anywhere depending on what is the layout of the plants, you can take them anywhere you can even bend them around the stem of the plant, you can pierce them with the drippers, you can have increased the number of drippers depending on your requirement from time to time in the beginning when they when the plant the small you might need only one dripper, when it needs more water you might need 2 drippers for the same plants so that can be that flexible they is available and you are using the laterals. In this case also the pipes which are PVC pipes, in the previous case they were the metal pipes on which you are installing the sprinkler head. In this case they are the PVC pipes on which you are putting the dippers but in both the cases they are known as laterals, okay. And beyond the laterals you will have either the sub-main or just the mainline, now that mainline and be of any material that is not of PVC that is the normally the mild steel which is used for that or it can be the plastic also these days plastic pipes are also being used but in this case also the water will be under pressure, so you will have to have a pump unit, you will have to have a filter unit because you want the water to be quite clean so that it should not clog the pipes, in this case clogging is a much bigger problem but the pressures, the prevailing pressures in their drip irrigation systems are much lower, when the water comes out of the dripper is almost at atmospheric pressure because what your requirement is that the water should just drip, the water should just trickle onto the surface.

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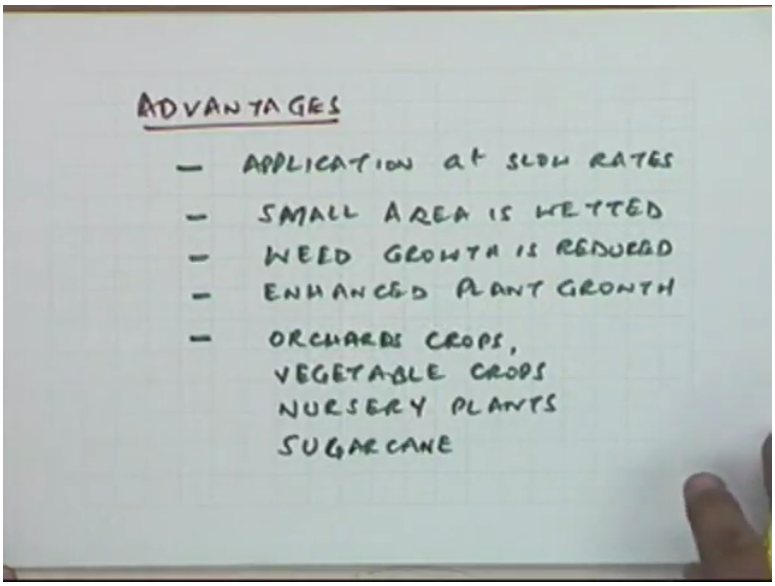

Now let us look at what are the advantages of such a system, you can think of many advantages after we have discussed the way this particular system has applying water onto the areas. You can…the application at slow rates are possible, so if the pressure are very, the

pressure requires are very low the rate at which we can supply the water can be very low, so even if you have very small quantity of water still you can you can cater to the requirement of the plants you can run the system.

Then we have seen that it does not wet the whole area, small areas. It does not wet the whole area only a portion of the area is wetted and that portion how much portion of the area should be wetted is under your control and you have to decide that depending on what is the spacing between the plants, so you will you are basically reaching each individual plants in terms of catering to its requirement. When you do not wet the whole area the weed problem is…as the weeds are there because of the fact that the moisture is available in the soil, so if the moisture is not there in the other area where you are not any interest in that area, the weed control is the weed growth is automatically reduced.

Then in this case also the fertiliser application is possible as in the case of sprinkler irrigation system, it has also been seen that using the system of plant growth is much enhanced. Now that is… Can you imagine what is the reason because in any conventional method even for that matter even the sprinkler irrigation method there you can have more intermittent applications, the frequency of application can be higher but in this particular case you are almost supplying water almost every day, the rates are so low that you are trying to replenish the rate of requirement with the rate of application.

You are trying to replenish the moisture in the soil at the same rate at which the moisture is being lost, so when you so when you will try to do that what is happening in fact, the stress level is much lower because in the conventional system the plant will be very happy when you are when you are brought the moisture level at the field capacity level just after the irrigation, now has the moisture level goes down the amount of force which the root system will have to apply to extract the moisture from the soil will keep on increasing and that will keep on increasing the stress level in the plant also.

When you are using the drip irrigation system, since the moisture supply is almost continuous the stress level and the plant is very low that is where the growth of the plant yield, the ultimate yield is also going to be affected and it has been seen that in many cases the yield have become so much for example in the case of coconut people have found that the yields have increased 3 times using the drip irrigation system. The farmer once he is known that yes this can be achieved they have automatically gone in for the drip irrigation system because that has that has proved as an incentive.

They will get the higher the yield more will be their benefit, so even if there is some initial cost if it can be offset by the increased production the farmer given a help may be that he does not have the initial investment, so if the help is given in the form of loans he will like to go in for such a system, so there are some situations maybe not all where you have lot of advantages using this system and that is where you have to decide what are the conditions under which you are irrigating and with system should be should be selected for applying irrigation water.

The suitability in terms of the crop as we have just mentioned the orchards is one all the orchard crop are the crops where this system can be very suitable then vegetable crops also, it is been seen that this system can be quite successful. You can also use for nursery plants all those crops which need nursery plants in that situation the system can be used. People have also used for sugarcane and it has been seen that the sugarcane yield also increases by using drip irrigation system.

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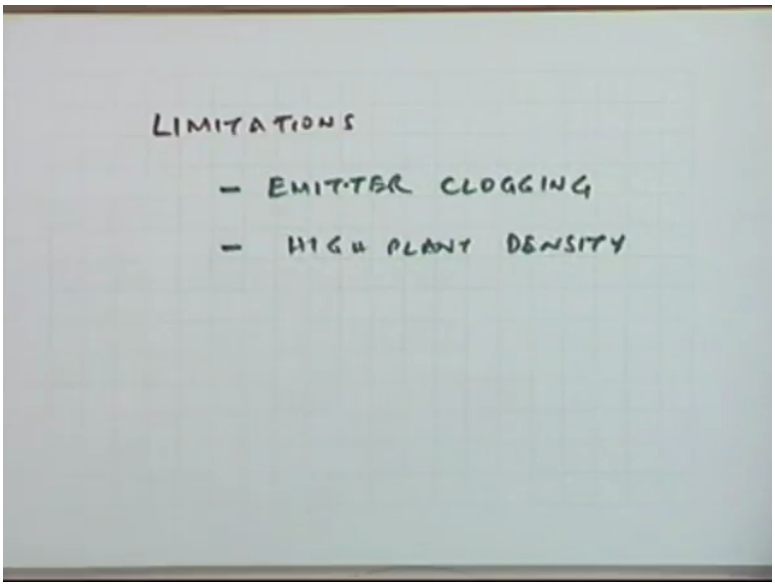

Let us have a look at the limitations of this system what are the possible…what are the problems which you encounter most of the time when you use the system? The major problem which is encountered is that of an emitter clogging. These emitters or drippers they are basically… there are 2 ways one is that you can place the emitter on the top of the ground surface, so in that case evaporation losses can be excessive because all the water is the water is being supplied at a very low rate majority of this water might get lost directly into the because the top surface will be wet all the time you will have lot of evaporation taking place.

So to avoid that sometimes you try to have an opening of the emitter slightly below the ground surface, you might embedded into the ground not a very shallow depth maybe around an inch or so for couple of inches. When you do that then the clogging can be the major problem even otherwise the clogging is not only because of that, clogging is also because of the impurities if they are there when they…the water is so the pressure at which the water is coming out of the emitter is so small that over the period of time you will find that the opening and the openings are also very small when we will come to the design level we will see that openings are very small, so even a small portion of impurities can clog the emitter.

Sometimes the soil can go inside and clog it some other time you might find that they can be depending on what type of these pipelines have been used there can be a possibility of algae formation if the water standing inside the pipe, so that can also clog the thing, so this basically the trouble is that you are having so many emitters spread all over the place, it might be too late before you detect that some emitters is clogged because the rate at which water is being supplied is so small you will not even observe and if you have not observed for a period which is detrimental to the plant by the time you realize that the plant is (())(50:08) it is too late. This is one of the major problems of the clogging problem is one of the major problems of the drip irrigation systems.

Then the other limitation is that it cannot be used for all the crops, the crops which are having high plant density these cannot be used because then the requirement will be that you need to wet the whole soil, so if that is the requirement then you do not the number of emitters which will be required will be so high that it is not justified to use this system, so in that case it is better to use the sprinkler system or any other surface irrigation system which uses the gravity flow.

Otherwise for some of the crops it has been found to be very successful, it saves a lot of water you have the complete control on the way the water has to be supplied, you also have the problem the advantages of using the fertiliser with it and the suitability has to be looked at with respect to all the factors put together. So with that we conclude this topic of irrigation methods we have looked at almost all the major irrigation methods which are being used in the present-day context, we have covered the conventional method, we have covered the methods which are rich in methods and next we will go in for these individual methods we will look into the design aspects of these methods, how we design the individual when we select the individual method.

We have looked at the selection process by looking at the suitability of these methods, so having selected a particular method what are the other things which need to be sorted out whether it is in the form of laying the fields that is that is the topic which we will cover after we cover all the methods that how we go in for farming of the areas, the land levelling and the land grading but before that we will we will look at what other various design processes for each of these methods, okay. Any questions? Okay thank you.