Water management
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Lecture No 16
Irrigation Methods (Contd.)

In the last class we had looked at what are the various factors… We just started with the looking at the factors which influence the selection of various methods and the 2 major factors which we have talked about were the soil, how the soil type influences the selection of methods? And then we looked at how the topography influences the irrigation methods?

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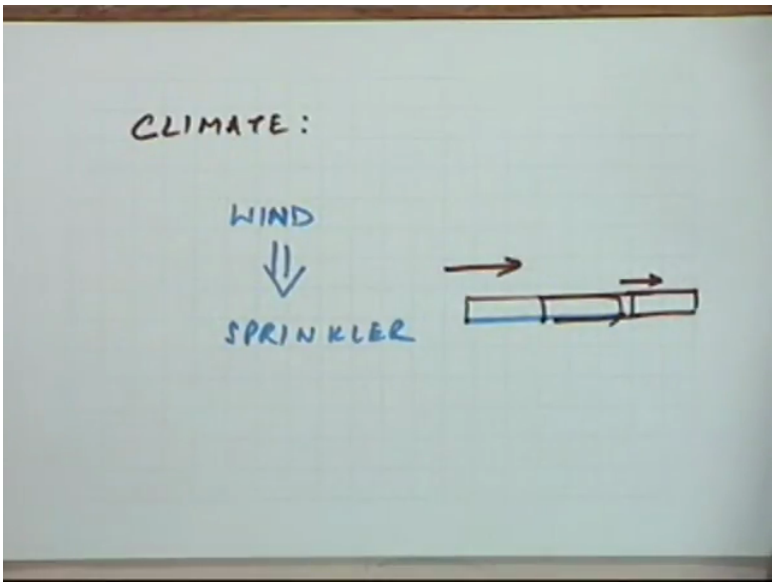

The other factors which can be included which have impact on the selection of the irrigation methods include climate. In the case of climate, how does it influence the irrigation method because as we have seen in the previous topics the climate is the one which influences the evapotranspiration requirements. Now if you climate is such that the evapotranspiration requirement is very high because of the climate then you might not be in a position to choose a method which needs which needs sufficient amount of water or sufficient quantity of water because in the case where your frequency is high, the frequency of irrigation or the number of times the irrigation has to be provided because what you do is that you are replenishing the deficit and the rate at which the deficit is being created is quite high because of this high rate the frequency at which the moisture has to be supplied will also be high.

So consequently you might not be in a position to choose a method which cannot be repeated very often, so that is how the climate will influence in the choice of the method because there

are some methods where you have complete control on the applications, the number of times the applications can be made whereas there are some methods where the control is not as good as some other methods, so these methods where you have to wait for the next application because of the complications and the layout of the system or the distribution network of the system, those methods might not be in a position to be getting the priority or getting the selection in terms of the climatic conditions.

So climate can be in some situations can be very influencing the factor in the selection. On the other side this is one, this is one aspect of the climate where we have said in general that those methods which are dependent on the gravity flow, they might not be highly suitable in some situations you cannot generalise but let us see the other extreme, let me say that if I have very windy conditions, the wind velocities are very high. In this climate where the wind velocities are very high you might find that the other methods which are suitable, which are capable of having a very high level of frequency of irrigation you might not be in a position for example let me say that this you are using under windy conditions, a method which is sprinkler irrigation method.

Now if you use sprinkler irrigation method because of the wind effect there will be a lot of moisture which will be different away from the target of the target level if your fields are somewhere here you might find that because of the windy conditions you might be applying, you might want to apply water here in this area over this zone your water might be drifted and it might be getting applied, some water might be applying here but there can be some portion of the water might be getting drifted.

So there can be losses which are spray losses which we will deal with subsequently, they might increase to an extend that this particular method and a very high windy condition might not become the natural choice you might have to look for some other methods if the conditions are not suitable for this method because of the windy conditions, so you have to look at various combinations in terms of the climate, what is the overall combination of the various factors which are influencing the climate and thereby in turn influencing the evapotranspiration and whether you can choose that specific method, if you choose the method what will be the other implied factors which had to which will influence the various aspects of irrigation.

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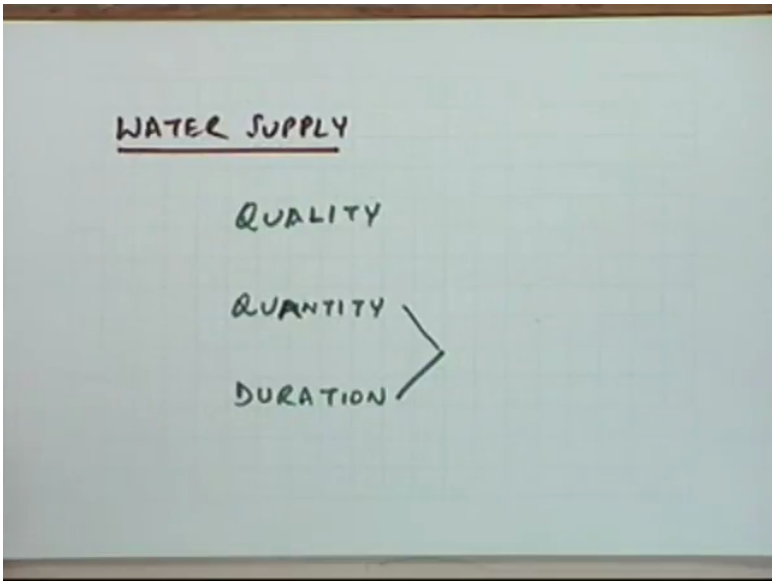

Let us go to the other factors which can influence the selection of the method of irrigation, water supply because in any irrigation there are some factors related to water Supply which have to be looked into and these factors vary from the when you say water apply the 3 attributes of water supply which you will have to consider will be the what is the quality of the water? What is the quantity of water and duration for which that that quantity of water is available. Now these 3 aspects can in different circumstances they can be very influencing factor in deciding what type of method should be suitable under those set of circumstances.

Let us take the example that if you are quality of water is not very good, you might need a method where you can enhance the moisture level of the soil or you can keep the moisture level of the soil quite high because if you will be using that method which can be applied in small quantities where the water can be even you can afford to supply water in small quantities are then as we have discussed earlier that in those situations where the moisture content is very low, the salt accumulation in the soil can be detrimental. The ill effects of salt accumulation of the in the soil can be less detrimental is the moisture content of the soil can be kept at a high level, so if you have that problem then it will be better to choose that method which can afford to let the moisture content of the soil be at a high level or in some cases where you can have sufficient quantity of moisture so that the salts which have accumulated in the top layer of the soil can be depleted and they can be pushed into the lower levels.

Similarly in the case of quality of water, now there are some methods where you cannot apply the water if the quantity of water is very low because of the effect that distribution of water

over the field will be very poor. Let us assume that if your quantity of water is small, now quantity can be in terms of the total volume or it can be in terms of the rate at which the water is available that is where the duration comes into picture. Now when you look at the quantity, you might have to club it along with the duration because if the rate at which the water is available is very low but is available for a very longer period you might have the same quantity covered in terms of volume if the rate of water was very high but for a very short duration.

So looking at the quantity in terms of volume as well as the duration for which is available your method of your choice of method of irrigation might be constrained because there are some methods where you cannot go below-level in terms of the rate of the water available. If the rate of water available is very small some of the methods might not be suitable for the application of water onto the field. There is this cannot be looked at as a standalone criteria, you have to look at the other parameter is like what is the slope of the field? What is the soil type? So it cannot be when you say quantity and duration you cannot look at these attributes in isolation, you will have to look at the other aspects of the topography of the field, the slope of the field, the type of the soil which is available but the supply, the water supply in terms of its quantity, in terms of its quality, in terms of rate of water availability they will certainly influence the method of irrigation to be selected.

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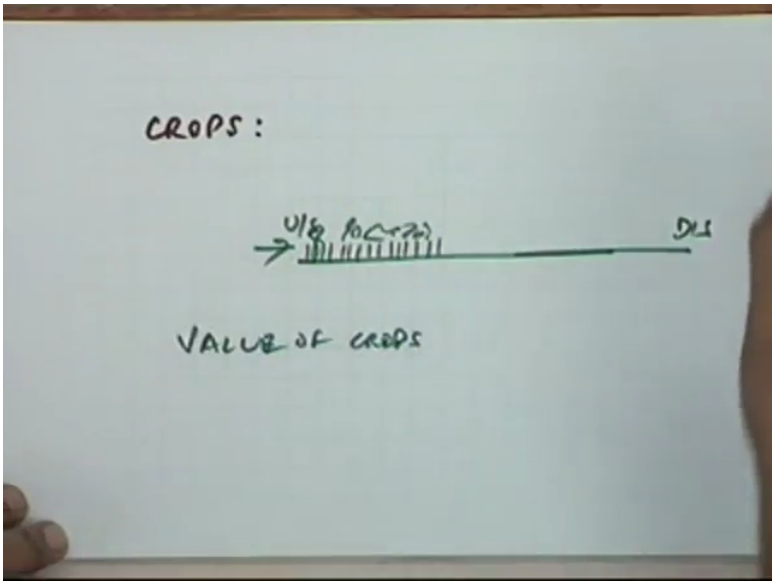

Then crops, crops will also influence which crops you want to cultivate, which are the crops in question, so depending upon the type of crop which you which you want to irrigate the method of irrigation will be dependent on the type of crop also. For example let us there are

various aspects of the crops how they influence the method, the first thing you can think in terms of the sensitivity of the crop to the (())(14:17) of the water. There are some crops which are very sensitive if the water stands on the ground for a sufficient period and because of the low aeration available, if the water will be standing you will get the saturation conditions or conditions which are close to saturation all the air will be displaced and it will be replaced with water, so under those circumstances there are some crops which gets influenced in terms of reduction in the yield.

Those crops if you have if you are cultivating those crops then you cannot choose a method of irrigation which can induce the conditions of saturation or which where the water might be standing for sometimes and reducing the aeration in the soil, so if you have such crops you will going for method where you have the application done in such a manner that the water is not it is not possible for the water to stand beyond a certain period which is not detrimental for the crop production.

Similarly the type of crop how much they grow and horizontal direction and in vertical direction in terms of how much resistance they provide to the flow of water, whenever you will have the crop grown into the field you will find that as the crop grows there will be (()) (16:18) of their stem, there will be depends on what type of crop it is if it is the fodder crop it will be is so close growing that you might find that the resistance to the flow of water will be so much that it might be it might not be possible for the water to move at a very fast rate and go to the next subsequent areas in the field.

In that situation you might choose a method where you do not have very elongated fields because otherwise you might find that most of the water which is been applied, it just keeps on infiltrating onto the upstream ends of the… If this is the field and if you are applying the water in the from upstream end and is flowing towards the downstream end if there is lot of crops, the density is very high you might find that the unevenness of the distribution of water will be too much, so you cannot choose a method of irrigation which needs very long fields, you might have to going for a method… Because when is a methods, we methods are distinguished on the basis of the shapes of the field, the size of the field how they are laid? All the methods which we will be covering just immediately after this you will find that the methods are not the method of application only, their differentiation is with respect to the shapes and size of the field also.

So this in this particular situation you will find that the crops can influence to extend the selection of the method, what type of method should be suitable to a specific crop? Then another aspect you can you can even consider that that the value of crops can also influence the method to be applied, if the crop is a high-value crops in that situation you might find it quite reasonable to invest more money, select the method which is more efficient but it needs more investment, so you might be able to justify that investment depending on how much is the return from that crop because if you are using a method which is very sophisticated but the crop value is very low, in that situation you might not be able to get the return from the crop which is commensurate with the investment which we have made.

So that that aspect will be very important in some cases where your crop value has to be looked into, it has to be taken into consideration because so why you go in for artificial irrigation? Because you want to have a security in terms of the water available, if the nature is not providing water you are trying to replenish the deficit, the moisture deficit in the soil whenever it is it is going beyond a certain limit so you are trying to replenish that in an artificial manner but the control with which you can have the security of this replenishment, it goes very high with high-level of investment but at the same time you have to look at whether it is justifiable depending on what is the outcome from the total activity and that outcome is only through the final crop production, so if the crop is not very is not very highly you can say in the market you cannot get very high price from the crop because it is a very low price crop you can take more risk because even if it fails you not losing much, so from that angle it has a bearing on the method of irrigation, which method of irrigation you should use can also be affected by the type of crop you are having in question.

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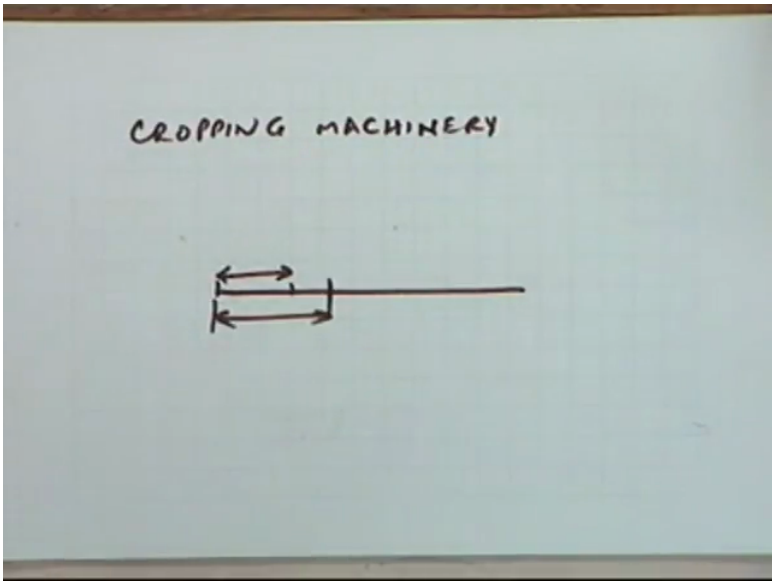

Cropping machinery is another factor which with the more mechanisation of the cropping activity we are finding that the requirements of these machines which you are using, these appliances which you are using for the mechanisation of various processes that has to be kept in mind, so sometimes depending on what type of implements you will be using you will have to take that into consideration while deciding on which method of irrigation you should be using. For example if you are using a method suppose you are having a tractor which is using and implement which has this much width or for in the end when you are using combine for harvesting it will have some width which is covering.

So if you are using the size of the fields which are not multiples of this width, you might find that it will be either it will be the operations will be more expensive because in some cases if suppose if you are having…this is the size of the field and in this case to cover this whole area you will have to go once and then the next time you will be only covering half the area, so it is not a multiple of the width of the implement which is being used.

In the beginning itself when you are designing your method you will have to keep this in mind otherwise they operations will be more expensive, you will have to put in more labour or more number of hours have to be spent to cover the same area, so those things are also now becoming important when you are designing the method you are looking at these requirements also, you will also look at what will be the… Where would be the turning strip where the machine will be taking a turn? Is that area available somewhere or not? If it is not available then it has to be provided otherwise you might be in terms of the time taken, in terms of the efficiency of the operation it might be creating problems.

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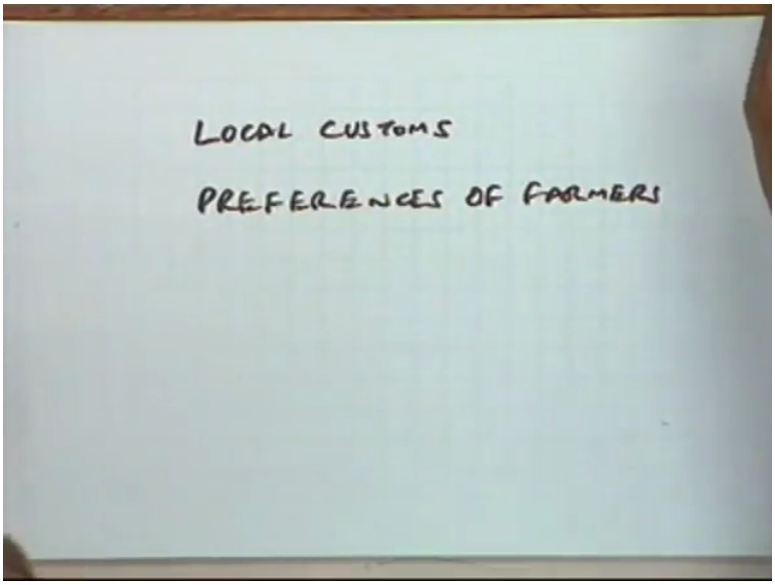

There are so many other factors which can influence for example the labour availability can also be a factor which can influence the type of method to be used, there are some methods which need less amount of labour there are some methods which need more labour, there are some methods which need unskilled labour, there are some methods which need skilled labour, so if you go in for a method which needs skilled labour and if the skilled labour is not available in the near vicinity of that area then you have problem, you might find that your operations are hampered or you might have to invest more money in terms of getting skilled labour, labour from far off places which might not be available at appropriate time because in many situations whenever the labour is in demand as the cropping seasons are same.

When the cropping season is prevalent in one area the other area, adjoining area will also have a similar because we are seasons are the same season when the crops are grown, we have the Rabi season, we have the Kharif season, so if the labour requirement is in one area the labour requirement is also in the same time in another area, so you will not find that the ever will be possible we obtain from the other adjoining areas, if the labour is not available it is not available, so from those angles it is very essential that whenever you design a method you have to look at these requirements, we have to look at whether the labour will be available during that time or the kind of labour which you require, will it be available or not.

If it is not available you might find that ultimately your operations might suffer, the timing might have to be changed and changing their timings you have seen that they have their own impacts. You might have some permanent irreparable damage done to the crops yield, so if the irrigation is delayed then the yield is going to be affected which you cannot repair by

providing more water later on so that is not possible to, so this becomes very important requirement to be looked at when you are looking at which method you are going to imply.

Then the local customs in preferences of the farmers, invariably you will find that you may you may keep on saying that yes this particular crop is very good for the area, there will be many other factors which will influence what is being grown in that area? The factors can vary from the individual requirement of the farmer because most of the farmers in India they are marginal farmers, they are farmers with very small land holdings and most of them is are doing farming fulfil their own requirements along with them if there is some surplus production we might sell it but basic requirement is what is the major factor in most of the cases because the area is a very small, the holdings are very small, so in that situation they will try to go in for those crops which they can use themselves and additional or the surplus can be sold.

These are the… The customs have developed from those requirements, so they do not want to leave the customs they do not want to listen to the various advices which are given to them they will take their own time, they might take once the irrigation water has been made available to them they might have to wait for 2 - 3 years before they get a full confidence that yes whatsoever is being recommended it can fetch them more money, it can be more useful and they can get a better return only then they might change, so many a times it might be there might be a gap between what is the best and what is being grown in the specific area. Those factors also many a times they are influencing factors they do not want to change the methods of irrigation because in some cases either it requires more investment because of the method of irrigation is such that it needs the grade to be very smooth, the grade to be very good the when we say grade to be very good means that the levelling of the area should be very perfect.

So in that situation they had to invest more, they will have to go in for may be land farming which will require some more investment and they do not want to indulge in that, so they will stick to their old method because they know that though they might be using more water, they might be losing some water they are not bothered because of various reasons may be because of the fact that water is available at hardly any price and they do not have to pay anything for that water, so there are many factors which go into this socioeconomic factors, the factors which are beyond the scope here.

You might not know what other reasons but there are many different factors which influence the actual prevailing methods, what methods are being used, how they whether they even if you tell them that yes these are not good methods, either they do not have the money invest or a do not want to invest that money because there is no benefit directly benefit they feel because if the water is getting wasted they not paying much for that, so it is not a situation where they are losing a lot of money directly, so you have to… That is not the scope of this particular subject right now, we are only looking at what is scientifically true, whether we can implement that or not those are things which are beyond the scope here but in general it has been felt that people are people have started understanding, they have seen in some cases where more water is being applied, there are some problems which are cropping up. The problem of waterlogging, the problem of salinity because of that they have started understanding things because their interested is in question now.

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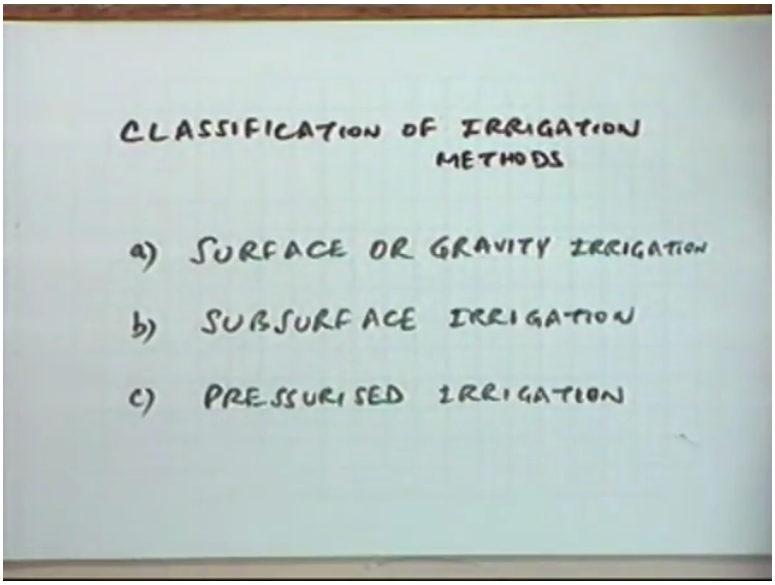

So now let us go to the various methods at this level, what are the various methods of irrigation which are… let us try to look at the classification of irrigation methods. There are many different nomenclatures which have been put forward there are various ways people will classify these methods. There is no unique method or unique way by which you will you can club these methods. I am just using one which I feel is quite reasonable one under the present circumstances with the availability of the methods which we have we are being, which are being practised, we can club them into surface or we might to make it more clear we can call them surface or gravity irrigation. So this will include all those methods which

use this phenomenon of the gravity flow and the water is being applied on the surface of the field.

In the second category we can put those methods where we are not applying the water on the surface of the field, you are putting the water in such a manner that it is coming through the sub surface source, so that we can call that group of methods we can term them as sub surface irrigation. Then other category where we are using the water, the water which is being supplied to the face is under pressure, so we will call them pressurised irrigation, okay. In this situation I like to differentiate a situation where you might be pumping some water and putting into the canal in that in that case it would not become a pressurised irrigation because ultimately the waters is taken to the field under the flow of gravity, you might be only tapping that water from a lower point and pumping it to take it to the head end of the canal or maybe augmenting the water into the canal by the pumping.

That in general is known as lift irrigation but that is not a method of irrigation, that lifting is only a part of augmenting the water which is being made available in the irrigation network at some point it will be…you might put some more water into the canal if the canal water which are getting from the resources, if it is coming from that aversion from a river or if it is coming from a dam if there is not sufficient you are augmenting that water by putting some water from a lower level into this canal through a lift irrigation or through the lifting of that water through pumping that is that is not that would not be called pressurised irrigation. Pressurised irrigation where here we mean those methods where we are using the pressure, the water under pressure is being made available when it comes to the field level, okay. So the category of methods which we are having under this pressure irrigation is the drip irrigation and sprinkler irrigation.

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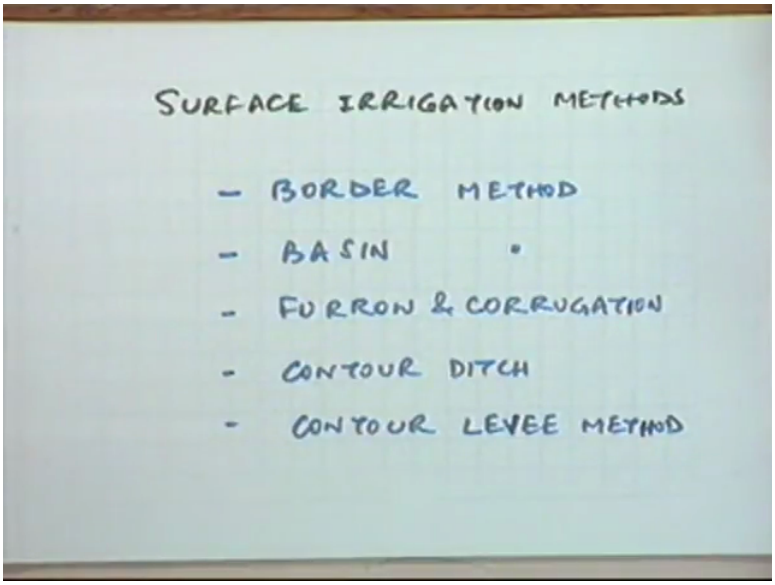

Now these 3 broad categories which we have which we have just listed, we will start with the surface irrigation. Surface irrigation methods, the various methods which are available under surface irrigation methods, now again the list can be very long there can be some local practices which are being followed because this surface irrigation methods are age-old methods but now looking at those methods which have survived the (())(38:24) of time and they have proven to be very useful those methods are border irrigation method, then we have basin irrigation method, we have furrow or sometimes is there is another class of irrigation called corrugation, corrugation methods.

These 3 are the major methods but they can be some local methods for example the contour ditch or you might have contour levee. These are some derivatives of the above methods but will have a look at them also but the first 3 are the major, the major categories of surface irrigation methods which are most popular all over the world. Now in general when you talk of the methods which are belonging to the surface irrigation or the gravity irrigation methods category, there are some common characteristics of these methods which can be looked at.

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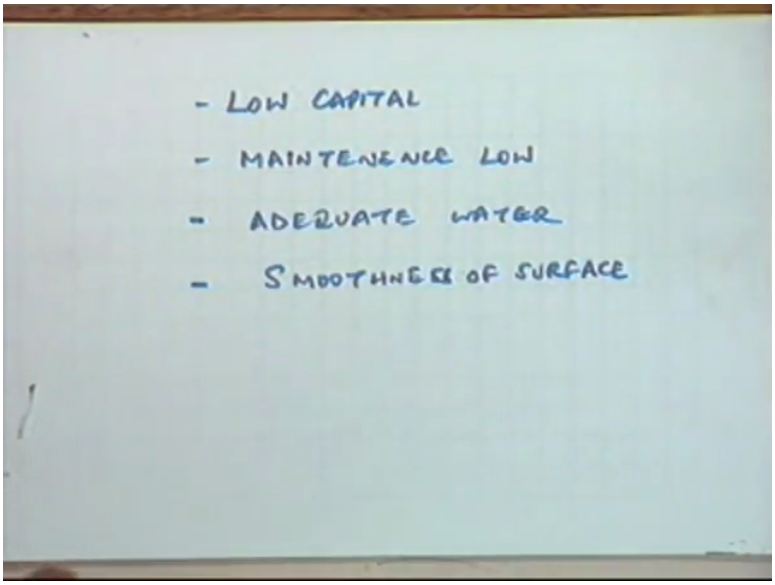

Now in general they are they involve low capital in comparison to other methods. The maintenance requirement is also not very high, they require low maintenance but at the same time the attributes, there are some attributes which you must look at before you decide for these methods. In general you will find that they require more water, the requirement of water should be…unless you have adequate water you might find that these methods are not suitable, so their requirements in terms of the quantity of water will be comparatively higher.

Then they will also require comparatively smoothness of surface, so whenever you want to use these methods, the fields, the surface on which you are applying the water should be smooth only then these methods can be used. You cannot use these methods on undulating areas unless they are the levelled they are graded properly and those whether the whether you should use the levelled area or (())(43:04) area will be a function of other parameters of the characteristics of the area.

Let us start looking at these methods one by one and then we can discuss their suitability and we go within the within the surface irrigation methods we look at these various forms of service irrigation methods where they are suitable. Right now we will be only looking at their characteristics and having covered all these methods having got some shield, got some idea what these methods are about then we will go to their design that how we can design these methods because each method you will have to consider some you will have 2 come out with the various parameters of those designs and which parameters are important is a function of which method you using.

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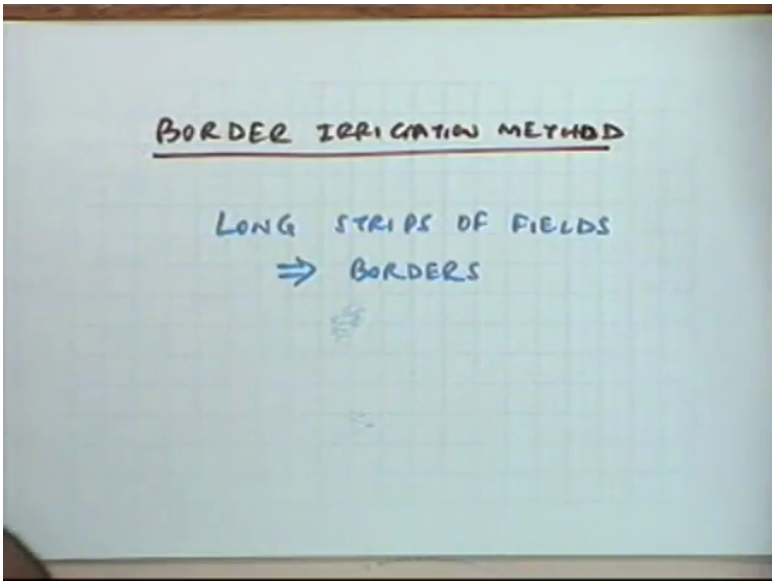

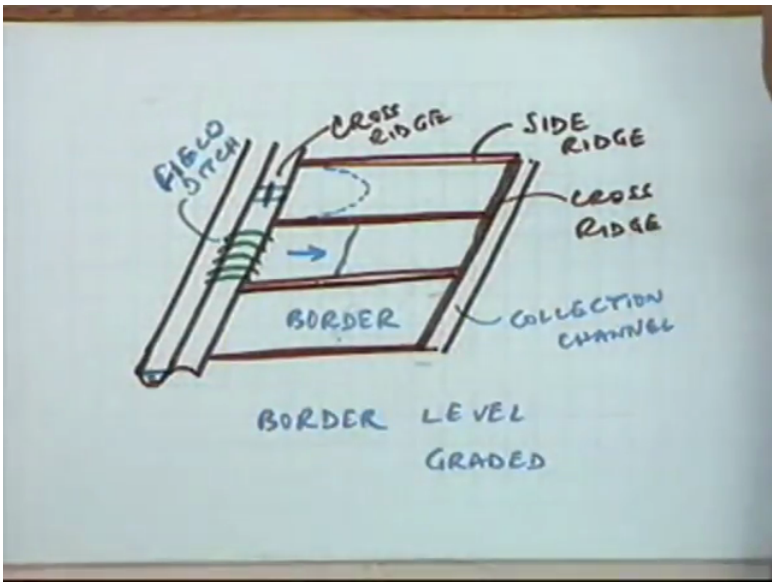

So let us first look at the border irrigation, in this method you are using long strips of long strips of areas which are laid parallel to each other and these long strips are termed as borders. They will look something like this, now each of these if you take, what is this? This is the this is the field which, this is the field channel which is providing water and let me say that there is water in this channel and then this is the ridge which you can call the cross ridge then these are the side ridge, these are the side ridges so each of these strip is called this is the border which is surrounded by the ridges on all sides, this is another cross ridge and this can be collection ridge or a collection channel. Now this collection channel in some cases it may not be there depending on whether there is any surplus water which is coming to the downstream area or not and that will be a function of what is the slope of the border.

The arrangement is such that you are supplying the water from the field ditch into the each of these borders either by providing the tubes which are letting the water flow into the border through the (())(49:01) or you might make a cut in this ridge and then you can have some control structure here, so through this opening the water can move into the border. Now over these 2 methods it is always preferable to use the number of pipes because the fact that in case you are you are using this method you might find that the waterfront, the way the water will move it will have an uneven front, more water will be moving the middle of the water and the side of the waterfront, when the waterfront will not be uniform as in this case you might be able to have a waterfront which is uniform, so in this case it will be more preferable because all these areas as you go a long in the in the direction of (())(50:22) of the field all these area across, they will get the same opportunity time.

So this is the arrangement which you have in the case of this border irrigation and the borders can either be levelled or it can be graded, so if you have some slope it will be graded level graded border. In that situation you might find it necessary to have collection ditch also which will collect the surplus water but if you level border in that case the water might not be coming out you will let the water to stay for a sufficient period and that will be decided by what type of soil you have, if you have clay soils you might like to give more opportunity time for the water to infiltrate into the soil.

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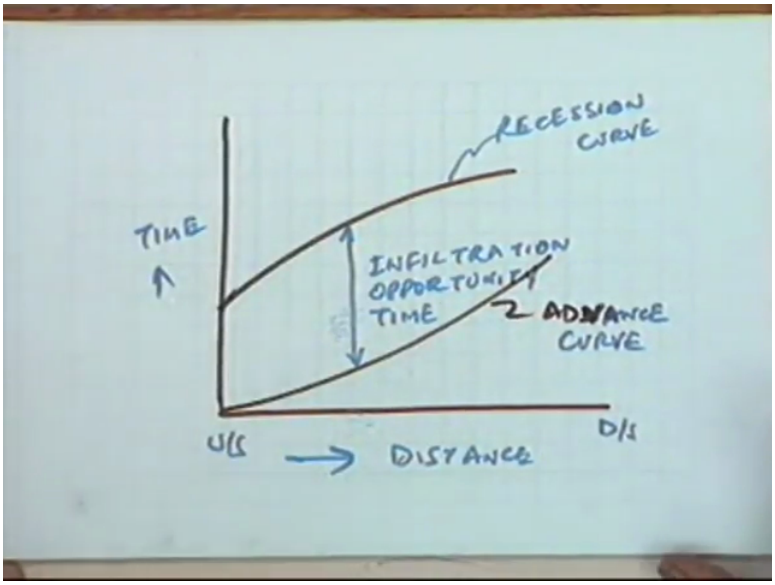

But in general if you try to let us try to look at the various phases of the movement of water in general you will find that there will be a there will be a stage where you have advanced, this is the advanced curve this is giving you the way the water is moving from the upstream

end to the downstream end and then you have a recession curve which gives you the variation, how the water recedes from various locations of the field, now these 2 curves are very important and knowing how much is the… At any location of the field how much is the opportunity time, this is what is called infiltration opportunity time and that is what decides how much infiltration will take place at a specific location of the field. This is the distance from upstream end to the downstream end and this is the time, okay. Any question?

Students: (())(54:17) will be like this or all these it will be, in the practical condition also this will be so much…

Her question is that is a theoretical curve or is it is being observed in practice also? This is a typical curve which might change when you go from one soil to another soil, so this is I have just given a typical but it will belong to some soil. The shape of these 2 curves, the advance curve and the recession curve will change with respect to the other characteristics like what is the slope of the field, what is the type of soil which you are using and but in general you will find that this is what will be observed in the field also.

The shape and the exact curvature these things will depend on many other properties that will see when that is what is a the basic crux of the whole design when you are saying that you want to design the irrigation method under a specific irrigation method what you want to design? You want to design the basic aspect at the infiltration opportunity time should be uniform along the length of the field that is the basic crux of the or the basic requirement of the design if you can keep that infiltration opportunity time as uniform as possible throughout the length of the field then you have achieved the best possible design, okay. Thank you.