Water management
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Lecture No 18
Irrigation Methods (Contd.)

We have been discussing the various methods of surface irrigation under the forces of gravity, all those irrigation methods which we have look at so far the border irrigation and the basin irrigation we have seen in details what other various circumstances under which they are suitable.

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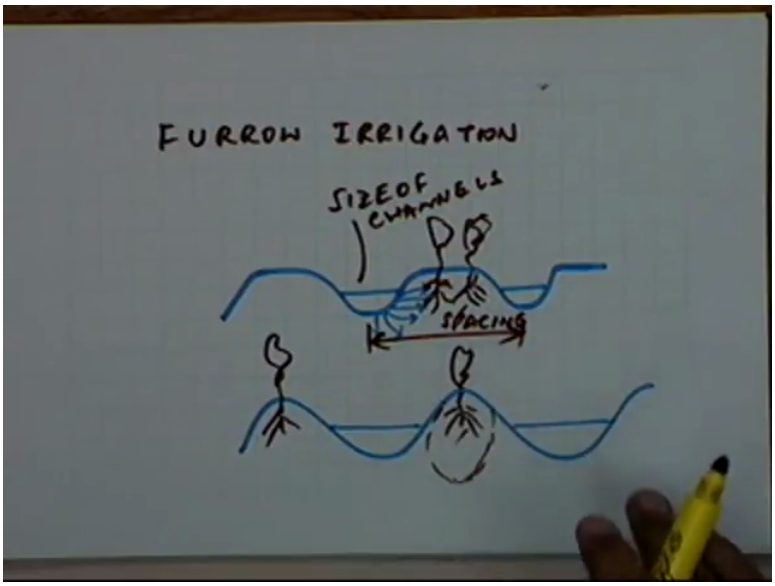

Today we will start looking at another method which belongs to surface irrigation method which is known by furrow irrigation. You must have visualise that the previous 2 methods we had gone into the details and we found that the check basin or the basin irrigation method is quite suitable when you have the soils which are either very permeable soils or they are very impermeable soils, either they are fine soils or they are the light soils, does that method can be used under those circumstances? But we also realize that there is a situation where you have some props which are which are quite susceptible to decay or to injury under situations where the water is getting collected and standing for a long duration.

So cater to those situations these methods are age old methods we are trying to peep into what would have been the way these methods have come into existence, so for catering to those type of situations it could have been felt that lets thing of some ways and means by which we can we can ensure that the water is not made to stand over the surface of the soil

but it can be still made available to the lateral literal moment because the water which is made available in the soil as we have seen that the deficit in the soil will ensure that the water moves from the with respect to the gradient, the potential which is available in the soil, the water will move from the wetter area to drier area, so that situation can be it can be made use of and that is what is exactly happening in the case of furrow irrigation method.

You construct the furrow, let me plot as it can be different shapes of these furrow not necessary that it has to be like this only, it can be a can be another situation where you have another type of cross-section, you might have something like this. In these furrows the water is water is made available in these channels, these are the cross-sections the thing which I have plotted here there is the cross-section view of these furrows so if I make the water available in this in these channels, these channels are the channels which are created and then the tendency of this water will be to move in the lateral direction, so the water can be spread in the lateral direction as well as they can be spread in the vertical direction.

This moment of moisture from these channels in to these areas will make this soil wet and then the plants can be grown in these areas, here you can have the plants which can be grown in this on these ridges. Now this area is getting water not in the same manner as it was getting in the case of basin and the border irrigation situation. This water is obtained, this soil will the moisture level of this soil will increase because of the water available in this channel, the adjoining channel and the moment of this moisture in the lateral direction that is the basic difference in the base method and the previous 2 methods which we have considered that in those methods the moment of the moisture is in the vertical direction because of the fact that the water is moving over those the fields in the form of a sheet of water whereas in this case the water is made to move in these channels and from these channels the water moves in these areas which are drier areas and the lateral direction as well as there will be some moment of moisture in the vertical direction also and the crop will be getting the moisture from this zone.

This will give opportunity for the crop to have a better irrigation there will not be any stage where the water will be chocking the total soil, the soil will always be having in the ports lot of air available, so all those some crops which are which are susceptible to the inundation of water in terms of their growth, in terms of their quality of yield which they can give all those crops now can be catered to using this specific method. So now if you let pay also tell that the

spacing between this and their designs which ultimately will be going in for. What will be the various aspects of design?

The aspects of design will be what should be the size of these channels? Or the size of these furrow, the spacing between the 2 adjoining furrows that spacing will decide how much is the area available on the ridge, so depending on that you might be in a position to even have in some cases to roles of the crop instead of one. All these things there are many other features which will decide whether you should have 2 rows because it is also a function of what type of crop? Which crop is going to be grown here? What will be their requirement? What type of soil you are having? Because the if you have the spacing between these 2 channels is too wide, now if that happens…

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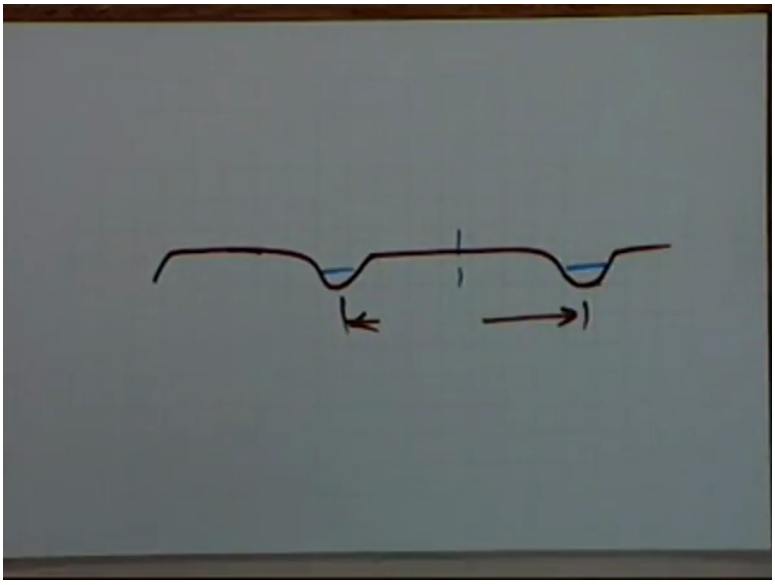

Let me say that you have a situation where you have a you have created something like this, now the spacing in the 2 channels is too wide, it might be difficult in this situation for the moisture to move in the lateral direction to an extend at least if you provide the water in both these channels at least moisture from this end should be able to reach up to this level from this channel should be able to reach up to this level and that will be a function of what is the what are the characteristics of the soil?

We have seen that the texture as well as the structure will decide how much what can be the possible moment of moisture and that is going to be the deciding factor in finding out how much is the possible spacing which we can provide then at the same time the other parameters will be the size of the stream size again, what stream side should be made to pass

through the channels that will be a function of again what is the infiltration capacity characteristics of the soil? What is the gradient available? How much opportunity time is required and all those things means the characteristics or those design parameters will remain similar but they will be subject to some of these constraints which we are looking at.

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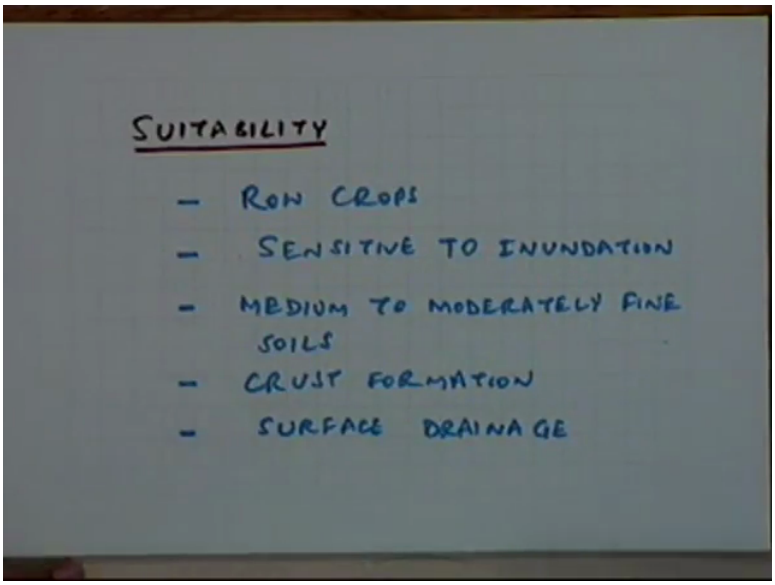

Having understood this now let us try to enumerate the suitability conditions under which this method can be suitable though we have already mentioned most of those things. First thing is that you can use this for row crops, you can use this method for those crops which are sensitive to inundation where you have to in some cases if you want to use this method then it might be having the standing water available for a longer period and then because of that standing water it might influence the yield of the crop.

This can be used for the soil consideration the medium to moderately fine soils, these soils will normally have quite income is in relatively will be having high holding capacity, the moisture holding capacity is much higher in these soils, so these soils wherever you have these soils we have seen that the methods like border irrigation method was not a very suitable method under these circumstances and though the check basin method was quite suitable but then in that case you are having smaller areas, you are having smaller fields where you are making the water stand for a longer period for letting the water to penetrate into the soil through infiltration whereas in this case if you have such a situation that your crops are not suitable to that those environments which you are creating by adopting the basin method then you should use this method or those similar soils.

There are some situations where you have the problem of crust formation, so if crust formation, crust formation is in some soil if the water is standing for some period when it dries up then the top soil will be will you will have the crust formation, it will have a tendency to just old together and there will be cracks on the soils and it will have a tendency to just breakup in the form of thick cakes, so that crust formation is quite bad if it is if there is being formed in the area is because that might influence the later on infiltration.

For those soils this method can be used because when you are wetting the partially area in this case, this is the only method of surface irrigation utilising the gravitational flow where you are not wetting the whole soil, you are wetting part of the soil so from that angle the crust formation problem can be tackled by using this method. Then this is also suitable where you have problem of surface drainage then some situation if the, if the area is having a lot of rainfall, the natural rainfall occurs quite frequently and with the conventional methods with the other methods which we have discussed so far basin as well as border irrigation, using those layouts you might find it relatively difficult to drain the whole area of that water which is accumulating because of the rainfall, the excess rainfall whereas in this method the drainage, the natural drainage will be very fast all that water which is being collected it has a tendency to drain off the area in a much better manner than with the previous 2 methods.

Now here again it may not be so in all the layouts, we are going to discuss various layouts which are possible under the furrow irrigation method but if you have an area which is flat area which is not having any grade, which is not having any slope then there will not be any difference much difference in the 2 even this situation than the drainage might not be very fast and very good whereas if you have the slight grade then this method, the furrow or the way you have constructed those channels, those channels will help in draining of the area very fast but there has to be some great, some minima grade which will ensure that the water is not standing there for longer period, it should be drained of the surface, so in general the surface drainage facilities naturally are much better when you go in for furrow irrigation system.

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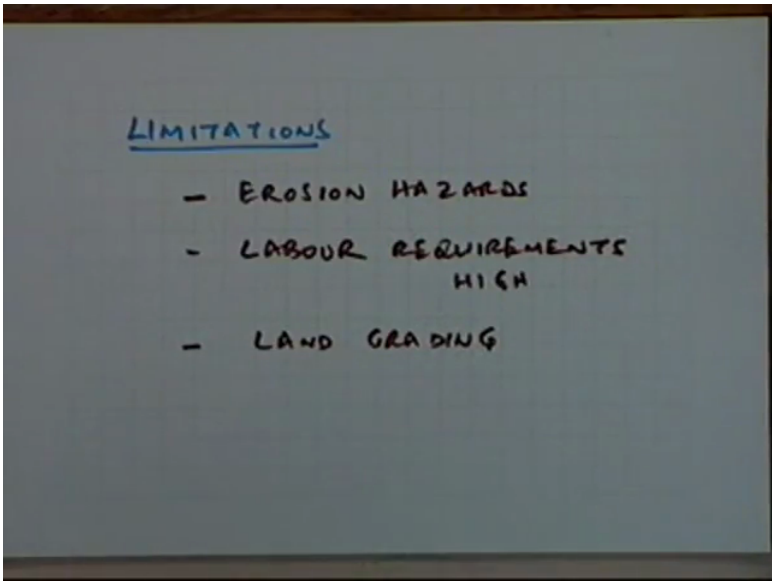

In terms of the limitations, what are the various limitations which might be encountered, the limitation of erosion have, this erosion hazard will be of the same order of magnitude because function of slopes, so in this method also if the slope become very steep then in that case erosion problems can be faced and your design will be constrained with respect to the erosion problems. Those limitations are the same as we have in the case of the previous 2 methods.

Let us look in terms of the labour, the labour requirements they are high in comparison to the previous 2 methods which we have looked at because in this case one is that you have to ensure that the grades are quite proper because in each individual channels how the water moves that is going to decide how much water will be penetrating into the beds of those furrows, so you have to take care of each individual channels and moreover the water is also being supplied to each individual channel whereas in the previous case you are supplying the water in the sheet to the whole area, so that way the simply the application requirement, the labour requirement from the application point of view is also going to be more in comparison to the previous 2 methods.

The land grading also is going to be much better than the other 2 methods, the grades in the furrows they should be quite uniform so that you can a lengths which you are selecting for the furrows they have to be big and only be the relevant lengths, the design lengths which we have come out with through the design methods those can only be applicable if the grades are proper throughout the length otherwise if the grade is not proper in the other case maybe that if the grade was not proper in the case of border it might create a hump where you do not have a patch where you do not have the water reaching only at one point or if there is a low

depression you might get excess water whereas in this case is the grade is not proper, if the graders not maintained it might not that the water might not reach in the remaining part of the furrow, so though you are handling each individual channels separately by the same time that channel is providing water to the total maybe couple of rows on both sides of the channel. It will have its own repercussions if the grades are not given properly and you have to look at those requirements very closely.

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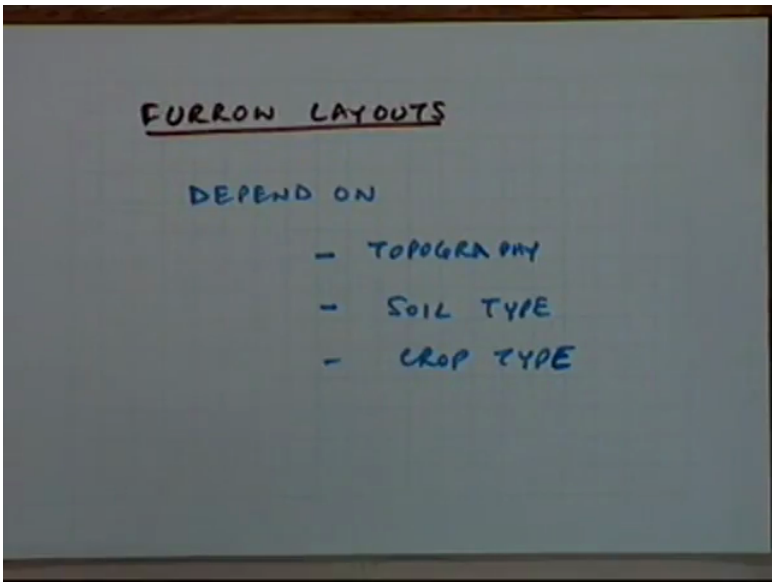

Then let us look at the various layouts which are I just mentioned that under various different conditions under different situations you might feel like adopting different layouts, so what are the various layouts possible. Before we go in for the layouts let us try to look at that what they depend on? Why you require these layouts? Were you requires different formations of these furrows? They are basically influenced by topography, soil type and crop type these are the 3 major factors which will influence which will dictate that which layout is this better than the other layout.

In some cases if the existing topography is such that you do not want to unnecessarily spend money on changing the layout, if the topography such that you can utilise the existing layout or the existing slopes, the prevailing slopes then I think there is nothing like that because by that by doing that you are saving lot of effort, unnecessary effort. You are also ensuring that the soil is not disturbed because in these land forming processes it will take lot of time for the soil to replenish its fertility. If the soil is disturbed, if the topsoil has been replaced by the soil which is from the lower horizons or the lower layers, so those low layers are not as fertile as the top player was as we have discussed earlier also. Whenever you go in for land forming

you are cutting the soil from some area and dumping it on to the other area, so at both the places let me make this point clear.

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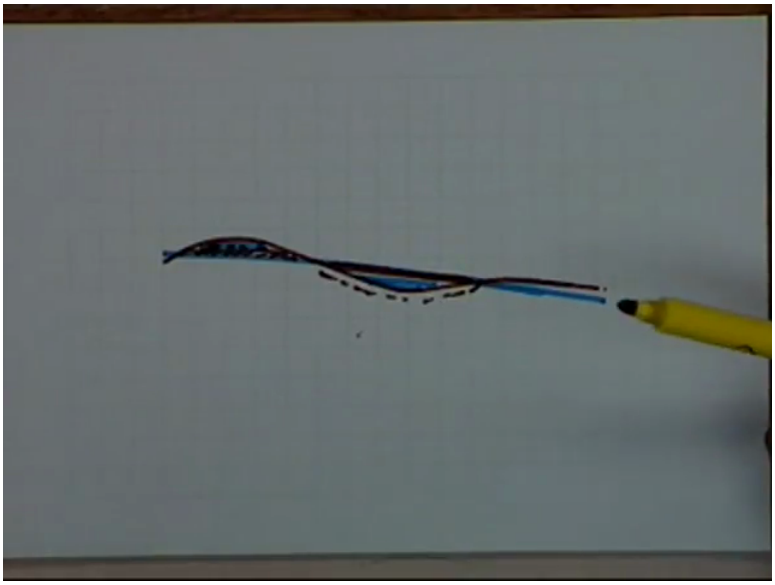

We have discussed that if you have this is the layout the existing layout you want to give a grade, you want to give a grade in such a manner that this is the grade which you want to get, this is a slope that you want to get the uniform slope in this area, so what you can do is you can remove this soil from the top and dump it on this because this is the filling area where you want to do some filling, this is the area from where you want to cut, this is also the area from cutting. You remove these soils and keep on dumping on this, so after sometime you will find that to reach this grade you have removed the soil from this zone which is the last strip that has come on the top of this. Now this is the most infertile soil which belonged to a lower depth that has been put here, so the existing soil which was fertile in this part, the existing soil which was fertile in this top part both have been dumped on this area, here you have expose the lower soil here you have dumped onto the fertile soil so in both the places you have problem.

So whenever you go in for any such land forming procedure you are indulging in this process that if possible it should be avoided because that is also from the angle of soil fertility it is very important and if you cannot avoid that then there is no other way because you want to get this grade to ensure that your applications, the water applications efficiencies and those other related things they can be enhanced. You can have better management of the distribution of water but the first priority is to be given to anything which can be done using the same existing topography, so if the undulation is not very excessive if you can use some

method by which you can avoid any alteration in the land topography you can you should use appropriate methods.

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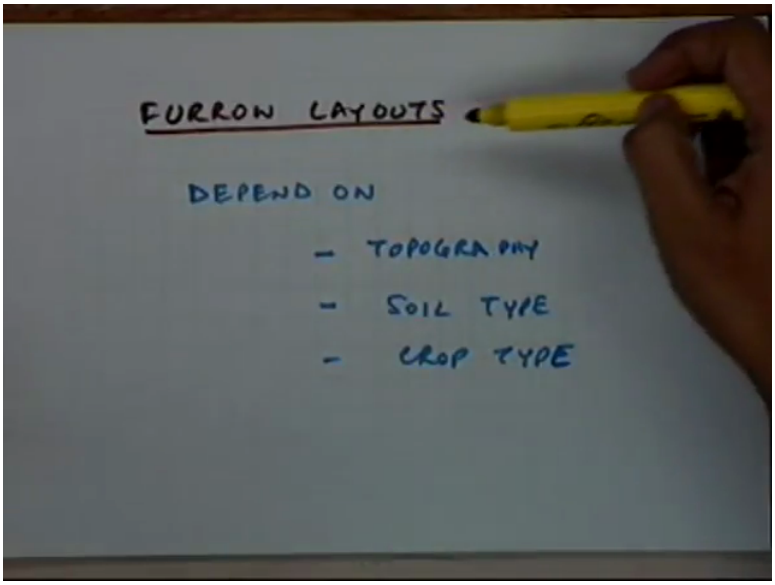

So there are some furrow layouts which use the topography in the same form in which it is available on that location. Then the soil type again depending on the soil type depending on the variation of soil type if you have soils which are having very low infiltration capacities you will have to make a layout which is having very minimal grade or even a flat, you should lay before furrows in such a manner that they are almost on the flat land there is no grade given to that, so that you can let the water be blocked into these the total length of the furrow, you will fill the furrow block the water and let it infiltrate taking the long period which it requires because the soil are very fine soils, so from that angle you will then lay the furrow in that manner.

Now the soil type can also dictate how the furrows should be laid, the crop type this parameter can also be sometimes they can influence the layout of the…I had discussed that in some cases if the crop is such that you can have close spacing between the 2 plants or more than 2 plants then you will try to, try to keep the spacing between the furrows with higher towards the higher side so that you can have more than 3 rows or more than 2 rows of the same crops. The crop can sometimes or in some cases the crop is such that it can be best grown if there is only a single row and the spacing between those 2 rows then in that case you can have the furrows laid in such a manner that you should have only the minimums spacing between the 2 furrows and there will be only one plant put on each ridge or the bed of the crown part of the furrow.

All those parameters put together will decide what should be the most appropriate layout of furrows in a particular area. What these layouts can be…now let us have a look at the common layout there can be many there is no end to that because at different location you might find that there is this one which can be most appropriate but some of them are the ones which are known to be common layouts which are being experienced, which are being used by the farmers in general.

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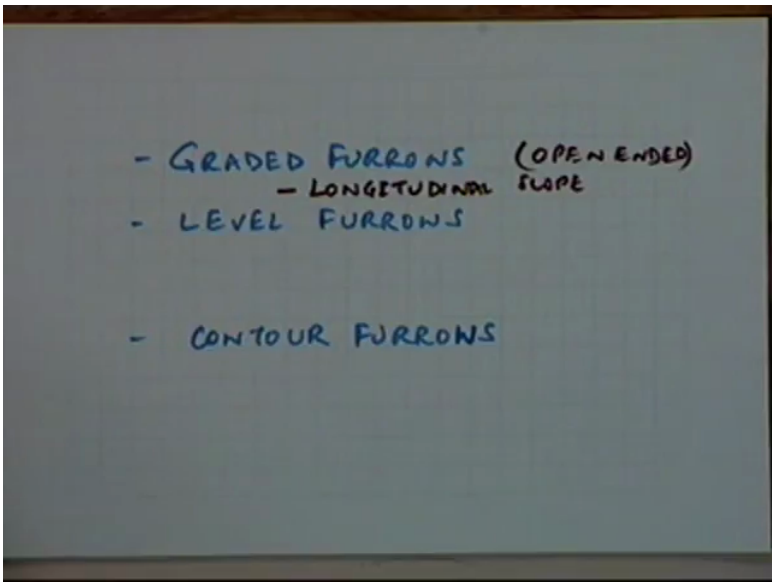

These are the graded furrows then you have level furrows, you have contour furrows now these 3 are the most common layouts. As the name suggests the graded furrows her those which have a longitudinal slopes, these will have longitudinal slope, now in this case a soil type since you are giving a grade to the furrow you will have those soils these will be suitable for those soils which are moderately having moderate infiltration rates, so in that case you will be in a position to get some water in filtered from the channels into the lateral areas even though the slope is there they will be, they can be open-ended, open-ended means that are not having a blockage in the downstream side, you let the water flow continuously but for that you have to have a very proper grade you cannot go in for open-ended furrows if the grade is not proper.

So for those areas where the where you want to use open-ended follows the length again, the length how much length you can go in for is a function of the grade, is a function of the soil type, is a function of what is the stream size which you are using and those are the features which we will look at when you will go in for the design because the design is nothing but a combination of these parameters that if you have these parameters …for example stream size

is something which may or may not be in your control as a farmer and our situation in India, a farmer will be getting a stream size which is the prevailing stream size which is being made available by the irrigation department or by the by that specific project what is the stream size available and this stream size he might not have any control on.

If you want a bigger stream size you might not be able to get that stream size unless he has the water availability is within his control he has a tube well which the size of the capacity of that tube well trip that can be weight and if he can… The maximum capacity if it is known and that is the maximum level of stream size he can choose below that he can always choose that stream size by diverting the water into 2 different streams, so he can reduce the stream size provided he has the control over the maximum available. Similarly there are some other situations where some of the things might not be under his control, so if the stream size becomes a fixed thing then the remaining components of designs are that if the stream size is fixed knowing the type of soils he might have to find out how much is the length of the furrow he can go in for and that also will be influenced by what type of crop he is using.

He might have to… he might like to know that what is the spacing between the 2 furrows which will give him the best results, he might be interested in knowing what should be the best grade to be provided because if he wants to go in for grading of the area, what slope should be given? So in case the slope is a prevailing slope he wants to use the prevailing slope then the design will be having a constrained on the slope as well. If the slope is fixed, the stream size is fixed he will he can only play with the size of the or the length of the furrow and the spacing between the furrows, so that way the different combinations even the case of designs there is no fixed being, it is always subject to what are the constraints available under the specific circumstances?

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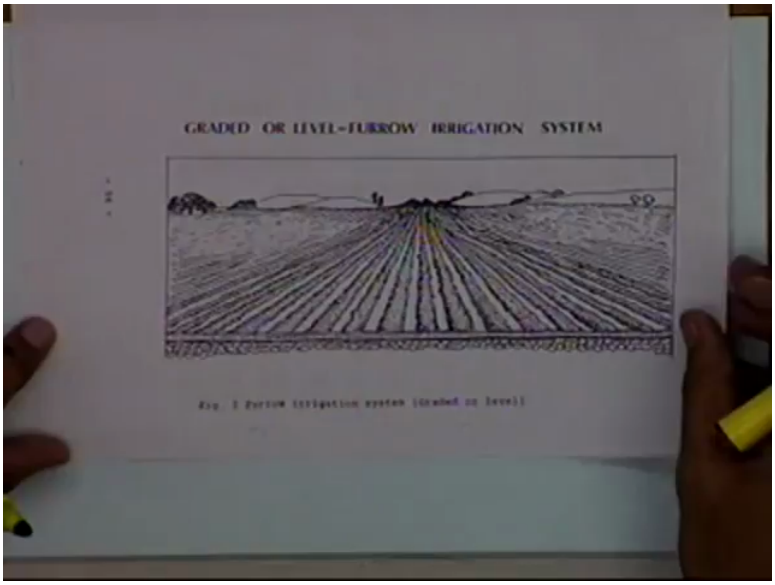

Now the level furrows or let me first show you the graded furrows, this is a picture of the furrows, in this case you might not be able to make out very much whether if the grade is there not, so this picture maybe of a level furrow or graded furrow but this is how they have been put. These are the channels which are where the water is to be made available and these are the ridges where the crop will be growing. This is what I had shown in… I had only shown the sectional view of this, so in general these will be the length of this is going in this direction and the water is to be made available…this is the supply ditch the water can be made available from this ditch into each of the individual furrow.

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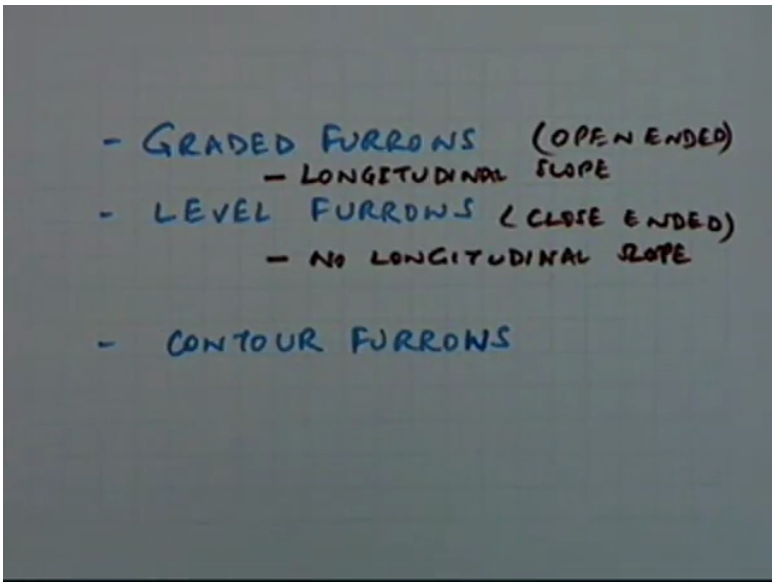

In the case of level furrows these are the furrows where there is no longitudinal slope, the grade is 0 you do not have any practically level furrows and they will be normally close ended, so that you can check the water once the furrow the total length is filled with water is the water will take long time to infiltrate give their opportunity by blocking the water and letting it stay within the channel, so that opportunity time will ensure that there is a lot of moment, lateral movement of water from the channel into the soil and for that purpose since the soils are fine soils the rate of infiltration are very low you make this provision to have the level furrows. Then the contour furrows are those furrows where you are making use of the natural topography and you laid the lay the furrows along the contours by the same time you give slight grade in the longitudinal direction of the furrows, so that the water can move from the upstream end to the downstream end.

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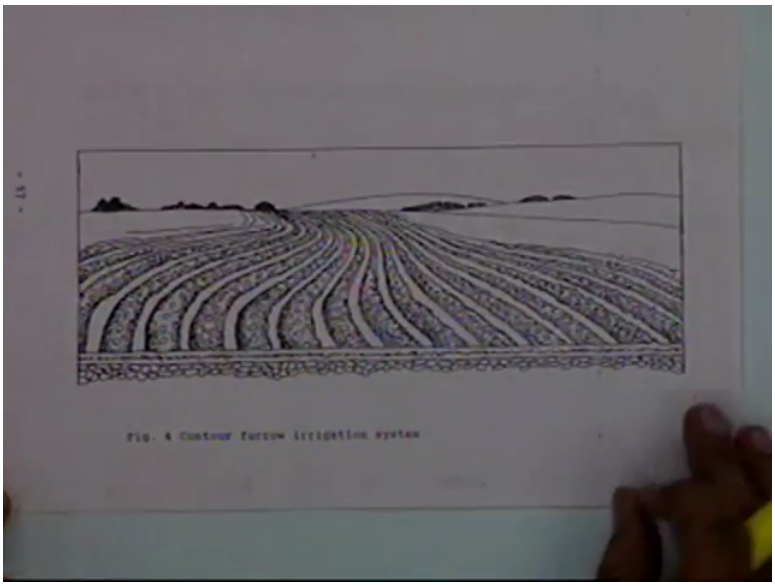

Let us see a picture of a contour furrow you can see here that it is using the natural topography of the area and in this in these situation the topographic has to be very mild mildly undulating topography you cannot use it on highly undulating topographic areas, so if there is very mild natural slopes you can avoid doing any land forming on that by going along with the along the contours and laying your furrows along the contours by the same time giving slide grade that means you might not be going exactly along that contours, you will be slightly going away also show that you can get the grade, the desired grade, so you will be going while going in the longitudinal direction you will be slightly going to the lower part of the contour, so that at grade is can be obtained again the level of grade required will be a function of the soil type, how much infiltration rate is desirable and that can be obtained and

that is what the contour furrow irrigation system looks like and there the main idea is the main advantage that you can try to make use of natural topography thereby reducing the chances of losing the fertile area and also avoiding the unnecessary labour or the infrastructural of the land forming expenses which have to be made if you are to go in for the grade to be to be required in the graded furrows or even in the case of level furrow.

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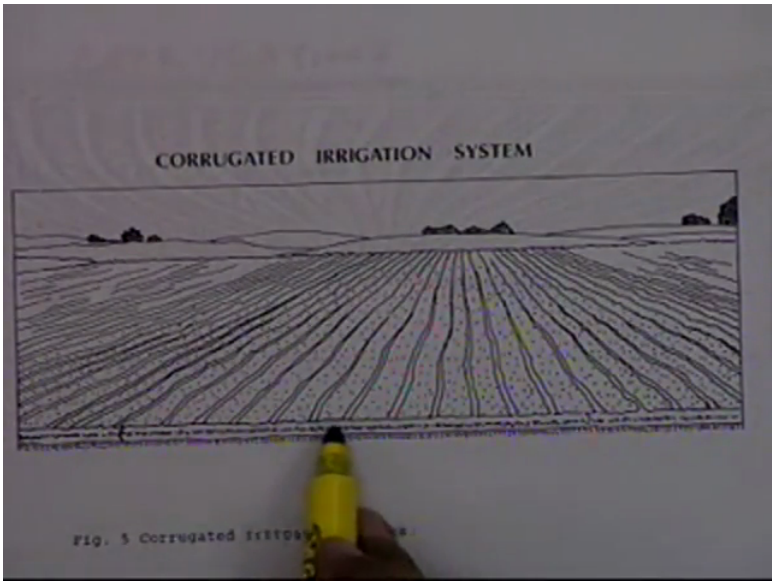

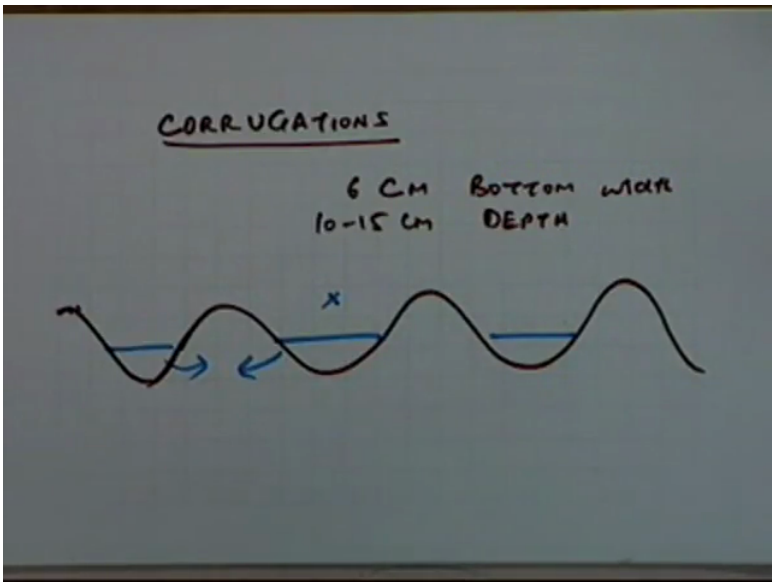

With that I have giving you enough idea about what we do in the case of furrow irrigation but there is one, there is one class of furrow irrigation which is sometimes put to use and is known as corrugations, these corrugations are nothing but they are the furrows of smaller size, the cross-section area of these furrows is very small in comparison and this is a picture

of that in which you have these corrugations which are nothing but they are small furrows and they have spaced quite far apart. Where do you use these corrugations?

In some situations you will find that either the crops which want to grow using the furrow method they are closed growing crops see you want a wider bed where you can grow the crop instead of having row crops you will use it for the closed growing crops then you go in for corrugations or sometimes way you feel that the amount of water availability is very small is quite (())(44:54) but at the same time you can your soils are such that you can cover a wide area, the soil can penetrate in the lateral direction up to a wider spacing then you can use this corrugation method.

In some cases when the soil salinity is a problem in the water which you are using is creating lot of salinity problems again the corrugation method can be quite handy because by doing that you can reduce the quantity of water to be used and in some situation you are also calling them there is not the nomenclature remains the same basically there is a way in the other the furrow irrigation methods there are sometimes situations where you do not supply the water in every channel in all the irrigation, you supply the water in alternate channels for example what am trying to say is that because when I mentioned about the salinity problem, that salinity problem can also be tackled in some situations by ensuring that if these are the channels in the normal furrow irrigation method you are supplying water to this channel in one irrigation, in the next irrigation you do not supply water in this channel, you supply the water in the other channels which were which were not supplied earlier.

So once the water is moving from this and to this side and the other irrigation is moving from this side to this side, so that can also be is also one way of managing your resources in such a way that it can be used in the water (())(47:08) you do not want to but at the same time you have to look at is it sufficiently satisfying the requirement of the crop, how much is the deficit which is still remaining? So all those things can be looked into, now this this way of supplying water is called alternate method and the corrugations, the order of magnitude of these corrugations, the size can be you can get an order of magnitude feeling about the size is 6 centimetre bottom width, 10 to 15 centimetre depth of these furrows or the corrugations which you use.

In the side slopes can be one is to one which you normally use in the case of corrugations, so with that I think will conclude the topic on furrow irrigation, what the furrows are? What the furrow irrigation method involves into and will deal with the remaining 2 methods which are

not very common method but at some in some situations they are being used which is the contour levee or the contour ditch method will discuss them and then we will go onto other methods of irrigation which are the 2 classes, one is the subsurface irrigation and the pressurised irrigation methods. Any question at this stage? Okay, thank you then.