Irrigation and Drainage
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Lecture - 55
Tutorial

Friends this is lecture number 55 basically the Tutorial whatever you probably the land during this is this week. We are going to see some of the problems and the solutions related to you know I had a logic design, hydraulic design of this surface drainage system and then cost and benefit ratio whether the drainage project is economical or the drainage project is you know worth thus we are going to discuss in this examples.

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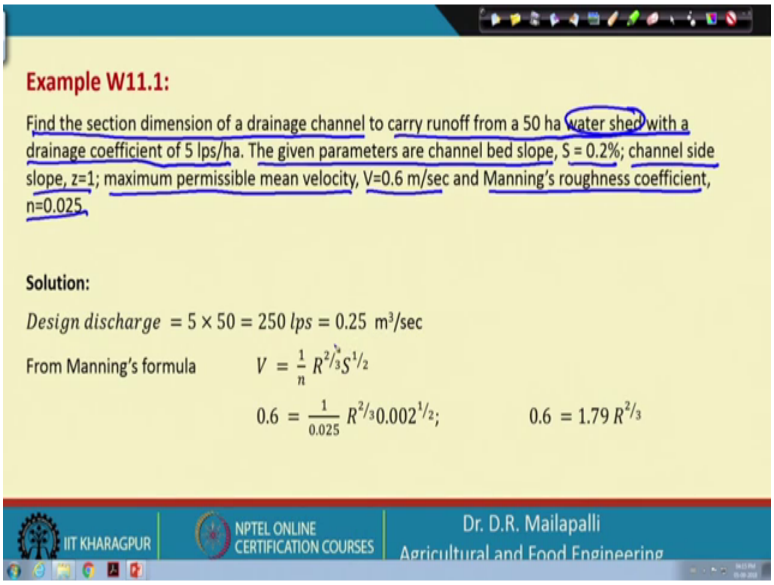

So, here I said this example number 1. So, the find a section dimension of drainage channel to carry runoff from a 50 hectare water shed, this is water shed, with a drainage coefficient of 5 litre per second per hectare. The average parameters are channel bed slope, that S is equal to 0.2 percent channel side slope where z is equal to 1 maximum permissible mean velocity that is V is equal to 0.6 meter per second and manning's roughness coefficient n is equal to 0.025.

So, in this the peak runoff ridge is given and manning's n and other parameters are given. So, only thing is you have to find out the design parameters of particular channel like what is breadth? And what is width? What is top width and a bottom width all those things. So, let us see the design discharge that is say 5 litre per second right per hectare and area 50 hectares.

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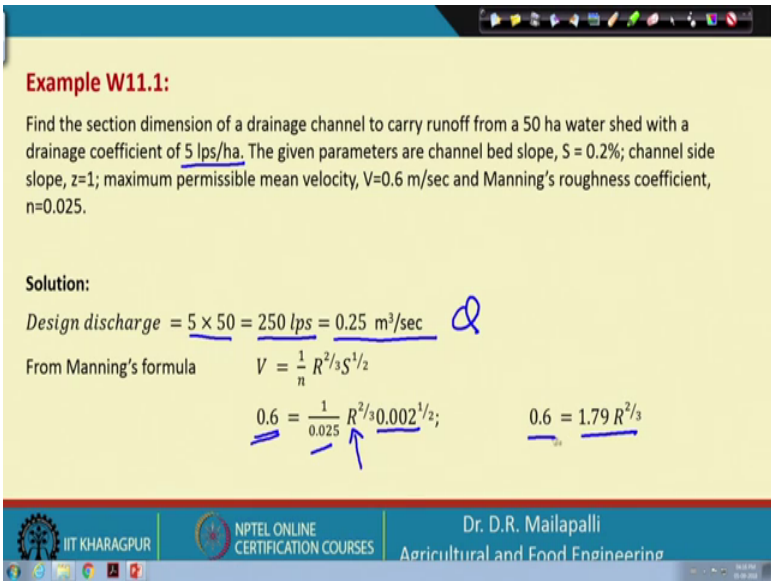

So, the total will be like 250 lps like 0.25 meter cube per second this is the capital Q and the manning's formula V equal to 1 by n R power 2 by 3 S per half. So, V is given 0.6. Now n is 0.025 and s is 0.2 percent that is 0.002 and only the unknown is you know R. So, the R you can get 0.6 is equal to 1.79 into R power 2 by 3. So, now you can find out R from this equation.

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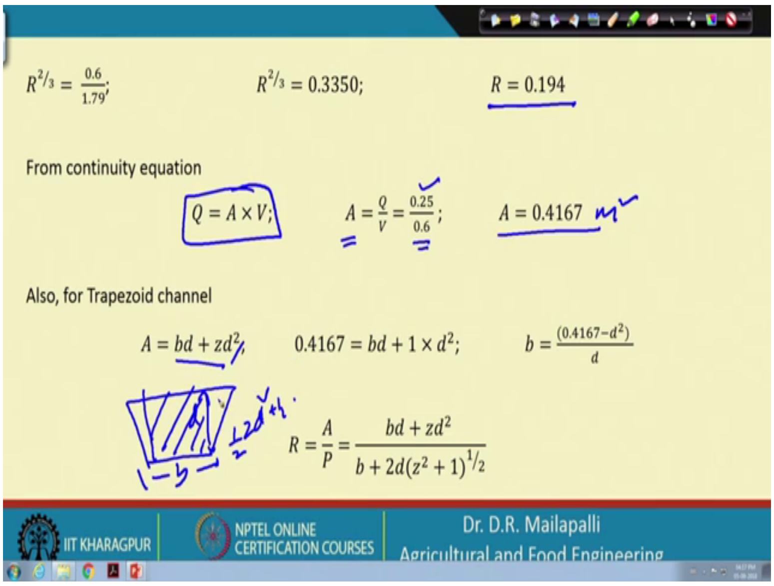

So, R is equal to here 0.194 from continuity equation Q is equal to A into V. So, where A is equal to Q by V we know the Q value right and the V is 0.6 now A is equal to 0.4167 you know meter square. So, now, A is equal to bd plus z d square.

So, this is if you consider the channel as trapezoidal channel. So, this is b and this is the d right. So, the bd so, this is a b d cross section and f z d square right f z d square plus f z square. So, that will be z d square. So, this will be now because the two triangles here.

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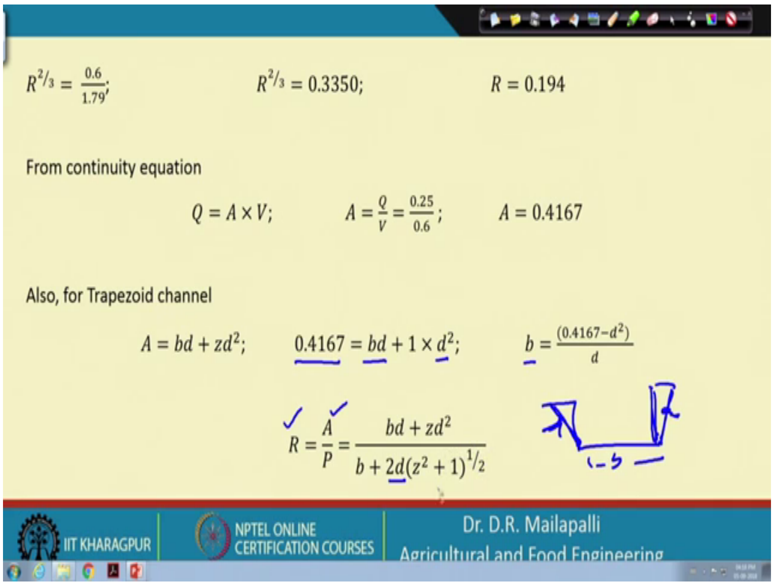

So, now substituting the values a value 0.1467 in bd plus z is 1 right side slope and d square. So, b is equal to a function of a d. So, now, R is equal to A by P you know since R we know, A we know right. So, the P like a perimeter so, the perimeter will be what this is a b and these lengths. So, it is a part of triangle right so, these lengths. So, that is 2 d plus z square plus 1 I mean the square root. So, you get this is a P.

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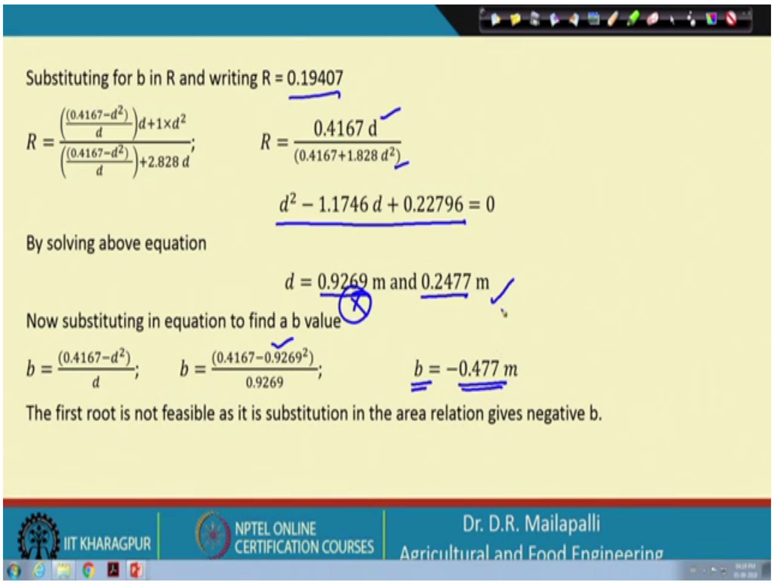

Now, substituting values for b and A and R right so, you get the values like R is equal to so, putting the all values. So, R is equal to d and this is also d right substituting R value as 0.19407. So, this equation, this is a quadratic equation d square minus 1.1746 d plus 0.22796 is equal to 0. So, it has two roots right. So, one is a d 0.92969 and 0.2477 meter. Now let us substitute any one of these that for example, b is equal to 0.9269 square right. So, now, sorry d is equal then you get b in negative terms. So, then this is not the value. So, we have to take 0.2477; so, taking the point substituting the d is equal to 0.2477.

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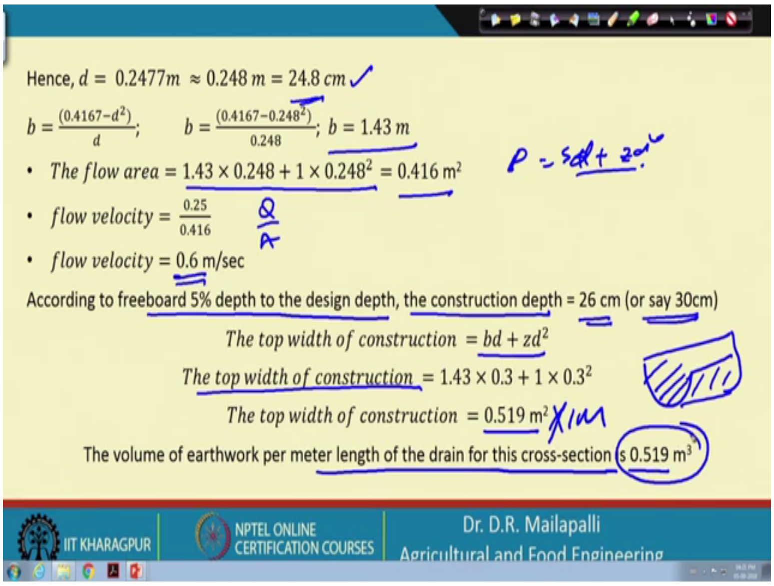

You get point 0.2477 you get d b we are b value 1.43 meter. So, 24.8 centimetre is depth and the breadth is 1.43 metre so, the flow area. So, now, the flow area substitute the in our area sorry P value that is the area perimeter. So, the perimeter will be the bd plus z d square right so, substituting that you get 0.416 that is a flow area, then flow velocity that is a Q by A right.

So, you get the flow velocity 0.6 meter per second. According to the freeboard so, this is a 5 percent depth to the design depth like freeboard you have to increase the free board because this is really important when there is siltation the water level definitely raises. So, we need to accommodate the raise by giving the 5 percent freeboard generally for soil conservation structures it will go up to 20 percent.

So, now depth d is equal 24.8. So, let us considering the 5 percent free board 26 centimetre you can go up to 30 centimetre same. Now top width of the construction bd plus z d square there is a top width; in the top width would be 0.149 meter square, this is the top width then the volume of earth work perimeter length of the drain for the this construction will be 0.519 meter cube. So, this is per like this is a 1 meter length. So, this is a flow a cross section right and then if you can put 1 metre length. So, the earthwork volume of earthwork will be 0.519 meter cube.

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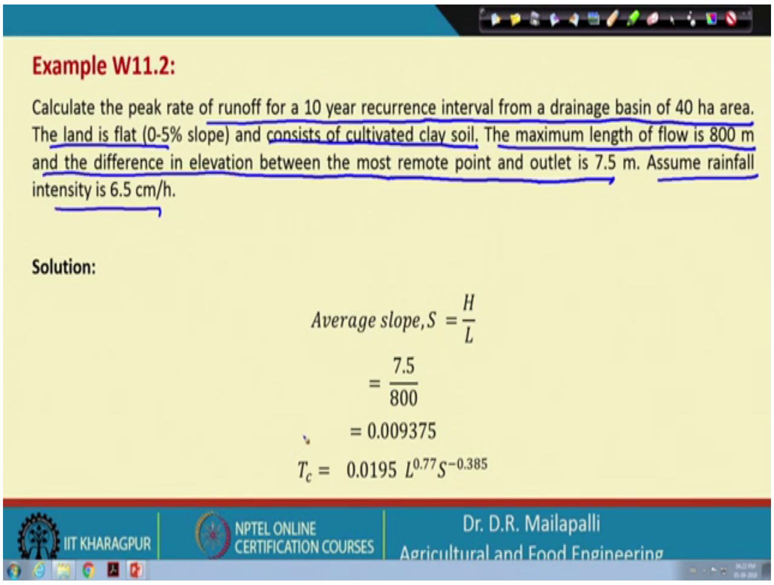

So, this is example number 2 in this we are going to find out what is the discharge I mean what is the peak discharge. So, here the, calculate the peak rate of runoff from 10 year or recurrence interval from a drainage basin of 40 hectare area. The land is flat so, it varies from 0.5 percent slope it consist of cultivated clay soil or the maximum length of flow is 800 meter and the difference in elevation between the most remote point in the outlet is 7.5 meter. So, assume rainfall intensity of 6.5 centimetre per hour per hour so, in our previous lecture.

So, for finding out the peak flow rate so, we have like rational method, in the rational method. So, the basically runoff coefficient is one thing and error concentration. So, once we know that I have a concentration that is the duration and knowing the return period you find out the intensity of rainfall that is I and area you know in watershed. So, Q is equal CIA by 360 you get another peak flow rate from the particular watershed.

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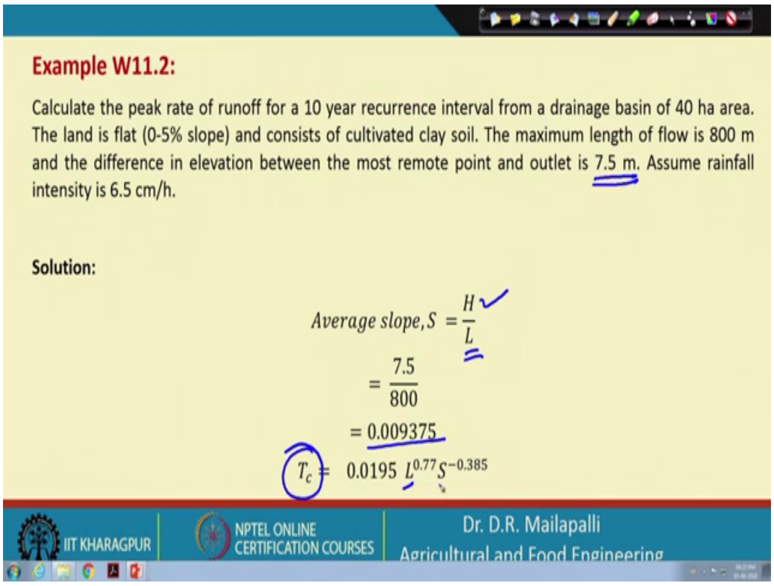

So, here in order to find out T c that is the terror concentration. So, this slope it is given like H. So, that is a different 7.5 meter most remote point to the outlet and then the length of run L. So, you get this is the slope. So, knowing l and s you get T c.

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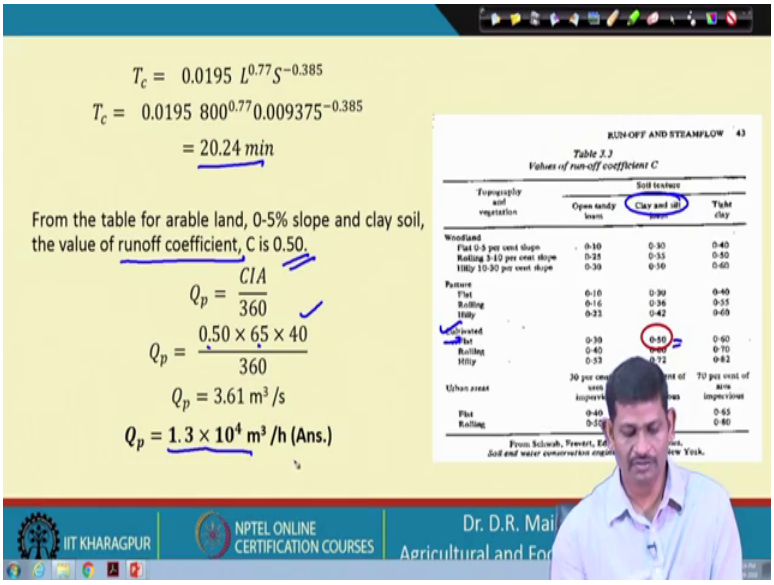

So, T c will be 20.24 minute and then next is the runoff coefficient C. So, giving values if you see in the cultivated land and the flat land and then clay soil so, this will give C is equal 0.5. So, C point 5 and area we know 40 hectares.

So, 0.5 into 65 is given right, 65 what is it annum per hour and 360. So, you get 1.3 into 10 power 4 metre cube per hour is a peak discharge from the particular 40 hectare watershed; and here example 3.

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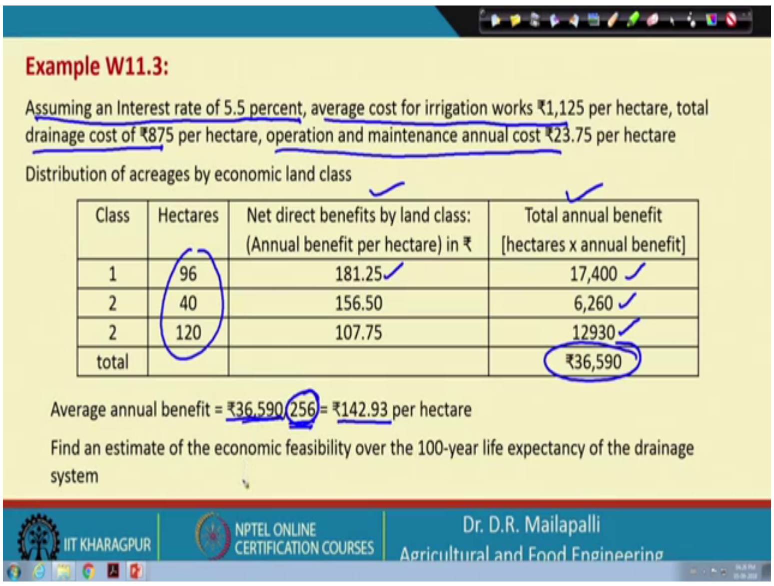

So, this is the drainage project economic evaluation. So, assuming an interest rate of 5.5 percent this is interest rate, average cost for irrigation works 1125 per hectare, total drainage cost 875 per hectare, operation maintenance cost annual cost is 23.75 rupee per hectare.

So, here I mean the area is been distributed and the net benefits by land classes right. So, here therefore, 96 hectares you may get you will get the annual benefits of 181.25 hectare 156.50, 107.75. So, based on the classes, one to second class the classes are based on soil group or the productivity those classes and the total annual benefits.

So, the hectares you know multiplied by you know these annual benefits you get 17400 6260 is 40 into 156. 5 then the total would be 36590 is the total annual benefit from the particular land. So, this is the total buts per hectare if you see. So, the average annual benefit 36590. So, 256 days basically we will use for you know the, what you call farming. So, that is why 256 and you get 142.93 per hectare. So, that is per hectare and then sorry.

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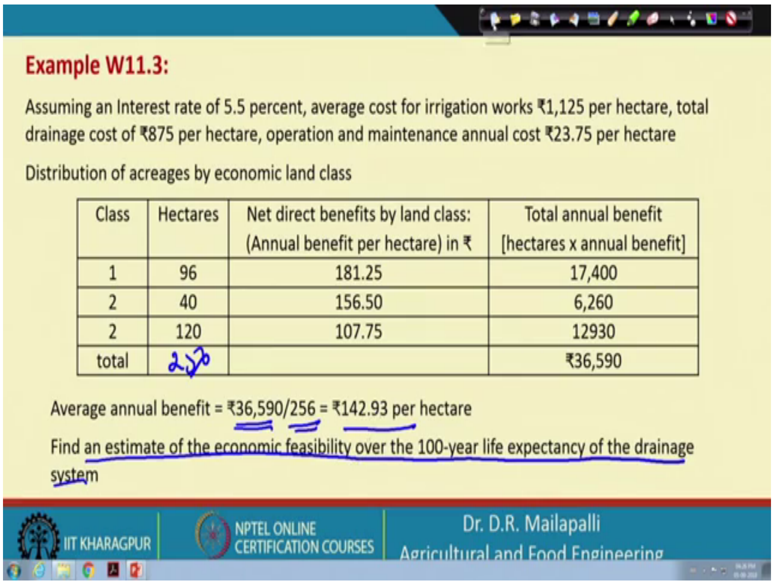

So, this is the total area 256 is the total area. So, this is the total annual benefit 36590 and this is the area total area.

So, this is 256 and 142.93 per hectare. So, find an estimate of economic feasibility over 100 year life expectancy of the drainage system. So, we are asking what is a economic feasibility whether the I mean worth to invest in this particular drainage project or not.

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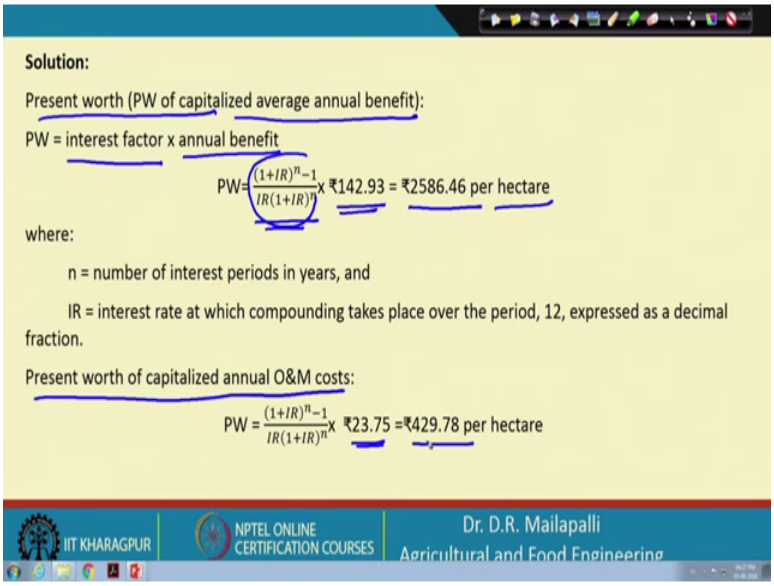

So, for that the present worth that is P W of capitalised average annual benefit. So, that is interest factor annual benefit. So, we know this equation from the previous lecture and multiplied by the annual benefit. So, you get this is a factor this is present worth factor multiplied by annual benefits.

So, you get 22586.4 per hectare is the present worth so; that means, benefits the value of benefits in the present time. So, there will be 2586 and then the present worth of capitalised annual and this is cost right operation cost if you see. So, the same thing so, 23.7 5 is given and present worth will be 429.78 per hectare.

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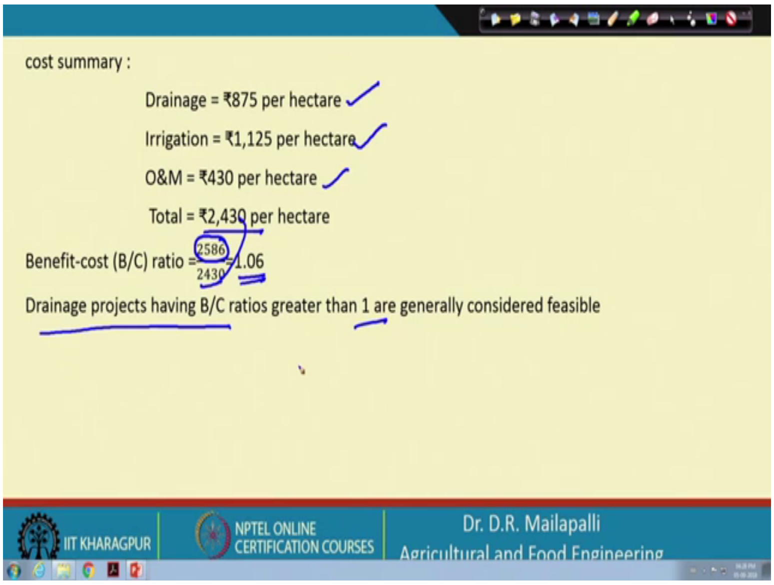

Now the cost summary if you see so, the drainage has some cost 875 per hectare that is given, irrigation cost 1125 per hectare operation maintenance worth 435 hectare the total is 2430 per hectare. So, benefit minus cost or benefits cost ratio so, this is the benefit 2536. So, the present value we calculated and this is a cost here a 1.06. So, drainage project a benefit cost ratio more than 1. So, it is considered as feasible so in this way in these projects the drainage projects. So, knowing the and expectations in 10 years 20 years time. So, those are the benefit. So, those benefits would be you know bring to the present value by multiplied with the discounting factor.

So, then we will compare with the cost and see whether the present benefits or more than the cost. So, if they are more than the cost then definitely its worth to invest in the particular or drainage project and cost benefit ratio like benefited by cost ratio simply more than 1. So, these things are need to be studied before investing in drainage project.

Thanks so much.