Farm Machinery
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Lecture – 59
Machinery Selection and Management Part – II

Welcome students to my lecture number 59 which is in fact, the second part of the Machinery Selection and Management of farm machines. Well, we in the first part we have talked of how we should have for a 20 hectare farm and if you are thinking of a certain set of machines, what should be the concept behind how the machine should be selected from available machines and depending upon their capacity and depending upon, what cropping crop rotation I take and cropping intensity, we are intending to have.

As I said that some of the equipment, which we did not include there could be that irrigation for irrigation, you can have equipment for transportation, you can have equipment, but then when we are talking of managing base and we are talking of the cost.

Now, I have taken here in a problem through, which we will just calculate the different costs of the machine, taking into consideration various aspects of the machine the ownership cost and then the terminus cost and the total cost, variable cost, etcetera. And then how do we find out what should be the actual cost of go in a particular machine irrespective of which machine is we have not taken the cost of each machine, which we took in the earlier part, but here we will take 1 particular type of machine and then where we will go into details of this calculations. So, let us go by the slide which I have.

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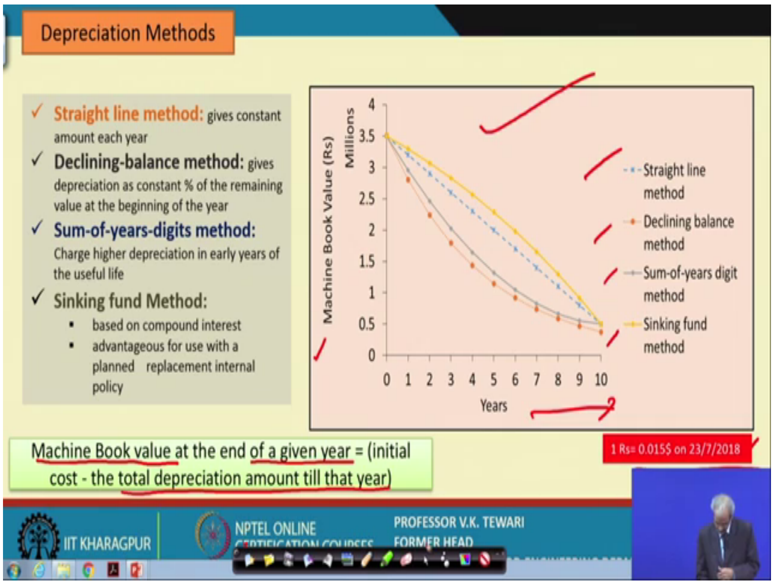

Now depreciation method, suddenly I have put a depreciation method why? Because when you have the equipment one important things, that should be kept in mind is that the depreciation of the equipment starts from the day 1.

So after, you have purchased and you have started using it then, it will start depreciate, now it does not get depreciated in 1 day as such as I say, but definitely you can say the depreciation start from the next day. So, after 1 year what will be the cost of this? After 2 years what will be the cost of this? After three years what should be the cost and its condition etcetera, because then everything has to be looked into.

Now, various methods are there how do you find these cost? So, some of the methods, which are used very you could say available literature and the people use depending upon their suitability as and when required, we have just listed those methods say here, straight line method gives constant amount each year. Now this is one method, which is very widely used and on a thumb rule basis, one can use it and find out, but then see the declining balance method gives depreciation as constant percent of the remaining value at the beginning of the year.

This is another way of looking at it, sum of years digits method charge higher depreciation in early years of the useful life. Yes you can think of because, early years definitely higher depreciation as it goes the definitely it will lesser and lesser sinking fund method has based on compound interest and then advantageous for use with a planned replacement internal policy depending upon what you think.

So, these are the 4 methods, which are generally found out for the because, calculating the depreciation of the equipment that you have thought of and in the when we are actually talking of the, see the remaining book value of the machine at the end of a given here. Then the initial cost minus the total depreciation amount till that year is the book value.

So, if we plot here, now here in this particular diagram, what I have shown is a machine book value. Here add the number of years on this side here. So, we find million rupees here, just for the international audience, we have to convert 1 rupees so, much dollar as on 23rd of July 2018.

Now, this is just an idea for the larger audience of outside, those who understand rupees fine, but those who do not understand for that we have put in million rupees here and the behavior of all these methods are given here to understand. It is not I did not go into details of the discussion of how it happens in all it is very simple to understand.

If you follow any one of the modern methods, you can calculate what exactly is and then plot over the period from 0 to 10 years depending upon what is the equipment. We do not find that any equipment last more than 10 years well you may say that there are equipment, which are some of the equipment, which can be used for 15 years to 20 years, but then depending upon their condition and the repair maintenance and then other parts to replacement of the parts etcetera.

You can use a machine that we do not talk of that because, if you go into that sort of a carcass, I tell you that you will definitely fall into problem because, repair and maintenance will keep on adding up here and there and it will create a very neck pain and so far as the success of the system is concerned. And that is why, we would consider the relevant and the most effective use period of the equipment and that is why, a 10 year period with the number of hours of each one of them are given in the standard books particularly the AC standards ACB, now what we call and from there we are used for our cost calculations etcetera, while selection of machines.

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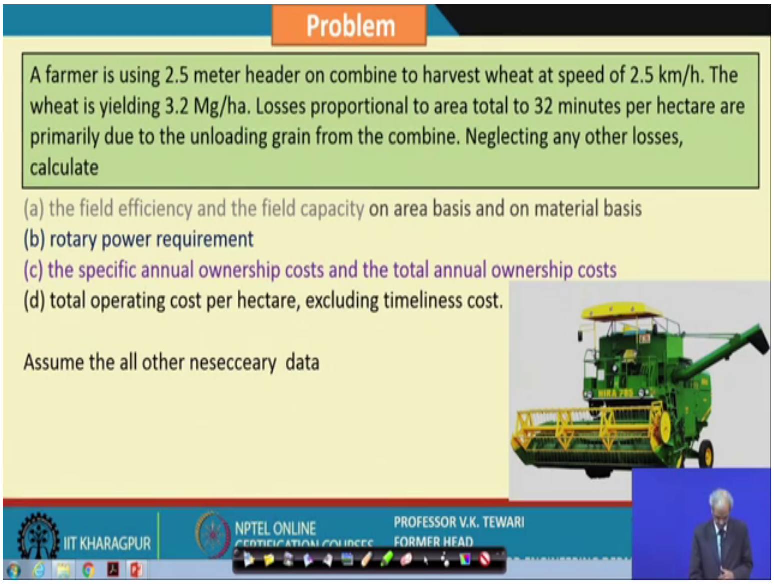

Now, let us see I have a put as a problem, but then we will get into the get in the details of this later. A farmer is using 2.5 meter header or on combine to harvest wheat at a speed of 2.5 kilometer per hour. The wheat is yielding 3.2 mega gram per hectare losses proportional to area total 2 32 minutes per hectare are primarily due to the unloading grain from the combine, neglecting any other losses.

Now, we need to calculate say for example, the field efficiency and the field capacity on area basis and on material basis total material, which is produced then rotary power, how much is the rotary power required? Then the specific annual ownership cost and the total annual ownership cost of the machine, which you have total operating cost per hectare excluding terminus of cost. Now you remember this, assume the all the other necessary data well we need to understand, what necessary data we need to take from the table etcetera.

So, that is why, this has been treated. Now as I said, we are talking of a combine. So, this is the combined, which has been given here and using this, how do you proceed, what are the methods that we adopt and how do you adopt them?

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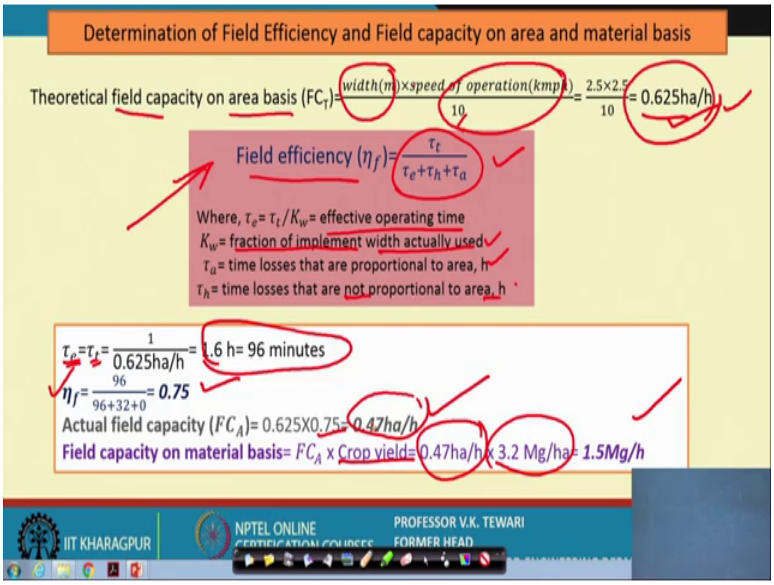

First determine the field efficiency and field capacity on area and material basis, this is first thing.

How do you what formulae we already know for this, well we are talking of the field capacity on area basis of this is known to you already from previous knowledge, which we have discussed. We are talking of the width of the machine then, we are talking of the speed of the machine here and this constant will give you, how much is the hectare per hour? This is given hectare per hour from the data, which has been given.

Now field efficiency, we know that field efficiency will have different components, it will think of what is the actual work done at that theoretical work done then, the losses which have taken place of various kinds of those for example, we are talking of fractional implement with actually used, then the time loss is that a proportional to the area. The time loss is a proportional not proportional to the area, there could be time losses, which are may be header loss and things like that.

So, here, if you talk of these you find something like this; that means, T t tau t here is talking of the total and t q, K w is talking of the fraction of the implement width actually used. So, with field efficiency given by this expression here, the total time or the theoretical time you can think of.

So, these are the times actually, now we have to think whether, how best we can estimate this parts that is essential. Now you see here that we have talked of 0.625 hectare per hour is the capacity theoretical capacity of this, which is FC T which we are calling now then with use of this what we get T e or T t here, which is the effective operating time effective operating time comes to this 1.6 hours it is just.

If you would take inverse of this you would get this vary and then the efficiency here we are talking of the time loss that are not proportional to area as equal to 0. So, we with these then we are getting that efficiency is about 0.75; that means, efficiency is above 75 percent q field capacity on the area basis that, you have got already actual capacity here, you got about 0.7 with this field efficiency, you get this value.

So, the field capacity on material basis is it crop yield has to be multiplied with this. So, we know that this is the hectare and this is the mega gram per hectare per hectare. So, on a field capacity on a material basis comes out to be the. So, much of mega gram per hectare per hour and the this is good point 0.625 hectare, which is come to about 0.47 hectare per hour.

So, this is the way we try to understand, now you need to look into these expressions, while considering the machine the various aspects, which we have given in this particular problem need to be very carefully understood and then the formulae to be used and answers to be produced out of that.

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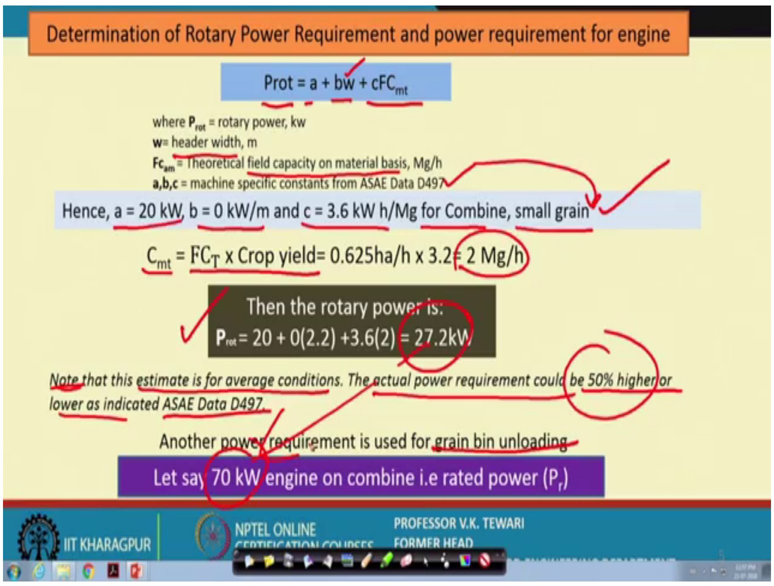

Now let us come to the determination of rotary power requirement and power requirement for the engine, yes it is very essential to know how much of rotary power will be required and what should be the requirement of the engines power? Actually total power of the engine which will be the main power and which will deliver to other units of the combine which is under consideration.

So there, here we find that the P rotary is given as a plus b w plus c FC m t where P rotary is kilowatt the header, w is the our header width then FC is theoretical field capacity and material basis and a, b, c are the specific constant, which we have got from the ASAE D 497 data this thing.

Now, hence a is 20 kilowatt, b is 0 kilowatt per meter and c is this for combine of for a small grains. Now this is the data which we have taken from this here and it is worth mentioning here, when we are trying to find out the total rotary power. Now using this formula here, we know that C m t is given as this into this, which comes out about 2 mega gram per hour. Now then the rotary power using this, equation can be simply found out to be the a p rot the a P rotary is about 27.2 kilowatt.

Now, there are certain considerations here, now this is the power required for the rotary portion only, but then you need to look into what should be the power, total part to be taken and the power of the engine here, this is the one which is required now once, you go for they this now there is something a note given, which is essential. And designers must look into it estimate is for average condition, this is for an average condition.

But then, actual power requirement could be 50 percent higher or lower as given in this. Now there is a data, we will also you there is data where in we have the various aspects, which are given and the designer can choose from there. So, this actual power could be 50 percent higher than this and it is always better to have a higher power because, you do not know, how much will be the requirement and what sort of eventualities which will come in the when the machine is under operation.

So, therefore, we can simply double this and you think of about 55 horsepower or of the engine could be taken now, another power requirement is grain bin unloading. Now for unloading, you will find you will show in the table there that for unloading also you required certain power. So, considering the rotary power and the in other exigencies including the power for unloading of the grain bin then, you will required another 30 percent of that. So, virtually you require a power, which can be as high as about 70 kilowatt, this is what we have worked out on the basis of this.

So, roughly we can think that about 70 kilowatt of engine on the combine is required for getting the rotary power and all sorts of power that will be required, we can say that if you do not have a 70 kilowatt engine may be about 80 and 90 kilowatt combine is available, you will have to choose, if it is a 60 kilowatt combine then this will not serve the purpose.

If it is a 80 kilowatt or 100 kilowatt combined then, you will have to take that because, this is the requirement basis, you cannot if you think that is about 70 kilowatt and we can do with only 65 kilowatt. Then I think that we will be in trouble at some point or the other and therefore, if the requirement is just for the engine and it is available about 80 kilowatt fine I think we should take to be with certain factor of safety.

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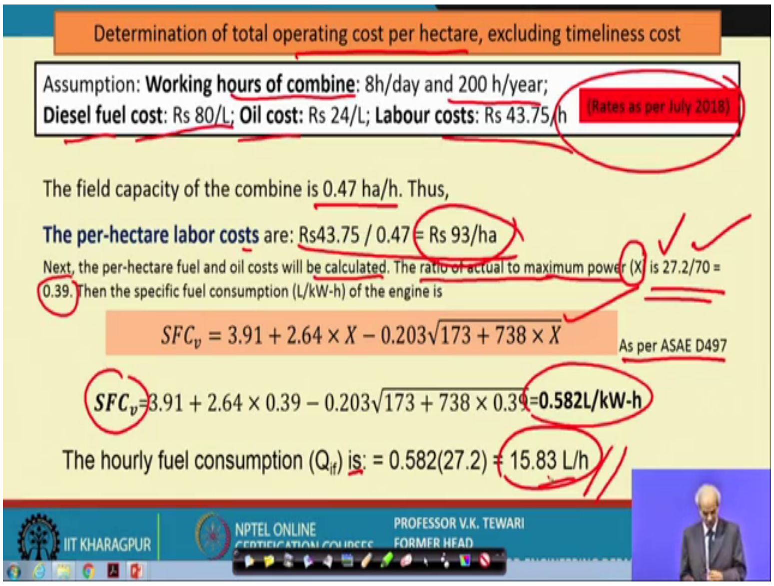

Now, determination total operating cost per hectare excluding terminus cost. So now, we if you exclude the terminus cost here, they determines total operating cost total operating cost per hectare works out to be. Now certain assumptions, when we want to do this, we have to have certain assumption, what are those assumptions? Well these assumptions could be working hours of the combined, well you see that these machines in fact, if you see in reality although we have taken about 8 hour per day.

But in reality, this machines is start from early morning and till late evening and about 14, 15, 16 hours we have seen to be used even the nights, they use lights and then the use this machines, but then for the calculations and for a general assessment and understanding of this problem, I think if you take 8 hour per day and 200 hours per year for the use of this machine.

In fact, although these are the standard values which we say that they are used much more than that, but then for this particular problem, we will limit to the values which are standard and which have taken we will not go for the reality. Reality could be about 300 hours or 275 hours or so.

But then, using this if you take the current value of the fuel cost, which we have given on the basis of the current value say at July 2018, in Indian conditions, the labour cost and the oil cost and fuel cost, if you had together then the these values are there. Now we need to take these values. So, using this value the field capacity of the machine is yeah here it is already given to us per hectare labour cost works out to be then rupees 93 per hectare ok.

Next the per hectare fuel and oil cost will be calculated, how do you calculate that? In fact, for that also the ASAE has given already a equation and why we follow this? Because these are the standard equations, which are being all over standards and which are being used all over by the scientists and engineers for finding out the specific fuel consumption and this is the expression, which is given here. Now where the ratio to actual ratio of actual to maximum power is given by X here in this rest L c is the equation.

So, this value as we have taken found to be 0.39. Now using this value 0.39 then what we get here is something of the order of this 0.582 liter per kilowatt hour. Now the hourly consumption is then given as 15.83 liter per hour.

Now, depending upon what is the type of the machine, what is the total horsepower of that this value be changed or this is a calculation which is on the basis of certain assumptions of the cost and the existing cost etcetera and the calculations which are say ratio of actual and maximum power, which we have taken as 70 and this the actual which is to be used include.

So, using this value which comes to about 16 liter per hour, now this value may change, this value will change depending upon the conditions, what you have depending about type of the machine, which you have taken this is actual. But then actual machine could be about more than 75 horsepower then in that case, these values will change, but it gives only an idea that how much hourly fuel consumption will take place? In fact, the oil consumption also will be there accordingly.

So, we need to calculate that as well, how much of oil will be required this talks of only the fuel consumption.

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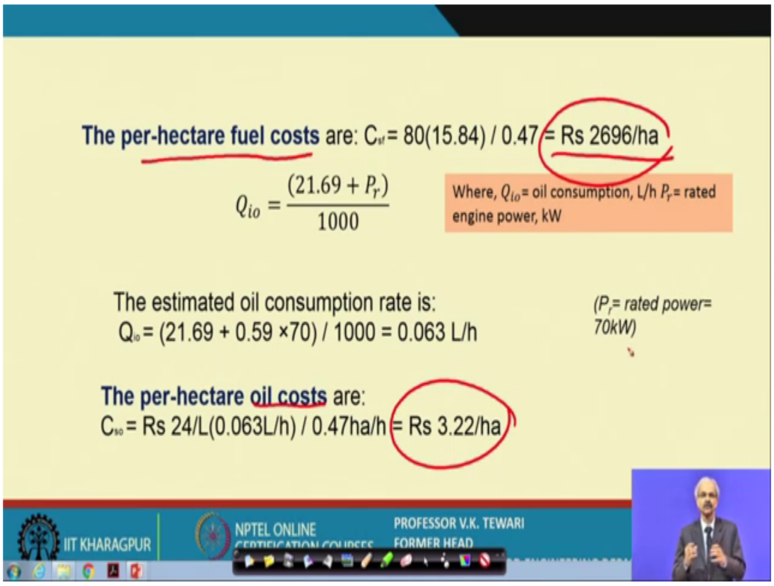

So, per hectare fuel cost that way then comes out to be about 2696 per hectare and the estimated oil consumption rate as I said that we need to also know about this, because the machine will required this oil, when it is being used for long duration of time, there will be requirement of this oil for lubrication and other aspects which are there in the machine at 3 different locations.

So, we it works out to be; it works out to be here, we are talking of so much the per hectare fuel cost, which comes out to be 2696 per hectare. My duties values, which are given a representative value, we have picked up and want to show you these are not the value, which will remains constant always.

But then what you have to understand is that these values or uncertain assumptions. So, as an engineer when you are going for it, you will have to consider, the data given, the conditions of the machine, availability of the machine and your own condition of the cost and the shelter or whatever that you have at your disposals. So, you have to consider all these things then only, you can come to the per hectare cost of the machine.

Now, per hectare cost of oil of course, as I said per hectare is something of this amount. So, we have taken rated power to be 70 kilowatt that as I said earlier. Now we using this, we are getting fuel cost as well as oil cost. So now, let us see what else is required because we are looking for the total cost, ownership cost of this particular equipment.

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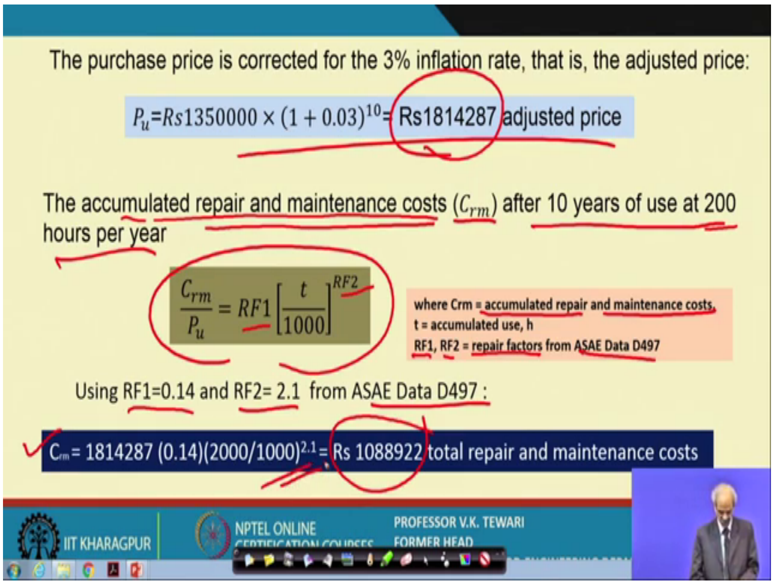

The purchase price is corrected for 3 percent inflation rate that is the adjusted price well, when you are talking of the interest rate, when you are talking of the machine when what you have purchased and then you are talking of correction inflation rates. So, changes inflation rate depending upon what is the, which year you are talking of and all that.

So, a very big figure comes at this point of time, which you may check if there is any mistake anywhere, well we are all with of all humble this thing we will accept that, but we hope that we have in a position to be a correct value that was given over here.

But then all apologies for any mistakes in these calculations although, we hope there would not be, but then if there are any we are ready to accept that and will be correct if at all. Now accumulated repair and maintenance cost for the 10 years use of the machine at only 200 hours per year, which I said that could be vary, it could be varying a lot. And you for that you can use the same our data of ASAE and this is given a C r m by P u, you know what C r m is the accumulated repair and maintenance cost and P u is known to us already, earlier then RF1 and RF2 equal talks of the repair factors from ASAE data.

So, repair factors are F1 and F2, now to these values can be taken to be this from this data. So, assuming this the C r m or the accumulated repair maintenance cost works out for this machine works out to be about this much value. So again, you can see that the calculations you may check.

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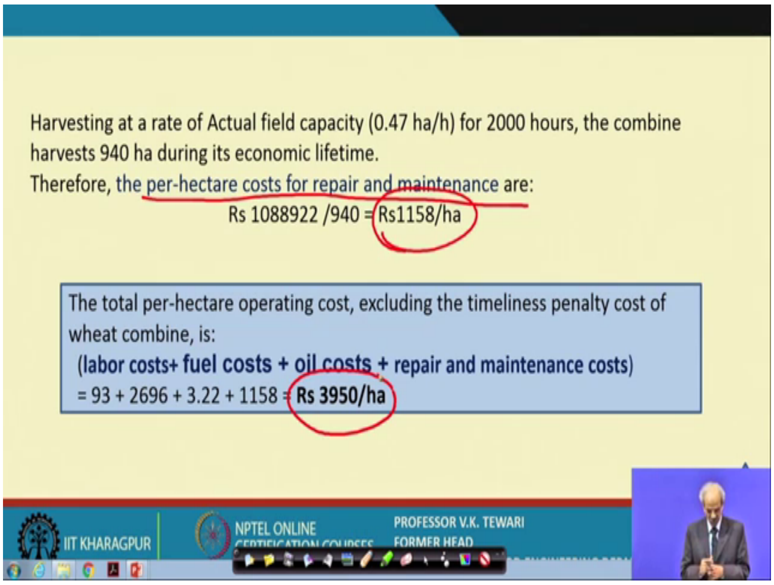

Well harvesting at rate of actual field capacity, now we have talked of say total in the life of that machine comes to be about 2000 hours, the combine harvests was 940 hectare well could be about 1000 hectare also during it is economic life time, yes it could be because as I said we are not talking only 200 hours.

It could be slightly more than that. So, if we safely even if you take 1000. So, you will get a very decent value of the total rupees per hectare, which comes to be for repair and maintenance cost. So, total per hectare operating cost excluding the timeliness penalty cost, if wheat combine is given as this much here.

Now, this is a cost which has been a consideration, which has considered with excluding the timeliness cost. Now remember that when we considered this we do not exclude this, but when we are excluding this is what it is. So, as an engineer you must be careful about all the parameters that I have talked of from right from the beginning to this point as to what are the parameters to be considered, what values to be taken which size of the machine to be taken for a particular operation etcetera. So, you need to look into this.

Now, with these 2 lectures of part 1 and part 2, what we have tried to explain to you is, how do you select machines? As I told in the previous one, that selection and management these are 2 important parameters, when we are talking of selection we are talking of what concepts to be followed in selection and then management.

You can think of if you go for simply calculations on a basis of the capacity of a machine, then you may find that about 3 4 units of tractor, 3 4 units of transplanter and certain machines and the cost of that will be quiet high and in fact, that is not the way of the way an engineer look into. Engineer must look into the economics of the whole management, what selection we should take so that it is manageable and it is worth having those system, because we are trying to talk about a particular model. If somebody has 20 hectare land and he is thinking of a crop rotation of paddy, wheat and green grain gram then, what should be the machines? And in the second part, we have try to look into what are the different cost which come.

So, accordingly you have to work out the cost of those machines also which you have taken for your analysis, because the movement you have a 20 hectare land and if you think of a high ton capacity of production. You will have larger and larger amount of production and say income will increase and then you would like to roll back the money back into this and have increase in area.

At once, you have from 20 hectare to about 100 hectare and beyond then all that then, you will have to think of increasing the machines, you may have you think of even storing of the grains etcetera and then maybe processing of the. So, you can think of a total aggresses to model where, we can consider about the equipment to be required management of the equipment then produce and then storing of the produce.

Then processing of the produce, then marketing of the produce, every gamut of information that has to be looked into has to be considered, when we are thinking of selection and management of machines. Well, I think this way I tried to give a sort of overview of how should you select a machine or a group of machines or a certain given hectare area and what management practices you should consider.

Well this will help you in solving some of the problems and I know that there could be some relations, some situations, where you may not be in a position to come to a conclusion. But then I hope that you will be able to follow this and if you have any questions, which we can always answer at some point of time, during the your process of understanding this we will be ready to help you out and I think, I would like to close this here.

Thank you very much.