Water Economics and Governance
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Lecture – 33
Economics of Water Projects : Financial Analysis

Hello everyone, earlier this week in the earlier sessions, we were talking about the economics of water projects. And in the previous session we discussed an approach how the economic evaluation or how the economic valuation of the entire water project is done. Taking clue from there, we will move towards the further financial analysis of water projects.

So, what are the different financial terms or what are the different numbers, which are calculated, computed in order to realization of whether a project is feasible or not.

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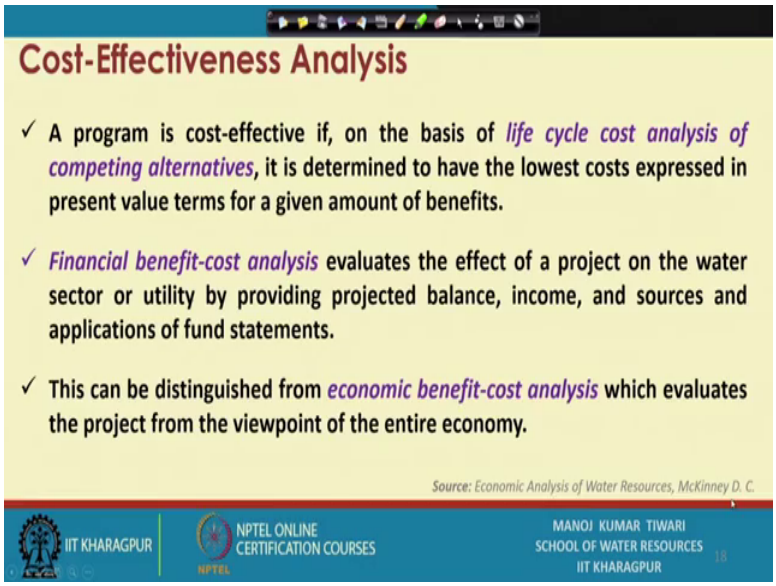

So, as while looking at the methodology if you connect from the previous session, so there is a cost effectiveness analysis that is needed, this cost effectiveness analysis is in fact, a program just to evaluate if a program is cost effective or not, and it is done on the basis of life cycle cost analysis of competing alternatives.

So, particularly if you have more than one alternative available, more than one option available for certain aim. Then it is determined based on the entire lifecycle of the alternative, entire life cycle of the project particularly.

So, during the basic inception of the project to its conclusion of its entire effect in that age, or in that duration what are the different life cycle cost that it is going to exert in terms of finances as well as in terms of social or environmental cost. So, this the entire lifecycle cost is determined to have lowest cost expressed in the present value terms for a given amount of benefit.

So, for a unit benefits how much cost is allocated, for how much cost is needed for a given unit benefit is estimated. This there are typically two type of benefit cost analysis one includes the financial and another is the economic.

So, financial evaluates the effect of a project on water sector or utility particularly, because we are talking about water sector otherwise the concept is wide it can be taken for any business stream. So, this financial cost benefit analysis evaluates the effect of a project on water sector or water utilities, by providing the projected balance of income sources applications of the fund statement.

So, all this thing is considered, while the economic benefit cost analysis evaluates the project from the viewpoint of the entire economy. So, finance is the one which basically considers project as a entity for one particular project while the economic benefit cost analysis is considers the viewpoint of the entire economy.

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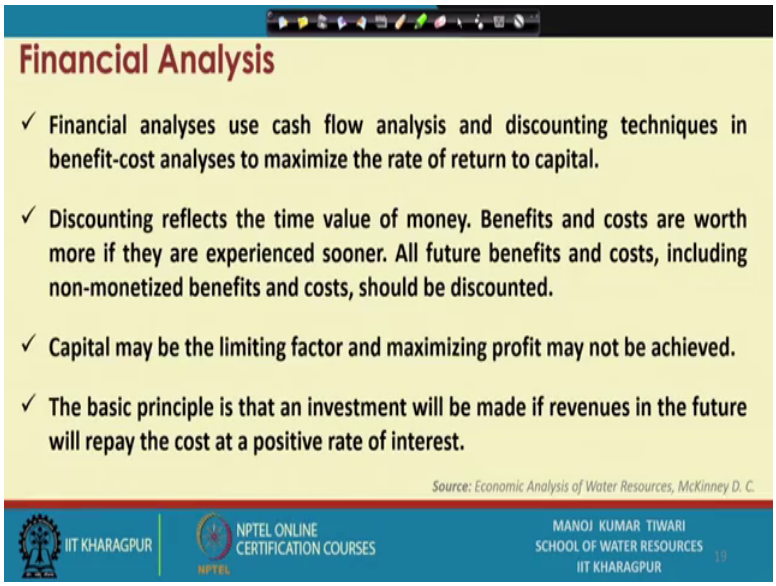

So, the financial analysis uses cash flow analysis and discounting techniques in benefit cost analysis.

So, we earlier talked about the discount rates. So, the discount rates usually which considers the time value of money. So, in when we go for a financial analysis we use what are the cash flow from different streams, from different channels, and we apply the discounting techniques in order to get the return on the capital in the real term, in the present value term.

So, when we apply the discounted rate we eventually, we are able to estimate the numbers in the present term. So, the entire purpose of this financial analysis is to see the cash flow analysis. What is the cash incoming into the system? And what is the cash leaving the system? So, that includes for all the cost in terms of cash and all the benefits in terms of cash.

So, this inflow and outflow of cash is analyzed and with the proper application of discounting techniques this, the in table we apply the benefit cost analysis to maximize the rate of return on the capital. So, what is our capital investment and how much return we can expect on to that capital. This discounting reflects the time value of money, and the cost are the benefits as well as cost are worth more if they are experienced sooner, while the future benefits and cost include the non-monetized, benefits and cost should be appropriately discounted.

The capital may be limiting factor and maximizing profit may not be achieved at times, because if your capital is limited you which is very often case actually with variety of projects. Many times we specify that this is our budget and whatever can be done under this budget, whatever maximum can be done under this budget that is what I want.

So, there the limiting factors become the capital, become the budget and the profit maximization, like on the per unit investment how profit or how the net benefits can be maximized that criteria takes the second replace then. The basic principle is that an investment will be made, if revenues in future will repay the cost at a positive rate of interest. So, it is there are actually several criteria's, which we will discuss in the next week.

When we go on to the discussion onto the different capital budgeting principles, but one of the criteria is that when we are investing something. And we account for all the cash flows all the cash inflows and outflows and then we see that in future, I am getting a positive rate of interest on my investment; that means, that project can be accepted.

If the rate of interest is not positive or not negative or is actually negative rather; that means, that this project is not likely to generate any return on the investment, or what whatever return is likely to generate is actually going to be lesser than the investments. So, whatsoever investments are being made, it will not get appropriate amount of return in the future from going forward with this project.

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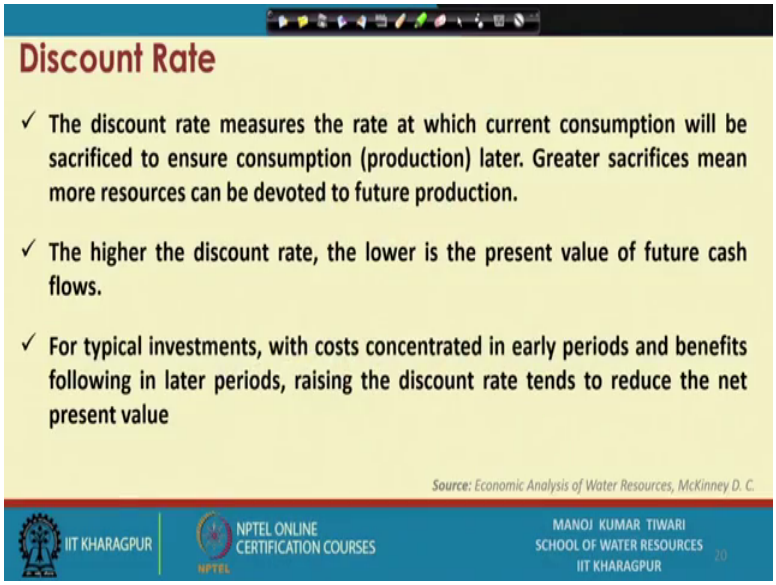

Then there are discount rates, so the discount rate measures the rate at which the current consumption will be sacrificed to ensure production in a later stage, or consumption in a later stage. The greater sacrifice means more resource can be devoted for future production. So, this translate that the if your discount rate is higher you're the value of the future cash is going to be the lower ok.

So, we will take certain example probably, so then it could be more clear one can see. That when the net discount rate is lower; that means, as it is a multiplying factor kind of, so if one is having an investment of 1000 rupee and discount rate is 0.8. So, the 1000 rupees value in today's time becomes 800, but if that discount rate is 0.6.

So, that 1000 rupees investment in future would lead just 600 rupees in present terms. So, higher the discount rate that way we see the values are lower. So, for typical investment the cost concentrated in early periods and benefit following in later periods raising the discount rate tends to reduce the net present value.

So, if my cost that investment is in today's time, if I am investing the capital in today and my benefits are expected to come from future. Then I will need to apply the discount rate on the benefits and that will reduce the net present value of the total project because the net present value of the benefits is going to be reduced, because of that additional application of the discount rate.

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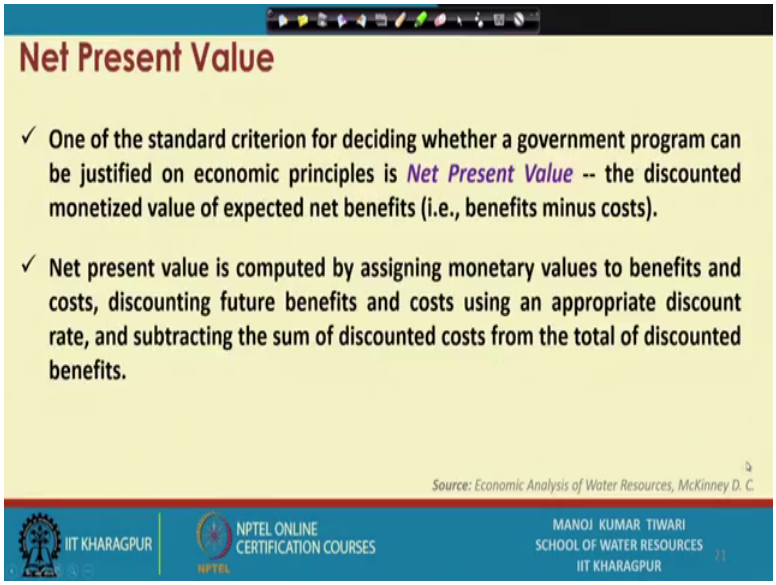

So, this discount rate that way becomes a key for the assessment of what value one is likely to expect in terms of the timeframe. One of these standard criteria for decision making, whether a program should be justified or not based on the economic criteria's, or economic principle is npv or net present value. So, the net present value is actually the discounted monetized value of expected net benefits.

Now, when we say the net benefit we are including the cost as well. So, net benefit is total benefits minus the total cost that is what net benefit is and when we apply the discounting rate. So, then we get the net benefit or in the terms of the present age, or present time and that is what is called the net present value or npv of a project, or of an asset for that matter. So, this npv or net present value is computed by assigning monetary values to the benefits and cost.

So, all the benefits and all the costs are assigned a monetary value, of course, those who are in the monetary terms will be taken straight forward. But the externalities or other as other benefit and social benefit and cost, or environmental benefit and cost, these social and environmental externalities, which cannot be taken in monetary term, are also assigned a value in monetary terms.

And then the like future benefit and cost are discounted using the appropriate discount rate, and then subtracted the sum of the discounted cost from the total discounted benefits. So, that is how one gets a net present value of the activity or of the project.

So, the total benefits and total costs will be estimated the appropriate discount rates will be applied then total cost will be subtracted from the net benefit or total benefits and that gives us the net benefit or net present value.

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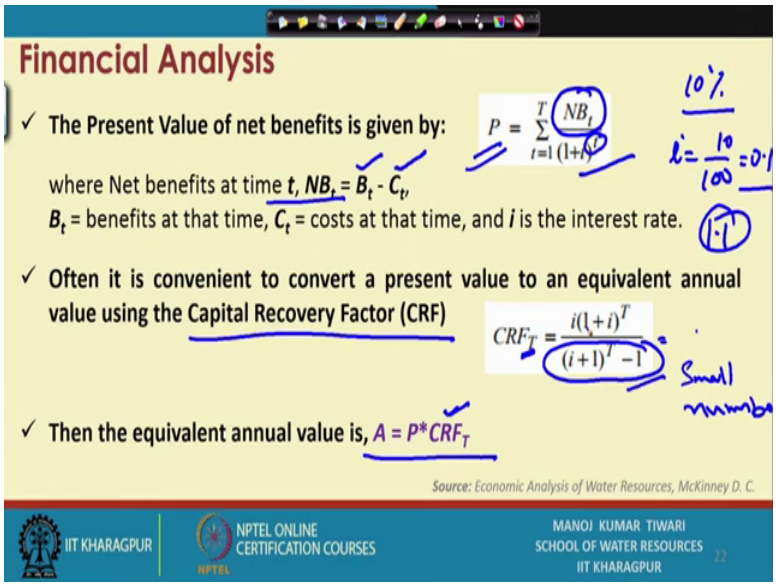

Now, for the financial analysis purpose the present value of net benefit is given by this formula, where the net benefits at time t will be equal to the benefits at time t minus cost at time t.

So, if we reduce the cost from the benefits we get the net benefits at time t, right if i is my interest rate or expected interest rate for that matter. So, interest rate in terms of let us say i expect a 10 percent interest. So, my i becomes by 10 by 100 is equal to 0.1. So, that way I can have an idea of i t is of course, time like when that in how many years or what is the expected timeline for the cost as well as for the benefits.

So, the net present value will actually be the net benefit at time t divided by 1 plus i. So, interest; obviously, interest rate means if I am expecting 10 percent interest rate. So, I have a multiplication factor of 1.1 because that is 10 percent additional. So, this to the power time t, and if i sum for all the benefits and cost in this fashion.

So, I get the net present value often it is convenient to convert present value to an equivalent annual value because when we go on to the compare. So, it is far better to compare based on an annual scale. So, it is better to convert that to annual value using another term which is referred as capital recovery factor or CRF.

So, this capital recovery factor CRF, if the project timeline is let us say t years or t is the timeline for the project or for the activity. So, this CRF is equal to in i 1 plus i to the

power t divided by 1 plus i, to the power t minus 1. So, this is solely depend on the interest rate and time. So, this is just a factor this is not including anywhere, the cost this capital recovery factor is just a factor that based on the timeline and based on the interest rate, how much capital recovery can be considered on an annual basis ok.

So, that would be estimated by this means and the equivalent annual value, can be then estimated as you like annual value can be estimated if the present value is multiplied by the capital recovery factor. So, in terms of annual, see it is likely because you see the interest rates are generally small we cannot have very high interest rate usually.

So, these capital recovery factors are typically very small numbers. The reason being that your interest rates are typically small, and this number would be larger, much larger then when you multiply this with the pretty small number like 0.1, or even lower because interest rate at times are even 10 percent interest rate in water business is very significant ok.

It is generally lower than that even lower than that. So, this number is going to be the very small and for the investments, present investment one can actually see what is going to be the annual value of that investment, and then this annual value can be used to compare the feasibility economic feasibility of the projects. So, that is how this in analysis can be used.

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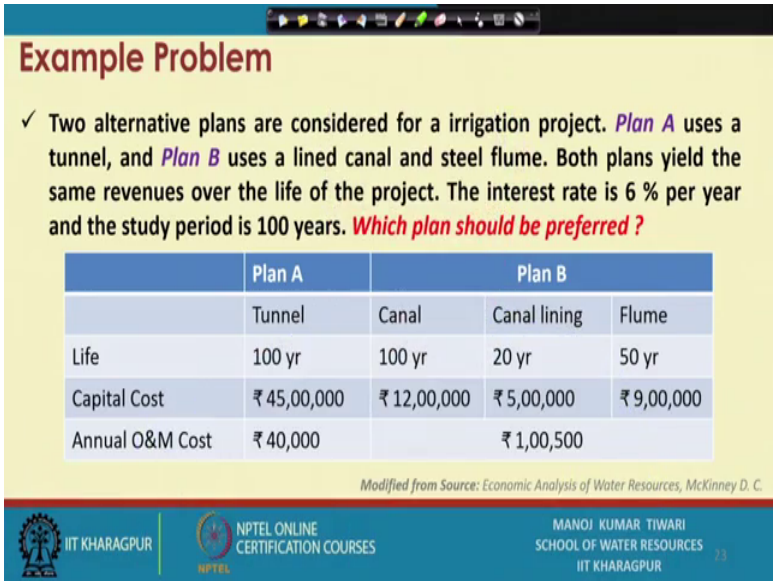

So, we will take a problem, an example and see how this can be helpful the analysis such analysis can be helpful. So, we have two alternatives over here, let us say we have one alternative in the form of plan A, and there is another alternative which is plan B. The plan A considers a tunnel and life is 100 years, the capital cost is 45 lakhs.

The annual operation and maintenance cost is 40000, on the other hand the plan B for the irrigation project considers a lined canal and a steel flume. So, the canal has a again life cycle of 100 years, the capital cost needed is 12 lakhs, the lining is applicable for 20 years and the capital cost needed is 5 lakhs.

The flume on the other hand has a life period of 50 years, with a capital cost of 9, and in collective mode the plan B, takes let us say this value for operation and maintenance. So, if one goes for the analysis of this plan A and plan B further. So, we can compute the capital recovery factor CRF using the data given.

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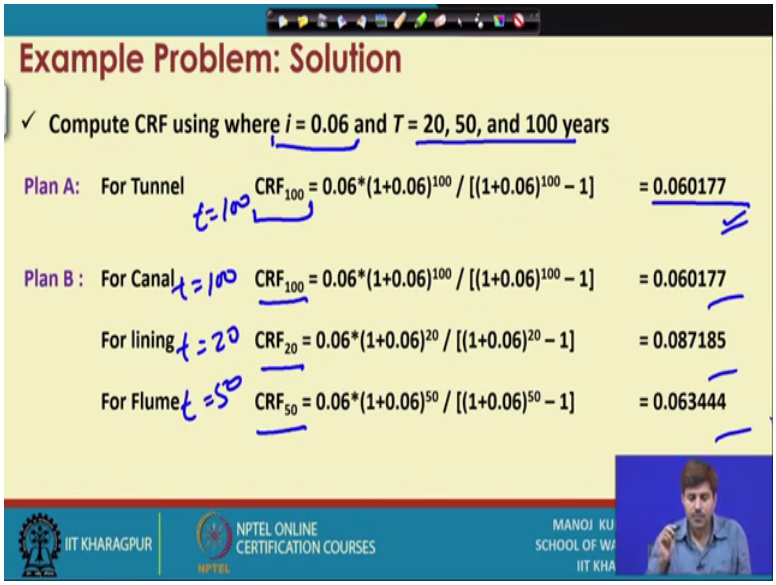

So, what is the data available to us, the data available to us is interest rate 6 percent. So, the i becomes 0.06, and then we have different timelines. So, for plan A, we have straight forward a tunnel, which has a t value of 100 years. So, the capital recovery factor for 100 straightaway and this we get as a capital recovery factor, because or i is this. So, i into 1 plus i to the power t divided by 1 plus i to the power t minus 1, for plan b we have three different items.

So, there is a canal with a time period of 100 years, there is a lining with time period of 20 years, and there is a flume with time period of 50 years, lifeline of 50 years. So, we have to compute CRF 100 for 20 and for 50 and respectively we will get the values, now once we get the capital recovery factor values.

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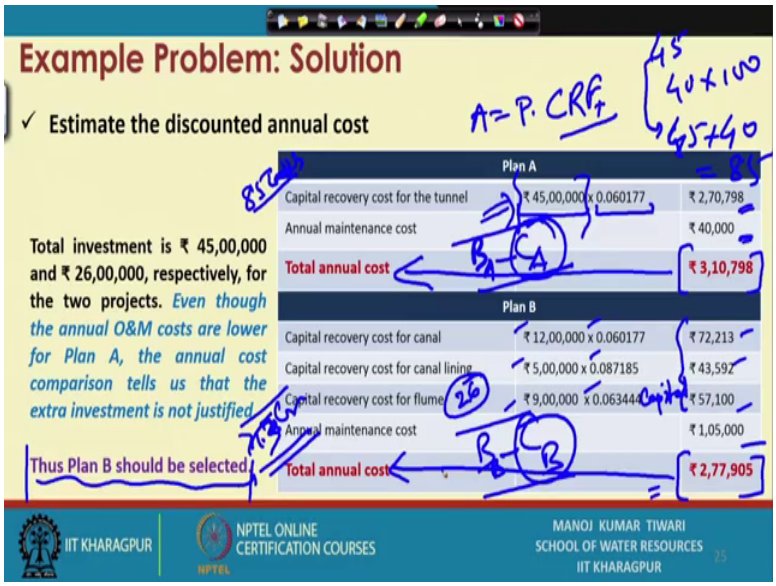

We can further do the estimate of the discounted annual cost. So, for the estimate of the discounted annual cost, you see the capital recovery cost for the tunnel. This is the capital cost of investment, and this is the capital recovery factor CRF value. So, you see that annual cost is actually capital cost into CRF for life cycle period.

So, CRF was estimated as this. So, this becomes the annual, I hope this is visible. So, this becomes the annual cost for capital purpose, then there is an annual maintenance cost which is straightforward given and a combination of these two will give us the total annual cost for project A. For plan B we have different capital cost for different components and different CRF values for different components leading to these three values which are in combination are the capital cost.

And the O and M cost is given separately, so when we add these we get the annual value of the capital plus O and M cost for plan B. So, now we have this number which is based on an annual basis for plan A as well as plan B, which considers the different requirements of plan A as well as different requirements of plan B.

So, when we go on to the estimating the discounted annual cost we can see that the discounted annual cost is lower for plan B as compared to plan A ok. Even though the total investment, is higher for plan A the O and M is fairly low it is just 40000, where as opposed to 1,05,000 over here. So, if you see if you do not discount time value of money if you see straight forward.

So, here if you see you have a 45 lakhs plus 40000 O and M that is going 400 years. So, 40000 going 400 years will make another 40 lakhs. So, total investment here one is doing 45 plus 40, which is equal to 85 lakhs ok. So, total investment in plan A is going to be 85 lakhs, over the period of 100 years as opposed to plan B where the total capital if you see.

So, 12 plus 5 plus 9 that makes 26 lakhs, here and 1 lakhs, for the 10,05,000, for the O and M purpose. Now if you exceed this also for 100 years this even 1 lakhs is going to be around 100 lakhs as you know. So, it is going to be over a core ok.

So, that way the total investment maybe more here, it is not maybe actually certainly more here it is going to be over 1.25, or because this is already 26 lakhs over here. So, it is going to be around 0.3 cores, total investment if one sees. So, that way one can see that the plan A needs lesser investment; however, still if you see the total annual cost its plan A, which is turning out to be costly primarily because the large portion of the investment are in the present terms.

When the large portion of the investment are in the present terms, so that is sort of giving the plant A, difficult times in order to because the time value of money for the future investment here the initial investment is just 26 lakhs as opposed to 45 lakhs here. And then rest is going to be in the future. So, if the time value of money is discounted that is what we are seeing that the total annual cost here is less.

So, when the total annual cost here is less, the total investment could be the different, but even though the annual O and M costs, are lower for plan A. The annual cost comparison clearly suggests that the extra investment being done here in plan A is not justified and hence plan B can be selected.

On a scale when we are just estimating the cost here, we have not considered the benefits. So, this cost analysis is assuming that the benefits are going to retain the same.

Whether one go for plan A, or whether one go for plan B, and since the benefits are same we can exclude that that is need not to be compared, because the benefits are same. If the value of benefits is also different, then we will have to compute the benefits separately again and get a net value by subtracting the cost from the benefits ok.

So, if the benefit here is let us say B A, so B A minus the cost A and benefits here is again B B, so BB minus the cost of B. So, then instead of just comparison of the cost, where the higher cost is not preferred lower cost is preferred, if there is a separate data available for the benefits.

So, that there is no point in just comparing the cost, but the point becomes in comparing the benefits minus the cos. And that gives us the net value or net present value or net benefits, and then there is a point of comparison of the net benefits and whose ever is having the higher benefit should be preferred obviously.

So, that is how this financial analysis is used in the project assessment or project evaluation for water supply sectors. We will conclude this session here only, and in next session we will talk about the different aspects, how the benefit cost analysis is done in order to evaluate the different alternatives or different options, different plans in for a given benefit, the benefit could also be different of course,.

So, what if the benefit, how the benefits are different, how we can go for a benefit cost analysis for the evaluation purpose. If benefits are same one need not in count for the benefit and we can analyze just the cost as we did here. And see whether it is acceptable or not, but if benefits are different then benefits also need to be accounted. So, that discussion we will do in the next session.

Thank you.