Micro Irrigation Engineering
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Lecture - 55
Economic Analysis of Micro Irrigation System (Part – 1)

Hello participants, I invite you to the lecture 55 of micro irrigation engineering subject, this lecture 55 is on economic analysis of micro irrigation system part 1. In previous lectures we discussed about theoretical aspects of micro irrigation system, we discussed about different components, we discussed about the basic hydraulics of micro irrigation system and its design and also we discussed on how the water is moving through a drip emitter and to model micro irrigation system or dripper.

One of the most important thing when we are designing the system we take care about how much is the energy, how it should be efficient hydraulically efficient system, but at the same time to adopt the system in the field, economics of the micro irrigation system or any system in that matter, it is important that whether it is economically viable. On the economics aspect, we are going to discuss the basic terminologies which are related to economic evaluation.

So, what are the different types of cost, what is the meaning of supply and demand, and how to evaluate, make the benefit cost analysis of the system. So, these are some terminologies which will be dealt in this particular lecture. I told you that planning of any irrigation system or for that matter any system when we are talking it should be economically and financially feasible. And this evolution means financial as well as economic evolution is important to make it acceptable by the society, by the market.

So, economic feasibility evaluation it assesses the economic viability of the planned development and as it assists in selecting the farm irrigation system among various alternatives, while financial feasibility evaluation assesses the financial condition and that will be encountered in developing and operating the irrigation farms that whether this particular alternative will be

the solution. Now, important part of the irrigation system is determining the expected annual cost of owning and operating each feasible alternative designs. So, there could be different plants, there could be different designs and then one should check which design or which particular option is feasible.

So, there are some agencies from which the financing is being given, maybe the finance is given by the government of India or state government or there are financial agencies like banks. So, they evaluate the soundness or whether the project which has been prepared it is sound enough and then the particular borrower will be able to repay the loan if he gets the finance from the funding agency.

So, a term called when we are talking about the cost, so there are different types of cost one is variable cost and other one is the fixed cost. So, means the total cost when we say it is the sum of these 2 costs and when you look the diagram here it say some particular output are produced, which has come to the market and then it has been given the cost then what is the total cost it involves.

So, that particular product we are putting then what is the variable cost and what is the fixed costs. Fixed cost is constant means it is fixed and but when we are making the total cost, so, sum of these 2 costs when we are making it, this plus this you can see, so, this green line it is the total cost or I am putting it say at one this at some particular cost it is there and then this some value it is given for the fixed cost and then some of these 2 is giving this value. So, this is the way so what is the fixed cost? Fixed cost are also known as annual ownership cost, they are generally independent of level of supply use. It includes annual depreciation, it includes the interest, and it includes the yearly expenditure, including taxes and insurance etcetera.

So, depreciation is the other part which is to be accounted. So, what is the meaning of depreciation? Depreciation means to distribute the cost of a given component over an expected life. So, each system, each component it has got expected life and that has to be taken into

consideration while we are selecting the annual cost. So, useful life for some of the components of irrigation system we can see because if we are taking water from the well. So, here it is say wells and casing.

So, depreciation means life of wells and casing, it is between 20 to 30 years and then annual maintenance and repairs it is in percentage at 0.5 to 1.5% of the initial cost which is there. So, that is taken care. Similarly, these are other components say pumping plant structure, pump, and vertical turbine pump. So, it has got some certain components under the pump that could be column, there are bowls and it has got a specific values.

These values are not exactly what is the prevailing market values but some value they are given for example it is given because this value is changing, the cost is always escalating and then it has got expected period of life. So, they are to be included and then this is the percentage of the initial cost, this is the value for the annual maintenance. So, this is 5 to 7% so, bowls and then columns etc. So, each has got it then centrifugal pump, power transmission and gear head here V-belt. So, like this for each these are the components and these components are it has got its own life and accordingly the annual cost is estimated.

Similarly, there are other components, these are the pipes. So, these pipes could be made up of different material PVC, HDPE and it has got its own life and then what are the annual cost maintenance. So, it comes to the 0.25 - 2.75% of the initial cost. So, aluminum pipes are of different material and it has got its own life. Plastic pipe, plastic trickle, surface means it is this irrigation that is a 10 years it has been reported and then this sprinkler heads, the drip emitters, the trickle filters so, it has got also and then considerable amount it goes for of the initial cost.

Then the reservoirs, then the mechanical move sprinkler system, continuously sprinkler system, and prime mover. So, each of these it has got its own and then these costs are taken or taken means considering the 1980 price. So, you can understand this much of depreciation has to be aided whereas the life of the system we will remain same and then approximately when we are

computing then one can take the values of the annual maintenance and repair costs. So, much of the percentage of the initial cost.

Interest cost which when we were talking about finding of the annual costs are taking the depreciation. Now, interest is the return from productivity invested capital. So, when money is borrowed to the finance for initial cost of the irrigation system. Interest is money paid for the use of borrowed money. So, particularly for agriculture purpose, the interest rate is low as compared to other commodity or other industries.

So, Government of India is giving priority and banks are giving priority for the irrigation system. We will discuss when we will come about the particular micro irrigation promotion, government of India is giving 50% of the cost for this so, here interest if 50% money it is taken from the bank accordingly the bank also charge interest. For agriculture purpose the interest rate is generally low.

So, variable cost, these costs are those which vary as the total cost to the farmer means grower. When the output for agriculture person and production it varies impact variable cost will vary in exactly the same proportion as the output. And these include the cost of labour, electricity charges and there are other expenses which are taken in the variable cost. Marginal cost is another terminology which is used marginal cost is increase in variable costs associated with the unit increase in the cost of production. So, that becomes the unit increase in the production then marginal cost also is associated with that.

Marginal cost is given by change in the total cost divided by change in the quantity of goods produced.

$$MC = \frac{\Delta TC}{\Delta Q} = \frac{\Delta VC}{\Delta Q}$$

So, this ratio gives the marginal cost which can be also given as a change in the variable cost divided by change in the total quantity of goods produced. And this is our discrete charge of the total quantity produced and for infinitesimal change of Q it can be given by marginal cost can be

given as the change in the total cost to that change in the total quantity of goods produced so, this way it is.

$$MC = \frac{\delta TC}{\delta Q} = \frac{\delta VC}{\delta Q}$$

Where,

MC = Marginal cost

Q = the total quantity of goods produced

VC = Variable cost

TC = Total cost

Then from there we are getting average cost, the average cost is the cost associated to each unit of production that how much it costs the average to produce one unit of output.

Now, total production cost can be shown here and you can see here a diagram has been plotted particularly means taken as an example for the maize production and when the input fertilizer or nutrient it has been aided. So, what we see in the first stage? In the first stage, we see there is an exponential increase in the production means as we keep on increasing the quantity of input fertilizer, the produce is also increasing.

But the rate of increase, if you see the slope of this curve, the slope of curve you may find that it is very steep. Whereas, in this case the slope it slowly it is there is an increase but the rate of increase is lesser than as compared to the phase 1, but when we come to the third stage it has come almost to the stable and no further in case if you further increase the quantity of input fertilizer then the yield decreases. So, output decreases when the further increase in the input that is your fertilizer is given.

Now, this can be illustrated by the law of marginal return. So, this is given means the law of diminishing marginal return given the fixed factors production cannot increase indefinitely until other factors also increase or decrease. So, that is an important part to be considered, when we are considering the total cost of production. Supply and demand this is a very important from the

marketing point of view that how the supply and demand of the commodity it is changing the price.

So, supply what is the supply? Supply is the quantity of a commodity that sellers are able and willing to offer for sale at different prices per unit of time, this is the important terminology and law of supply states that quantity of goods offered or willing to offer by producer or owner for sale, it increases with increase in the market price of the good and falls if vice versa, in the supply it is decreased then you may find that means the price it is falls then supply also decreases. So, all other things remaining unchanged provided all other things are unchanged. So, supply is a function of we can say the price means the price of related goods and then the number of producers. So, supply it is a function of the price of the item, then price of related similar goods and then the number of producers.

Now, this is the diagram you can see here, when you are seeing the trend is almost same, trend is same means when supply is being given you are seeing that at the quantity it is increasing, this is the case when we are seeing that when the quantity is increasing the prices increasing means the quantity increasing at the price is increasing when only one is there and then when you see here, it is the example it is given.

That a case of a soybean for example, that say that is some new soybean farmer enter the market clearing after one you see that he gets the good price. So, he increase the area under cultivation and then he gets the price it happens, but what happened? More soybean when it is being produced its price remain the same meaning that the supply curve itself shifts to this part means the supply has increased, but the price, he will not going to get the price.

So, in other words supply will increase, but the price he will not going to get the same price though so, other factor can shift the supply curve as well, what we see? Change in the price of production, if the change in the price of production if the drought occurs let us say when there is a water scarcity particularly when there is drought case. So, then price of the same commodity it increases, so that it becomes the same but trend of the curve when you see whether it is S1 or S2

or S3 is same. But the curve changes its position depending on the market prevailing price and the market or other climatic factor and other prevailing factor it happens.

Demand is the other term which is used in this economic analysis. So, demand is the desire to possess and willingness and ability to pay particular goods. It is an effectiveness of the desire which explains ability and willingness to pay for a particular commodity. Law of demand states that as the price increases the consumer buyer will buy less of a particular commodity or and vice versa. So, major characteristics of demand are ability and willingness to pay for a particular commodity by the user.

The demand is always at a given price. These are the major characteristics of the demand ability and willingness to pay. Second thing is demand is always at a given price and demand is always per unit of time. So, it is also a function of time. Now, you can see here the curve is plotted, here there is a quantity means this is produce, which are in the number and this is the price. So, price when the price falls, say this is the case P1, and so P1 at this particular quantity Q1 and then what you find that this is the point at which it is intersecting, but when the price falls or same quantity it is coming this is your, this particular value. So, P1 to P2 the quantity demanded increase from Q1 to Q2. So, that means your part of the same product but the demand has increased.

So, this is a negative relation between price and quantity hence, the negative slope of the demand a schedule that a demand schedule this is the understanding about how the demand with the price it is varying with the change in the quantity and price of the product.

Benefit cost analysis or cost benefit analysis. It provide the systematic set of procedure by which any industry or owner can assess whether to take a project or an irrigation system or any cropping pattern or any technology when there is a choice between mutually exclusive projects or program or crop means, whether we are getting benefit whatever investment we make. So, cost benefit analysis is used to assess the value for money of large projects or adoption of new technology in agriculture or changing cropping pattern.

So, this is a very important thing when the technologies are coming up when need to know say we are talking about precision agriculture, we are talking about the application of drones and then application of fertilizer at a particular but whether we are getting benefit out of that, but how much benefit, how much it is a cost effective, those are to be analyzed. So, net present value expresses the difference between the discounted present values of future benefits and then discounted present value of future costs.

So, NPV is given by

NPV = PV (Benefits) – PV (costs).

PV is the present value that benefit minus the cost, since PV minus means your present value, present cost and present how much benefit. That will be the net present value and the formula to calculate the present value for a given future value. And the given interest rate can be estimated by using this expression

$$PV = \frac{FV}{(1+i)^n}$$

Where the future value divided by one plus interest rate to the power number of years or what is the period. So, for a given period PV can be present value can be estimated. Now, there is a decision rule that net present value means your decision rule whether to accept or reject, if NPV is greater than 0, we will accept, if it is less than 0 means we are in loss and we will not accept or we will reject.

So, benefit cost ratio is given by the term

$$BCR = \frac{PV\ (Benefits)}{PV\ (Costs)}$$

That is the benefit divided by the cost means present value benefit and present cost. So, denominator of the benefit cost ratio. So, the present value of all the project cost not just per capital cost. So, decision rule here if BCR that is benefit cost ratio is greater than 1, it is to be accepted, if it is less than 1 that project needs to be rejected. Now, it should be clear that when

net present value is greater than 0, then BCR will be greater than 1, if it is less NPV is less than 0, then it is going to be means benefit cost ratio is less than 1.

Internal rate of return, this is another important terminology. So, this is the given interest rate at which the net present value of the project equals to 0. So, when IRR is greater than the rate of interest means your internal rate of return is greater than the interest someone is paying, then only it is to be accepted otherwise not. Payback period, initial investment divided by the net cash inflow value, so, this is estimated once one can decide in favor of the project with shorter payback period decision can be taken solely based on the payback period criteria.

Break-Even analysis, this is another important terminology, an important aspect when we are evaluating the project when we are in a spending in the project. So, Break-Even is used to give answer that what is the minimum level of sales that ensures the company will not experience loss, or how much sell can decreased so that company is still continues to get profit. So, this analysis of the level of sale at which the company or project would make zero profit as its name implies this approach determines the sales need to Break-Even.

Now, you can see here this particular diagram. So, this diagram it is plotted between the outputs and with cost. So, there are 2 costs you can see here fixed costs and other one is the variable cost and then the some of these 2 costs. Some of these to cast means your fixed cost, variable cost. So, there is a linear relationship and then there is a linear relationship with the output and income.

Now, here the description I can say the line OA is the variation of the income at varying level of the production activity and OB is the total fixed cost in the business. So, as output increases the variable cost means it also increases, total cost will also means when output we are increasing the total cost will increase and mainly the variable cost will also increase. So, at low level of output costs are greater than income.

At the point of intersection means, this is the point where we can say that the point of intersection that this is the point P, the costs are equal means this cost is equal to the income whatever the cost means, your income is as well as profit we can say this is at this point it is equal. So, this is your Break-Even point if this cost is less than means, then it is a loss and when the profit will be there. So, this cost is more than the total cost is your total income is more than the cost involved that fixed cost plus variable cost. So, this particular value we can say when let us say at this particular point, so, this is the cost involved and then above this is the profit. So, this income can be taken means total income minus total cost involved that will give us the profit and that is what the important. Break-Even point can be computed by using the relationship

$$BEP = \frac{TFC}{(SP - VCP)}$$

Where,

BEP = Breakeven point (units of production)

TFC = Total fixed costs

VCP = Variable costs per unit of production

SP = Selling price per unit of production

So, this way, we have a studied different terminologies. For more detail, you may go through these references for more study. So, in this particular lecture, we have studied the total cost including variable as well as fixed costs. We also try to learn supply demand concept, we also try to learn the breakeven point analysis and cost benefit analysis. So, this we discussed and then further on this topic we will discuss in the forthcoming lecture in your lecture 56. Thank you very much.