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Introduction

In fisheries projects, costs are easier to identify than benefits because the expenditure pattern is easily visualized. The various types of costs involved in the project are:

Project costs: These include the value of the resources in maintaining and operating the projects for e.g. physical goods, land labour, debt service, taxes etc.

Associated costs: Costs that are incurred to produce immediate products and services of the projects for use or sale.

Primary costs or direct costs: These include costs incurred in construction, maintenance, and execution of the projects.

Indirect costs or secondary costs: value of goods and services incurred in providing indirect benefits from the projects such as houses, schools, hospitals etc.

Real costs and nominal costs: costs at current market prices are nominal costs, whereas if costs are deflated by general price index, these are termed as real costs.

Social costs: these are technological externalities and technological spill over accrued to the society due to the presence of projects i.e., pollution problems, health hazards, salinity conditions etc.

Replacement costs: Many aquacultural projects require investments that have different lifetimes. A good example is found in the case of water pumping scheme in which the earthworks and pump platforms may be expected to last ten to fifteen years but the pumps themselves may have a life of only five to six years. In preparing the analysis, allowance must be made for the replacement costs.

Next to identifying the costs, the estimation of benefits is imperative to ascertain the impact of the project. Taking into account two situations i.e., 'with' and 'without' the projects generally does this. The difference is the net additional benefit arising out of the project.

Intangible costs and benefits

Almost every aqua project has costs and benefits that are intangible. These are creation of new job opportunities, better nutrition as a result of improved water supply. Such intangible benefits are real and reflect true values. They do not however lend themselves to valuation.

Financial aspects deal with the revenue earning consideration of a project. In financial analysis, particular emphasis is placed on the ability of the project to meet all

operating costs and also to earn an adequate return on the funds invested. Here different criteria like the payback or cutoff period, net present value, benefit cost ratio, internal rate of return, etc. are used to evaluate a project. Financial analysis is done with a view to estimate profitability, ignoring the benefits or costs to the society

There are different methods to estimate the profitability of the fish business. There are two types of measures of project worth i.e. undiscounted and discounted. The basic underlying difference between these two lies in the consideration of time value of money in the project investment. Undiscounted measures do not take into account the time value of money, while discounted measures do.

A. Undiscounted measures of project worth

1. Ranking by inspection.

In some cases, we can tell by simply looking at the investment cost and the time when the net value of incremental production occurs that one project should be accepted over another if we must choose. In general, there are two instances:

With the same investment, two projects produce the same net value of incremental production for a period, but one continues to earn longer than the other.

In other instances, for the same investment, the total net value of incremental production may be the same, but one project has more of the flow earlier in the time sequence, say in the second year itself than the other in the third year.

2. Pay back period:

The pay back period is the length of time from the beginning of the project until the net value of the incremental production stream reaches the total amount of the capital investment. The pay back period is a basic and common means of choosing among investments in business enterprises, especially when the choice entails a high degree of risk. In fisheries projects, however it is not often used.

The two important weaknesses of the payback period are:

- I) It fails to consider earnings after the pay back period. Both project I and II has the same payback period of three years, but we know by inspection that project II will continue to return benefits in the third year, where as the project I will not. Hence payback period is an inadequate criterion for the choice between these two alternatives.
- II) It does not take into consideration the timings of proceeds. Suppose we modify the project III and project IV so that each has a capital cost of 42,000. Now each has a payback period of four years and they have equal rank or order of preference for undertaking alternative investments. Yet we know by inspection that we would choose project IV over project III because, more of the returns on project IV are realized earlier. This is obviously desirable, since the earlier the

benefits received; the earlier it can be reinvested (or consumed) hence, the more valuable it is.

Table I. Pay back period, Four Hypothetical Pump Irrigation Projects.

Project	Pay back period	Rank
1	3.0	1
2	3.0	1
3	3.5	4
4	3.5	3

3.Proceeds per unit out lay

Investments are some times ranked by the proceeds per unit out lay, which is the total net value of incremental production divided by the total amount of the investment as shown in the Table II

Table II Proceeds Per Unit of Outlay, Four Hypothetical Pump Irrigation projects (Rs)

Project	Incremental cost	Total net value of incremental production	Proceeds per unit outlay	Rank
	Capital items			
1	30,000	30,000	1.00	4
2	30,000	34,100	1.14	3
3	30,000	42,000	1.40	1
4	30,000	42,000	1.40	1

By this criterion, we find that projects II and I are correctly ranked. But projects III and IV receive equal rank, although we know by simple inspection that we would choose project IV because its returns are accrued earlier. Here, again, the criterion for proceeds per unit of outlay fails to consider timing; money to be received in the future weighs as heavily as money in hand today

4.Average annual proceeds per unit out lay method

Another criterion for investment choice is the average annual proceeds per unit of out lay, which is obviously related to proceeds per unit out lay. To calculate this measure, the total of the net value of incremental production is first divided by the number of years it will be realized and then this average of the annual proceed is divided by the original out lay for the capital items. Table 1-4.illustrates the measure. We see how this operates: project I rank much better than project II, although we know by simple inspection that project II is the project we would choose. Similarly the criterion cannot select between projects III and project IV, although, again by inspection, we know we would prefer project IV because its benefits are accrued earlier. This criterion is misleading because it seems to allow for time by introducing " annual" in to the terminology.

Table III.Average Annual Proceeds Per Unit Outlay, Four Hypothetical Pump Irrigation projects (Rs)

Project	Incremental cost	Net value of incremental production	Average net value of incremental production	Annual proceeds per unit outlay	Rank
	Capital items				
1	30,000	30,000	15,000	0.50	1
2	30,000	34,100	11,367	0.38	4
3	30,000	42,000	14,000	0.47	2
4	30,000	42,000	14,000	0.47	2

This investment criterion has a very serious flaw. By failing to take in to consideration the length of the time of the benefit stream. It automatically introduces a serious bias towards short-lived- investment, with high cash proceeds.

B. Discounted measures of project worth

Many economic decisions including fish production involve benefits and costs that are expected to occur at future time period. The construction of ponds race ways, and fish tank, for example, requires immediate cash outlay, which with the production and sale of fish, will result in future cash inflows or returns .In order to determine whether the future cash inflows justify present initial investment, we must compare money spent today with the money received in the future.

The time value of money influences many production decisions. Everyone prefers money today to money in the future. Therefore in order to invest a rupee in fish production today, one must be guaranteed a return in the future that is equal to or greater than the rupee invested today. The preference for the rupee now instead of a rupee in the future arises from three basic reasons: Uncertainty, Alternative uses and Inflation.

Uncertainty- influences preferences because one is never sure what will take place tomorrow. Alternative uses- it will determine whether one invests in one project or another.

Inflation-affects the purchasing power of the rupee.

Interest

Interest is the price paid for the use of credit. The interest rate is considered as an exchange price between present and future rupee. The interest rate can be of two type: Simple and compound. Re.1 today exchanges for $(1 + I)$ one period in the future or alternatively Re 1 payment made one period in the future exchanges $1 / (1 + I)$ now. (I = interest rate, either simple or compound). The interest rates are always positive because of the (+) ve time preference for money i.e. the sooner money is available, the greater its value.

Compounding

The process of finding the future of a present sum is called compounding. We have Rs.1000 to invest in a bank paying interest at 6 percent compounded annually. ($i=6$ percent). After 1year we will have $Rs.1000 + Rs.1000xi = 1000(1+i) = 1000(1+0.6) = Rs. 1,060$.

After 2 year we will have Rs.1000 (1+i)+1000(1+i) x i
 $=1000(1+i)(1+i)=1000(1+i)^2$
 $=1000(1+0.6)^2 =Rs.1,123.6$

So a general formula for obtaining in case of value of a series of payments the future value of a present sum may be written as

$$V_N=V_o (1+i)^N$$

Where, V_N = Future value
 V_o =present value
i= Interest rate
N=Number of conversion period

If a fish farmer wants to invest money in a finfish production activity which will generate returns over a number of years (*N*). The fish farmer wants to know the value of payments a or returns after a number of years .We are finding the future value of series of payments which is easy to calculate using this formula

$$V_N=P_o (1+i)^N + P_1 (1+i)^{N-1} + P_2 (1+i)^{N-2} + \dots + P_n$$

$$= \sum_{N=0}^N P_N (1+i)^{N-n}$$

Where, V_N =the future value of a series of payments.
 P_N =the payment of each conversion period (*n*)(*n*= 0, 1, 2, 3,*N*).

Example

Let us consider the income from an aerator in the pond which will yield income flows of Rs. 300,400, 500, 600, and Rs.700 during the 1st to 5th year of functioning. If we assume that interest rate is 9percent then what is future value of the series of payments?

$$V_N= 300(1.09)^4+400(1.09)^3+500(1.09)^2+600(1.09)^1+700(1.09)^0$$

$$= Rs.2,889.53$$

But the summed value of the income generated over the 5-year period is Rs.2500. The additional accrued amount is the result compounding, since it is believed that the income received is invested at 9 percent per year.

Discounting

The process of finding the present value of a future payment is called discounting. The future value must be discounted to reflect the earnings lost by not being able to immediately invest the future sum in the alternative investment. The general formula for discounting is as follows:

$$V_o = \frac{V_N}{(1+i)^N} = V_N(1+i)^{-N}$$

$$\text{For series of payments, } V_0 = \sum_{n=0}^N \frac{P_n}{(1+i)^n}$$

Where, V_0 = the present value of the payment series.
 P_n = the payment for each conversion period (n)
 (n = 0, 1, 2, 3,N)
 i = Interest rate.

Example

If return from five years is Rs. 300, 400, 500, 600, 700, for the 1st, 2nd, 3rd, 4th, & 5th year respectively at a discount rate of 9 percent, the present value of the return is

$$V_0 = \frac{300}{(1.09)^1} + \frac{400}{(1.09)^2} + \frac{500}{(1.09)^3} + \frac{600}{(1.09)^4} + \frac{700}{(1.09)^5}$$

$$= 275.23 + 336.67 + 386.09 + 425.06 + 454.95 = \text{Rs. } 1877.97$$

Discounted Measures of project worth

The technique of discounting permits to determine whether to accept for implementation, projects that have variously shaped time streams i.e., patterns of when costs & benefits fall during the life of the project that differ from one another - and that are of different durations. The most common means of doing this is to subtract year-by-year the costs from the benefits to arrive at the incremental net benefits stream-the so-called cash flow-and then to discount that. This approach will give one of three discounted cash flow measures of project worth:- the net present worth , the internal rate of return or the net benefit investment ratio . Another discounted measure of project worth is to find out the present worth of the cost and benefit stream separately and then to divide the present worth of the benefit stream by the present worth of the cost stream to obtain the benefit-cost ratio.

Because the benefit and cost streams are discounted, the benefit -cost ratio is a discounted measure of project worth. But because the benefit and cost streams are discounted separately rather than subtracted from one another year-by-year, the benefit-cost ratio is not a discounted cash flow.

1. Discounted pay back period

It is a simple method which estimates the length of the time required for an investment to itself out; that is the number of years required for a firm to cover its original investment from the net cash inflows.

Although the period is easy to calculate, it can lead to erroneous decisions .As can be seen from our example, it ignores income beyond the payback period, & therefore is biased towards projects with shorter maturity periods .The pay back period is sometimes used by investors who are short of cash and need to reinvest all cash flows that occur in early stages of the projects. Investors who are risk averse often use this technique in evaluating projects. Such investors need to receive cash at the early stages of projects since the future is uncertain. This, the payback period method is somewhat better reflection of liquidity than profitability.

Table: Net cash inflow for project A & B:

Project A					Project B				
Year	Invest-ment	Net Cash Inflow	Discount factor (12%)	Present value of Net cash inflow	Year	Invest-ment	Net Cash Inflow	Discount factor (12%)	Present value of Net cash inflow
0	2000	-	1.000		0	2000	-	1.000	
1		700	0.893	635.10	1		300	0.893	267.90
2		600	0.797	478.20	2		400	0.797	318.80
3		500	0.712	356.00	3		500	0.712	356.00
4		400	0.636	254.40	4		600	0.636	381.60
5		300	0.567	170.10	5		700	0.567	396.90
6		200	0.507	101.40	6		800	0.507	405.60
7		100	0.452	45.20	7		900	0.452	406.80

The first project (A) is a Rs.2000 investment for the purpose of one aerator, & the second (B) is to invest in a feed shed of equal cost. The payback period for the aerator is 3.5 years and that for feed shed is approximately 4.3 years. If decision-maker wants to cover the cost of investment in the shortest period of time, project (A) will be preferred over (B). But this decision completely unwise because the discounted payback periods for project (A) & (B) are nearly 6.8 years and 5.8 years respectively. So the project (B) is to be preferred over the other one and this will be actually wise decision.

2. Derivation of Incremental Net-Benefit (Incremental cash flow)

When we consider a project, we see it as earning a gross benefit streams from which we must deduct the capital investment and pay the operation costs-the costs of machinery, fertilizer, hire labour, consultants and the like. What is then left over is a residual (what will likely be negative in the early years of the project) that is available to recover the investment made in the project (the return of capital) a compensate for the use of resources invested in the project (the return to or on capital). The residual is the net benefit stream. Deducting the without-project net benefit gives the incremental net benefit stream.

The major characteristic of the incremental net benefit stream or incremental cash flow is that it includes, without differentiating, both the return of capital and return to capital. To compute the incremental net benefit or cash flow we do not deduct from the gross benefit neither any allowance for the depreciation (that is return of capital) nor any allowance for interest on the capital investment employed that has been supplied by the entity for which we are doing the analysis.

We do not deduct depreciation because the incremental net benefit stream already allows for the return of capital over the life of the project.

We do not deduct interest on the capital supplied by the entity for which we are doing because in effect the result of a discounted cash flow analysis is the allowance for the return to the entity's capital.

Income taxes must be deducted to arrive at the incremental net-benefit. It may include non-cash elements like values of home- consumed production and of wages in kind.

The incremental net benefit is the increase in net benefit with project as opposed to the case without project. In early stages of the project the incremental net benefit usually is negative. The net incremental benefit is the basis for calculating measures of project worth, the most important of which are discounted measures of Net Present Value (NPV), Internal Rate of Return (IRR) and Net Benefit Investment Ratio (N/K) ratio. In reaching these measures (usually called Discounted cash flow analysis), costs are entered in the year they are incurred, and benefits are entered in the year they are realized. As a result, no depreciation is deducted before arriving at the incremental net benefit.

In building project accounts for the financial analysis, the incremental net benefit may be derived as (1) the incremental net benefit before financing in which case any financing transaction is excluded, and (2) after financing in which case loans or their financial receipts are added to the incremental net benefit and debit service or other financial payments are subtracted from the incremental net benefits.

3. Net present value (NPV)

It is a discounted cash flow technique (DCF) .It is the present value discounted at firm's required rate of return on the stream of net cash flows from the project minus the project's net investment. The NPV method uses the discounting formula of a non-uniform or uniform series of payments to value the projected cash flow for each investment alternative at one point in time. To obtain the NPV, the following formula is used: -

$$NPV = - INV + \frac{P_1}{(1+i)^1} + \frac{P_2}{(1+i)^2} + \frac{P_3}{(1+i)^3} + \dots + \frac{P_n}{(1+i)^n}$$

Where, P1.....P_n are net cash flows.

i = the interest rate or marginal cost of capital .

n = the project expected life.

INV = the initial investment.

The model indicates that the net cash flows of the project are discounted and then added to yield the NPV. The initial investment is negative since it represents a cash flow.

or

$$NPV = \sum_{t=1}^n \frac{P_t}{(1+i)^t} - INV$$

An investment project would be accepted if the $NPV > 0$ and rejected if $NPV < 0$. This is because the money being invested is greater than the present value of the net cash flow. If $NPV=0$, the decision maker would be indifferent. The NPV method assures that funds may be reinvested at the firm's interest rate. In case of series of cash out flows and cash inflows the can be written as

$$NPV = \sum_{t=1}^n \frac{B_t - C_t}{(1+i)^t}$$

Where,

B_t → Benefit in each year

C_t → Cost in each year

i → Discount rate

4. Benefit cost ratio (BCR)

It is also called as Profitability Index (PI). It is the ratio of present value of future net cash flows over the life of the project to the net-investment.

$$PI = \frac{\sum_{t=1}^n \frac{P_t}{(1+i)^t}}{INV} \quad \text{or} \quad PI = \frac{\sum_{t=1}^n \frac{B_t}{(1+i)^t}}{C_t}$$

(in case of series of cash inflows and outflows in a year)

The method usually produces the same result as the NPV and IRR in project evaluation, but it is very important in separating projects of varying sizes. If a project has a PI value greater than or equal to 1, ($PI \geq 1$) it should be accepted and should be rejected if the PI value is less than 1 ($PI < 1$).

Example: A fish culturist has invested and got Net benefit at the end of 1st, 2nd, 3rd & 4th year of fish culture in the following way:

Year	Investment (Rs.)	Net benefit	Discount factor (12%)	Present value investment	Present value of Net benefit
0	40,000	-	1.000	40,000	-
1	2,000	15,000	0.893	1,786	13,395
2	3,000	20,000	0.797	2,391	15,940
3	4,000	19,000	0.712	2,848	13,528
4	1,000	16,000	0.636	636	10,176
Total	50,000	70,000		47,661	53,039

NPV = Present value of Net benefit – present value of investment
= 53,039 – 47,661 = 5378 (+) ve

BCR or PI = $\frac{\text{Present value of Net benefit } 53,039}{\text{Present value of investment } 47,661} = 1.11$ (more than 1)

5. Internal Rate of Return (IRR)

It is the interest rate that will equate the sum of net cash flows to the initial investment. The interest rate that satisfies this equation is called internal Rate of Return (IRR).

There is no way of finding the IRR. One is forced to use a systematic procedure of trial & error to find out the discount rate that will equate the net cash flows to the initial investment.

When the NPV = 0, then

$$\sum_{t=1}^n \frac{P_t}{(1+i)^t} = \text{INV} \quad \text{or} \quad \sum_{t=1}^n \frac{B_t - C_t}{(1+i)^t} = 0 \quad (\text{in case of series cash flows})$$

i = Internal Rate of Return (IRR)

Acceptability of project depends upon comparing the IRR with the investor's required rate of return (RRR) sometimes called minimum acceptable rate of return (MARR). If IRR is greater than RRR (MARR), accept the project, if IRR is less than that, reject the project, if IRR=RRR, be indifferent.

If NPV is greater than (or less than) zero (0), and only if the IRR is greater than (or less than) RRR, the NPV & the IRR method result in identical decisions to either accept or reject an independent project

The IRR method implicitly assumes that returns from an investment are reinvested to earn the same rate as the IRR of interest

Example: Initial investment capital for composite fish farming is Rs.25, 000.

Year	Cash flow (Rs.)	Discount factor (12% Ra)	Present value (12%)	Discount factor (20% Rb)	Present value (20%)
1	12,000	0.8929	10,715	0.8333	10,000
2	10,000	0.7972	7,972	0.6944	6,944
3	8,000	0.7118	5,094	0.5767	4,630
4	6,400	0.6356	3,432	0.4823	2,604
Total			27,813		
24,178					

NPV (for 12percent discount rate Ra)= 27,813-25,000 = 2813

NPV (for 20percent discount rate Rb)= 24,178-25,000 = - 822

$$IRR = Ra + \frac{(Pv-C) \times \Delta r}{\Delta Pv}$$

Where, Ra = Minimum rate of (i.e.12percent

ΔPv

interest

as bank rate of interest)

Pv = Present value of cash flow (at Ra)

$$(27,813-25,000) \times 8$$

C = Capital

$$= 12 + \frac{3635}{3635}$$

ΔPv = Difference between the 3635

present values

= NPV (Ra) - NPV (Rb)

$$= 18.19\text{percent}$$

Δr = Rb - Ra

6.Net-Benefit Investment Ratio (N/K ratio):

This is also a discounted measure of project worth.

The present worth of the net benefits

$$N/K \text{ ratio} = \frac{\quad}{\quad}$$

The present worth of the investments

$$\sum_{t=1}^n \frac{N_t}{(1+i)^t}$$

$$N/K \text{ ratio} = \frac{\quad}{\quad}$$

$$\sum_{t=1}^n \frac{K_t}{(1+i)^t}$$

Where,

N_t = incremental net benefit in each year after stream has turned positive

K_t = incremental net benefit in initial years when stream is negative.

$t = 1, 2, 3, \dots, n$

n = No. of years

i = interest (discount) rate

The selection criterion is to accept all projects with a net benefit-investment ratio (N/K) of 1 or greater.

Thumb rule for selection of a project

Pay Back Period should be minimum

Net Present Value should be positive

Benefit Cost Ratio more than one

Internal Rate of return more than the Bank rate of Interest

Net benefit-investment ratio (N/K) more than one.