

Economic Evaluation of Soil And Water Conservation Technologies

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Introduction

Soil and water are the two basic resources of life. The quality and quantity of these resources has a great bearing on nation's wealth and welfare. The agricultural production in India recorded significant increase due mainly to what is called Green Revolution technology. But, it has by passed the larger tracts of rainfed regions. As a result, the inter-regional and inter-class disparities have widened. This, when considered together with the food and fibre requirements of the country's growing population and the issues of globalization and sustainability, makes it imperative to increase the productivity of rainfed lands.

The rainfed lands are subject to varying degrees of erosion. About 175 m.ha. of land in the country was subject to various forms of erosion out of which 69 m.ha. is experiencing critical degree of erosion. Such large extent of erosion, if not contained, will lead to productivity losses necessitating higher costs to produce the same level of output over time and agricultural production cannot be sustainable.

Nature of Soil and Water Conservation Technologies

The principal aim of soil conservation is the control of soil loss and retaining the resources *in situ*. These measures build up the resources over time. The benefits from soil and water conservation measures are, therefore, distributed over time and the beneficial effects may not be as visible in the beginning. Farmers often fail to recognize these benefits, which is why the adoption of these measures is rather slow.

Often there are unavoidable tradeoffs between environmental protection and agricultural growth at given level of technology. It needed to incorporate these trade offs into decision making process both at micro (farm level) and macro (regional level).

Evaluation of Soil and Water Conservation Technologies

Evaluation of any technology is necessary to find out the worthiness of the investment made. As such, it is essential to make better use of available resources. In addition, a clear knowledge of economics of soil and water conservation technologies would help convince farmers for adopting these technologies. Evaluation will also help refine or modify the technologies wherever necessary.

Evaluation can be done at different stages. When the evaluation is done before the implementation of a programme, it is called '*Ex-ante*' evaluation. Here, the stream of costs and benefits as expected from the technology are compared. Some times, evaluation is done at some point of time during the implementation of a programme. This would be helpful to judge whether the programme is progressing in the desired direction. Such an evaluation is referred to as concurrent evaluation. It is also

common to carry out the evaluation exercise after the implementation of the programme taking into consideration all the realized (actual) costs and benefits. This is called 'Ex-post' evaluation. A comparison of these three types of evaluation may throw up some useful lessons for the future.

Evaluation Methodology

When the costs and benefits from a technology are realized in a year, a simple benefit-cost analysis will give the economic viability of the technology. If the benefits associated with the technology outweigh the costs, the technology is considered to be economically viable. Alternatively, the viability can be examined by a partial or complete farm budgeting techniques. Partial budgeting technique is employed when only a part of the enterprise(s) is affected by the introduction of the technology. On the other hand, complete or whole farm budgeting is used when all the enterprises in the farm are influenced.

When the costs and benefits are distributed over time, as is the case with most of the soil and water conservation technologies, various measures employed in project worth measurements have to be computed to assess the economic viability of the project. The principle in these techniques is that all the costs incurred and benefits accrued at different points of time are discounted or compounded so that they can be related to a single point of time. Only then will they be comparable. Pay Back Period (PBP), Net Present Worth (NPW), Benefit-Cost Ratio (BCR), Internal Rate of Returns (IRR) and Annuity Value (AV) are the important measures in this regard.

Pay-Back Period

It is the number of years an investment project taken to recover its costs from returns.

Net Present Value

It is the discounted value of all cash inflows net of all cash outflows of the project during its life time.

$$NPV = \sum (R_t - C_t) / (1 + i)^t \quad (t= 1 \text{ to } n \text{ years})$$

Annuity Value

Uniform annual return, which helps in determining the repayment period, is computed by dividing the NPV by the present values of an Annuity Value of Rs.1/- over the life of the project.

$$AV = \sum (NPV / (1 / (1 + i)^t))$$

Benefit-Cost Ratio (BCR)

It is the ratio of discounted value of all cash inflows to the discounted value of all such outflows during the life of the project.

$$\text{BCR} = \frac{\sum R_t / (1+i)^t}{\sum C_t / (1+i)^t}$$

Internal Rate of Return (IRR)

It is that discount rate at which the NPV is zero.

where, R_t = Returns in the t^{th} year
 C_t = Costs in the t^{th} year
 i = Interest rate of discounting rate

Data Needs and Quantification Problems

The information on costs incurred and benefits accrued at different points of time is the primary requirement for assessing the economic viability. The benefits from the soil and water conservation technologies include yield and employment gains, asset formation, cost savings, which can be expressed in monetary forms. On the other hands, the quality gains such as improvement in soil quality, off-site benefits, groundwater recharge, etc. are difficult to be quantified. Similarly, the direct costs that go into the soil and water conservation measures include construction costs, maintenance costs, etc. which can be quantified. It is, therefore, useful to consider all the benefits and costs that can be quantified in assessing the economic viability. A statement describing the impact on environment or qualitative change may be appended at the end so that atleast a subjective assessment can be made, for qualitative change may some times be considered more important in view of the future needs of the country.

Evaluation is also determined by the perspective from which it is being done. Identifying and quantifying the costs and returns as well as externalities will change to a great deal when looked from a macro or societal perspective compared to that of a micro-perspective.

Other methods of evaluation include programming (linear/dynamic/goal), simulation modeling etc.

The tables that follow provide some examples of the methods mentioned.

BUDGETING

Eg: Improved seed vs local seed

Debit	Credit
Increased cost	Decreased costs
Seed cost	Plant protection expenditure
Seed treatment	
Other inputs	
Decreased returns	Increased returns
	Extra yield
Total: A	Total: B
Decision rule: If B>A, then one can adopt the technology	

Economic evaluation of conservation practices in castor, HRF, CRIDA, 2000

Treatment	Yield (kg/ha)	Costs (Rs/ha)	Net returns (Rs/ha)	Addl. costs (Rs/ha)	Addl. Returns (Rs/ha)
Farmers' practice	528	1582	2136		
Glyricidia much	1082	3465	7484	1883	5348
Mung cover	776	3805	9136	2223	6996

Economic evaluation of conservation practices in castor, Nallavelli, 1999

Treatments	Total costs (Rs/ha)	Total returns (Rs/ha)	Additional costs (Rs/ha)		Addl. yield (kg/ha)	Addl. returns (Rs/ha)
			Material	Labour		
T ₁ : I.M. + conservation furrows	3981	4593	150	400	92	1245
T ₂ : I.M. + vegetal cover with mung bean	3836	4837	206	200	110	1489
T ₃ : I.M. + Glyricidia mulch	4131	5335	201	500	147	1987
T ₄ + Traditional management (FYM @ 5 t/ha + 10-30-0 kg/ha NPK as basal)	3430	3348	-	-	-	-

Profitability measures for a typical farm pond in an Alfisol

Particulars	Measures
Pond size, m ³	500
Pay back period, years	10
Net present value, Rs	29849
Benefit Cost Ratio	1.57
Internal rate of return, %	18.97

Net present values for tobacco producer curers under different soil conservation levels

Conservation method	NPVs under different discount rates			
	5%	8%	10%	12%
No soil conservation	51,884.2	46,994.6	43,510.4	40,787.6
Bench terraces	63,680.4	54,495.8	49,156.9	44,999.9
Lock and spill drains	61,511.1	52,419.1	47,463.0	43,117.7
Stoned terraces	64,086.9	54,039.1	48,567.2	43,289.9

Effects of increased economic goals on environmental variables

Economic goal (at farm level)	Level of environmental variable for Dhading district						
	Soil erosion (Mg/ha)		Cattle grazing (AM)	Forest fodder lopping (000Mg)	N use (kg/ha)	P Use (kg/ha)	Pesticide use (kg/ha)
	Crop land	Pasture					
Food grain production (Mg/ha)							
1.0	4.68	0.28	1.46	22.22	47.30	0.68	59.84
1.4	6.58	0.63	3.29	70.25	34.20	0.90	33.98
1.8	11.22	1.24	6.41	66.51	53.79	8.00	93.98
Milk production (kL/HH)							
0.50	5.62	0.48	2.48	0.00	53.63	10.81	55.61
0.75	6.13	0.56	2.93	174.78	26.88	0.00	30.18
1.00	6.73	0.65	3.38	321.67	19.59	0.00	35.22
1.25	8.39	0.64	3.33	828.21	14.55	0.00	18.85
Cash income (US\$/ha)							
410.00	5.91	0.53	2.76	38.81	29.57	0.00	28.33
447.00	6.25	0.53	2.74	62.42	38.80	3.06	49.49
522.00	6.93	0.52	2.69	108.53	56.85	10.10	90.71
597	7.60	0.51	2.64	154.64	74.92	17.24	131.92

AM: Animal moths HH: Household

Source: Pant and Pandey 2001 American Journal of Alternative Agriculture, 16: 114-123