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Benefit - Cost Analysis Of Irrigation Tank Rehabilitation

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Abstract— In the State of Tamil Nadu millions of farmers who are small and marginal are dependent upon irrigation tank systems for their livelihood. With limited water resources, vagaries of the monsoon, and looming water scarcity in many parts of India, the need for rehabilitating and restoring the tanks assumes significance. In the initial years (1980s), the focus was to maximise the agriculture production per unit of water supplied to the farmers fields and recently, the emphasis has been shifted towards livelihood approaches through community based tank rehabilitation with involvement of multiple stakeholders. To prove the above statement a study was carried out in rural village named "Kalur", Polur Taluk, Thiruvannamali district of Tamilnadu, India. Interview schedule were prepared and the data were gathered and analysed using SPSS (Statistical Package for Social Science). The result shows that the benefit incurred in post tank rehabilitation period is very high through farming, non-farming and off-farming activities.

Key words: Agriculture, Economic analysis, Tank Rehabilitation, Irrigation, Crop Production

I. INTRODUCTION

Although the general understanding of the irrigation tanks was to produce irrigated crops, the fact is that it also provides water for other uses like livestock, agricultural labours, brick making, fish rearing, duck rearing, washing, etc. The quantities of water used for these activities may be low, but it has high value in terms of the household income. Recognising the multiple uses of water in irrigation tank systems is critical and necessary to include while rehabilitating tanks. The value of water in irrigation tanks has been under estimated because of a failure to be familiar with the multiple uses. A more accurate assessment that includes all uses will better inform decisions about carrying out tank rehabilitation. Even within tank systems, taking all uses into account can lead to more productive, increase on net benefit and environmentally sustainable use of water.

Papers in this collection demonstrate how including the value of other water uses could change the evaluation of irrigation systems. Bakker and Matsuno (2001) present a framework for valuing all uses of water with particular attention to ecological services, which are perhaps the most difficult to place values upon. Renwick's (2001) paper provides evidences of the contribution of fisheries in Kirindi Oya Irrigation System in Sri Lanka. It is notable that this secondary use of irrigation provides an additional 18% beyond the value of water for paddy irrigation alone. This is in a context where not much intensive work has been done to maximise the fisheries production. Palanisami and Meinzen-Dick (2001) study of tanks in Tamil Nadu compares performances of tanks on a number of measures and found that including all major productive uses of tanks (excluding domestic uses and livestock) increases the total value of output by 213% over irrigation alone. However, a much more dramatic difference is seen when revenue from all uses is compared to revenue from irrigation alone. Total revenue is more than triple the revenue that is generated only from irrigation (Shah 2003). Studies at other sites may reveal more or less change in the total value of water uses in irrigation systems. The fore coming analyses part describes the livelihood options and increased income during post rehabilitation period for non-farming and off-farming activities in the selected rural village. Estimation of increased income from various livelihood options was carried out for increased cultivated area of respondents alone.

II. METHODOLOGY

A. Study Area

Kalur Eri is a non-system rural tank located at 12°27'40' North Latitude and 79°08'51'' East Longitude in Chetpet block of Polur taluk in Thiruvannamalai district. The registered ayacut is 214.64 ha and the tank capacity is 2.59 M m^3. Paddy and sugarcane are the major crops cultivated. Groundnut, ragi, cholam, cumbu, pearl millet, maize, urdu dhal and chicken pea are also cultivated in dry and garden lands. Tank and wells are the sources of irrigation along with an annual rainfall of about 1100 mm. This tank was rehabilitated in the year 2012 withWorld Bank funding of Rs 40 lakhs. Data for the pre-rehabilitation period was collected through recall method. For the pre and post-rehabilitation period data were collected with an interview schedule for the years 2010 and 2015 in study village respectively.

B. Economic Measures

Investment appraisal was carried out to find whether the tank rehabilitation was economically viable using the discounted cash flow technique and the measure of benefit-cost Ratio, net present worth, internal rate of return and pay back period for the investment on tank rehabilitation.

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C. Benefit – Cost Ratio (BCR)

This is the ratio obtained when the present worth of the benefit stream is divided by the present worth of the cost stream. The BCR implies that returns per rupee of investments. The criterion is BCR should be greater than one.

$$BCR = \sum_{t=1}^{n} \frac{B_t / (1+i)^t}{C_t / (1+i)^t} \qquad t = 1,2\ldots\ldots\ldots\ldots,n$$

Where

B_t = Benefits in the period 't'

C_t = Cost in the period 't'

i = Discount rate

t = number of years

D. Net Present Worth (NPW)

The most straightforward discounted cash flow measure of development project worth is the net present worth (NPW). This is simply the present worth of the incremental net benefit or incremental cash flow stream. It may also compute by finding the difference between the present worth of the benefit stream less the present worth of the cost stream.

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

E. Internal Rate of Return (IRR)

This is the rate that makes the net present worth of the incremental net benefit stream or incremental cash flow equal zero. It is the maximum interest that a project could pay for the resources used if the project is to recover its investments and operating costs and still break-even.

$$IRR = LDR + (HDR - LDR)\left[\frac{NPW \text{ at } LDR}{\text{Sum of } NPW \text{ at } HDR \text{ and } LDR}\right]$$

Where, LDR and HDR are respectively the lower and higher discount rates. The criterion is to select the project with IRR greater than the opportunity cost of capital or bank interest rate.

F. Pay back period

Pay back period is defined as the length of time required for the stream of cash proceeds produced by an investment, to equal the original cash outlay required by the investments.

$$P_{bp} = T_{cc} / N_b$$

in which, P_{bp} is the pay back period

T_{cc} is the total capital cost of rehabilitation

N_b net benefit per year

III. ANALYSIS AND INTERPRETATION

It is evident from the data that Table 1 throws light on three aspects of investment appraisal. Internal rate of return, benefit cost ratio and net present value are all higher for non-farming and off-farming activities than farming alone. This reveals that tank rehabilitation program is highly beneficial for indirect users in Kalur. But their income is dependent upon farming activities. Therefore, they are getting benefited mutually. Pay back period of the amount spent for the tank rehabilitation is found as one and half years with the income incurred from selected farming, non-farming and off-farming respondents alone. It may by further reduced with the income earned from the entire Kalur farming, non-farming and off-farming activities.

Table 1 Investment appraisal for farm, non-farm and off-farm activities in Kalur

S.No.	Description	IRR %	BCR	NPV (Rs.)	PBP (Years)
1	Farming	12.00	1.04	2,16,053	3.25
2	Non-farming and off-farming	12.58	1.47	7,05,276	2
3	Farming, non-farming and off-farming	13.00	2.51	79,57,765	1.35

IV. BENEFIT COST ANALYSIS OF TANK REHABILITATION FOR STUDY TANK

Economic measures evaluate the project worth by comparing the value of goods and services generated or conserved with the cost by assessing its effect on social welfare needs and viability. There are various undiscounted and discounted measures, which are available to evaluate the projects. The undiscounted measures ignore the time value of money and simply evaluate the worth of the projects. Discounted measures such as Net Present Worth (NPW), Benefit-Cost Ratio (BCR) and Internal Rate of Return (IRR) are used for this purpose. For the economic analysis of the rural village, the lowest discount rate and the highest discount were selected as 10% and 15% respectively. Since the Kalur tank was rehabilitated in the year 2001-2002, it was decided to do the appraisal for 10 years i.e. till 2011 to 2012. In view of the fact that there won't be any increased benefits on the year of tank rehabilitation (2001-2002), the net benefit was considered as zero. While the data were collected only for the year 2004-2005, the same net benefit value was assumed for the remaining years for the purpose of analysis. Regarding the capital cost, Rs. 40.01 lakh was the initial investment during the tank rehabilitation. Apart from this, Rs. 250/ha was approved by the Government every year as tank maintenance charges. So, for 214 ha of registered ayacut, the total amount was Rs. 53,500/-. For successful functioning of the Water Users Association, Rs. 20,892/- was spent every year for conducting meetings, association renewal fees etc. A sum of Rs. 11,00,000/- was allotted for this village in the year 2005-2006 from the NREGA scheme, which was used for desilting and broadening the drainage channel for a total length of 5 km. Depth and width of the channel were increased to 1.2m and 3m respectively. The Public Works Department sanctioned Rs. 5,00,000/- in the year 2006-2007 to carry out partial desilting in the tank bed closer to the deepest sluice for retaining water for a long time and make use to recharge the wells said by the villagers.

Table 2 Increase of per capita tank based income through various activities

S.no	Description	Unit	Kalur Tank
1.	Command Area	ha	215
2.	Rehabilitation cost	Rs	2900000
3.	Demographic details		
4.	Population	number	2167
5.	Land holders	number	411
6.	**Benefits**		
7.	Yield		
8.	Paddy	bags/ha	7
9.	Sugarcane	tons/ha	10
10.	**Gross income**		
11.	Paddy	Rs/ha	3500
12.	Sugarcane	Rs/ha	10250
13.	Total gross income	Rs/ha	13750
14.	By product (5%)	Rs/ha	680
15.	Total expenses	Rs/ha	4000
16.	Net income	Rs/ha	9750
17.	Net Agricultural tank income	Rs/ha	2092740
18.	Wages for 175 days at Rs 60 per day	Rs	2253720
19.	**Net Agricultural tank income**	**Rs**	**4346460**
20.	Income per capita from agriculture	Rs	2005
21.	Net Agricultural tank income	Rs	**4346460**
22.	Employment generation in rehabilitation works	persons days	7638
23.	**Wage at Rs 70/day**	**Rs**	**534660**
24.	**Associated Tank based income**		
25.	Livestock	Rs	27000
26.	Mini contract labour group	Rs	605000
27.	Fuel wood	Rs	291000
28.	Brick making	Rs	500000
29.	Soda factory	Rs	207000
30.	Washing	Rs	32000
31.	Fish rearing	Rs	100000
32.	Rat trapping	Rs	99000
33.	Barber	Rs	48000
34.	Duck rearing	Rs	0
35.	Sheep or goat rearing	Rs	0
36.	Tank bund tree plantation	Rs	70000
37.	**Income from off-farm activities**		
38.	Water market through lorries	Rs	0
39.	Water packing companies	Rs	0
40.	Cement concrete hollow block company	Rs	0
41.	**Total Associated tank based income**	Rs	**1979000**
42.	**Total net tank income**	Rs	**6860120**
43.	Income per capita	Rs	3175
44.	**% of total increase in per capita tank based income**	**%**	**58**

V.CONCLUSION

It is evident from the data that Table throws light on three aspects of investment appraisal. Internal rate of return, benefit cost ratio and net present value are all higher for non-farming and off-farming activities than farming alone. This reveals that tank rehabilitation program is highly beneficial for indirect users in Kalur. But their income is dependent upon farming activities. Therefore, they are getting benefited mutually. Pay back period of the amount spent for the tank rehabilitation is found as one and half years with the income incurred from selected farming, non-farming and off-farming respondents alone. It may by further reduced with the income earned from the entire Kalur farming, non-farming and off-farming activities.

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