

CHAPTER 4

BENEFIT-COST ANALYSIS OF TULSHI PROJECT

4.1 SIGNIFICANCE OF BENEFIT-COST RATIO

Since 1951, Indian Government has accepted the policy of agricultural development through the irrigation development. Hence, irrigation has been assigned a high priority in investment decisions. It is necessary to ensure that this investment is being gainfully spent because capital resources are limited. Due to scarcity of capital, the government selects such irrigation projects whose capital value is less than its benefits. Different criteria are used for the purpose of selecting viable schemes of irrigation. Benefit-Cost Ratio is one of the techniques so used to judge the economic feasibility of the project.

Benefit-Cost Ratio is the ratio between present worth of Benefits and Costs.

$$\text{Benefit - Cost Ratio} = \frac{PW_B}{PW_C}$$

where PW_B is the present worth of benefits and PW_C is the present worth of costs. Present worth of benefits and costs is calculated as below:

$$PW_B = \sum_{t=1}^N (P/F, i, t) \times B_t$$

where, N - Number of years

P/F - Present worth factor,



i - Internal rate of return (%)

t - time period

B_t - Benefit

C_t - Cost

This method is very useful for economic evaluation of projects. If Benefit-Cost Ratio is greater than one, then the project is said to be economically feasible. Projects can be ranked according to the magnitude of their Benefit-Cost Ratio. Higher the Benefit-Cost Ratio, greater the priority. The project having maximum Benefit-Cost Ratio is selected from amongst different alternative projects under considerations.

The Second Irrigation Commission (1972) endorsed the use of Benefit-Cost Ratio as the appropriate criterion for judging the economic soundness of an irrigation project and recommended that any irrigation project with a Benefit-Cost Ratio greater than 1.5 should be an acceptable proposition. The Commission further recommends that a lower limit of 1.0 for Benefit-Cost Ratio should be acceptable for irrigation projects in the drought-prone and tribal areas. The lower limit in drought-prone areas is to cover additional costs involved in protective irrigation. The Commission also suggested a format for calculation of Benefit-Cost Ratio.

The annual benefits are calculated from the yield of the various crops due to irrigation in the command area. For this purpose, the details are taken from the agricultural

department about yield from the crops due to irrigation in the command area and the net benefits. Deduction of the existing produce is made, all other benefits are added and the annual net benefits are worked out. For this purpose, the annual cost of the project is worked out by considering simple interest on capital cost, other costs on lift irrigation schemes, maintenance and establishment are added and annual cost of the project is worked out. The ratio of annual benefit and annual costs known briefly as B-C Ratio is thus calculated. It is expected that the value should be greater than 1.5, if the said project is to become feasible and consequently, get sanction for construction.

In this light, the Benefit-Cost analysis of Tulshi Irrigation Project is done in the following pages.

4.2 BENEFIT-COST RATIO OF TULSHI PROJECT

The criteria recommended by the Second Irrigation Commission for calculation of the Benefit-Cost Ratio (B-C Ratio) is now employed for the Tulshi Irrigation Project. It is not worthwhile to calculate the ratio for the year immediately after the completion of the project as some time needs to be elapsed for necessary readjustments and stabilisation of the changes. Hence, the calculations here have been done for the year 1984-85, that is, after a lapse of about 6 years from the completion of the original project.

TABLE - 4.1
BENEFITS AVAILABLE FROM AGRICULTURAL PRODUCE PER HECT IN THE COMMAND AREA OF TULSHI PROJECT AFTER IRRIGATION (1984-85)
(in Rs.)

Sr. No.	Crops	GROSS BENEFIT FROM THE CROP										COST OF THE CROP										Net Benefit Col.
		Yield in Qt/ha	Rate in Rs/Qt	Value	Deduct for F.H.P. @10% of col.5	Net for price	Fooder Receipt 25% for Rabi Sower	Imple ments charges @3% of Col.7	Total Bene-fit per ha.	Seed cost	Ferti-lizer cost.	Total of Col.No (11+12)	Add Fodder Expt. 10% of Col.7	Imple ment charge es @3% of Col.7	Labour charges @2% of Col.7	Cost of pesti des.	Irri gation charges work-ing Capital @13.5% of Col.13to18 for crop duration	Intere st on Expendi ture Col.	Total Expendi ture Col.	Net Benefit Col. (10-20)		
1	Sugar	1500	22.00	33000	3300	29700	-	891	30591	2500	3430	5930	2970	891	5940	460	750	3422	20363	10228		
2	Vegetables**	262.5	175.00	45800	4580	41220	-	1236	42456	125	260	385	4122	1200	8244	34	50	650	14688	27768		
3	Paddy (HYU)	50	202.00	10100	-	10100	-1515	303	11913	120	900	1020	1010	303	2020	380	50	225	5007	6906		
4	Pulses (HVV)	10	419.00	4890	-	4890	-	147	5036	275	505	780	487	147	978	125	75	185	2662	2259		
5	Wheat	20	230.00	4600	460	4140	414	124	4698	300	375	675	414	124	928	200	75	100	2417	2261		
6	Paddy (Hot Weather)	40	202.00	8080	-	8080	1212	242	9534	120	900	1020	808	242	1616	380	50	198	4339	5195		
7	Onion	260	68.75	17875	1787	16088	-	482	16570	800	1468	2268	1608	482	3216	65	75	339	3053	8517		
8	Maize	25	175.00	4375	437	3938	-	118	4056	60	212	272	393	118	786	-	50	61	1680	2376		

NOTE: * F.H.P. = Farm Harvest Price.
** Average figures taken for various vegetables and pulses.
Source: Excess Note of Tulshi Irrigation Project

To begin with, estimates of the net value of irrigated produce per hectare for the command area are made. Details of calculations are given in Table 4.1. These values are worked out by the Agricultural Department of the State Government and hence, are adopted as they are. Table 4.1 presents details in three parts: (i) gross benefit from the crop; (ii) cost of production of the crop, and (iii) net benefit accruable from each crop per hectare. Cropwise gross benefit, total expenditure and net benefit are given in columns 10, 20 and 21, respectively.

As a second step, these calculations per hectare are used as basis for converting the figures for the estimated command area of 4,720 hectares, through an intervening step of total benefit from different crops per 1,000 hectares. The intervening step can be seen in Table 4.2.

Table 4.2

Net value of irrigated produce from Tulshi Project per 1,000 hectares of irrigable area

Sr. No.	Crop	% area of crop	Area (ha.)	Net bene-	Total bene-
				fit per Hectare	fits for 1000 ha.
				Rs.	Rs.
1	Sugarcane	33	330	10,228	33,75,240
2	Vegetables	5	50	27,768	13,88,400
3	Paddy (HY)	50	500	6,906	34,53,000
4	Pulses (HY)	12	120	2,259	2,71,080
5	Wheat*	30	300	2,261	6,78,300
6	Paddy* (HW)	20	200	5,195	10,39,000
7	Onion*	4	40	8,517	3,40,680
8	Maize*	5	50	2,376	1,18,800
			Total		106,64,500

Source: Tulshi Irrigation Project Report, 1987.

Note: *Follow on crops.

TABLE 4.3

BENEFITS AVAILABLE FROM AGRICULTURAL PRODUCE PER HECTARE IN THE COMMAND AREA OF TULSHI PROJECT BEFORE IRRIGATION
(In Rs.)

Sl No	Crops	COST OF THE CROPS															Net Benefit Col. (10-20)			
		Yield in Qt/ha	Rate Rs/Qt	Value	Deduct for F.H.P. @10% of Col. 5	Net Price.	Fodder Receipts @25% for Rabi Sower 10% to Rabi Wheat 15% for Jawars Pady.	Implement charges @3% of Col. 7	Total Benefitted	Seed cost.	Fertilizer cost	Total of Col. (11+12)	Add Fodder Exp. 10% of Col. 7	Implement charges @3% of Col. 7	Labour charge @20% of Co. 7	Cost of pastures.		Irrigation charges	Interest on working Capital @13.5% of total 13 to 18 for crop duration	Total (10-20)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1.	Paddy	16	202	3232	-	3232	484	96	3813	120	406	526	323	97	346	180	-	68	1489	2324
2.	Jawar	6	210	1260	-	1260	189	37	1488	48	-	48	126	37	252	45	-	24	532	954
3.	Maize	12.5	175	2182	-	2187	318	65	2590	60	100	160	218	65	436	-	-	100	980	1600
4.	What	5.5	2.30	1265	-	1265	189	37	1493	48	-	48	126	37	252	45	-	29	537	954
5.	Gram	7	485	3381	338	3043	-	91	3134	670	337	1007	304	91	808	45	-	93	2148	986

NOTE: F.H.P. = Fram Harvest Price.

SOURCE: Excess Note of Tulshi Project

Thus, as per Table 4.2, total benefit accruable per 1,000 hectares is Rs.106.65 lakhs. Therefore, for 4,720 hectares of the command area, it comes to Rs.503.39 lakhs by the following calculation:

$$\frac{4720}{1000} \times 106.65 = 503.39$$

This is the net value of irrigated produce for 4,720 hectares.

As a further step, it is necessary to deduct from this net value, the value of 'existing produce' to arrive at the figure of the net addition to the crop value due to the availability of irrigation facility from the project. Here the term 'existing' produce connotes the produce before irrigation.

In this context, per hectare net benefit that was available before irrigation facility, is estimated in Table 4.3 by following the procedure adopted by the Agricultural Department on the State Government. Cropwise gross benefit, total expenditure and net benefit are given in columns 10, 20 and 21, respectively. Then, these calculations are used to estimate the net value of the 'existing produce', that is, produce before irrigation for 4,720 hectares. Table 4.4 presents the relevant details.

Thus, as per Table 4.4, the benefit accruable per 1,000 hectares is Rs.25.75 lakhs. Therefore, for 4,720 hectares of the command area, it comes to Rs.121.54 lakhs by the following calculation:

Table 4.4

Net value of the agricultural produce before irrigation
in the Tulshi Project command area (for 1,000 ha.)

Sr. No.	Crop	% area of crop	Area (ha.)	Net bene-	Total bene-
				fit per Hectare Rs.	fits for 1,000 ha. Rs.
1	Paddy	38.60	386.00	2,324	8,97,064
2	Jowar	3.25	32.50	954	31,005
3	Sugarcane	16.42	164.20	8,628	14,16,718
4	Food Crops	17.92	179.20	588	1,05,370
5	Grass	19.86	198.60	100	19,860
6	Maize	3.63	36.30	1,600	58,080
7	Wheat*	0.43	4.30	954	4,102
8	Gram*	4.33	43.30	986	42,694
				Total	25,74,893
				Say Rs.25.75 Lakhs	

Note: *Follow on crops

Source: Tulshi Irrigation Project Report, 1987.

$$\frac{4720}{1000} \times 25.75 = 121.54$$

This is the net value of the agricultural produce before irrigation for 4,720 hectares.

The net agricultural produce due to irrigation is Rs.503.39 lakhs - Rs.121.54 lakhs = Rs.381.85 lakhs.

Now, in the light of these results, actual B-C Ratio of the Tulshi Project is estimated, the details of which follow in Table 4.5. The estimates are for the year 1984-85.



As per the calculation, the B-C ratio has been well high at 2.53. As is said earlier, the rock-bottom minimum ratio for any irrigation project is unity. However, for launching any project, the minimum expected ratio is 1.5. Any higher ratio than this would strengthen the case of the project for execution. The Tulshi Project provides a high margin from the expected minimum so that there is no doubt that in the long run, the project would continue to be economically viable. One important reason of this viability is that the planners have made it a low cost proposition by avoiding canal network and providing for lift irrigation through Kolhapur-type weirs. In fact, the topography of the river basin itself has compelled the planners to frame the scheme in this manner. The entire river basin is a hilly tract so that development of canal irrigation for a wider command area is well-nigh impossible.

A point worth noting. The method of estimating B-C Ratio as given in Table 4.5 is the officially accepted one by the Government of India and evaluations of all the projects in the country are done on the same lines.

4.3 ALTERNATIVE METHOD OF ESTIMATING BENEFIT-COST RATIO

The experts from Water and Land Management Institute (WALMI), Aurangabad, have studied a number of irrigation projects for gauging their impact on agricultural and economic development of the region. They have proposed an alternative method to calculate the Benefit-Cost Ratio, which

Table 4.5
Benefit-Cost Ratio of Tulshi Project (1984-85)

		(Rs.in Lakhs)
<hr/>		
(A)	<u>BENEFITS</u>	
(i)	Net value of irrigable produces for 4,720 hectares	503.39
(ii)	<u>deduct</u> Value of existing produce	<u>121.54</u>
		381.85
(iii)	<u>add</u> benefits due to	
(a)	Pisciculture	1.34
(b)	Drinking water	<u>8.25</u>
	Net Annual Benefit	<u>391.44</u>
<hr/>		

(B) CAPITAL COST

Capital cost of the project is capital cost of dam plus capital cost of lift irrigation schemes.

Capital cost = 949.19 + 230.51 = 1,179.70

ANNUAL COST

(i)	Annual cost of the project (by considering simple interest at 10 percent on capital cost)	117.97
(ii)	Depreciation value at 2 percent on capital cost	23.59
(iii)	Energy charges on lift irrigation schemes	4.19
(iv)	Maintenance cost	7.64
(v)	Establishment cost	<u>1.17</u>
	Net Annual Cost	<u>154.56</u>

$$\begin{aligned}
 \therefore B - C \text{ Ratio} &= \frac{\text{Annual benefit}}{\text{Annual Cost}} \\
 &= \frac{391.44}{154.56} \\
 &= 2.53
 \end{aligned}$$

Source: Tulshi Irrigation Project Report, 1987.

may be called as "Net Present Worth Method". Therefore, by using net worth of benefits as also costs, the Benefit-Cost Ratio of Tulshi Irrigation Project is calculated. The expenditure made on the project from 1965 to 1990 and the agricultural returns after storing the water in the dam are used to calculate the B-C Ratio. Agricultural returns are calculated on the basis of the agricultural produce, which is given by the Agricultural Department for Tulshi command area. Relevant details of the official data and further calculations are presented in Table 4.6. As per the suggested alternative method,

$$B - C \text{ Ratio} = \frac{PW_B}{PW_C}$$

and

$$\text{Net Present Worth} = PW_B - PW_C$$

Using the totals arrived at in Table 4.6, the B-C Ratio and the Net Present Worth of the Tulshi Project are calculated as under:

$$\begin{aligned} \text{Benefit-Cost Ratio} &= \frac{PW_B}{PW_C} \\ &= \frac{443.32}{207.76} \\ &= \mathbf{2.13} \end{aligned}$$

$$\begin{aligned} \text{Net Present Worth} &= PW_B - PW_C \\ &= 443.32 - 207.76 = \mathbf{235.56} \end{aligned}$$

As regards the B-C ratio, by applying the "Net Present Worth Method", it is found to be 2.13, which is marginally different from the figure of 2.53 arrived at by using

Table 4.6
Economic evaluation of Tulshi Irrigation Project by
Net Present Worth Method

Year	Expen- diture	Return	D.F.	(Rs.in Lakhs)		
				Present Worth @12%		
				Cost	Benefit	Net Benefits
1965-66	0.23	-	0.8929	0.20	-	- 0.20
1966-67	3.47	-	0.7922	2.73	-	- 2.73
1967-68	3.00	-	0.7118	2.13	-	- 2.13
1968-69	8.00	-	0.6355	5.08	-	- 5.08
1969-70	9.57	-	0.5674	5.43	-	- 5.43
1970-71	11.62	-	0.5066	5.88	-	- 5.88
1971-72	24.42	-	0.4523	11.045	-	-11.045
1972-73	52.09	-	0.4039	21.04	-	-21.04
1973-74	82.26	-	0.3606	29.66	-	-29.66
1974-75	84.89	-	0.3220	27.33	-	-27.33
1975-76	106.71	-	0.2875	30.70	-	-30.70
1976-77	136.01	-	0.2567	34.91	-	-34.91
1977-78	55.19	-	0.2292	12.65	-	-12.65
1978-79	21.21	61.16	0.2046	4.34	12.51	+ 8.17
1979-80	12.83	178.35	0.1827	2.34	32.58	+30.24
1980-81	5.05	222.03	0.1631	0.82	36.21	+35.39
1981-82	5.55	221.67	0.1456	0.81	32.27	+31.46
1982-83	12.99	284.56	0.1300	1.69	36.99	+35.30
1983-84	17.38	328.77	0.1161	2.01	38.17	+36.16
1984-85	15.25	391.44	0.1037	1.56	40.59	+39.01
1985-86	11.61	455.60	0.0926	1.08	42.18	+41.10
1986-87	17.56	544.30	0.0826	1.45	44.95	+43.50
1987-88	10.15	535.94	0.0738	0.75	39.55	+38.80
1988-89	18.91	660.57	0.0659	1.25	43.53	+42.28
1989-90	14.69	744.75	0.0588	0.86	43.79	+42.93
Total	723.26	-	-	207.76	443.32	235.56

D.F. : Discount Factor.

Source: Compiled on the basis of data collected from the Agricultural Department of the Tulshi Irrigation Project.

the conventional method. Therefore, the alternative method too reinforces the inference that the Tulshi Project is an economically viable proposition. The estimated net present worth of Rs.235.56 lakhs speaks for the soundness of the project.

..ooOoo..