

Water Use Efficiency & Economic Feasibility of Irrigation Projects: A case study of Economic Evaluation of Itiadoh Irrigation Project

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The Economic Feasibility of Irrigation Project is directly related with water use efficiency of the project. The economic benefits are dependent on how efficiently the water is utilized for irrigation & non irrigation purposes. And also how much area is irrigated, to what extent the losses are reduced. The present paper discusses the Benefit-Cost ratio and Internal Rate of Return of Itiadoh irrigation project – A major project in Gondia district of Maharashtra State, is estimated as per the guidelines of Central Water Commission. Also achieving the water use efficiency through crop diversification is emphasized. The benefit cost ratio estimated is 0.86 (<1) less than the norm of B-C Ratio for tribal area. Also, the Internal Rate of Return of Itiadoh Project is estimated as 8.81% (<10%), less than the norm for the projects in tribal area, hence the project did not prove to be economically feasible. The highly water intensive crop, paddy after paddy, one crop in kharif and one crop in rabbi & hot weather (together), very less crop diversification has proved the project economically infeasible. In addition, negligible non irrigation water use, with absence of agro based industries has ultimately affected output prices of agriculture produce. Hence inclusion of cash crops, short duration crops and vegetables with proper modifications in the distribution network with improved off farm & on farm water use efficiency will help improve the economic performance of the project. The ensured higher market price to farmers, additional number of agro-based industries & hence suitable crop cultivation may help improve the total benefits due to project.

1. INTRODUCTION

The water use efficiency & hence performance evaluation of an irrigation project can be examined with two major components viz. the status of distribution network (DISNET) (off-farm) and the on-farm system. This ultimately decides the economic feasibility of the irrigation Project. It is obvious that, the off-farm system / DISNET should deliver water to farms with sound adequacy, high efficiency, dependability and equity. These are the parameters commonly considered for assessing over all performance of an irrigation system.

2. BACKGROUND:

Central Water Commission (CWC), Ministry of Water Resources (MoWR), Government of India (GoI) had assigned the “Post Project Performance Evaluation Study” of Itiadoh Irrigation Project, Gondia district, Maharashtra State, to Water and Land Management Institute (WALMI), Aurangabad.

3. PRESENT METHODOLOGY:

For Economic Evaluation of irrigation projects, the second Irrigation Commission, 1972, Government of India, has suggested the Benefit-Cost Ratio technique. The main features of this technique are (WALMI, 2004) –

3.1. Benefit-Cost Ratio :

i.e. $B/C = \frac{\text{Net annual benefit.}}{\text{Annual Cost}}$

- the norm for acceptance is $B/C \geq 1.5$ in general
- for tribal area & drought prone area the norm for acceptance of project is $B/C \geq 1$.
- (a) Net annual benefit is calculated using the
 - Concept of without project & with project.
 - The crop pattern without project & with project.
 - Annual gross value of farm produce, annual expenditure on agriculture production, net annual benefits are calculated for without project & with project
 - The net annual benefits due to project are estimated as difference between annual benefits with project & without project.
- b) Annual cost is calculated by considering the components
 - Interest on capital @ 10%
 - Depreciation of the project @ 1% of the cost of the project
 - Annual Operation & Maintenance charges
 - Maintenance of head works @ 1% of its cost

3.2. Discounted cash flow technique: Internal rate of Return (IRR)

The B-C Ratio mentioned above ignores time value of money therefore discounting technique IRR is suggested for economic analysis of project is the discount rate at which discounted benefit cost ratio is = 1

IRR is the discount rate at which discounted benefit cost ratio is = 1 & market prices are considered for estimation. Norm suggested is, IRR has to be $\geq 12\%$ in general & 10% for drought prone /tribal areas/chronically flood prone area.

4. ECONOMIC EVALUATION OF ITIADOH PROJECT (WALMI, 2010):

4.1. Salient features:

The project was commissioned in the year 1971-72 and was designed to irrigate 17,980 ha. Kharif season utilization is 100% while utilization in Hot weather is 62%.

Water Storage		Command	
Total storage	- 381.587 MCM	Gross Command Area (GCA)	- 30161 Ha.
Live storage	- 317.874 MCM	Culturable Command Area (CCA)	- 22751 Ha.
Dead storage	- 63.71 MCM	Irrigable Command Area (ICA)	- 17980 ha.
Expenditure : Rs. 804.63 Lakhs(1970)			
Compounded cost : 27732.3 Lakhs (2005 -2006)			

4.2. Present Actual Benefit -Cost Ratio of Itiadoh Project

4.2.1. Information referred for calculation of Benefit Cost Ratio:

For the estimation of present actual benefit-cost ratio, following are the assumptions.

1. The reference year / base year is 2005-2006. All the costs and benefit values are converted to the base year.
2. Salient features of Itiadoh Project mentions ICA as 17980. The data given by the office of Executive Engineer, Bagh - Itiadoh Irrigation Division, Gondia are referred.
3. The total cost of the project is compounded to get the total cost for the year 2005- 2006.
4. Actual annual O & M costs for past 16 years from 1989-90 to 2004-05 are compounded for the year 2005-06 & average of the same is taken.

5. The output price values for with project situation for paddy are considered as given by Agriculture Produce Marketing Committee (APMC), District- Gondia, for the year 2005-2006. The weighted average of price for paddy is considered for estimations.
6. The circular of Joint Director Agriculture, Nagpur, for the year 1990-91 has been referred wherever necessary. The input prices from this circular are converted to year 2005-06 by referring to whole sale price index values. (Ref: RBI website). In addition to the direct agricultural income, the income through by product is also taken into consideration. The total agricultural income is estimated in the proportion 9:1 of direct agriculture benefits with market value & minimum support price respectively.
7. The Agriculture Diary 2006-07, published by Dr. Punjabrao Krishi Vidyapeeth, Akola has also been referred.
8. The non-irrigation benefits viz. water charges through drinking/domestic water supply from reservoir & canal are estimated referring circular of WRD, for the year 2005-2006. No benefits through water supply for industries is mentioned.
9. The net benefits from fisheries and Khas grass is considered as mentioned by Itiadh project authorities.
10. Since the pre-project crop pattern & the yield of paddy, for without project was not available, a sample survey was carried out in the un-command area of Itiadh project, just outside the command and the same has been analyzed & is referred.
11. For the minimum support price, the data has been retrieved from internet.
12. The with project crop pattern has been referred from actual survey conducted during Evaluation study.
13. For estimation of Gross value of farm produce, the standard CWC table format is referred.
14. For Benefit-Cost Ratio estimation, the standard format is attached as Table.1
15. The expenditure on manure & fertilizers is taken as 60% of the recommended dose. This has been the actual practice observed during the sample survey.

4.2.2 Cost on Cultivation.

The cost of cultivation of crop "without project" and "with project" for different crops is estimated separately as per the prescribed procedure CWC.

4.2.3 Expenditure on inputs:

The detailed estimation of expenditure on inputs viz. Seeds, Manure, Fertilizers and Pesticides and irrigation water charges is done as per the prescribed procedure of CWC.

4.2.4 The expenditure on labour

The expenditure on labour for the crop pattern considered is,

Without Project : Rs. 299.85 lakhs.

With Project : Rs. 737.22 lakhs.

4.2.5 The interest on capital and Land Revenue

The interest on capital is taken as 10% of capital cost as per the guidelines of CWC (compounded to the year 2005-2006). Interest on capital : Rs. 2773.23 lakhs.

The land revenue for without & with project is considered as 2% of Gross Value of Farm Produce.

- Without project : Rs. 29.99 lakhs & - With project : Rs. 121.27 lakhs

4.2.6 Total annual expenditure on cultivation

(a) Without the project = Rs 1133.70 lakhs

(b) With the project = Rs 3198.3 lakhs

4.2.7. Agricultural Income:

4.2.7.1. Without project crop pattern.

The total area under the crop for without project is considered which is equivalent to the total ICA of the project. The total annual income without project is estimated considering the yield per ha. for the without project crop pattern as mentioned in the sample survey conducted for without project. Agriculture Income without project is Rs. 1499.26 lakhs.

4.2.7.2. With project crop pattern.

Total annual income is estimated with project crop pattern referring to circular for B-C ratio issued by joint Director, Agriculture, (1990-91). These values have been converted to year 2005-06 by referring whole sale price index values Agriculture Income with project is Rs. 6063.5 lakhs.

4.2.8. The production

The production of crop per hectare is considered as per the survey results, which is very much comparable with the value mentioned by APMC and as given by Bagh- Itiadoh Irrigation Project Division, Gondia..

Total production (without project) of Paddy = 26.03 thousand tones

Total production (with project) of Paddy = 91.25 thousand tones

(With project production is 3.5 times as compared to without project situation)

4.2.9. Total annual income:

The total annual income is considered by adding gross value of farm produce & the dung receipts and other benefits (non-irrigation). Total annual income

- without project is Rs. 1566.73 lakhs (through irrigation)
- with project is Rs. 6245.41 lakhs. (through irrigation) and
- Non irrigation benefits Rs. 334.58 lakhs
- Hence Total income with project is = Rs. 6245.41+ 334.58 lakh
= Rs. 6579.99 lakhs or Rs. 6580.0 lakhs
- Net incremental benefit (Benefit due to project) = Rs. 2948.66 lakhs

Compounded capital cost = Rs. 27732.29 lakhs for 2005-2006

4.2.10. Annual Cost calculations (In Rs. Lakhs):

- Interest on capital @ 10%= 2773.23
- Depreciation of the project @ 1% of the cost of the project=277.32
- Annual Operation & Maintenance charges as average of 16 years data = 241.8
- Maintenance of head works @ 1% of its cost = 131.45
- Total Annual cost (1 to 4) = 3423.80

4.3. Internal Rate of Return (IRR) of Itiadoh Project

4.3.1. Information referred:

1. Total cost = Rs. 27732.29 lakhs
2. The year-wise capital cost was taken as 5%, 10%, 15%, 20%, 20% and 25%.
3. Benefits were received from the year 1971-72, however maximum benefits (90%) were received from the year 1973-1974 till 1980.
4. 100% benefits have been assumed from 1980 - 81 onwards.
5. Life of Project 100 years.
6. O & M Cost=34.1265 = 34.13 @ 150/Ha. of CCA of 22751 Ha. for the years when actual data is not available From 1990-91 to 2005-06 actual O & M have been considered.
7. O & M Cost = Rs. 373.25 lakhs for the years from 2006-07
= Annual O & M + 1% maintenance for headworks.
9. All Costs and benefits are estimated for the base year 2005-2006

Table 1. below gives detailed estimation as per the format prescribed by CWC (CWC, 2010).

Table -1. Calculation of Benefit Cost Ratio

Calculation of benefit cost ratio				Rs. in lakhs	
	Particulars			Without Project	With Project
A	GROSS RECEIPTS			A.1.	A.1
1	Gross value of farm produce			1499.26	6063.50
2	Dung receipts @ 30% of the fodder expenditure			67.47	181.91
3	Total (A): Gross Receipts (1+2)			1566.73	6245.41
B	Expenditure on seeds			70.86	113.93
2	Expenditure on manure,Fertiliser,pesticides etc.			392.67	1064.16
3	Expenditure on hired labour			299.85	737.22
4	Fodder expenses	Without Project 15% of Item A.1	With Project 10% of item A.1	224.89	606.35
5	Depreciation on implements	2.7% of item A.1	2.7% of item A.1	40.48	163.71
		Without Project	With Project		
6	Shared and Cash rent	5% of Item A.1	3% of item A.1	74.96	303.18
7	Land Revenue	2% of Item A.1.	2% of item A.1.	29.99	121.27
8	Irrigation water Charges			-	88.48
9	Total (B): Expenses (1 to 7)			1133.70	3198.30
C.	NET VALUE OF PRODUCE:				
1	Total Gross receipts (Total A.3)			1566.73	6245.41
2	Minus total expenses (Total B.8)			1133.70	3198.30
3	Net Benefit of produce: (1-2)			433.03	3047.11
D.	ANNUAL AGRICULTURAL BENEFITS:				
1	Net Benefit With Project (C.3)			3047.11	
2	Net Benefit Withourt Project (C.3)			433.03	
3	Net Annual Benefits (D): (1-2) (Net Incremental Benefits)	D3		2614.08	

4	Other Net Annual Benefits				
	a) Drinking water supply 3.072Mm3 @ Rs.1.5 for 10m3=1.5*3.072=			4.608	
	b) Others:(water supply through canal)				
	- Annual Benefits from Fisheries			4.5	
	- annual Khas Grass benefits			1.68	
	- Zhansinagar LIS 25.228Mm3@ Rs. 5.8 per 10m3 = 5.8*25.228=			146.3224	
	- Navgao feeder scheme17.659 Mm3@ Rs.5.8/10m3 = 5.8*17.659			102.4222	
	- Zaree Talav Feeder scheme 12.94 Mm3@Rs. =5.8*12.94= 5.8			75.052	
	TOTAL BENEFITS			2948.66242	
	TOTAL CAPITAL COST = 804.631 as per 1970-71 DSR				
Compounded capital cost =				27732.29	for 2005-2006
G	Annual Cost				
1	Interest on capital @ 10%		2773.23		
2	Depreciation of the project @ 1% of the cost of the project		277.32		
3	Annual Operation & Maintenance charges as average of 16 years data		241.8		
4	Maintenance of head works @ 1% of its cost *		131.45		
5	Total Annual cost (1 to 4)		3423.80		
	BENEFIT-COST RATIO =	= Annual Benefits/ Annual cost			
		= 0.86			
* is the 1% cost on head works (i.e 13145.11, 47.4% of Total cost 27732.29) = 131.45					

4.4.Results:

1. Benefit –Cost Ratio = Net Annual Benefits / Annual cost = 0.861

The Benefit -Cost ratio as envisaged is minimum one for the project in tribal area.

2.The Internal Rate of Return of Itiadh Project is estimated as 8.89%. For the projects in Tribal area for economic viability, as per the norms IRR should be 10%.

Even though Irrigation Project does not satisfy the norm for Internal Rate of Return with existing crop pattern, the proposed crop pattern makes the project economically feasible. A marginal crop diversification can prove the project to be economically feasible.

The study carried out by WALMI, has proposed the following crop pattern (Table2.) considering water availability, soil type & climatic conditions.

Table 2. Proposed Cropping Pattern for Itiadoh Irrigation Project

Sr.No.	Crops	Area (ha)	Percent area w.r.t. total area	Base period (days)
1	2	3	4	5
I	Perennials:			
1	Orange / Guava	540	03.00	365
2	Sugarcane	360	02.00	365
II	Kharif Seasonals			
3	Paddy	13485	75.00	130
4	Soyabean	2697	15.00	110
5	Green manuring (sunn hemp)/Fodder maize	899	05.00	50
III	Rabi Seasonals			
6	Wheat	1798	10.00	120
7	Gram	1798	10.00	120
8	Linseed/Mustard	899	05.00	100
9	Vegetables	719	04.00	120
IV	Hot Weather Seasonals			
10	Paddy	2679	15.00	120
11	Chillies	360	02.00	150
12	Ground – nut	899	05.00	120
	Total		151.00	

5. CONCLUSIONS:

- (i) The benefit cost ratio is 0.86 which does not satisfy the norm of B-C Ratio for tribal area. Also is estimated as 8.89%. For the projects in Tribal area for economic viability, as per the norms IRR should be 10%. Hence the project is economically not feasible.
- (ii) Highly water intensive crop like paddy, ultimately leads reduction in area under crop & hence benefits.
- (iii) There has been a very less crop diversification because of which the benefits are not seen on the higher side. Inclusion of cash crops, short duration crops, and vegetables with proper modifications in the distribution network will help improve the water use efficiency and hence economic performance of project.
- (iv) The market price actually being received by farmers is on lower side which leads to less net benefit to farmers.

- (v) Additional number of agro-based industries & hence suitable crop cultivation may help improve the total benefits due to project to the individual farmers, as well as to the Nation.
- (vi) Revenue through domestic water supply, fisheries & Khas Grass is considered. However no supply of water for industries is mentioned in the data given by concerned project authorities.

Considering overall situation of the project, there is still scope for improvement in the economic performance of Itiadoh Project.

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