

Economic Impact of Four Cylinder Pedal Pump in a Selected Area of Bangladesh

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ABSTRACT

The study was conducted in Rajshai Barind area to know the short and long term impact of for cylinder manual (Pedal) Pump developed by Bangladesh Agricultural Research Institute. The Pump was dominated by small farmers who cultivated vegetables in homestead fallow land. Simple cost and return analysis indicated that the pump was profitable in the short-run. It was found that in both private and social point of view the pump was profitable and acceptable in the short run as well as in the long run. The command area of the pump was 0.20 ha. The pump was found underutilized. For full utilization of the pump, its operation should be extended to the main field where water source is available. Nevertheless, the pump is a substitute to modern irrigation system.

Key words: Pedal pump, irrigation, vegetable production.

INTRODUCTION

The development of Bangladesh agriculture is largely depend on the development of irrigation. Due to extreme scarcity of surface water and timely rainfall, vast tract of land remains uncropped or inadequately cropped during the year. Most of the crops are still grown under rainfed condition and naturally good harvest is uncertain.

Under the present circumstances and socio-agro-economic condition of the Bangladesh farmers and management problem of the large scale irrigation Bangladesh Agricultural Development Institute (BARI) developed Four Cylinder Pedal Pump (FCPP) suitable for small scale irrigation both for surface and ground water irrigation and serve as an important source of complementary irrigation through out the country. It is suitable as because the pump can be manufactured by locally available iron materials. The design is so simple that any local engineering workshop can easily fabricate. It is technically suitable and the price of the pump is within the affordable range of the poor farmers. One or two persons can operate it up to 15 minutes without rest. No risk is involved in adopting the technology and there is no adverse impact on environment. Given the advantages of this technology and the socioeconomic condition of Bangladesh, there might have great potentiality of this technology. It is urgent need to know the actual performance of this BARI technology. Therefore, a detailed socioeconomic impact study needs to be carried out before going for dissemination and suggestion for improvement and recommendation.

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Some studies were recently conducted on irrigation aspects in the Barind area. These are mostly cost and return analysis (BMDA, 1999; Haque and Khan; Hassan and Islam, 1997; Gafur and Latif, 1995). Since irrigation investment is the project type of investment, the present study used the discounted measures of project worth where the cost present study lies mostly with the methodological aspect.

METHODOLOGY

The study was conducted in Godagari upazila under Rajshahi Barind tract because BARI mostly supplied this irrigation technology in these areas. A formal field survey was conducted from 30 farmers using FCPP in this area. Another 30 non-users of FCPP were also being selected and interviewed. The field data for the study covered 2004-2005 kharif and Rabi seasons. Various books and reports were consulted to collect the necessary secondary information.

In accordance with the objective of the study 1. Enterprise costing/and 2. Discounted measures of project worth were used.

Benefits, costs and prices: In developing countries, pricing of cost and benefits items poses some problems due to market distortion. This problem can be solved using shadow price or accounting prices instead of ordinary market prices. Therefore, for economic analysis wherever necessary and possible ordinary market price was adjusted by using the suitable conversion factor. For financial analysis the prevailing market prices were used for the analysis and the pricing is not that difficult. In financial analysis out of pocket cost of the farmers was considered.

Investment cost: Investment cost included cost of purchasing the FCPP. Therefore, investment cost was involved with irrigation only.

Operation and maintenance cost: This cost was incurred for irrigation only and the following cost were included: Cost for making FCPP operational, labour cost for the operation of FCPP and labour and material costs for making pump house, cost for spare parts and repairing of pump.

Production costs: This cost was involved in connection with production with and without FCPP. The items included under this head were land preparation to harvesting and the primary processing in the production.

Quantification of benefits: Benefit (inflow) with and without project consisted of- With project: a) Gross value of production b) Salvage value; Without project: Gross value of production.

Salvage value: It was estimated the salvage value would roughly equal to 25 percent of the value of materials costs of FCPP.

Life of the project: Life of the project was assumed to be 10(ten) years.

Discount factor: The discount factor or the opportunity cost of capital was assured to be 15 per cent.

Cost of land: The farmers who were involved with irrigation had to forego the non-irrigated output from the same piece of land. This foregone output was the cost of land for those farmers who were presently associated with irrigation (for With project). This method was termed as very defensible (Gittinger, 1972).

Benefit-cost-ratio: Benefit cost ratio is defined as present worth of benefits divided by the Present worth of costs.

Internal Economic and Financial Return: Internal rate of return when used in economic analysis is termed as Internal Economic Return (IER) and when used for financial analysis, it is termed as Internal Financial Return (IFR). Internal rate of return can be calculated by using the formula as:

$$\text{Lower discount rate} + \text{Difference between the discount rates} \times \frac{\text{Present worth of cash flow at the lower discount rate}}{\text{Absolute difference between the present worths of the cash flow at the two discount rates}}$$

Depreciation: The FCPP is a simple device. Therefore, straight line method of calculating depreciation was used.

RESULTS AND DISCUSSION

Land area: Table 1 shows that average land area owned by FCPP growers was only 0.19 ha and that of homestead area of them was 0.05 ha. None of the farmers used their pump in the main agricultural field mainly because of lack of water sources. All the farmers in the study area used this pump for homestead (kharif and rabi seasons) vegetable production and they used 53% of their homestead area for this purpose. They introduced FCPP for last 3 years and engaged in irrigation as a whole for 4 years only.

Table 1. Size of holding of FCPP farmers

Items	Land area (ha)
1. Owned land area	0.19
2. Homestead are	0.05
3. Pond	0.01
4. Mortgage in land	0.48
5. FCPP* area	0.03
6. Number of years FCPP introduced	3
7. Number of year irrigation introduced	4

- a. BARI four Cylinder Pedal Pump,
b. Fifty three percent of homestead area

Vegetable produced: In both the seasons viz. kharif and rabi. The kharif season vegetables grown were snake gourd, bitter gourd, read amaranthus, Indian spinach, okra green amaranthus, brinjal, gima kalmi and chilli. The rabi season vegetables grown were tomato, brinjal, radish, red amaranthus, spinach, chilli, cabbage, country bean, bottle gourd and green amaranthus.

Gross return: The gross return in the kharif season was Tk. 59546/ha and that in the rabi season was Tk 81817/ha. The rabi season gross return was 1.37 times higher over kharif season, because number of vegetables in the rabi season was higher and the farmers in this season realized a very high return from tomato alone. They also observed higher return from brinjal and chilli production as compared to these same vegetables in the kharif season. In both seasons the farmers earned Tk 141363/ha from vegetable production (Table 2).

Table 2. Gross income returns from different vegetable production with FCPP

Rabi season		kharif season	
Vegetables	Gross return	Vegetables	Gross return
1. Tomato	42321	1. Snake gourd	10974
2. Brinjal	8179	2. Bitter gourd	1302
3. Radish	6635	3. Red amaranths	2894
4. Red amaranthus	2659	4. Indian spinach	10974
5. Spinach	1742	5. Okra	10907
6. Chilli	9748	6. Green amaranths	4537
7. Cabbage	1193	7. Brinjal	7166
8. Country bean	7598	8. Gima kalmi	6353
9. Bottle gourd	1594	9. Chilli	4440
10. Green amaranths	148	-	
Total	81817	Total	59546

Both season Gross return = (81817+59546 = 141363 per ha)

Total Cost: The total cost in the kharif season was Tk 51048/ha in the kharif season and 64760/ha in the rabi season. Total (net) was 1.27 times higher in kharif season, mainly because the number of human labour for the operation of FCPP was higher in this season. Per ha cost in rabi season could have been much higher if the pump not being introduced and pump house was established in the kharif season. In calculating total cost, interest on operating cost was added to the total variable cost. Fixed cost was treated as annual capital cost for FCPP and worked out as depreciation cost for one year (Table 3).

Table 3. Average cost of production with FCPP^a

Items		Costs (Tk/ha)		
		Rabi season	Kharif season	Both season
Variable cost				
1	Human labour	48259	31826	80085
	Family	36193	25461	61654
	Hired	12066	6365	18431
	Draft power	1977	3706	5683
	Material costs	13852	12918	26770
Total operating cost		640088	48451	112539
Interest on operating capital		672	566	1238
Total variable cost		64760	49016	113776
2.	Fixed cost			
	Annual capital cost for FCPP	-	2031	2031
Total gross cost		64760	51048	115808
Total (Net) cost		64760	51048	115808

a. Command area 0.50 ha

b. Depreciation costs for pumps per year

Net return: Table 4 shows that return per ha was worked out as Tk. 8498 and Tk. 17057 in the kharif and rabi season respectively when full cost of human labour was considered. Net return in the rabi season in the case was found to be double than the kharif season. Net returns in both rabi and kharif seasons together was Tk. 25557/ha. While only higher human labour costs was considered rabi and kharif season net returns were Tk. 53250/ha and Tk. 33959/ha respectively. In this case rabi season net return was 1.57 times higher than that of kharif season. When added together the net return of both the seasons was Tk. 87209/ha considering higher labour costs of human labour.

Table 4. Economic returns from different vegetable production with FCPP considering full labour costs, for family and hired labour

Items	Costs (Tk./ha)		
	Rabi season	Kharif season	Both season
Gross Return	81817	59546	141363
Total cost	64760	51036	115796
Net return	17057	8498	25557

Economic and financial analyses: For analytical advantage the above cost and benefit items were further classified and adjusted in the following ways-

Investment costs: Table 5 presents the investment cost of the FCPP project from economic and financial points of analysis with a view to arriving at total investment cost. The material costs, local manufacturing cost, transport charges, manufacturers' profit, overhead etc. were computed separately and then added up together. These details were worked out for financial analysis. In economic analysis all these cost excepting the cost of skilled labour items could not be accepted as

they were and thus corrected by applying appropriate conversion factors which was 0.60 and 0.67 for material costs of FCPP, and costs for overhead, transport and manufacturers' profit. Thus the investment costs for 1 ha of land were worked out as Tk. 7359 for economic analysis and 10946 for financial analysis.

Table 5. Investment cost estimate of BARI four cylinder pedal pump per unit

		Total cost estimate of FCPP	
Subject		Estimated cost (Tk.)	
1	Total material cost	1337.27 ^a	
2	Labour cost	300.00 ^b	
3	Overhead cost and transport	75.00 ^c	
4	Incidental expenses (10% of A)	133.73 ^d	
5	Total cost (A+B+C+D)	1846.00	
6	Manufacturer profit (20% of E)	369.20 ^e	
Grand Total, Farm Gate Per unit (E+F) =		2215.20	

Source: Adapted from cost estimated by farm Machinery and post harvest Process Engineering Division, BARI, Gazipur.

Note: ** Only in the case of economic analysis these figure (a,b, c, d and e) were multiplied by the planning commission conversion faced 0.60, 1.0, 0.67, 67.0 and 0.67 respectively to get the accounting price of machinery, skilled labour, overhead, transport and manufacturers profit. Thus, for economic analysis per unit of FCPP has calculated as Tk. 1489.

Operation and maintenance costs: This included the items like human labour costs, costs for changing of spare parts and repairing and costs for FCPP. For the purpose of economic analysis, human labour costs under this section was multiplied by the conversion factor (0.50) for unskilled labour and the cost for spare parts and repairing was adjusted by the conversion factor 0.65. Thus operation and maintenance costs for economic and financial analyses were calculate as Tk 22452/ha and Tk. 11129/ha for one crop year (Table 6).

Table 6. Operation and maintenance cost of per unit of FCPP for economic and financial analysis of the project

		(Tk/ha)	
Inputs		Economic analysis ^a	Financial analysis ^b
1.	Human labour for the Operation of FCPP	21102	9706
2.	Cost for Changing of spare parts and repairing	114	188
3.	Cost for FCPP house	1236	1236
Total		22452	11130

a. Human labours were multiply by planing commission conversion feature (.50) to get the accounting price of it.

b. Only hired labour costs were considered to get the out of pocket cost of the farmers

Production cost: The items included under this head were costs for land preparation to harvesting and primary processing of the vegetables. This is shown in Table 7. This cost was involved in producing both irrigated and non-irrigated vegetables. For economic analysis per ha production costs for irrigated vegetables were calculated as Tk. 49971/ha and 68911/ha respectively and that for non-irrigated vegetables were Tk. 17253/ha and 19526/ha respectively. For economic analysis production cost items at market price were adjusted where necessary particularly in the case of human labour to reflect the scarcity value of this item.

Gross value of production: Most of the vegetables produced were non-traded goods. Therefore, the question of the use of international price did not arise and market price of the vegetables produced were used both in the economic and financial analyses. Therefore, gross value of production (mentioned Table 4) hold good for both economic and financial analysis of the FCPP project.

Table 7. Production cost of vegetables with FCPP

Items	(Tk./ha)			
	Economic Analysis ^a		Financial analysis ^b	
	With project	Without project	With project	Without project
1. Human labour	18940	2273	37880 ^a	4547 ^a
2. Draft Power	5683	3410	5683	3410
3. Cost of inputs	25348	11569	25348	11569
Total	49971	17252	68911	19526

a. For economic analysis these figures are multiplied by plating commission conversion factor (0.50) for unskilled labour.

Benefit cost ratio: Present worth of benefits and costs were calculated as Tk. 710049 and Tk. 602700 respectively at 15 per cent discount rate and the benefit cost ratio was calculated as 1.18 (Table 8). It was found that benefit cost ratio was more than 1 (one) which indicated that the FCPP project was acceptable from economic point of view. Internal rate of return was found to be more than 50 percent in both economic and financial analyses which indicated that FCPP project was profitable both from the society and farmer's point of view (Table 8 and 9).

Table 8. Economic analysis^a of the four cylinder pedal pump irrigation project (Considering 50 percent labour scarcity)

Items	Without project	With Project (FCPP)					Total
		Years					
		1	2	3	4 - 9	10	
1. Inflow							
A. Gross value of production	63613	141363	141363	141363	141363	141363	
B. Salvage value						1653	
Total	63613	141363	141363	141363	141363	143016	
2. Outflow							
A. Investment cost	-	7359					
B. Operation & maintenance cost	-	22452	22452	22452	22452	22452	
C. Production cost	17253	49971	49971	49971	49971	49971	
Total	17253	79781	72423	72423	72423	72423	
3. Net benefit without project	46361	46361	46361	46361	46361	46361	
4. Total cost due to project	-	126130	118783	118783	118783	118783	
5. Incremental benefit	-	15221	22580	22580	22580	24233	
6. D. F. 15%	-	0.870	0.756	0.658	2.489	0.247	
7. Present worth of gross benefit at 15% discount rate	-	122984	106871	93016	351853	35325	710049
8. present north of gross cost at 15% discount rate	-	109745	89801	78160	295653	29341	602700
9. D. F. 50%	-	0.667	0.444	0.296	0.541	0.017	
10. Present north of incremental benefit at 50%	-	10153	10025	6684	12217	430	39509

Note: B.C.R = $\frac{710049}{602700} = 1.18$ (Approximately) : IER is greater than 50%

B.C.R = Benefit-Cost Ratio
IER = Internal Economic Return
a Analysis was made one per ha basis

Table 9. Financial analysis^a of the four cylinder pedal pump irrigation project (Considering hired labour only)

Items	Without project	With Project (FCPP)					Total
		Years					
		1	2	3	4-9	10	
1. Inflow							
A. Gross value of production	63613	141363	141363	141363	141363	141363	
B. Salvage value	-	-	-	-	-	1653	
Total	63613	141363	141363	141363	141363	143016	
2. Outflow							
A. Investment cost	-	10946	-	-	-	-	
B. Operation & maintenance cost	-	11129	11129	11129	11129	11129	
C. Production cost	19526	68911	68911	68911	68911	68911	
Total	19526	90987	80041	80041	80041	80041	
3. Net benefit	44088	50376	61323	61323	61323	62976	
4. Total cost without project	44088	44088	44088	44088	44088	44088	
5. Incremental benefit	-	6289	17235	17235	17235	18888	
6. D. F. 50%	-	0.667	0.444	0.296	0.541	0.017	
7. Present north of incremental benefit at 50%	-	4196	7653	5103	9323	321	26596

IFR is greater than 50 percent

IFR = Internal Financial Return

a Analysis was made one per ha basis

CONCLUSION

FCPP increased farmers' productivity, farm income and employment in small farm condition of very small farm condition. It effectively utilized the family labour. It increased vegetable production and consumption. Other than homestead area farmers were not interested to use FCPP because near the main field ponds were not available. Also availability of irrigation through underground water source may not be technically feasible in the barind area by this method (FCPP can use both surface and ground water for irrigation).

LITERATURE CITED

- BBS. 2002. Statistical Year Book of Bangladesh. Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
- BMDA. 1999. Progress Report. Barind Multipurpose Development Authority, Rajshahi, Ministry of Agriculture, Government of the peoples' Republic of Bangladesh, Dhaka, Bangladesh.
- FFYP. 1998. The Fifth Five Year Plan. Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
- Ghafur, A. and Latif, A. 1995. Barind Integrated Area Development Project: An Evaluation. The Bangladesh Development Studies, Agargaon, Dhaka-1207, Bangladesh.
- Gittinger, J. 1992. Economic Analysis of Agricultural Project Washington. The Economic Development Institute, Institutional Bank for Reconstruction and Development, 1972.
- Haque, M. A. and Khan, M. H. 1999. Impact of Barind Multipurpose Development Project on Socioeconomic Development in Rajshahi Region. *Bangladesh Journal of Training and Development* 12(1&2), 25-31.
- Hassan, M. N. and Islam, M. N. 1997. Water Utilization under different Deeptubewell Management in Barind Area of Bangladesh. *Bangladesh Journal of Water Research* 14-18, 10-19.