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PROFITABILITY OF LOW LIFT PUMP AND INCOME INFLUENCING FACTORS OF LLP OWNERS AND USERS IN SOME SELECTED AREAS OF BHOLA DISTRICT*

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Abstract

The study examined the profitability of Low Lift Pump (LLPs) and income influencing factors of the owners and users of LLP. A purposive random sampling technique was used for collecting primary data from 74 LLP users and 30 LLP owners from January to March, 2010 through two sets of pre-tested questionnaires. Descriptive as well as statistical techniques were used in the study. Three discounting measures such as: BCR, NPV and IRR were selected for financial analysis taking 11 percent market interest rate (i.e. opportunity cost of the capital). BCR was 1.20, NPV was Tk. 35,673 and IRR was 47 percent from financial point of view which indicate LLP was a profitable business. Sensibility analysis also showed positive results when considering either O&M cost increased or gross return decreased by 10 percent. Crop and LLP machine were found main income source for the farmers and LLP owners respectively. The service, business and other family member's income were found to be significant factors influencing the farm income.

Key words: LLP, Profitability, O&M, BCR, NPV, IRR.

1. Introduction

Food security becomes a concerning issue in the world as well as in Bangladesh from the last few years because of not only high price of food in the world market but also unavailability of food. For that reason, the government of Bangladesh emphasis on the highest possible food grain production specially rice production since rice is the staple food of Bangladesh. Among the three types of rice, Boro rice contributes about 57.59 percent in total rice production in 2008-09 (BER, 2009). Irrigation is the "leading input" in rabi season specially for Boro rice production. Without irrigation, HYV Boro rice cannot be produced in the dry season (Dec/Jan-Apr/May).

Minor irrigation plays a crucial role in Bangladesh agriculture and therefore in the national economy. Its population and level of poverty, Bangladesh is very much needed

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to enhance crop production. Almost all of the cultivable lands are under cultivation and additional crop output can only come from increasing yield or cropping intensity and efficient use of scarce resources as well as better cultural and management practices. Methods that are available to achieve this goal depends heavily on irrigation particularly STW and LLP minor irrigation technologies and manually operated pumps (MOA, 1995).

There are two main sources of water in Bangladesh e.g. surface and ground water. STW and DTW are used for lifting groundwater and LLP is used for using surface water. Because of saline underground cannot use in the study area. Only surface water is used through Low Lift Pump (LLP) in the study area. There are no STW and DTW in the study area.

There are few studies are on LLP irrigation but studies on profitability and income influencing factors are available. Investment in STW was more profitable than investment in LLP but investment in DTW does not appear to be profitable under the prevailing circumstances (Chakravorty, 1985). DTW and STW projects were unprofitable from the viewpoint of society but quite profitable from the view point of both farmers as well as individual owners/managers of tubewell projects. The profitability of the projects was positively related with command areas (Miah, 1987).

Investment in DTW and STW were profitable from the viewpoint of the participating farmers and managers, but unprofitable from the view point of society (Miah and Hardaker, 1988). The returns of tubewell owners/managers as well as water users from irrigated HYV paddy production had significantly declined over the years and level of returns was too low to provide incentives for improving performance of irrigation or production. With regards to the type of tubewells, the net returns per hectare of irrigated crops under STWs was about twice as high as under DTWs. The major reason for this difference being about 17 percent higher yields under STWs than DTWs (Mandal, 1989).

Diesel operated STWs and DTWs under cash payment systems were profitable. Electrically operated DTW projects under cash payment systems were making losses, since the managers were required to pay a huge amount of brides to the official of BPDP for electricity connection. The results of sensitivity analysis suggest the profitability of the project was positively related to water charges (Uddin, 1992). Per hectare net returns of MV Boro paddy production under LLP and STW projects were Tk. 14,075 and Tk. 9,680 respectively. The MV Boro growing farmers under LLP projects are making relatively more profit than the farmers of STW projects (Khan, 2003).

The above mentioned literature shows that the studies have been taken regarding profitability and efficiency of different irrigation systems mainly for STW and DTW. But there are a little study was done in this aspect of LLP irrigation system especially in costal Bangladesh. At this stage of irrigation in Bangladesh agriculture it is high time to evaluate the LLPs. The broad objective of the study is to examine the economic analysis of low lift pump and to identify the income influencing factors.

2. Methodology

Methodology is an indispensible and integral part of any research. The reliability of any scientific research depends to a great extent on the appropriate methodology used in the research. The steps of methodology are describe below-

Selection of the study area: The selection of the study area is an important step, which largely depends upon objectives set for the study. For this study data were collected from three unions of Charfashion upazila under Bhola district. Bhola is one of the districts where there is no use of STW and DTW. Farmers of this district use only Low Lift Pump (LLP) for irrigation. Charfashion upazila is situated in the southern part of Bhola district where LLP was used more than other areas. For this study selected three villages, namely, Southfassion, Nilkomol and Ginnajor under Charfassion upazila because of their geographical locatoin. These three villages represent the whole scenario about the LLP.

Selection of sample and sample size: It is not possible to make a social survey covering all household. For this reason sampling is done to select representative farms to minimize time and cost of the study. Sample will be selected through purposive random sampling technique. Total sample was 120 (explain details in below).

Table 1: Description of sample

Respondents	Southfassion, (Sample size)	Nilkomol (Sample size)	Ginnajor (Sample size)	Total Sample size
LLP users	30	30	30	120
LLP pump owners	10	10	10	
Total	40	40	40	

*In this study purposive random sampling were used.

Data collection: Data collection is the most important element of social science research. The accuracy of result depends on the types of data, data collection methods, selection of respondents, etc. In this research only primary data was used.

Methods of primary data collection: Primary data was collected through direct interview or face to face interview from the rice cultivators. We also collected primary data though Focus Group Discussion (FGD) and Key Information Informant (KII).

Analytical techniques: Collected data were classified, tabulated and analyzed in terms of the objectives set for the study. Both descriptive and statistical techniques were used to find important relationships among the relevant variables.

Descriptive technique: Descriptive technique of analysis is generally used to find out the crude association or difference between two variables. In this study descriptive technique was used to illustrate the whole picture of analysis. The sum, mean gross returns etc. of this technique is based on arithmetic average.

Statistical technique: In statistical technique we can use several models to satisfy our objectives.

Financial analysis: There are three tools for financial analysis namely, BCR, NPV and IRR. In case of project analysis financial techniques are very important because to see the result of financial analysis we can take decision for investment.

In the study the following statistical techniques were used. Three discounting measures have been employed to assess the investment decision, namely;

i. BCR: BCR means benefit- cost ratio is. If the ratio is greater than 1 (one) then the project will be accepted because it means if we invest one taka then we get benefit more than one taka.

The working formula of BCR- (1)

$$BCR = \frac{\sum_{i=1}^{n} \frac{B_i}{(1+r)^n}}{\sum_{i=1}^{n} \frac{C_i}{(1+r)^n}}$$

Where, Bi=Benefit from the LLP, Ci=Costs for the LLP r= Discounting rate, i = Time (1,2,3……n)

ii. NPV: NPV is another tool of financial analysis. NPV means Net Present Value. We earn profit in future but it must be compared with the present value of money. Net present value means the present value of future income. If it is positive then the project will be profitable.

The working formula of NPV is as followed- (2)

$$NPV = \sum_{i=1}^{n} \frac{(Benefit - Cost)_i}{(1+r)^n}$$

Where, r =discounting rate i=Times (1, 2, 3, 4……n)

iii. IRR: The last and the most important tool is IRR. It means Internal Rate of Return. IRR describes at which rate we get benefit. It must be greater than the market interest rate because if it is equal or lower than market interest rate then it is better to keep money in bank rather than investment. In this analysis we assume market interest rate is 10 %.

(3)

$$IRR = Lower\ discount\ rate + (difference\ between\ lower\ and\ higher\ discount\ rate) \times \frac{Present\ value\ at\ lower\ discount\ rate}{Absolute\ difference\ between\ present\ values\ of\ two\ discount\ rates}$$

Regression analysis: To find out the income influencing factors of LLP owners and farmer's the following log-lin function will be used.

$$lnY = \beta 0 + \beta 1\ lnx1 + \beta 2\ lnx2 + \beta 3\ lnx3 + \ldots\ldots + \beta n\ lnxn + U_i \quad (4)$$

Where

Y= Total Income (tk/yr)
X_1=Crop (tk/yr) X_2=Business (tk/yr) X_3=LLp pump (tk/yr) X_4=Service (tk/yr) X_5=Livestock (tk/yr)
$ß_1$, $ß_2$,$ß_3$ = Co-efficient of the relevant variables U_i = Disturbance term ln = Natural logarithm

3. Results and Discussions

Profitability of Low Lift Pump: There are several costs associated in operating LLP machine. These costs can be divided into investment/capital costs and O&M costs. These costs are described in the following section of the study.

Investment costs: Investment cost of the LLP includes the cost of motor, pump, pipe, filter, etc. The average investment cost of LLP was Tk. 35, 000 (Table 2). The investment costs of LLP are presented below:

Table 2: Investment costs of LLP

Sl.No.	Cost items	Costs of LLP (Tk.)	% share of total costs
1	Motor	20,000	57.14
2	Pump	6,000	17.14
3	Pipe	7,500	21.43
4	Filter	1,000	2.86
5	Carrying	500	1.43
	Total	35,000	100

Source: Field survey, 2010

Operation and maintenance costs: O&M costs varied from owners to owners and season to season. The different components of O&M costs are presented below in table 3.

Diesel costs: In the study area, most of the LLP pump operated by diesel. It is found that on an average, the diesel cost was Tk.8, 500 per rabi season and it was 26.98% of the total O&M costs (Table 3).

Cost of spare parts: Spare parts were an important cost item for LLP. In the study area, the LLP owner spent a considerable amount of money for buying spare parts in each year during rabi season. The average cost of spare parts was Tk.1, 500 and it was 4.76% of the total O&M costs (Table 3).

Cost of mechanics: LLP owners needed mechanics round the irrigation season to repair motor/engine. The average cost of mechanics was Tk.500 and it was 1.58% of the total O&M costs (Table 3).

Operator's salary: The main task of the operator is to operate the LLP during the rabi season. The average salary was Tk.16, 000 per season and it was 50.79% of the total O&M costs (Table 3).

Table 3: Average operation and maintenance costs of LLP

Sl.No.	Costs items	Costs of LLP (TK.)	Percentage (%)
1	Diesel	8,500	26.98
2	Spare parts	1,500	4.76
3	Mechanic charge	500	1.58
4	Operator's salary	16,000	50.79
5	Drainage cost	3,000	9.52
6	House costs	2,000	6.345
7	Total O&M costs	31,500	100

Source: Field survey, 2010

Drainage costs: Every year the LLP owner made "katcha" drain through the farmers' plots to distribute water. Average cost of making drainage was Tk.3, 000 and it was 9.52% of the total O&M costs (Table 3).

House costs: A house was made for the operator by the LLP owner. The average house cost was Tk. 2,500 per year and it was 6.35% of the total O&M costs (Table 3).

Returns from LLP: The gross benefits from the LLP irrigation system are presented in table 3. Total return from the machine can be finding out by multiplying command area with per unit charge of water.

Table 4: Benefits from the LLP

Items	Average command area (ha)	Per hectare machine charge (Tk)	Total machine charge (Tk)	Salvage value (Tk)
LLP	13	8,615	1,12,000	2,500

Financial analysis of the LLP investments: The main purpose of this section is to examine the investment decision on LLP irrigation system. We use three discounting measures namely, BCR, NPV and IRR for this purpose. The financial analysis, however, is based on the following assumptions:

- All the LLPs were purchased in cash.
- The life of LLP was 7 years.
- Production technology will remain the same throughout the project life.
- Prices of all inputs and outputs were given and constant throughout the project life.

Based on the above assumptions, the summary results of financial analysis are presented as below

Table 5: Summary results of financial analysis

Sl.No.	Discounted Measures	Values
1	BCR at 11%	1.20
2	NPV at 11% (Tk)	35,673
3	IRR (Percent)	47

It is evident from the table that investment in LLP was profitable. All the discounting factors appear positive results. BCR was 1.20 that means, invest of Tk. 1 would return back Tk.1.20 from the project even it discounted at 11%. The value of NPV was Tk. 35,673 that indicated investors made profit by Tk. 35,673 from the project. IRR was 47% that was obviously higher than the opportunity cost of capital or market interest rate (11%). In this analysis, the discount rate was considered 11% that is the prevailing market interest rate in the commercial banks.

On the basis of survey results, the O&M costs may not be same throughout the project life. The prices of input or output and production technology may not also be same over the project life. Little and Mirrless (1974) and Miah (1987) pointed out that the uncertainties of a particular project arise from many unpredictable influences. One cannot perfectly predict future technology or actions of the government, any of these can quite easily falsify the assumptions upon which the appraisal is based. Keeping in view the limitations of the appraisal calculation of LLP minor irrigation project, making any generalization it is, therefore, felt necessary to conduct sensitivity analysis, which have been done in the following section (Khan, 2003).

Sensitivity analysis of the LLP project: The result of sensitivity analysis shows how the value of the investment criteria changes due to changes in the value of any variable in the discounted cash analysis. Sensitivity analysis can be done in two ways. In the first way, if the O&M costs increased by 10 percent and all other costs and benefits are remained constant, then what happen in the profitability of the project. Again, if all the costs are remain constant but benefit decreases by 10 percent, then what happen in the profitability of the project.

Sensitivity analysis in case of increasing 10 percent O&M costs: At first we calculate BCR, NPV and IRR when O&M costs increased by 10 Percent. It is clear from the table 6 that the investment in LLP still profitable though O&M costs increases by 10 percent.

Table 6: Summary results of sensitivity analysis at 10% increased O&M costs

Sl.No.	Discounted Measures	LLP project
1	BCR at 11%	1.10
2	NPV at 11% (Tk)	20,831
3	IRR (Percent)	26

Sensitivity analysis in case of decreasing 10 percent of gross return: BCR, NPV and IRR also calculated when gross return decreased by 10 percent. It is also clear from the table 7 that the investment in LLP still profitable though gross return decreases by 10 percent.

Table 7: Summary results of sensitivity analysis at 10% decreased of gross return

Sl.No.	Discounted Measures	LLP project
1	BCR at 11%	1.08
2	NPV at 11% (Tk)	14,233
3	IRR (Percent)	17

It is clear from the above discussion that the LLP minor irrigation project was profitable in financial analysis. The sensitivity analysis also indicated the same results.

Income influencing factors of the LLP owner and users: There are many factors influence the total income of the respondents such as, income from crops, service, business, livestock, other family members, etc. By using log-lin function it can find out the effects of different variables in the total income. Table 6 demonstrates the results from the analysis.

Income from crops (X1): It was observed from the regression that the coefficient of crop income was positive and significant at 5 percent level of significance in all four cases. The result indicates that 1 percent increase in crop income would increase family income by 0.75 percent for owner cultivators, 0.89 percent for cash tenant, 0.75 percent for owner cum cash tenant and 0.35 percent for LLP owners, if other things remaining the same.

Table 8: Value of different co-efficient in different types of respondent

Variables	Coefficient of different types of owner			
	Owner cultivators	Cash tenant	Owner cum cash tenant	LLP owners
Intercept (ß0)	1.22	0.88	1.02	1.12
Crop income (X1)	0.75*	0.89*	0.75*	0.35*
Service income (X2)	0.071*	0.051*	0.067**	0.071*
Business income (X3)	0.091**	0.071**	0.082**	0.089*
Livestock income (X4)	0.051*	0.061*	0.054*	0.035*
Others family member income (X5)	0.076*	0.069*	0.055*	0.086**
LLP income (X6)	0.22*			0.65*
R Square	0.912	0.89	0.84	0.93

*Indicates significant at 5% level of significance
** Indicates significant at 10% level of significance

Income from service (X2): From the table it can be seen that the value of the coefficient was positive and significant at 5 percent level of significance in case of owner cultivator, cash tenant and LLP users and the coefficient of owner cum cash tenant was significant at 10 percent level of significant. The result indicates if 1 percent increase in service income then family income would increase by 0.071 percent in case of owner cultivators, 0.051 percent in case of cash tenant, 0.067 percent in case of owner cum cash tenant and 0.071 percent in case of LLP owner, when other things remain the same.

Income from business (X3): The value of business coefficient was positive and significant in 10 percent level of significance in case of owner cultivator, cash tenant and owner cum cash tenant and the value of LLP owner's coefficient was significant at 5 percent level of significance. The result indicates that 1 percent increase in business income, keeping other things remain constant, would increase family income by 0.091 percent for owner cultivators, 0.071 percent for cash tenant, 0.082 percent for owner cum cash tenant and 0.089 percent for LLP owners.

Income from livestock (X4): It was observed from the regression that the coefficient of livestock income was positive and significant at 5 percent level of significance in all four cases. The result indicates that 1 percent increase in livestock income, keeping other

things remain constant, would increase family income by 0.051 percent for owner cultivators, 0.061 percent for cash tenant, 0.054 percent for owner cum cash tenant and 0.035 percent for LLP owners.

Income from other family members (X5): The value of other family member's income efficient was positive and significant in 5 percent level of significance in case of owner cultivator, cash tenant and owner cum cash tenant and the value of LLP owner's coefficient was significant at 10 percent level of significance. The value of coefficient was positive and significant in all cases. The result indicates if 1 percent increase in other's family members income then family income increased by 0.086 percent in case of owner cultivators, 0.069 percent in case of cash tenant, 0.055 percent in case of owner cum cash tenant and 0.086 percent in case of LLP owner, when other things remain the same.

Income from LLP (X6): LLP owners and owner cultivators have income from LLP. From the table, value of coefficient was positive and significant at 5 percent level of significance. If other things remain the same, if 1 percent increase in LLP income, then family income increased by 0.22 percent and 0.65 percent for owner cultivators and LLP owners, respectively.

Value of R square: The multiple co-efficient of determination (R^2) is a summary measure which tells how the sample regression line fits with the data (Gujarati, 1995). In our table the value of R^2 was 0.912, 0.89, 0.84 and 0.93 for the owner cultivators, cash tenant, owner cum cash tenant and LLP owners respectively, that means the variables considered in the models can explain 91 percent for owner cultivators, 89 percent for cash tenant, 84 percent for owner cum cash tenant and 93 percent for LLP owner, of the total variation of income.

4. Conclusions

From the result of the present study it can easily be concluded that there is a considerable scope apparently exists in the study for the expansion of LLPs to enhance the productivity of HYV Boro paddy and to increase the farmers' income. The results of the study reveal that the investment in LLP is profitable. Due to the introduction of LLP the cropping pattern was changed and cropping intensity also increased in the study area. The government and non-government organizations should come forward for the expansion of LLP so that farmers can easily use it. It may also be concluded that LLP creates a revaluation in the agricultural sector especially in the coastal areas. LLP influenced income of the LLP owners significantly.

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Appendix

Table 1: Financial Analysis of LLP

Year	Investment Cost (Tk.)	O&M Cost (Tk.)	Gross Costs (Tk.)	Gross Benefit (Tk.)	D.F. value	PWC at 11% D.F. (Tk.)	PWB at 11% D.F. (Tk.)	Incremental Benefit (Cash Flow) (Tk.)
1	35,000	31500	66500	45,500	0.9	49850	40950	-24190
2	0	31500	31500	45,500	0.812	25578	36946	6577
3	0	31500	31500	45,500	0.731	23057	33260	5921
4	0	31500	31500	45,500	0.659	20758	29984	5337
5	0	31500	31500	45,500	0.593	18679	26981	4801
6	0	31500	31500	45,500	0.535	16853	23136	4333
7	0	31500	31500	48000	0.482	15183	21560	3904
						179928	215601	

Results: BCR at 11% =1.20 NPV at 11% = Tk. 35,673 IRR at 11% = 47%

Table 2: Sensibility Analysis considering 10% increases of O&M costs

Year	Investment Cost (Tk.)	O&M Cost (Tk.)	Gross Costs (Tk.)	Gross Benefit (Tk.)	D.F. value	PWC at 11% D.F. (Tk.)	PWB at 11% D.F. (Tk.)	Incremental Benefit (Cash Flow) (Tk.)
1	35,000	34650	69650	45,500	0.9	62685	40950	-21735
2	0	34650	34650	45,500	0.812	28135.8	36946	8810.2

3	0	34650	34650	45,500	0.731	25329.15	33260.5	7931.35
4	0	34650	34650	45,500	0.659	22834.35	29984.5	7150.15
5	0	34650	34650	45,500	0.593	20547.45	26981.5	6434.05
6	0	34650	34650	45,500	0.535	18537.75	24342.5	5804.75
7	0	34650	34650	48000	0.482	16701.3	23136	6434.7
						194770.8	215601	

Results: BCR at 11% =1.10 NPV at 11% = Tk. 20831 IRR at 11% = 26%

Table 3: Sensibility Analysis considering 10% decreases of Gross Benefits

Year	Investment Cost (Tk.)	O&M Cost (Tk.)	Gross Costs (Tk.)	Gross Benefit (Tk.)	D.F. value	PWC at 11% D.F. (Tk.)	PWB at 11% D.F. (Tk.)	Incremental Benefit (Cash Flow) (Tk.)
1	35,000	31500	66500	40950	0.9	59850	36855	-22995
2	0	31500	31500	40950	0.812	25578	33251.4	7673
3	0	31500	31500	40950	0.731	23026.5	29934.45	6907
4	0	31500	31500	40950	0.659	20758.5	26986.05	6227
5	0	31500	31500	40950	0.593	18679.5	24283.35	5603
6	0	31500	31500	45,500	0.535	16852.5	21908.25	5055
7	0	31500	31500	48000	0.482	15183	20942.9	5759
						179928	194161	

Results: BCR at 11% =1.08 NPV at 11% = Tk. 14233 IRR at 11% = 17%