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Enhancing irrigation and production capacity of small farmers through low-cost engine operated centrifugal pump

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Abstract

A study was undertaken to introduce a 2 hp diesel shallow tubewell (STW) technology and to evaluate the economic feasibility of the technology in eight upazilas under Dinajpur district. A total of twenty four STWs with four types of pump including 3.8 cm bearing, 3.8 cm bearingless, 5.08 cm bearing and 5.08 cm bearingless coupled with 2 hp diesel engines were installed in respective sites for field testing purpose. Low initial investment relative to its competitors (3-10 hp STW technology), lighter weight, less fuel consumption, simple operation and maintenance and easy on farm water management are positive indications of the 2 hp STW technology. The research results indicated that each type of 5.08 cm pump performed better result with 2 hp engines in terms of benefit-cost ratio. In all stages of study, bearingless pumps performed better result than pumps with bearings. The study suggests that more research, development and demonstration are necessary to familiarize bearingless pump for STW technology.

Keywords: Pump, Shallow tubewell irrigation, Economic feasibility

Introduction

Irrigation water can play a vital role as a leading input because the productivity of other inputs such as high yield variety, seeds and fertilizers largely depend on the availability of ensured water supply in the crop fields. Miah (1991) argued that the availability of irrigation facilities has given farmers an unprecedented degree of environmental control; a control that is almost absent in rain fed crop family. There are two sources of irrigation water: surface water and groundwater. Groundwater irrigation seems to have a better prospect and the government of Bangladesh is giving emphasis on the development of groundwater irrigation technologies. In Bangladesh, shallow tubewell (STWs) were introduced in the mid seventies. Although late to enter the irrigation sector, STWs use has overtaken that of low lift pumps (LLPs) and deep tubewells (DTWs), and has now become the most important irrigation technology in Bangladesh. STWs have been procured and managed in the private sector with little subsidy at the beginning, but STWs are not currently subsidized. Islam (2000) suggested that STWs irrigation scheme should be encouraged for betterment of investor.

In Bangladesh, the agriculture sector consists of a large number of small and marginal farmers. However, this significant farming community is increasingly facing constraints in obtaining affordable technologies for production increases. Limited access to technologies and services for support, affordable extension of irrigation and financial resources are the factors that have affected most on gross production loss or reduced production. Total cost of production could be reduced by any saving of water through adopting improved practices of technology and management (Sarker, 1991). Of the major agricultural inputs enhancing productivity, low cost irrigation has a significant role. Irrigation cost was identified as an important factor for the increase of production of *boro* rice (Rahman *et. al*, 1999). As small and marginal farmers cannot afford high cost technology to utilize for self-land cultivation and share cropping practices, there is a constant need to provide resourceful support on a sustainable basis. Adequate access to irrigation facilities at a reasonable price is one of the critical areas where intensive attention is required. The owners and managers of STWs were making profits annually by selling water (Mandal, 1986). The demand at the farmers' level represents market potential for low cost mechanized pump. This segment, requiring low cost engine operated water lifting pump, has still remained untapped due to non-availability of an appropriate and affordable technology. At present, only 3 hp with 7.62 cm x 7.62 cm pump is available in the market at a relatively high cost, not at an affordable price for the small and marginal farmers. Considering the emerging need for enabling an affordable quality product, to facilitate adequate irrigation and increased production of the marginal farmers, the study presents possibilities for portable low horse power (2 hp) diesel engine to operate with an adaptable low cost centrifugal pump. The ultimate beneficiaries of this study will be the small and marginal farmers engaged in rice, wheat and vegetables production. The introduction of the low cost portable engine operated pump will create opportunity for the low income earning small and marginal farmers for sustainable land use, adequately and timely irrigation and to increase cash crop yield. Considering above views in mind a study was undertaken to see the impact of low cost 2 hp STW on the economic benefit of the farmers and to identify the crop (paddy or vegetables) which is more beneficial for the same.

Materials and Methods

The study conducted an information-sharing workshop to explore the perceived prospects and technical aspects of 2 hp STW technology among the farmers, dealers, producers and NGOs in Dinajpur district. A special training programme was organized for installers and mechanics to increase technical skill. To assess the farmer's need for irrigation a baseline survey was conducted to select suitable farmers for field-testing and demonstration. In addition to that extension materials e.g. leaflet, folder, signboard and operation manual were prepared and distributed among the farmers, dealers, producers, installers, mechanics and NGOs. To provide innovation exposure to the users, an orientation on 2 hp STW operation and maintenance was arranged in Dinajpur district. Later in *boro* season the field performance of 2 hp STW with economic profitability were monitored through questionnaire and interview schedule to evaluate economic benefit.

To get considerable analytical data, 6 diesel pump-sets for each of the following mentioned types (Table 1) were tested during the field-testing period. A total of 24 engine operated pumps were tested with the following 4 different types and sizes of centrifugal pumps and 2 different sizes of well.

Table 1. Types of pumps powered by 2 hp engine used for field-testing of STW

Engine specification	Centrifugal pump specification (impeller size)	Pump made of	Pump type	Nos. of diesel pump set to be tested
2 hp	5.08 cm×5.08 cm	Cast iron	With bearing	6
2 hp	5.08 cm×5.08 cm	Cast iron	Without bearing	6
2 hp	3.8 cm × 3.8 cm	Cast iron	With bearing	6
2 hp	3.8 cm × 3.8 cm	Cast iron	Without bearing	6

For the farm owner, the selection of agricultural machinery is furnished after the cost calculations for the alternatives, which were checked earlier for the technical sustainability and viability. Determination of financial benefit, i.e. Benefit-Cost Ratio (BCR) is the most important factor for considering viability of ownership.

Two sets of questionnaire were used in this piece of research for data collection. The questionnaire was prepared to collect relevant data relating to cost of different items related to agricultural production system and questionnaire was used to collect production input cost and production output. The information was collected initially in local units and after checking, it was converted into standard unit.

The following calculation procedures were followed in determining BCR.

a) **Fixed costs**

Depreciation, D= (P-S)/L

Where, P= purchase price of the pump set (including boring cost) in taka

S= salvage value in taka = 10% of P (considering average life and cost)

L= machine life in year

Interest on investment, I = ((P+S)×i))/2 (James and Lee, 1971)
Where, i = interest rate in %

Total fixed cost = (D+I) in taka

b) **Variable costs:**

Cost for tillage, fertilizer, seed/seedling, diseases and insect control = X in taka

Cost for repair & maintenance = R in taka

Fuel & oil cost = F in taka

Labour cost = O in taka

Transportation cost = T in taka

Total variable cost = (X+R+F+O+T) in taka

Gross cost = Total fixed cost + Total variable cost

c) **Gross return:** [Sub- total of all output/income items]

Benefit-Cost Ratio = Gross return/ Gross cost
Benefit-Cost Ratio = P_{wb}/P_{wc}
Where P_{wb} is the present worth of benefit (Gross return) and P_{wc} is the present worth of cost (Gross cost).

Results and Discussion

Irrigation is considered as the most important economic commodity in the predominantly rice growing area like Bangladesh and its proper utilization draw much attention of policy planners. Determination of financial benefit, i.e. Benefit-Cost ratio (BCR) is important factor for considering viability of a technology. The BCR must include all sorts of direct and indirect cost and values, risks and responsibilities and interests. The BCR of the 2 hp engine-pump is calculated to find out the profit scale, on the basis of which the users can take their decision whether they will install their engine- pump or not. The collected information through questionnaire and interview were analyzed and presented in Table 2.

Table 2. Financial/cost rates of different items in the study area related to agricultural production system

Production input items		
Name of item		Rate (Tk.)
Lease value of land		5000.00-7000.00/acre/year
Labour wage		40.00-50.00/man day
Tillage		2.00/decimal/plowing
Seed	Paddy	10.00-15.00/kg
	Wheat	10.00-12.00/kg
	Potato	10.00-12.00/kg
	Onion	300.00-350.00/kg
	Garlic	70.00-100.00/kg
Fertilizer	TSP	9.00-12.00/kg
	Urea	6.00-7.00/kg
	Potash	9.00-10.00/kg
	Oil cake	9.00-9.50/kg
Pesticide	Granular	80.00-90.00/kg
	Liquid	40.00-50.00/bottle (40 ml)
Fuel and oil	Diesel	20.00/liter
	Oil	120.00/liter
Water charge	Hourly	30.00-40.00
	Seasonal	1500.00-2000.00
Production output items		
Paddy		220.00-250.00/40 kg
Straw		1976.00-2470.00/hectare
Wheat		300.00-350.00/40kg
Potato		160.00-250.00/40 kg
Onion		250.00-300.00/40 kg
Garlic		400.00-450.00/40 kg

The BCR of the 3.8 cm and 5.08 cm pump was calculated for paddy and vegetables by using field monitoring data and is presented in Table 3 and Table 4. Data was collected for one cropping season during January to May 2002. All values are the average of 6 samples values. From Table 3 and Table 4, it can be seen that the BCR of 5.08 cm pump is higher than 3.8 cm pump for each type of crop. The farmers under both types of pumps were benefited from their irrigated rice or vegetables production. Similar result was observed by Miah (1989) and he stated that the participating farmers were earning profits from HYV *boro* cultivation under STWs irrigation system. The BCR of 3.8 and 5.08 cm pump was 1.59 and 1.67, respectively for paddy, 1.62 and 1.70, respectively for vegetables. Higher command area and comparatively less fuel consumption of 5.08 cm pumps are the reasons for its higher BCR. These results indicate that vegetable production is more profitable than paddy for each type of pump. Since the BCR is greater than 1, it indicates that the new technology is economically viable and a good sign for profitability of the technology in future.

Table 3. Benefit-Cost Ratio of 3.8 and 5.08 cm bearingless and bearing pump for paddy production (life-15 years, unconfined aquifer, suction lift-4-6m)

Farm input cost (taka)		3.8 cm pump	5.08 cm pump
Cost type	Cost item		
Fixed cost	Depreciation	873	905
	Interest on investment	133	138
	Lease value of land (for four month)	7000	10000
	Total fixed cost	8006	11043
Variable cost	Land preparation (tillage)	3500	5000
	Labor cost (land preparation to harvesting)	6962	9946
	Fertilizer	3815	5450
	Seed	1105	1579
	Insecticide	1050	1750
	Fuel and oil	2712	3750
	Repair and maintenance	150	150
	Transportation	700	1000
	Others incidental cost	200	500
	Total variable cost	20194	29125
Total farm input cost/gross cost		28200	40168
Command area		1.42 ha	2.02 ha
Farm output cost			
Product	Quantity		
Paddy	7680 and 1100 kg for 3.2 and 5.08 cm pump	42240	60500
Straw	-	2500	3500
water sales	-		1000
	Total farm output cost/gross return	44740	65000
Benefit-Cost Ratio (BCR)		1.59	1.62

Table 4. Benefit-Cost Ratio of 3.8 and 5.08 cm bearingless and bearing pump for vegetables production

Farm input cost (taka)		3.8 cm pump	5.08 cm pump
Cost type	Cost item		
Fixed cost	Depreciation	873	905
	Interest on investment	133	138
	Lease value of land (for four month)	10000	15000
	Total fixed cost	11006	10500
Variable cost	Land preparation (tillage)	7000	16575
	Labor cost (land preparation to harvesting)	11050	9000
	Fertilizer	6000	3825
	Seed	2550	3750
	Insecticide	2500	5775
	Fuel and oil	2855	150
	Repair and maintenance	150	3000
	Transportation	2000	500
	Others incidental cost	500	10500
	Total variable cost	34605	53075
Total farm input cost/gross cost		45611	69118
Command area		1.42 ha	3.04 ha
Farm output cost (taka)			
Product	Quantity		
Vegetables	For sales	74200	114300
Vegetables	For family consumption	2000	2000
water sales	-		1500
	Total farm output cost/gross return	76200	117800
Benefit-Cost Ratio (BCR)		1.67	1.70

Conclusion

The newly introduced 2 hp STW technology is basically replacing the manual irrigation system and available higher hp STW technology, which are in use to produce a variety of crops by the small and marginal farmers. The lighter weight of the 2 hp machine is an additional attraction for the farmers. The machine can be easily transported after use for safekeeping. The acceptance of the 2 hp STW technology is a function of price. The new technology reduces the cost of initial investment relative to its competitors, the 3 hp and 4 hp STW technologies. It is also important that farmers showed their keen interest for the new technology due to less fuel consumption, simple maintenance and on farm water management. The benefit cost ratio of the 2 hp STW technology for one cropping season was greater than 1 in all cases. As a new practice, the technology is said to be economically viable. Vegetable production is more profitable than paddy for each type of pump resulting the BCR for 3.8 cm and 5.08 cm pumps 1.59 and 1.67, respectively for paddy, 1.62 and 1.70, respectively for vegetables.

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