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Research Note

RETURNS FROM POWER TILLER UTILIZATION IN BANGLADESH: AN ANALYSIS OF FARM LEVEL DATA

M.K.Hasan, M.T.H. Miah and M.A.S. Mandal

I. INTRODUCTION

Animal power is still the main source of tillage operation in Bangladesh although there is a tremendous shortage of draught animals in the country. Moreover, the condition of the cattle of the country is extremely poor due to ill nourishment, lack of suitable breeding programs. This shortage of draught power began to be realised since the late 1950s, when the government started considering power tillers and/or tractors as suitable substitute for animal power. It is now assessed that there is a deficiency of approximately 5.8 million animals or 132,000 mechanical tillers in the country (GOB 1990).

The importance of the use of power tiller is emphasized on several grounds. Gill (1983) argued that machines: (i) cultivate more thoroughly resulting in higher yields; (ii) can cultivate heavy, dry or otherwise difficult soils, facilitating early planting; (iii) complete the job faster and thus permit more timely planting and faster turnaround between crops which in turn facilitates increased yields, greater cropping intensities and perhaps the introduction of new crops, rotations and varieties. Despite the shortage of draught animals, only a few farmers have currently been using power tillers for land preparation in Bangladesh.

Introduction of power tiller, of course, depends largely on the comparative economics of ploughing the land by power tiller and/or animals as well as their relative merits and demerits. At present, power-tiller engines are being used for multiple purposes. The tillers, for example, are used for cultivation, irrigation and transportation purposes. It is, therefore, essential to know the relative

The first author is a Scientific Officer, On-Farm Research Division, Regional Agricultural Research Station, Jessore. The second two authors are respectively Associate Professor and Professor in the Department of Agricultural Economics, Bangladesh Agricultural University, 'Mymensingh 2202, Bangladesh. The paper is based on a Master's thesis done by the first author.

profitability of using power tillers and animals in crop production, and also the profitability of tiller use for multiple purposes. This study was therefore designed to fulfil the following objectives.

The main objectives of the study were:

i. to determine the relative profitability of growing high yielding variety (HYV) of boro paddy by using animal labour, power tiller and combined animal power and power tiller from the viewpoint of individual farmers ;

ii. to assess the profitability of using a power tiller for multiple purposes from the viewpoint of owners of power tillers; and

iii. to suggest some policy guidelines.

The following hypotheses were tested :

(a) There is no difference in costs and returns in HYV boro paddy cultivation between farms using animal power and power tiller, and combined animal power and power tiller.

(b) Multiple uses of power tillers are unprofitable from the viewpoint of owners of tillers.

In addition to objective (ii), the effect on profitability due to variation in the life of a power tiller, and investment cost was also investigated in this study.

The paper is organised as follows : Section II deals with analytical techniques. The major findings of the study are presented in Section III. Policy implications and concluding remarks have been given in Section IV.

II. RESEARCH METHODS

To fulfil the objectives of the study, Gouripur and Mailakanda unions of Gouripur Upazila in the district of Mymensingh, which are located about 26 km to the east of Mymensingh town, were purposively selected for the investigation. It was learned from the distributors of tillers in Mymensingh town that there were a substantial number of tillers in the study area which were being used for multiple purposes. In this area, HYV boro paddy was being cultivated by using animal power, power tiller and combined animal power and power tillers.

First of all, 15 owners of tillers were selected randomly. At the second stage, 90 farmers, at the rate of 30 from each category namely, animal, power tiller and combined animal plus power tiller operated farms were selected randomly for the study.

Two types of questionnaires: one for owners of tillers and another for boro growers, were prepared separately in Bengali for collecting relevant primary data. The period covered by the study was the whole boro season (January to May 1989) for the farmers and this was a complete financial year (1988-89) for the owners of tillers. The formal survey, however, was conducted during the period from June to August 1989.

The profitability analysis of HYV boro paddy was done by using simple costs and return analysis considering the different activities such as : by using animal power, power tiller and using both animal and power tillers. The whole analysis, however, was done considering (i) full costs and (ii) cash cost approach. In case of former analysis, all components of costs paid in cash or in kind were taken into account in determining the profitability of HYV boro, while in latter case, as the name suggests only the out of pocket expenses were covered.

The method of project appraisal suggested by Gittinger (1982) was followed for the appraisal of multiple uses of tiller. By considering the objectives as well as the hypotheses of the study, only financial analysis was followed in this study. The main three discounted measures such as : benefit-cost ratio (BCR), net present value (NPV) and internal rate of return (IRR), were employed to assess the profitability of tiller. Mathematical formulation of these discounted measures are presented below :

$$BCR = \frac{\sum_{t=1}^{n} \frac{Bt}{(1+i)^t}}{\sum_{t=1}^{n} \frac{Ct}{(1+i)^t}}$$

$$NPV = \sum_{t=1}^{n} \frac{Bt-Ct}{(1+i)^t}$$

IRR is that discount rate i at which $\sum_{t=1}^{n} \frac{Bt-Ct}{(1+i)^t} = 0$

Where :

B_t = benefits derived from uses of power tiller in each year;

C_t = costs incurred in each year for utilisation of power tiller for different purposes;

t = 1, 2, 3, ... n

n= number of years; and

i = interest (discount) rate.

Benefits of Power Tillers

The benefits of power tillers included the following items :

(a) Hire charges of tillers for land cultivation - these include the cash received by owners of power tillers from the client farmers for cultivating land by tillers;

(b) Water charges - cash received by owners of tillers from participating farmers for supplying irrigation water to their crop fields by the pump set which , in fact, is operated by the engine of power tiller;

(c) Transport service charges - cash received for transporting goods from one place to another by trolley which is also operated by the engine of power tiller;

(d) Salvage values - estimated at 20 percent, 50 percent and 30 percent on the initial values of power tillers , pump sets and trolley, respectively when the life of a tiller was considered 5 years only. But in case of 10 years life of a tiller, salvage values were estimated at 10 percent, 25 percent and 15 percent on the initial purchase values of power tillers, pump sets and trolley respectively. These values have been shown as benefits in the last year of the relevant life of the tillers.

Costs of Power Tillers

The costs of power tillers include the following items:

(a) Investments costs- included capital cost of power tiller itself including the cost of pump set and trolley; and

(b) Operation and maintenance (O&M) costs- involve the cost of fuel , cost of spare parts, mechanic fees, salaries of drivers and assistants.

Discount Rate

To select an appropriate discount rate for the appraisal of power tiller, the opportunity cost of capital which is considered as 16 percent, is chosen for the financial analysis of this study.

III. RESULTS AND DISCUSSION

First of all, the results of costs and returns analysis of HYV boro paddy, and then the financial analyses together with sensitivity analyses of power tillers are presented.

Costs and Returns of HYV Boro Paddy

To test the set hypothesis (a), a simple activity budgets (see Dillon and Hardarker 1980) of per hectare HYV boro paddy was prepared on the basis of full costs as well as cash costs.

Assuming Ho to be true:

$H_0 : C_a = C_t = C_c$ and $B_a = B_t = B_c$

H_1 : H_0 is not true,

Where :

Ca = total per hectare gross costs of HYV boro cultivation by using animal power,

Ct = total per hectare gross costs of HYV boro cultivation by using power tiller,

Cc = total per hectare gross costs of HYV boro cultivation by using both animal and power tiller,

Ba = per hectare total gross benefits from HYV boro paddy which is grown by using animal power,

Bt = per hectare total gross benefits from HYV boro paddy which has been produced by using power tiller ; and

Bc = per hectare total gross benefits from HYV boro paddy which has been grown by using both animal and power tiller.

It can be seen from Table 1 that the per hectare gross benefits is the highest under combined animal power and power tiller use and this is lowest for farms using animal power only. The benefit figures were Tk. 25,410.00, Tk. 26,522.00 and Tk. 27,482.00 under animal, power tiller and combined animal as well as power tiller cultivation respectively. When F-test was employed on gross benefits of per hectare boro, gross benefits of combined animal and power tiller operated farms are significantly higher than that of animal power and power tiller operated farms at 5 percent level of significance. However, there is no significant difference in gross benefits under the animal and power tiller operated farms. Ho is therefore partially rejected. This implies that the per hectare gross benefits of HYV boro paddy are not same for each category of farms having different techniques of land preparation.

Table 1. Per Hectare Costs and Returns of HYV boro Cultivation Using Different Methods of Land Preparations.

Sources of power	Over full cost (Tk/ha)			Over cash costs (Tk/ha)		
	Gross return	Gross cost	Net return	Gross return	Gross cost	Net return
Animal power	25,410	16,167	9,243	25,410	9,118	16,292
Power tiller	26,522	15,184	11,338	26,522	10,447	16,075
Animal power and Power tiller	27,482	15,717	11,765	27,482	9,983	17,499

Source : Adopted from Hasan (1990, p. 40)

In full cost analysis, the per hectare gross cost is the highest under animal power cultivation and this is the lowest under power tiller cultivation. It can be seen from Table 1 that these costs are Tk. 16,167.00,Tk. 15,184.00 and Tk. 15,717.00 per hectare under animal, power tiller and combined animal and power tiller cultivation, respectively. The result of F-test, however, indicates that there is no significant difference in gross costs producing HYV boro paddy among farms cultivated by animal, power tiller, and combined animal and power tiller at 5 percent level of significance. H_0 is, therefore, partially accepted.

In case of cash cost calculation, it can be seen from Table 1 that the per hectare cash cost is the highest under power tiller cultivation and this is the lowest under animal power cultivation. These costs are Tk. 9,118.00, Tk. 10,417.00 and Tk. 9,983.00 under animal, power tiller, and combined animal and power tiller cultivation respectively. The result of F-Test indicates at 5

percent level of significance that there is no difference in costs, between farms using combined animal and power tiller, and animal power for HYV boro cultivation. Similarly, there is no significant difference in cash costs under power tiller, and combined animal and power tiller cultivation.

The F-test, however, shows that there is a significant difference in cash costs under animal and power tiller cultivation. Ho is, therefore, rejected partially. This implies that there is a significant difference in cash costs between farms using animal power and power tiller for HYV boro cultivation. The test, on the other hand, indicates that there is no significant difference in cash costs under animal power, and animal plus power tiller or power tiller and animal plus power tiller cultivation.

It is evident from the above mentioned discussions that the return under combined animal and power tiller cultivation is relatively higher than that of the animal or power tiller cultivation (Table 1).

Since the highest per hectare yield of HYV boro was obtained under the combined animal and power tiller cultivated farms, the net return, as expected, was also the highest in this category of farms (Table 1). The reason of the highest yield under combined animal and power tiller cultivated farms was that a number of initial tillages were given by power tillers well ahead of puddling by animal power , which facilitated not only better quality of final land preparation but also helped decomposition of weeds and stubbles adding to soil nutrients and fertility.

Financial Analysis of Power Tiller

The financial analysis, as stated earlier, has been conducted from the viewpoint of individual owners of power tillers taking into account the relevant expenditures and incomes from the cultivation of land , irrigation and transport service. The appraisal, however, is based on the following assumptions. These are :

(a) All power tillers with pump set and trolley are purchased in cash.

(b) The average area of land cultivation by a power tiller is 49.0 ha in a year, the average command area under pump set which is operated by the engine of the power tiller, is 5.0 ha in each boro season and

the transportation period of trolley which is also operated by the same engine of the tiller, is 5 months a year. There will be no change in the cultivated area and period for every item during the life of power tiller.

(c) Production technology will remain the same.

(d) Prices of all inputs and outputs are given and constant.

Hypothesis (b), that multiple uses of power tillers are unprofitable from the viewpoint of owners of tillers, can be written:

H_0 : BCR of the tiller is less than unity , or NPV of the power tiller is less than zero, IRR of the power tiller is less than the opportunity cost of capital.

H_1 : H_0 is not true.

It can be seen from Table 2 that the BCR of the power tillers for 5 and 10 years life period is more than unity and NPVs are also positive at 16 percent discount rate i.e., opportunity cost of capital. The tiller also yields much higher IRR than the possible opportunity cost of capital. Ho is, therefore, rejected. In other words, the investment in power tiller is highly profitable business from the viewpoint of individual owners of tillers considering its multiple uses.

Table 2. Results of Financial Analyses of Power Tillers Considering 5 and 10 Years Life of Tillers.

Discounted measures	Tillers' Life	
	5 years	10 years
BCR at 16%	1.13	1.20
NPV at 16% (Tk.)	43,108	88,919
IRR (percent)	48.69	52.68

Source : Adopted from Hasan (1990, p.46)

Sensitivity Analysis of Power Tillers

The assumptions that were made in earlier section for the financial analysis of the tillers, may turn out to be unrealistic in an uncertain world. Before making any valid generalisation, it is, therefore, felt necessary to conduct the sensitivity analysis.

The financial analysis of the power tiller, as presented in Table 2, has been

reworked separately in this section to see what happens on the profitability of tillers under the following circumstances.

Assuming all benfits of the tiller to remain the same but the following changes are occured then what would happen in the profitability of a tiller: if all costs increase at the rate of 10 percent, or, if the investment cost of power tiller remains Tk. 50,000.00 but O & M costs increase by 10 percent; or, if investment cost of power tiller becomes Tk. 80,000.00 but all other costs remain the same.

Table 3 . Results Sensitivity Analysis of Power Tillers Considering 10 percent Increase in Costs.

Discounted measures	Tillers' life	
	5 years	10 years
BCR at 16%	1.03	1.09
NPV at 16% (Tk.)	11,532	44,845
IRR (percent)	23.30	32.48

Source : Adopted from Hasan (1990, p.49).

The results of sensitivity analysis considering the above mentioned circumstances are presented in Table 3, 4 and 5. It is evident from Table 3 that BCR of power tiller is greater than unity for 5 and 10 years life of the tiller, NPVs are also positive at 16 percent discount rate, and IRR is also higher than the opportunity cost of capital. This implies that if the costs increased at the 10 percent while the benefits of having tiller remain unchanged, investment on power tillers is still profitable from the viewpoint of owners.

Table 4 indicates, as expected , that the BCR of power tiller is greater than unity, NPVs are positive and IRR is higher than the opportunity cost of capital for 5 and 10 years life of a tiller. In other words, owners of tillers can also make profits if the O & M costs increase at tolerable limit.

The results of the study support the popular belief of the people that the owners of tillers can earn more profits from the multiple uses of tiller under some changing circumstances. Investment on power tiller for multiple uses is highly profitable business from the viewpoint of individual owners of tillers.

Table 4. Results of Sensitivity Analysis of Power Tillers Considering Tiller Price Tk. 50,000 and 10 percent Increase in O and M Costs of Tiller

Discounted measures	Tillers' life	
	5 years	10 years
BCR at 16%	1.08	1.13
NPV at 16% (Tk.)	26,506	88,919
IRR (percent)	37.15	44.57

Source : Adopted from Hasan (1990, p.50)

It can be seen from Table 5 that BCR of the power tiller is greater than unity, NPVs are positive and IRR is higher than the opportunity cost of capital for the tillers having 5 and 10 years life. This means that the owner of tiller can also make profits if the investment cost slightly increases in future.

Table 5. Results of Sensitivity Analysis of Power Tillers Considering Tiller Price Tk. 80,000 and Other Costs Remaining Unchanged.

Discounted measures	Tillers' life	
	5 years	10 years
BCR at 16%	1.08	1.16
NPV at 16% (Tk.)	27,766	72,133
IRR (per cent)	32.49	40.84

Source : Adopted from Hasan (1990, p.50).

IV. CONCLUDING REMARKS

The study reveals that the benefits of growing HYV boro paddy are significantly higher under combined animal power and power tiller cultivation than that under animal and power tiller operated farms. Extension workers can therefore encourage farmers to use both animal and power tiller for land preparation in growing HYV boro paddy to increase farm income of individual farmers. The results of the study also indicates that the higher return can be earned under power tiller operated farms than the returns of the farms using

animal powers for land preparation. It is therefore recommended that the farmers can cultivate their farms for HYV boro paddy cultivation by power tillers.

Since the gross returns as well as net returns of HYV boro paddy under power tiller cultivation are higher than the animal cultivating farms, policy makers may pay immediate attention to encourage farmers to use power tillers to increase foodgrains production of the country.

It is evident from the results of appraisal of tillers that the multiple uses of power tillers are highly profitable from the viewpoint of individual owners of tillers and hence, investment in power tillers can be made by individual farmers elsewhere in Bangladesh. Thus, the shortage of animal power can easily be met with tillers within the shortest time which in turn, would help in increasing food production of the country . The policy makers should take necessary measures so that the supply of tillers can be ensured in the door steps of farmers.

Since the findings of the study are based on the data of a particular area of Mymensingh district in Bangladesh, the results should therefore be interpreted with a considerable caution if any greater generalization is sought for other crops in different topographical regions of the country.

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