

Improvement and validation of two-wheel tractor operated potato planter

M A Hoque^{1*}, M A Hossain², M A Mottalib³, M R Karim¹

(1. Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh;

2. Training and Communication Wing, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh;

3. Spices Research Centre, Bangladesh Agricultural Research Institute, Bogura, Bangladesh)

Abstract: Potato planting operation are carried out manually, which are time consuming, costly and labour intensive. To address the issue of potato planting, a power tiller operated potato planter was improved in Bangladesh Agricultural Research Institute (BARI). Modifications were done on potato cup, tuber hopper, bed shaper and furrow opener. The performance of the planter was evaluated at BARI, Gazipur, Regional Agricultural Research Station (RARS), Jashore; Tuber Crops Research Station (TCRS), Bogura and Breeders Seed Production Station (BSPS), Debiganj, Panchagarh during *Rabi* (dry winter) season of 2017-20. Effective field capacity and field efficiency of the planter were 0.11 ha h⁻¹ and 78.57%, respectively. Yield of BARI Alu-36 at BARI, Gazipur were not varied with the planting methods. Potato planter saved 89% labour requirement and 81% planting cost, comparing with manual potato planting method. Though potato yield was not varied between planted with potato planter and manual methods at farmer's field in Bogura but the statistically higher yield was found in machine planted field at TCRS, Bogura with BARI Alu-41. But yield of BARI Alu-41 in machine planted fields was not varied with planting methods at farmer's field in Jashore. Yield of BARI Alu-36 at RARS, Jashore was not varied with the planting methods. But yields of BARI Alu-36 were higher in machine planted plot than the manual method at farmer's field of Jashore Sadar and Jhikorgachha in Jashore. Net return from BARI potato planter was calculated as US\$ 971.24 per season. The payback period and benefit cost ratio (BCR) of the planter were also estimated as 1.61 year and 1.17, respectively. Therefore, the improved potato planter may be recommended for dissemination for planting of seed potato in the farmers' levels.

Keywords: Potato, Planter, Labour requirement, Cost saving, Payback period

Citation: Hoque, M. A., M. A. Hossain, M. A. Mottalib, and M. R. Karim. 2025. Improvement and validation of two-wheel tractor operated potato planter. *Agricultural Engineering International: CIGR Journal*, 27(3): 112-121.

1 Introduction

Potato plays an important role in the economy and food security of Bangladesh. Potato production and area coverage were 10.14 million tons and 0.46 million ha, respectively during 2022-23 year (BBS,

2023). Timely planting is a pre requirement for good crop harvest. Potato planting operation is carried out manually by laborers which is time consuming and costly. Share of labour cost is high as 48.5% for total crop production cost (Biswas, 2024). Agricultural labours are decreasing at the rate of 4% per year and they are more interested to work off farm works. The labour involvement in agriculture is 40.6% (BBS, 2023). Short supply of labour creates problem of timely potato planting and harvesting operation. Due to delay planting, farmers could not get better yield as compare to their high investment. Maximum yields

Received date: 2024-10-24 **Accepted date:** 2025-03-12

***Corresponding author: M. A. Hoque, Senior Scientific Officer.** Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh, +8801712635503, arshadulmpe@gmail.com

and low disease incidence were recorded in crop planted before 15 October. With delay in planting, disease incidence was increased significantly, which resulted in maximum yield loss (47.9%) in 1 December planted crop (Singh et al., 2005; Kumar et al., 2017). Potato farming is a profitable business under present condition of Bangladesh agriculture. Agricultural operations are highly time bound and farmers prefer to do their jobs on time (Fuad and Flora, 2019; Gurung et al., 2017). The level of mechanization in different regions is different due to differences in natural conditions, cultivation requirements, and agronomy (Zhang et al., 2024). The number of power tillers has increased a lot because it is the best suited to small land size and plain field. According to latest estimates the number of power tillers are about 745,000 operating in the country (Rahman et al., 2021).

Late-planted potatoes are unsuitable for tuberization which receive very short winters, resulting in non-profitable yields (Ramírez et al., 2025). Short supply of labour creates problems of timely potato planting and harvesting operation. The development of equipment for the mechanized planting of potatoes is an urgent need in potato production (Zheng et al., 2021; Ramírez et al., 2025).

Ebrahem et al. (2011) designed cup type potato planter for small plot lands which was big and was driven with four-wheel tractor. Several researchers (Wakchaure et al., 2017; Gavrilov et al., 2020; Wang et al., 2020) have made efforts to develop and modify the cup-type potato planter in small scale, to promote the development of this kind of potato planter. Pal and Chattopadhyay (2020) developed a machine which performed satisfactorily for sowing potato tubers with a mean tuber spacing of 173 mm at a depth of 222 mm from the ridge top surface. The mean ridge height and width was 122 mm and 360 mm, respectively. The field capacity and field efficiency of the machine was 0.074 ha h⁻¹ and 65%, respectively. Niu et al. (2017) developed an electric motor induced vibratory cup-chain potato metering device equipped with tilting cups. The main

advantage of the metering mechanism was its improved metering performance, but it required an external power source to operate the metering mechanism. Mandloi et al. (2018) developed a horizontal nine-cell disk type metering mechanism (made of aluminum) for small tractor functioned paired-row semi-automatic potato planter. But paired row planting of potato is not popular in Bangladesh. Thus, power tiller operated potato planter development is time bound which can help farmers to minimize the planting cost considerably. Considering the available number of power tiller, BARI has been developed power tiller operated small potato planter which demonstrated in the research station as well as in the farmers' field (Hossain, 2009; Hossain et al., 2013). The potato planter saved time and planting cost. But, the farmers were reluctant to use it due missing seed tubers, depth control and bed making problems (Hossain et al., 2013). To ensure precision placement of seed tuber at specified depth and maintain desired bed height the research was under taken to improve the BARI Potato Planter and evaluation in the farmers' fields.

2 Materials and methods

BARI potato planter (Figure 1) was redesigned considering the problems obtained from field experiences. According to the improved design (Figure 2), the isometric (Figure 3) and schematic views of the potato planter was drawn using SolidWorks 16 Software. The potato planter was fabricated according to improve design Janata Engineering, Chuadanga. Belt slippage was found in cup transmission which belt was changed with chain. Potato cup was fitted with chain (Figure 2). Rubber double cups were changed with oval shaped single cup to be introduced to accommodate wide range of potato tuber. Modified tuber hopper was introduced for efficient tuber picking. A tuber box was redesigned to get the potato tuber easily near to cup. Inclined cup movement and modified potato dropping arrangement was used for fixing better tuber placing. Two disks with diameter of 230 mm were

incorporated in front of bed shaper to get decent bed. A bed shaper (Figure 7) was redesigned to increase the bed height and soil on the potato tuber. Two types of metering cup were designed and fabricated using aluminum moulding (Figure 5). A small cup was

designed for Grade-A (28-40 mm) size potato and big cup was designed for Grade-B size (40 mm -50 mm) potato tuber. A new furrow opener (Figure 6) was designed to place the potato tuber at deeper position.

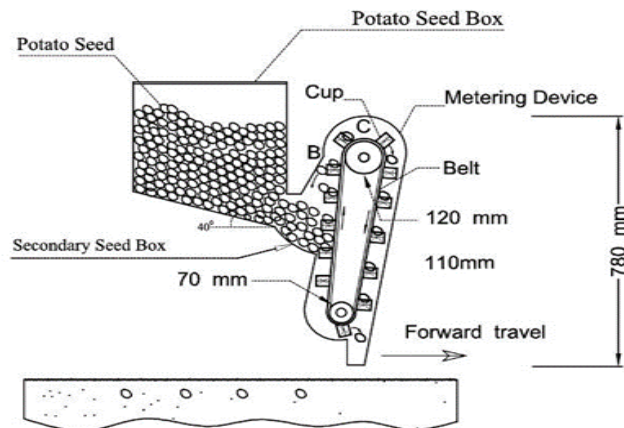


Figure 1 Main working principle of previous potato planter model

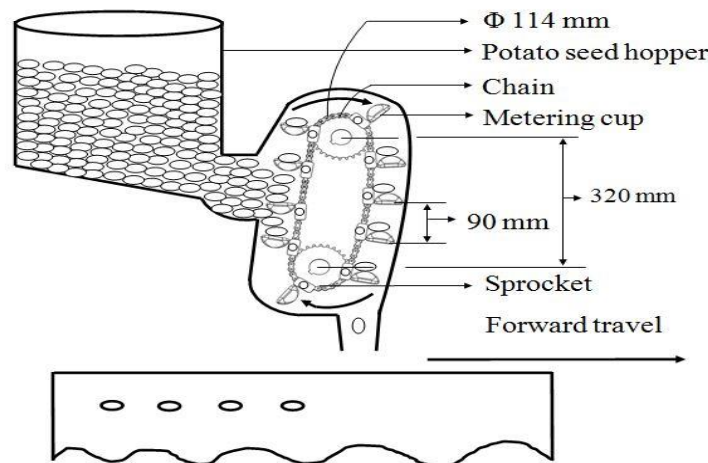


Figure 2 Main working principle of improved potato planter model



Figure 7 The improved potato planter and its important functional parts

The improved potato planter was tested in the laboratory of FMPE Division, BARI, Gazipur, Bangladesh before finalizing the prototype during 2017-2018. The width of the planter was 0.6 meter.

The following parameters were evaluated during the laboratory tests.

2.1 Effective field capacity

Effective field capacity was determined by the

following equation (Hunt, 2001).

$$EFC = \frac{A}{T} \quad (1)$$

Where, EFC = effective field capacity (ha h^{-1}), A = actual operational area (ha), T = Total operating time (h).

2.2 Theoretical field capacity

Theoretical field capacity is the rate of harvesting that would be obtained if the machine was performing its function 100% of the time at rated forward speed and always covered 100% of its sowing width. It was calculated by the following equation (Hunt, 2001).

$$TFC = \frac{SW}{10} \quad (2)$$

Where, TFC = theoretical field capacity (ha h^{-1}), S = rated forward speed (km h^{-1}), W = sowing width (m).

2.3 Field efficiency

The field efficiency (FE) was determined by the following equation (Hunt, 2001)

$$FE = \frac{EFC}{TFC} \times 100 \quad (3)$$

2.4 Coefficient of tuber distribution uniformity

To calculate the coefficient of uniformity of tuber distribution, prepared land with measurements of 20×0.6 m was filled with a layer of fine soil. Planting was performed on at the speed of 2 km h^{-1} . An area of one row with a length of one meter was randomly selected using a wooden frame in each replication. The planted potato in this area were separated from the soil. The coefficient of uniformity of tuber distribution was computed using the following equation as cited by Afzalnia et al. (2012) and Senapati et al. (1992).

$$S_e = 100 \left(1 - \frac{Y}{D} \right) \quad (4)$$

Where, S_e = coefficient of tuber distribution uniformity (%), Y = average numerical deviation of average number of plants per meter length of row from average desired number of plants per meter run, and D = average number of plants per meter length of row.

2.5 Coefficient of planting depth uniformity

To measure plant depth uniformity, planted potatoes were irrigated gently and adequate time was provided for tuber emergence. Once emerged, tubers were cut at the soil surface. A part of the stem that was inside the soil (from soil surface to tuber remnants on the root) was taken out and its length was measured. This length was considered as a criterion to compare the planting depth of the plater. Ten samples were taken, and the coefficient of planting depth uniformity was calculated using equation as cited by Afzalnia et al. (2012) and Senapati et al. (1992).

$$S_d = 100 \left(1 - \frac{Y_d}{D_d} \right) \quad (5)$$

Where, S_d = coefficient of planting depth uniformity (%), Y_d = average numerical deviation of depth of tubers planted from pre-set planting depth (cm), and D_d = average depth of tubers planted (cm).

2.6 Field Performance Test of Potato Planters

2.6.1 Field operation

The modified potato planter was evaluated at TCRS (Tuber Crop Research Station), Bogura and RARS (Regional Agricultural Research Station), Jashore during 2017-2020 with a view to observe the accuracy of planting, mass awareness. The evaluation was also done in 16 farmers' field of Bogura and Jashore to popularize mechanized seeding among the farmers. The planter was also intensively tested at BSPC (Breeders Seed Production Centre), Debiganj, Panchagarh for material strength analysis and perfection. All of the study areas are situated in Bangladesh. The geographical location of the study areas is shown in Figure 8. The study areas are characterized by mainly two cropping seasons i.e., *Kharif* (March–October, summer crops), and *Rabi* (October–March, winter crops). The potato is the most prominent and cash crop of Rabi season. However, the potato planter worked as tilling, placing potato seeds in regular interval and earthing up simultaneously in single operation. BARI Alu-7, BARI Alu-25, BARI Alu-36 and BARI Alu-41 were selected for the trials. Date of planting in Bogura and

Jashore were 24-27 November and 20-24 November respectively. The harvesting dates were 07-10 March in Bogura and 20-22 February in Jashore. The

machine planted fields were compared with the manual planting. Fertilizer, irrigation, pesticides and all others inputs were applied equally.

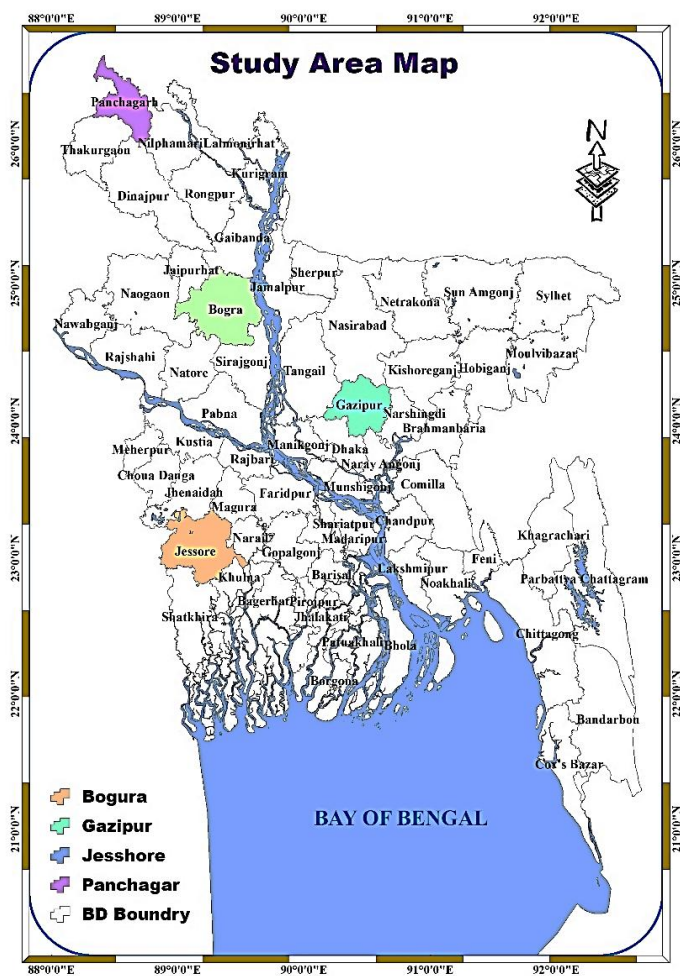


Figure 8 Location of the study areas

2.6.2 Field Experimentation

The design of the experiment was randomized complete block design (RCBD) with four treatments and three replications. The number of participating

farmers was 12. The unit plot area was 8-10 decimal (423-485 m²). Total four treatment combinations including a control were distributed randomly in each farmer plot as one treatment as well as one replication.

Table 1 Area under experimentation of different varieties of potato in research stations

Sl. No.	Name and address of the experiment field	Variety	Area (ha)
01	BSPS, Debiganj, Panchagar	Cardinal	0.81
		Courage	0.81
	RARS, Jashore TCRS, Bogura	BARI Alu-46	1.21
		BARI Alu-53	0.81
		Lady Rosetta	1.01
Total area			4.65 ha

Table 2 Area under experimentation of different varieties in the farmers' fields in different locations

Location		Potato variety	Planted area (ha)	
District	Upazila		Planter	Manual
Bogura	Shibganj	BARI Alu-36	0.16	0.10
		BARI Alu-41	0.08	0.06
	Gabtali	BARI Alu-25	0.18	0.14
		BARI Alu-36	0.18	0.14
		BARI Alu-41	0.16	0.14
Jashore	Jashore	BARI Alu-7	0.28	0.13
	Jhikorgacha	BARI Alu-7	0.43	0.15

2.7 Financial analysis

Financial analysis of the potato planter was done. Operating cost of the machine included the fixed cost and variable cost. Fixed cost of the machine included capital consumption and shelter. Variable costs included labour, fuel, repair & maintenance. One labour was required for operating the machine. In calculation of cost per year is assumed and the following equation was used as provided by Hunt (2001).

2.7.1 Fixed cost

Fixed cost of the machine included annual depreciation, interest on investment, and shelter. Capital consumption included depreciation and interest.

Capital consumption (CC)

$$CC = (P - S)CRF + S \times i \quad (6)$$

Where, P=purchase price (US\$), S=salvage value (US\$), and CRF= capital recovery factor.

$$CRF = \frac{i(1+i)^L}{(1+i)^L - 1} \quad (7)$$

Where, i= rate of interest (10%), L=life of machine (yr).

Shelter, T=3.0% of purchase price of the machine, US\$

Total fixed cost per year

$$FC = CC + T \quad (8)$$

2.7.2 Variable Cost

In calculation of variable cost, the following relations were assumed:

- 1) Labour cost per hour, $L_b = \text{US\$ man h}^{-1}$;
- 2) Fuel cost per hour, $F = L \text{ h}^{-1}$;
- 3) Repair cost, $R = 0.035\%$ of P.

Total variable cost:

$$VC = L_b + F + R \quad (9)$$

2.7.3 Annual cost/operating cost

$$AC = FC + VC \quad (10)$$

2.7.4 Benefit-cost ratio (BCR): It is the ratio of annual gross return to total costs. The method of benefit-cost analysis is simple in principle. The formula of calculating BCR (undiscounted) is shown as below.

$$BCR = \frac{\text{Gross return (US\$ / yr)}}{\text{Cost of production (US\$ / yr)}} \quad (11)$$

2.7.5 Payback period: It is length of time which takes to recover the invested capital or until the net benefits equal the investment cost. In the study, payback period is calculated by successively deducting the initial investment from the net return until the initial investment is fully recovered. Payback period (PBP) of a machine was calculated by the following equation:

$$PBP = \frac{\text{Initial investment (US\$)}}{\text{Net return (US\$ / yr)}} \quad (12)$$

3 Results and discussion

Comparative parameters between previous and improved models of potato planter are shown in Table 3. Metering device in previous model was dual cup type, but it was single cup type in improved model. Mould casted metallic cups were used instead of rubber cup. There were 10 cups instead of 13 pairs of potato cups fixed on a 40 mm flat belt, forming an endless loop. The cup size was 40 mm. According to the design criteria, potato cups were positioned 110 mm apart from each successive cup to provide the recommended 250 mm spacing for planting whole potato tubers in previous model. Space between cups was also changed to 90 mm with transmission ratio 1.15 in the improved model. The belt was coupled between drive and driven pulleys 780 mm distance vertically arranged on the toolbar frame but in improved model chain-sprocket system was used with 25° inclinations. In the forward speed of potato planter without drive wheel slippage, metering cup hold one-piece tuber and release it near the bottom of the open furrow due to chain-sprocket systems. The spacing between one tuber to another tuber was controlled by the numbers of metering cups and gear-sprocket ratio.

Performance of previous and improve potato planters for tuber spacing uniformity is shown in Table 4. There were 10 observations, and each observation was replicated three times for both types of planters. It was observed that potato to potato

distance was 23.08 cm in previous model which was changed to 20.41 cm by the improved planter that improved the uniformity of potato placement 11.33% over previous planter that was much closer to standard spacing of potato. So, the potato spacing was found satisfactory for improved planter. A remarkable modification was observed in potato depth of the

modified planter (Table 5). The average planting depth by improved planter was 9.76 cm which was close to recommended depth (10.00 cm) of potato planting. The planting depth uniformity increased 24.58% over the previous planter. Therefore, the improvement planter is more precise to plant potato than previous planter.

Table 3 Comparative parameters between previous and improved models of potato planter

Parameter	Previous model	Improved model	Remarks
Type of metering device	Dual cup	Single cup	
Material of cup	Plastic	Metallic	Mould casting
Number of cup	13	10	
Space between cup, mm	110	90	
Metering device coupled with	Belt	Chain	
Transmission ratio	1.71	1.15	
Tuber to tuber spacing, mm	250	200	

Table 4 Performance of previous and improved potato planter for spacing uniformity of potato

Observation No.	Number of potatoes dropped in 1.0 m distance							
	Previous potato planter				Improved potato planter			
	Trial 1	Trial 2	Trial 3	Mean	Trial 1	Trial 2	Trial 3	Mean
Mean	4.20	4.30	4.50	4.33	4.90	4.70	5.10	4.90
Stand deviation	0.42	0.67	0.53	0.53	0.57	0.48	0.32	0.22
Mean tuber spacing (cm)	23.81	23.26	22.22	23.08	20.41	21.28	19.61	20.41
Uniformity (%)	84	85.98	90	86.66	97.99	93.98	101.99	97.99

Table 5 Performance of previous and improve planter for planting depth uniformity of potato

Observation No.	Planting depth (cm)							
	Previous planter				Improved planter			
	Trial 1	Trial 2	Trial 3	Mean	Trial 1	Trial 2	Trial 3	Mean
Mean	7.73	8.20	7.78	7.30	9.80	9.68	9.80	9.76
Stand deviation	1.45	1.91	1.55	1.21	0.20	0.31	0.40	0.18
Uniformity (%)	77.25	82	77.75	73	98	96.75	98	97.58

Performance test of potato planter was conducted in the on station at FMPE Division, BARI, Gazipur. Average tuber size of 35 mm used for cup type planter with operating speed was 2.4 km h⁻¹. The planter can form one bed of 600 mm width in single pass. Power tiller of 12 hp (9 kW) was capable to operate the potato planter. Effective field capacity of the cup type planter were 0.10 ha h⁻¹ and field efficiency 71.4% respectively (Table 6). Average fuel consumption of the cup type potato planter was 1.25 L h⁻¹. It was also found that EFC varied on field size and shape. EFC was higher in larger field size compare to small field size and irregular shape of field.

3.1 Field performance of the potato planter

Yield and yield contributing characters at Jashore Sadar, Jashore with BARI Alu-7 are shown in Table 7. The yield and yield contributing characters of mechanically planted and manually planted fields of each farmer were not significantly varied. But average yield of machine planted five fields was significantly higher than that of manually planted field due to higher tuber numbers and weight per hill in machine planted field. Yield and yield contributing characters at Jhikargacha, Jashore with BARI Alu-7 are shown in Table 8. The yield and yield contributing characters of mechanically planted and manually planted fields of each farmer were not

significantly varied. But average yield at Jhikargacha, significantly higher than that of manually planted Jashore of machine planted five fields was field.

Table 6 Performance of the potato planter

Performance parameter	Measured value
Average forward speed, km h ⁻¹	2.4
Width of planter, mm	600
Theoretical field capacity, ha h ⁻¹	0.14
Effective field capacity, ha h ⁻¹	0.10
Field efficiency, %	71.4
Fuel consumption, L h ⁻¹	1.25

Table 7 Yield and yield contributing characters at Jashore Sadar, Jashore with BARI Alu-7

Treatment	Plant height, cm	Stem/ hill, Nos	Tuber/hill, Nos	Tuber wt/hill, kg	Yield, t ha ⁻¹
Machine planted	55.92	4.28	9.48	0.62	30.08
Manual Planted	50.92	3.36	8.32	0.50	28.22
T-test	*	*	*	*	**

Table 8 Yield and yield contributing characters at Jhikargacha, Jashore with BARI Alu-7

Treatment	Plant height, cm	Stem/ hill, Nos	Tuber/hill, Nos	Tuber wt/hill, kg	Yield, t ha ⁻¹
Machine planted	54.55	5.25	11.1	0.66	29.75
Manual Planted	47.5	4.7	8.9	0.52	27.48
T-test	*	*	*	NS	*

Yield and yield contributing characters at Gabtali and Shibganj, Bogura with BARI Alu-41 are shown in Table 9. The yield of mechanically planted and manually planted fields of individual farmer were not significantly varied. Average yield of machine planted five fields was not significantly higher than that of manually planted field. Yield and yield contributing characters at Gabtali and Shibganj,

Bogura with BARI Alu-36 are shown in Table 10. The yield of mechanically planted and manually planted fields of three farmers were significantly varied. The higher potato yield was found in machine planted field. Yield of BARI Alu-36 in machine planted fields was significantly higher than that of manually planted field.

Table 9 Yield and yield contributing characters at Gabtali and Shibganj, Bogura with BARI Alu-41

Treatment	Plant height, cm	Stem/ hill, Nos	Tuber/hill, Nos	Tuber wt/hill, kg	Yield, t ha ⁻¹
Machine planted	64.47	4.67	14.20	0.97	31.10
Manual Planted	63.00	3.73	13.47	0.92	27.26
T-test	NS	NS	NS	NS	NS

Table 10 Yield and yield contributing characters at Gabtali and Shibganj, Bogura with BARI Alu-36

Treatment	Plant height, cm	Stem/ hill, Nos	Tuber/hill, Nos	Tuber wt/hill, kg	Yield, t ha ⁻¹
Machine planted	85.20	4.30	14.65	1.01	31.55
Manual Planted	78.90	3.75	13.30	0.95	25.52
T-test	*	NS	**	*	**

Yield and yield contributing characters at TCRS and Shibganj, Bogura with BARI ALu-41 are shown in Table 11. The yield of mechanically planted and manually planted fields were not significantly varied. Average yields of machine planted fields and manually planted fields were statistically similar.

3.2 Financial Analysis

Financial analysis of potato planter is given in

Table 12. The main cost items were fixed cost and variable cost. The annual use of the machine was assumed to be 30 days per year. Three operators were required to operate the machine and daily wage was US\$ 4.35 per day (8 hours). The variable cost was the sum of operator's wage, repair and maintenance cost and fuel (diesel) cost. The total operating cost of the potato planter was calculated as US\$ 30.03 per

hectare. Potato planter saved 89% labour requirement and 81% planting cost, respectively compare to manual potato planting method. The gross return in a year was obtained by custom hire basis was US\$ 1800.00 against the total cost of US\$ 828.72. So,

the net return per year was estimated as US\$ 971.24. Benefit cost ratio of potato planter was also found to be 1.17 and the pay-back period was 1.61 year. Therefore, the potato planter is economically profitable for custom hire business.

Table 11 Yield and yield contributing characters at TCRS, Bogura and Shibganj, Bogura with BARI Alu-25

Treatment	Plant height, cm	Stem/ hill, Nos	Tuber/hill, Nos	Tuber wt/hill, kg	Yield, t ha ⁻¹
Machine planted	64	5.6	14.1	1.04	37.365
Manual Planted	59.8	4.1	12.8	0.92	31.91
T-test	NS	NS	*	NS	NS

Table 12 Financial analysis of potato planter

Parameters	Planter	Manual
Price (Planter: US\$ 55000 and PT: US\$ 125000)	1565	
Total annual use, h	240	
Labour requirement, Nos ha ⁻¹	4	37.50
Total fixed cost, US\$ h ⁻¹	0.69	-
Total variable cost, US\$ h ⁻¹	1.68	21.74
Total operating cost, US\$ h ⁻¹	3.45	
Capacity of the machine, ha h ⁻¹	0.12	-
Total operating cost, US\$ ha ⁻¹	30.03	163.04
Custom hire planting charge, US\$ ha ⁻¹	65.22	
Gross return (custom hire basis) US\$ yr ⁻¹	1800.00	
Net return, US\$ yr ⁻¹	971.24	
Payback period, yr	1.61	
BCR	1.17	

4 Conclusion

BARI potato planter was improved as per farmers' feedbacks during operation in the farmers fields. Belt transmission of the potato cup was changed with chain in the potato planter. Aluminum made oval shaped potato cup was fitted with chain. Tuber hopper was modified for efficient tuber picking to get the potato tuber easily near to cup. Bed shaper was redesigned to increase the bed height and soil on the potato tuber. A furrow opener was incorporated to place the tuber potato in deeper position. Field capacity of the potato harvester in Bogura and Jashore was almost similar as found in Gazipur. Effective field capacity of the potato planter was 0.115 ha h⁻¹ and field efficiency 78.57%. Yields of BARI Alu-7, BARI Alu-41 and BARI Alu-25 were not significantly varied with the planting methods. The BCR and payback period of the potato harvester was 2:1 and 1.35 year respectively. The improved potato planter was found technically suitable and

economically profitable technology for planting of potato. Results suggested that this machine may be recommended for dissemination in the farmers' fields through Department of Agricultural Extension and NGOs.

References

- Afzalania, S., A. Khosravani, A. Javadi, D. Mohammadi, and M. S. Alavimanes. 2012. Effect of tillage and planting methods on the soil properties, grain drill performance, and wheat yield. *Journal of Agricultural Science and Technology A2*, 21(5): 537-543.
- BBS. 2023. Yearbook of Agricultural Statistics. Dhaka, Bangladesh: Bangladesh Bureau of Statistics (BBS). Statistics and Informatics Division (SID). Ministry of Planning Government of the People's Republic of Bangladesh.
- Biswas, S. K. 2024. Survey Report on Irrigation Management in Bangladesh. Gazipur, Bangladesh: Irrigation and Water Management Division, Bangladesh Agricultural Research Institute.
- Ebrahem, I. Z., A. E. Ayman, and R. Guidetti. 2011. A new

- small potato planter for Egyptian agriculture. *Journal of Agricultural Engineering*, 42(3): 7-14.
- Fuad, M. A. F., and U. M. A. Flora. 2019. Farm mechanization in Bangladesh: A Review. *International Journal of Research in Business Studies and Management*, 6(9): 15-29.
- Gavrilov, V. N., A. B. Semenov, A. M. Novikov, V. A. Ivanov, and A. G. Terentev. 2020. Uniform planting of sprouted tubers semi-automatic potato planter. *Vestnik of Kazan State Agrarian University*, 15(3): 64–70.
- Gurung, T. R., W. Kabir, and S. M. Bokhtiar. 2017. Mechanization for sustainable agricultural intensification in SAARC Region. Dhaka, Bangladesh: SAARC Agriculture Centre and Krishi Gobeshona Foundation.
- Hossain, M. I. 2009. Development of power tiller operated potato planter cum fertilizer applicator. Ph.D. diss., Department of Farm Power and Machinery, Bangladesh Agricultural University, Mymensingh.
- Hossain, M. I., M. J. Islam, B. K. Goshwami, and M. I. Hossain. 2013. Field performance of power tiller operated cup type potato planter for maximize crop production. *Bangladesh Agronomy Journal*, 16(2): 51-59.
- Hunt, D. 2001. *Farm Power and Machinery Management*. 10th ed. Iowa State University Press, Iowa, USA.
- Kumar, A., S. Kumar, and S. Kumar. 2017. Evaluation of field performance and operating cost of developed potato planter operated with power tiller. *International Journal of Current Microbiology and Applied Sciences*, 6(12): 1021-1029.
- Mandloi, K., R. Swarnkar, Y. C. Yoganandi, H. K. Raulji, and K. L. Dabhi. 2018. Development of a mini tractor drawn semi-automatic two row planter cum fertilizer applicator. *International Journal of Agricultural Engineering*, 11(1): 13-22.
- Niu, K., X. Fang, Y. Liu, C. Lv, and Y. Yuan. 2017. Optimized design and performance evaluation of an electric cup-chain potato metering device. *International Journal of Agricultural and Biological Engineering*, 10(2): 36-43.
- Pal, G., and P. S. Chattopadhyay. 2020. Development and testing of a power tiller operated single row potato planter with bucket elevator type metering. *Journal of Agricultural Engineering*, 57(2): 85-96.
- Rahman, M. M., M. R. Ali, M. M. H. Oliver, M. A. Hanif, M. Z. Uddin, T. U. Hasan, K. K. Saha, M. H. Islam, and M. Moniruzzaman. 2021. Farm mechanization in Bangladesh: A review of the status, roles, policy, and potentials. *Journal of Agriculture and Food Research*, 6: 100225.
- Ramírez, D. A., M. M. Hossain, E. H. M. S. Rahaman, C. Mestanza, J. Rinza, J. Ninanya, F. de Mendiburu, H. Loayza, M. Gatto, and J. F. Kreuze. 2025. Potato production under zero tillage with rice straw mulching as a promissory technology to diversify rice-based systems in Southwest Coastal Bangladesh. *Journal of Agriculture and Food Research*, 19: 101603.
- Senapati, P. C., P. K. Mohapatra, and U. N. Dikshit. 1992. Field evaluation of seeding devices for finger-millet. *Agricultural Mechanization in Asia, Africa, and Latin America*, 23(3): 21-24.
- Singh, B., B. S. Lakra, N. Ram, and S. Mahender. 2005. Effect of planting time on black scurf development in potato. *Annals of Biology*, 21(2):245-248.
- Wang, G., W. Sun, L. D. Chen, H. Zhang, X. Liu, H. Li, X. Yang, and H. Yang. 2020. Realization of an integrated seeding and compensating potato planter based on one-way clutch. *International Journal of Agricultural and Biological Engineering*, 13(7): 79–87.
- Wakchaure P., A. Shriram, R. Vikas, D. Swapnil, B. Onkar, and P. Atish. 2017. Design and fabrication of potato planting machine. *Int. Res. J. Eng. Technol* 4, 4: 1057-1060.
- Zhang H., H. Li, W. Sun, H. Li, X. Liu, G. Sun, Y. Lu, Y. Chen, and W. Xing. 2024. Optimization of potato planter soil lifting device based on TRIZ Theory. *Agriculture*, 14(10):1695.
- Zheng, Z., H. Zhao, Z. Liu, J. He, and W. Liu. 2021. Research Progress and Development of Mechanized Potato Planters: A Review. *Agriculture*, 11(6), 521. <https://doi.org/10.3390/agriculture11060521>