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Economic Analysis of Mechanical and Manual Transplanting of Rice: A comparative study

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A B S T R A C T

Assam is a state where rice is considered as a staple food and occupies about two third of total cropped area in the state. The agro climatic condition of Assam is best suitable for rice production. Most of the rice cultivation in the state is done by traditional manual transplanting method which involves number of labourers. But in the present situation due to shortage of labourers in the main cropping season the cultivation of paddy suffers a setback. The farmers in this region possess limited knowledge about mechanization of rice cultivation. In order to overcome this problem, an attempt was made to introduce mechanically transplanted rice cultivation in few areas using a self-propelled walk behind four row mechanical transplanter. The data from the demonstrated plots like plant height (cm), number of tillers per hill, number of plants per meter square and grain yield (kg/ha) were collected and were compared with a control plot where only manual transplanting was done. Also, cost of cultivation for both the demonstrated and control plots was found out and economic analysis was done. From the analysis, it has been found out that the gross return for mechanical and manual transplanting was Rs. 97012 and Rs. 92928 respectively and net return for mechanical and manual transplanting was Rs. 66859 and Rs. 55939 respectively for both the methods of transplanting. Benefit cost ratio was also calculated where it was found to be 3.21 and 2.51 respectively for mechanical and manual transplanting respectively.

Introduction

Rice is considered as the most important cereal cultivated worldwide. In Asia and more particularly in India, it is a widely consumed staple food. More than 60% population of the country is highly dependent on this food crop for their living (Samal *et al.*, 2020).In Assam, rice occupies about two third of the total cropped area in the state. The total area under rice in Assam is around 50 lakh hectares with total production of 52 lakh tonnes and average productivity of 2.1 t/ha. Conventional manual hand transplanting is the most preferred way of paddy cultivation in this region.

However, there are some disadvantages in this method of cultivation. Manual hand transplanting of paddy in puddled soil is a time consuming, labour intensive operation

and involves lots of drudgery. Also in direct sowing of seeds in puddled soil, weed infestation becomes a major problem thereby reducing yield of the main crop to a great extent. Considering all these disadvantages, the present study was undertaken to compare the conventional technologies with modern agricultural technology involving mechanical transplanter for cultivation of paddy. Usage of mechanical transplanter reduces labour cost and drudgery of humans and ultimately boosts up economy of the farmers.

Materials and Methods

The study was conducted in few pockets of Lakhimpur and Morigaon districts of Assam. For this study, mat nursery was prepared using wet method where farm yard manure, polythene sheets and iron frame was provided. The mat nursery was prepared 15-20 days ahead of transplanting in main field. 40kg seeds of Ranjit sub-1 were used for transplanting one hectare of main field. A nursery bed of 50 m long, 1.5 m wide and with 15 cm height was prepared. The polythene sheets used for the purpose were also 50 m long and 1.5 m wide and size of the iron frame was 1.5 m long, 1.25 m wide and 0.75 cm thick. Drains were dug around the nursery beds with 50 cm width and 15 cm in depth. After sowing of seeds in nursery bed, sufficient care was taken to provide irrigation in the drains to maintain water level and facilitate well development of seedlings. After attainment of 20 cm height the seedlings were transplanted in main field using four row self-propelled walk behind paddy transplanter. In case of conventional nursery also 40 kg seeds of Ranjit sub-1 were used for transplanting one hectare of mainfield. A nursery bed of 1000 m^2 was prepared for transplanting one hectare of mainfield. All kinds of fertilizers, pesticides and biopesticides were provided in both the demonstration and control plots (manual transplanting).

Different data like plant height (cm), number of tillers/hill, number of plants per square meter and yield (kg/ha) were collected and compared with control. Moreover, economic analysis for both the plots was done and benefit cost ratio (B: C) was also compared.

Results and Discussion

From the study it was found that average plant height (cm), number of tiller per hill, number of plants per meter square and grain yield (kg/ha) of Ranjit sub-1 in mechanically transplanted plot was 120 cm, 20, 24and 5345 kg/ha respectively whereas it was 119 cm, 16, 19 and 5120 kg/ha in control plot where manual transplanting was done.

The difference in yield and yield attributing characters may be due to age of seedlings in nursery. The transplanting of young aged seedlings(twenty days old seedling)along with soil and roots intact resulted in early adaptation of seedling to soil thereby showing better yield performances (Uphoff, 2002) than transplanting of twenty five days old seedling in manual transplanting. Moreover, roots of seedlings in mat nursery are less likely to get damaged by uprooting or cutting of mat for transplanting. In mechanical transplanting, 2-3 seedlings per hill were planted whereas in manual transplanting generally, 4-5 seedlings were planted. The difference of number of seedlings while transplanting by both methods also contributed to difference in yield and yield attributing characters. The reason for difference is well explained by Maiti and Bhattacharya (2011) and Rasool *et al.*, (2013) where they reported that planting fewer numbers of seedlings per hill produced more healthy leaves and tillers and ultimately produced higher grain yield. More number of tillers and higher yield may also be due to proper row to row and plant to plant spacing in mechanically transplanted paddy over random manual transplanting.

The cost of cultivation of paddy by mechanical transplanting and manual transplanting was also studied and presented in Table 1. From table 1, it can be found out that cost of preparation of mat nursery for mechanical transplanting of paddy (Rs.1950) was higher than that of conventional nursery bed preparation for manual transplanting (Rs. 800). Also, from the table it can be concluded that labour charge for transplanting (Rs.1250) and weeding operations (Rs.1000) was reduced in mechanical transplanting over manual transplanting (Rs.5500) due to use of mechanical paddy transplanter and power weeder.

From the table it can also be found out that cost incurred in plant protection was also lesser in mechanical transplanting (Rs.1500) than that of manual transplanting (Rs.2000). This may be due to maintenance of proper row to row and plant to plant spacing in mechanical transplanting. Previous study also shows that use of power weeder in paddy field reduces incidence of pests and diseases. Some pathogens overwinter or over summer in weeds and thus serve as inoculum for the main crop during its season and use of power weeder greatly reduces weed percentage in field thus contributing to better yield performance. According to Rajendran *et al.*, (2018), use of power weeder increases the sprouting of more tillers per hill through providing more aeration to the roots and also increases the nutrient uptake from soil which ultimately leads to better yield than conventional techniques.

Economic analysis from both the methods of transplanting shows that cost of cultivation for manual transplanting (Rs.36989) was more than that of mechanical transplanting (Rs.30153). Gross return for both manual and mechanical transplanting was Rs. 92928 and Rs.97012 respectively. Net return for mechanical transplanting (Rs.66859) was also higher than manual transplanting (Rs. 55939). A benefit cost ratio of 3.21 was found in case of mechanical transplanting than that of manual transplanting *i.e*., 2.51.Thus, it can be concluded that mechanical transplanting of paddy has more profitability than conventional manual transplanting and can boost up farmer's economy.

Table.1 Cost of cultivation (Rs/ha)

S.No	Operations	Manual transplanting	Mechanical transplanting
	Nursery		
1	Nursery bed preparation	800	1950
2	Seeds	2000	2000
	Main field		
3	Land preparation	6750	6750
4	Fertilizers (Basal+ Top dressing)	3689	3689
5	Transplanting		
	Labour cost	5500	1250
	Fuel cost for machine	0	420
6	Weeding		
	Labour cost	5500	1000
	Fuel for power weeder	0	844
7	Plant protection	2000	1500
8	Harvesting	6750	6750
9	Carrying	1750	1750
10	Threshing	2250	2250
Total		**36,989**	**30,153**

Table.2 Economic analysis

Manual transplanting				Mechanical transplanting			
Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C
36,989	**92928**	**55939**	**2.51:1**	**30,153**	**97012**	**66859**	**3.21:1**

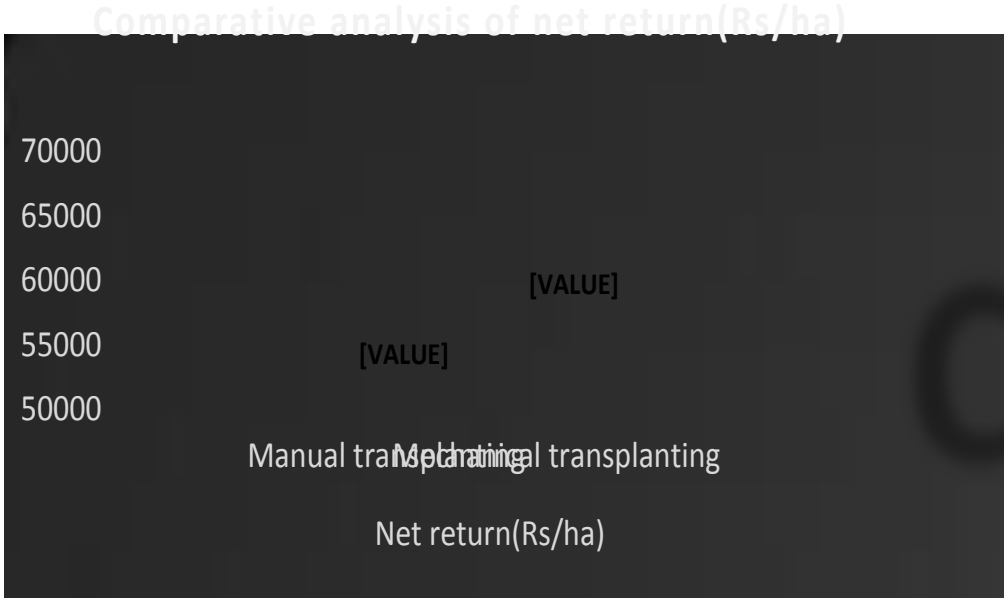

Fig.1 Comparative net return (Rs/ha) analysis

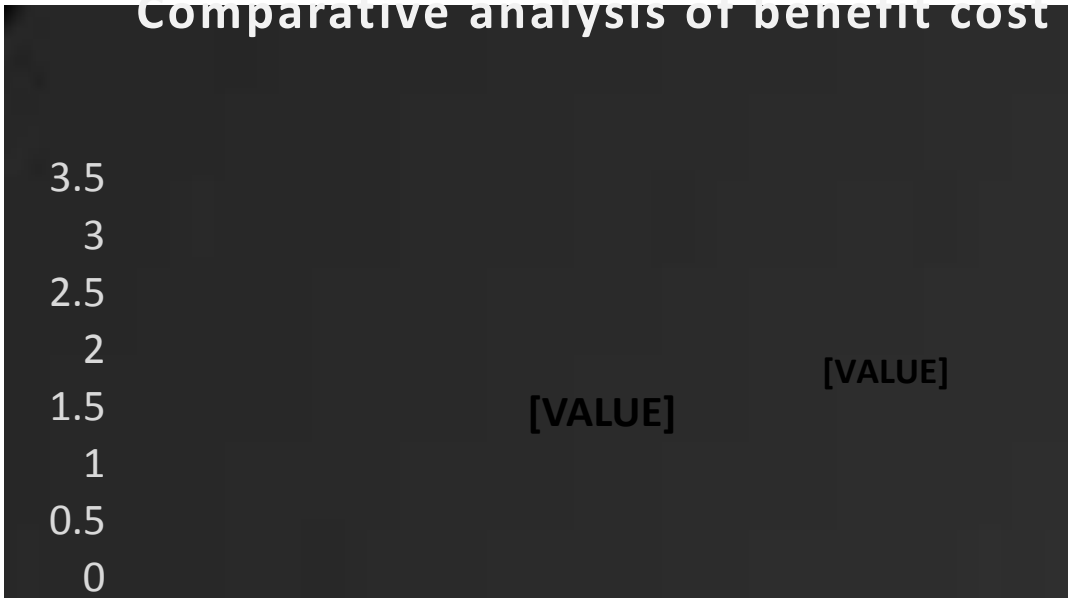

Fig.2 Comparative benefit cost ratio analysis

From the study, it has been found out that mechanical transplanting of paddy is emerging as an utmost necessity in present situation. The shortage of labourers in main cropping season and low cost of cultivation involved greatly necessitates this technology in farmer's field over conventional manual transplanting.

The popularization of mechanical transplanting can be achieved through establishment of different custom hiring centres. Such centres will facilitate economic way of cultivation of paddy over conventional methods. Through mechanical transplanting of paddy cost of labourers, reduction of disease and pest incidence, reduction of weed incidence and less time for cultivation of paddy can be achieved.

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