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Self-propelled Walking Behind Type Rice Transplanter – A Better Alternative For Manual Transplanting

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ABSTRACT

Rice transplanting by self-propelled transplanter ensures timely operation, saving in cost and minimum human drudgery. A detailed economics of both manual and mechanical transplanting were worked out based on the study done at College of Agricultural Engineering, Bapatla during the year 2008-09. The self-propelled walking behind type rice transplanter gave net profits of Rs.1189 and Rs.1860 ha^{-1} when annual use of machine was one season (300 h) i.e *kharif* and two seasons (500 h) i.e both *kharif* and *rabi* respectively over manual transplanting. The field capacity, field efficiency and fuel consumption of the transplanter were 0.12 ha ha^{-1} , 58.39% and 5.10 l ha^{-1} respectively. The grain yield in respect of mechanically transplanted rice crop was 5.13 t ha^{-1} and incase of manually transplanted rice crop was 4.57 t ha^{-1} . 12% more yield and an additional income of Rs. 8339/ha were realized for mechanical transplanting over manual transplanting.

Key words : Economics, Manual rice transplanting,Mechanical rice transplanting, Self-propelled walking behind type rice transplanter

Rice is largely grown by transplanting of seedlings under puddled field condition. Transplanting healthy and vigorous seedlings gives a more uniform crop stand with higher yield than direct seeded rice (Khan and Gunkel, 1989). Transplanting in India is mostly done manually, which is tough and involves enormous drudgery and human stress in sweltering weather. It consumes about 250-300 man-h/ha, which is approximately 25% of the total labour requirement for rice cultivation (Singh and Hussain, 1983). In addition, non-availability of labour has compounded the situation and paddy transplanting has emerged as the problem in the major rice-growing region. This results delay in transplanting and decrease in yield. Optimum plant density and timeliness of operation in paddy is considered essential for optimizing paddy yield which may be possible if dependence on hired labor is minimized. Since long, mechanical transplanting using self-propelled transplanter has been considered as the most promising option because it saves labor to the tune of 90% of that required in manual transplanting, minimizes stress and drudgery, ensures timely transplanting and attains optimum plant density contributing to higher productivity (Sahay, 2002).

These factors have encouraged to investigate the performance evaluation of self-propelled walking behind type rice transplanter compared to manual transplanting in order to know whether or not the mechanical transplanting is efficiently utilized by farmers and also find out its economic viability.

MATERIALS AND METHODS

The required data was collected from the field experiment conducted at College of Agricultural Engineering, Bapatla during the year 2008-09. The field performance of the transplanter in terms of field capacity, field efficiency, machine index and fuel consumption and economic analysis were evaluated (Renoll, 1970) in a plot size of 30 m X 50 m by following RNAM test codes for farm machinery and compared with manual transplanting. The field was first ploughed by a rotavator and then puddled with a peg type cultivator with two passes after flooding to about 10 to 15 cm depth of water for 24 h. The rice transplanting was done with self-propelled transplanter after a period of 48 h sedimentation period (time gap in between puddling and transplanting). A Korean make self-propelled walking behind type 4-row rice transplanter, marketed by M/S Southern Agro Engine Pvt. Ltd., Chennai, (specifications given in Table 1) was used in the experiment (Fig. 1 and 2). Detailed economics of both the methods of transplanting were worked out by considering cost of operation at the time of transplanting, cost of inputs, intercultivation and harvesting by taking local prices into consideration.

Cost of operation of transplanter was calculated by assuming its life as 10 years and annual use of machine as 300 h in one season and 500 h in two seasons. The total transplanting cost including fixed and variable costs was determined by straight line method on hourly basis and subsequently converted into cost per hectare by taking into account the field capacity of transplanter. The cost of manual transplanting per hectare was determined by taking cost of nursery rising and its management, nursery uprooting and transplanting.

RESULTS AND DISCUSSION

The field capacity of the transplanter was found to be 0.12 ha h^{-1} with field efficiency of 58.39 % at an average operating speed of 1.73 km h^{-1} (Table 2). The effective transplanting time was 61.92% with machine index of 92.27. Nursery feeding and their time to time placement consumed 24.37% of total time of operation when 2 persons were employed as loaders during the field operation of rice transplanter. The fuel consumption of the transplanter was measured as 0.61 l h^{-1} and 5.10 l h^{-1}. The economic analysis showed that the cost of operation of the transplanter was Rs.241 h^{-1} and Rs.160 h^{-1} by considering 300 and 500 h of annual use respectively while using in one and two seasons (Table 3). Taking into account the average field capacity of the machine, the cost for transplanting of one hectare area was calculated as Rs.3566 and Rs.2895 respectively for the above mentioned annual uses. The above estimated cost of transplanting included the cost of nursery rising, its management, uprooting, transportation and feeding etc. The cost of manual transplanting was estimated as Rs.4755 ha^{-1}. Thus, a net profit of Rs.1189 and Rs.1860 ha^{-1} at 300 and 500 h of annual use of machine respectively would be realized over the manual transplanting (Table 3). The transplanter requiring a heavy initial investment had a high annual fixed cost but the total transplanting cost per hectare gradually reduced when the area coverage per year is increased.

Table 1. Technical specifications of self-propelled walking behind type transplanter.

Sl. No.	Particulars	Specifications
1	Trade name	Manam Rice Transplanter
2	Model	ARP-4UM
3	Dimensions (L × W × H), mm	2350 × 1480 × 800
4	Engine power, kW	2.2
5	Fuel	Petrol
6	Cooling system	Air cooled
7	Weight, kg	177
8	Walking mechanism	Double wheel driven
9	Type of float	PVC moulded
10	Working mechanism	Crank type planting mechanism
11	Number of rows	4
12	Row spacing, mm	300
13	Hill to hill spacing, mm	110 to 200
14	Depth of transplanting, mm	25 to 125
15	Traction wheels	
	(a) Diameter, mm	600
	(b)Number of lugs	27
	(c)Track width, mm	650
16	Planting speed, m/sec	0.3 to 0.5
17	Nursery required	Mat type nursery

Fig. 1 and 2: Self-propelled walking behind type rice transplanter and it is in operation

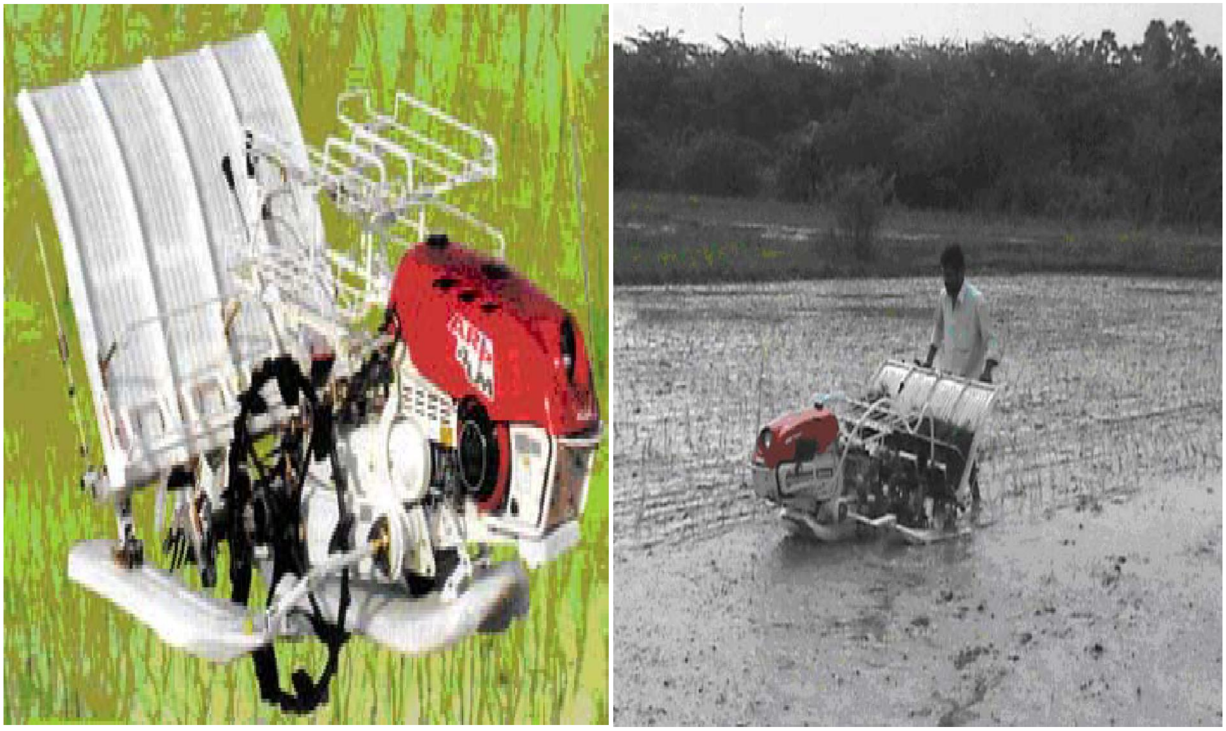

Table 2. Field evaluation of self-propelled walking behind type rice transplanter

Sl. No.	Particulars	Values
1	Average operating speed, km/h	1.73
2	Average turning time, min/turn	0.20
3	Width of operation, cm	120
4	Field capacity, ha/h	0.12
5	Field efficiency, %	58.39
6	Percent distribution of operating timea.	61.92
	a. Effective transplanting timeb.	
	b. Non – transplanting timei.	
	i. Turning timeii.	5.18
	ii. Mat feeding and adjustmentiii.	24.37
	iii. Others (cleaning of clogged fingers, engine shutdown etc)	8.52
7	Machine index	92.27
8	Fuel consumption, l/ha	5.10

Fig. 3. Grain and straw yields of rice crop under mechanically and manually transplanted rice.

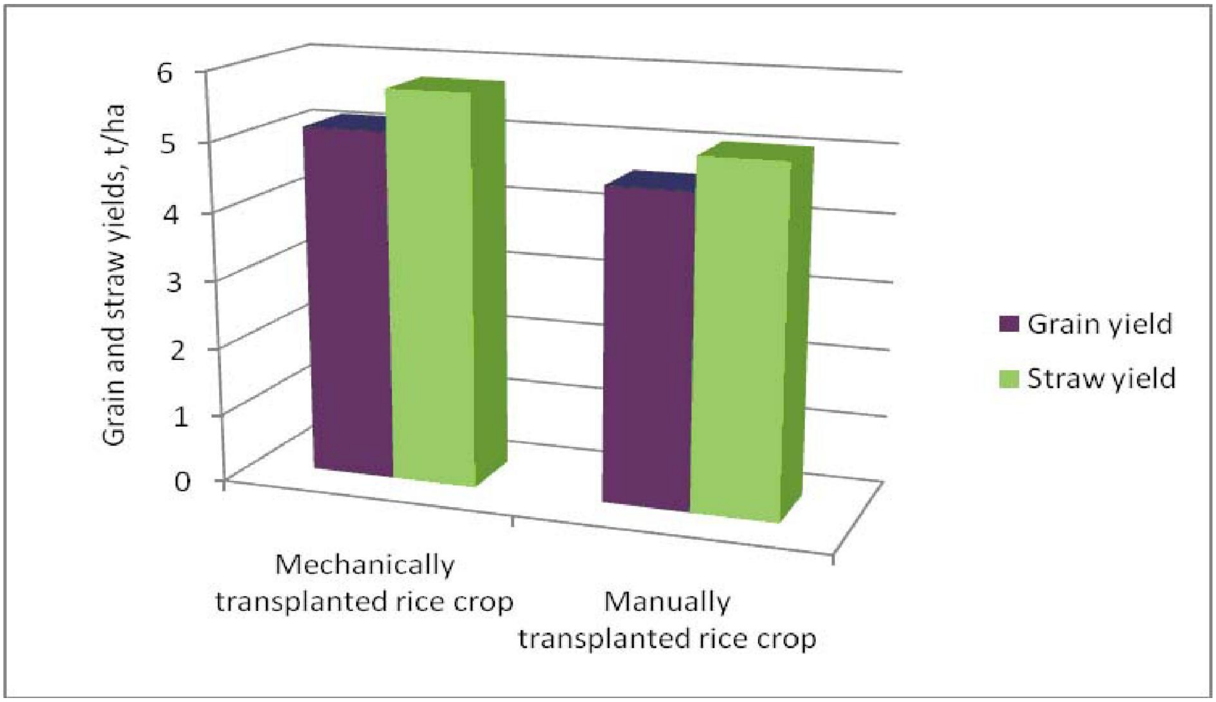

Fig. 4. Cost of cultivation for rice cropunder mechanically and manually transplanted rice.

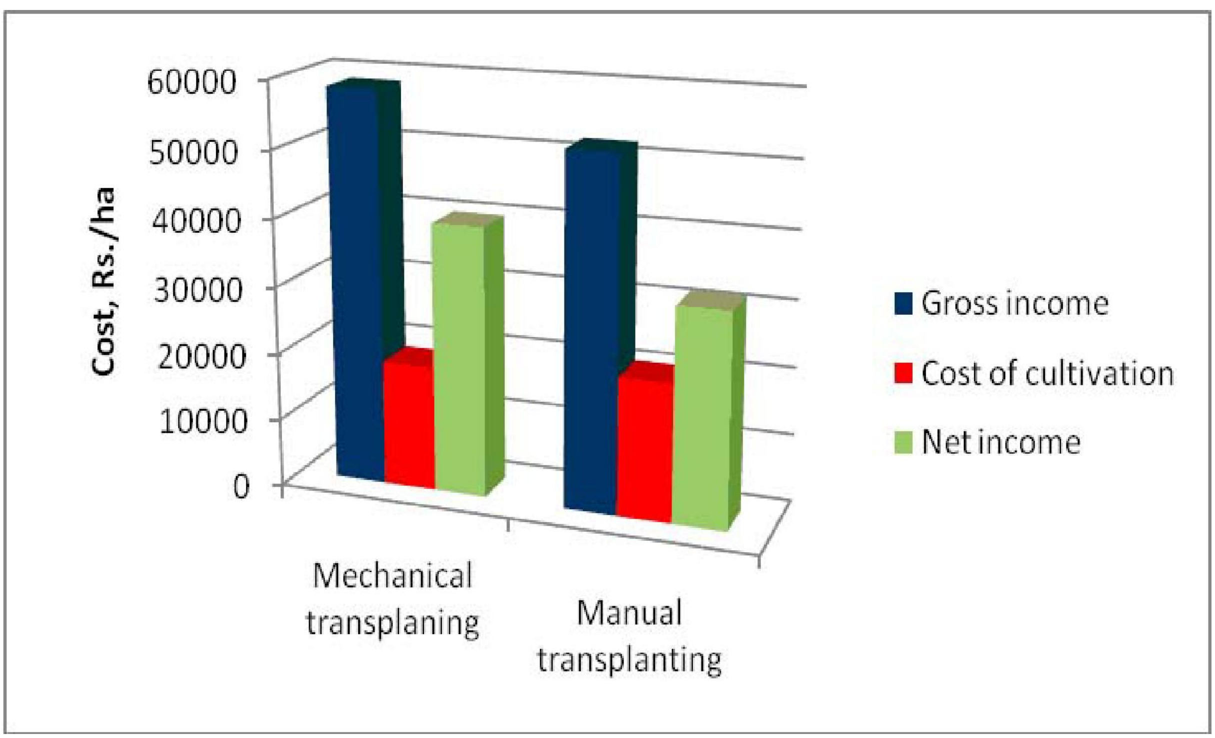

Table 3. Cost of operation of rice transplanting for both the methods.

S.No.	Activity	man-h/ha	Cost (Rs./ha)
1	Cost of operation of self-propelled walking behind type rice transplanter		
	(i) Fixed cost		1679
	(a)One season (300 h $year^{-1}$)		1008
	(b)Two seasons (500 h $year^{-1}$)		332
	(ii)Variable cost		
	(iii)The cost of operation		
	(a)Cost of polythene sheet for raising mat nursery	65	150
	(b)Nursery raising (nursery bed preparation and management etc)	25	900
	(c)Nursery mat cutting, transport and tray loading		300
	(d)Operator cost		205
	Total cost of transplanting		
	(a)One season (300 h $year^{-1}$)		3566
	(b)Two seasons (500 h $year^{-1}$)		2895
2	Cost of manual transplanting		
	(i)Nursery raising and its management	85	900
	(ii)Nursery uprooting		150
	(iii)Transplanting	220	3705
	Total cost of manual transplanting		4755

The grain and straw yields as shown in Fig. 3 for mechanically transplanted rice crop were 5.13 and 5.74 t ha^{-1} respectively and for manually transplanted rice crop, they were 4.57 and 5.06 t ha^{-1} respectively. Therefore, it was concluded that about 12 % of yield was increased for mechanically transplanted rice crop over manually transplanted rice crop due to more number of tillers per hill. It was inferred from the study that the total cost of cultivation and gross income for mechanical rice transplanting using self propelled walking behind type rice transplanter were Rs. 18591 and Rs. 58475 respectively and whereas in case of manual rice transplanting they were Rs. 20480 and Rs. 52025 (Fig. 4). Hence, the net income for mechanical rice transplanting was Rs. 39884 and for manual rice transplanting was Rs. 31545. Therefore, it was concluded that an additional income of Rs. 8339 was obtained for mechanical rice transplanting with self propelled walking behind type rice transplanter due to reduced cost of cultivation and additional yield over manually transplanted crop.

Net monitory profits of Rs.1189 and Rs.1860 ha^{-1} were achieved at 300 and 500 h annual use of transplanter, respectively, over the manual transplanting. The field capacity of self propelled walking behind type rice transplanter was found to be 0.12 ha h^{-1} with field efficiency of 58.39 % at an average working speed of 1.73 km h^{-1}. The man-h ha^{-1} required for transplanting with self propelled walking behind type rice transplanter decreased to 25 man-h ha^{-1} from 220 man-h ha^{-1} incase of manual rice transplanting.

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