

**CAN MECHANIZATION REDUCE LABOUR AND WATER DEMAND IN AGRICULTURE?
A CASE OF RICE TRANSPLANTERS IN ANDHRA PRADESH**K Gurava Reddy¹ and Kakumanu Krishna Reddy²¹Acharya N G Ranga Agricultural University, Rajendranagar, Hyderabad²International Water Management Institute, Hyderabad, India

ABSTRACT: Mechanization in agricultural sector is advancing in developing countries like India. Rice is a labour-intensive crop and requires about 80-90 labour days per acre. Timely availability of labour and water for various activities of rice is becoming a problem. The cost of the labor among the cultivation cost also increased from 15-18 % to 45-47% during the last decade. Water scarcity is also increasing due to climate variability in the country. Hence, to overcome labour shortage and sustain rice production with less water, the recent phenomenon observed in Andhra Pradesh state is the use of machine transplanters and harvesters. These are resulting in the process of mechanization and increasing their popularity during the recent years. The machinery transplantation was taken up in 21 farmers fields covering 0.4 ha each. The field observations from the farmers' fields show that machinery transplantation reduces seed by 50 % and labour by 22%. The nursery cost for the machinery transplantation is higher compared to traditional transplantation method (by Rs 2330). The other major observations noticed during the validation of technology was, that number of hills per sq.m and tillers in a hill are higher compared to the manual transplantation, resist lodging during heavy floods. The effective tillers in a hill range from 12-15 and also increase the panicle grain number. The yield of rice was found to be higher by 6-7 q/ha compared to the manual transplanting. The total variable cost with the machine transplantation does not show any significant difference with the transplantation method. Government is also promoting machine transplanters through subsidized policy to the farming community. However, relevant capacity building programs on the mat nursery preparation for machine transplanting is lacking.

Key words: Machine Transplanting, Labour Utilization, Cost of Cultivation

INTRODUCTION

The primary resource affected by the climate change is water. In arid and semi-arid regions of India, any shortfall in water supply due to climate change will enhance competition for water use for a wide range of economic, social and environmental applications. The population growth with the improved living conditions also increases the demand for food production and thereby increasing the demand of water in multiple folds (UNESCO-WWAP, 2009) in the river basins. The major portion of water available in the Indian river basins is used for irrigation of rice and thus poses major challenges to water management, especially during unfavourable weather or climatic conditions. Around 95% of the cultivated area under rice is irrigated, and requires about 1200 mm to 2500 mm of water depending on the soil texture, structure and profile conditions (Reddy & Reddi, 1995). Of all the major cereal crops grown in India, rice constitutes 24% of the total food grains produced contributing 96 million tonnes. The projected climate scenarios for mid (2021-2050) and end centuries (2071-2100) in the Krishna River Basin shows a change in the future water availability, where farmers need to adapt for the new technologies (Palanisami et al., 2011).

Paddy is a labour-intensive crop and requires about 50-70 labour days per acre from nursery raising to harvesting. Timely availability of labour for various activities of paddy is becoming a problem for farmers and unable to take proper measures to protect the crop. This can be attributed to several factors including the migration of labourers from villages to nearby towns and cities in search of employment. With agriculture becoming risky due to frequent weather or climate changes (droughts and floods), people in rural areas find it more secure to get a job in urban areas. Another factor is the ongoing government welfare programs such as the National Rural Employment Guarantee Act (NREGA) that hire rural people. On the other hand, the rural population has decreased from 82.7 % in 1951 to 68.8% in 2011 (Population census, 2011).

The availability of labour is becoming problematic in Andhra Pradesh and other south Indian states, as rural people are migrating to nearby cities and towns for higher wages or being hired in the government social welfare programs, for eg, the National Rural Landless Employment Guarantee program. Hence, the cost of hiring in labour has significantly increased during recent years. For example, in the lower Krishna river basin (Krishna, Guntur and Prakasam districts) of Andhra Pradesh state, costs for labour in rice cultivation accounted for 29 % of the total cultivation costs during 2006-07, and increased to 49 % in 2010-11 (Technical program, 2011).

Hence, to sustain rice production and ensure food security with these challenges new adaptation strategies have to be developed and upscaled. The present study tried to analyse the performance of Machine transplanting in field conditions in selected villages in the Krishna River basin of Andhra Pradesh. The paper will briefly present the results from the study, followed by up-scaling strategy and recommendations to the policy makers.

RESULTS AND DISCUSSION

Field observations and data collection

The machine transplantation was validated in 21 farmers' fields on a pilot basis in CLIMARICE (www.climarice.com) project during Kharif 2010-11 & 2011-12, in order to generate relevant biophysical observations and economical data. The study was conducted under Nagarjuna Sagar Project (NSP) - Krishna river basin from Guntur district of Andhra Pradesh, India. The biophysical observations and data collected during the validation are given in Table 1.

Table 1: Field observations on machine transplanting (N=21)

S. No	Item	2010-11		2011-12	
		Traditional	MT	Traditional	MT
1	Seed rate (Kg)	68	38	72	32
2	Days to transplant	30-35	15-18	30-35	15-18
3	Cost of nursery including seed (Rs)	10170	12500	11050	11500
4	Labour required for transplanting/ seeding operations	25	3	24	2.8
5	Spacing (cm)	30 X15 (Zigzag)	30 X16	30 X15 (Zigzag)	30 X16
6	No of hills/sq-meter	22	23.80	23.20	25
7	No of effective tillers/hill	11.20	12.10	15.60	15.10
8	No of grains/ panicle	121	119	126	123
9	Days to maturity	149	144	144	141
10	Water utilized (mm)	1510	1490	1265	1128
11	Grain Yield (kg/ha)	4584	5203	6411	7104
12	Water use efficiency (kg/ha/mm)	3.03	3.49	5.06	6.29
13	Total cost of cultivation (Rs)	40511	40559	45674	45712
14	Gross returns (Rs/q) @993/- (2010-11) & 1000/- (2011-12)	45618.42	51665.79	64110	71040
15	Gross margin (Rs)	5107.42	11106.79	18436	25328
16	Benefit cost ratio	1.12	1.27	1.40	1.55

- The field observations from the farmers' fields show that machinery transplantation utilizes less seed rate and labour by 50%.
- The nursery cost for the machinery transplantation is higher compared to traditional transplantation method (by Rs 2330).
- The other major observations noticed during the validation of technology was, that
 - The number of hills per sq.m and tillers in a hill are higher compared to the manual transplantation,
 - Resist lodging during heavy floods.
 - The effective tillers (with panicle) in a hill range from 12-15 and also increase the panicle grain number.
 - The yield of paddy was found to be higher by 6-7 qt/ha compared to the manual transplanting.
 - The machinery transplantation does not show any difference in its total variable cost with the transplantation method.
 - For traditional transplantation we need 8-10 laborers per acre where as for the machine transplantation one person is enough to hand over the trays.
 - Uniformity in spacing (30 x 12/14/16cm) between the plants helps them to grow well.

Input utilization pattern

Labour utilization

Labour is the vital component in rice cultivation. From nursery, transplanting to harvesting at every stage labour requirement is high in traditional conventional method of rice cultivation.

Activity wise labour requirements

An attempt is made to get the difference in labour requirement at each stage of rice cultivation under different methods. The results presented in the Figure1&2 clearly indicates that labour requirement at some stages of crop growth is less in Machine Transplanting compared to conventional. It can be concluded from the results that about 22 per cent reduction in case of Machine transplanting than to conventional rice cultivation method can be observed

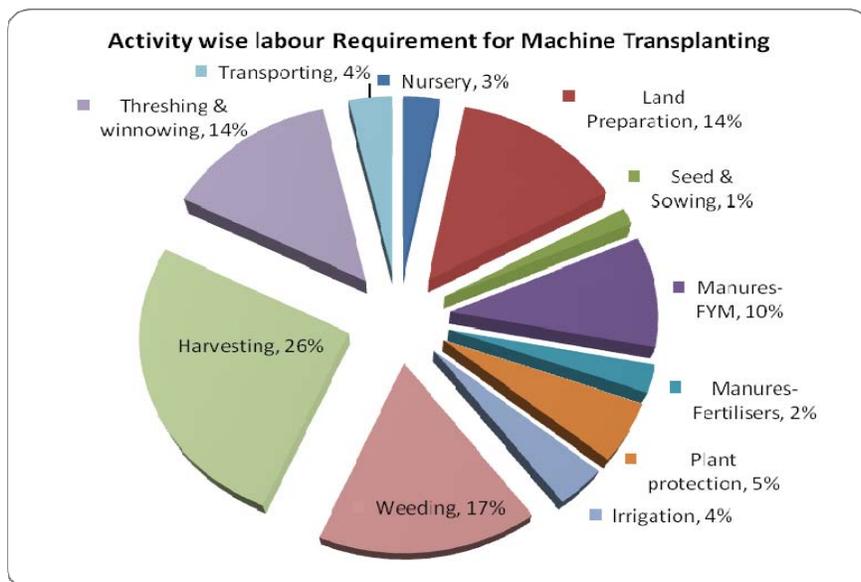


Figure 1: Labour use for different activities in machine transplanting

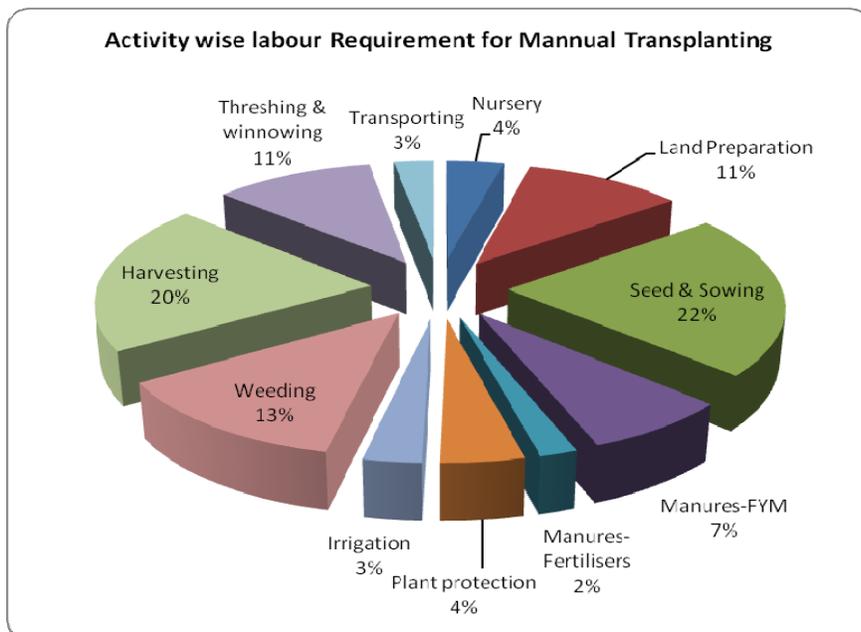


Figure 2: Labour use for different activities in manual transplanting

Gender wise labour requirements

A close look at Figure 3 indicate that with regard to machine transplanting 37 per cent reduction observed in men labour followed by 15 percent reduction in women labour and 7 percent increase in machine labour.

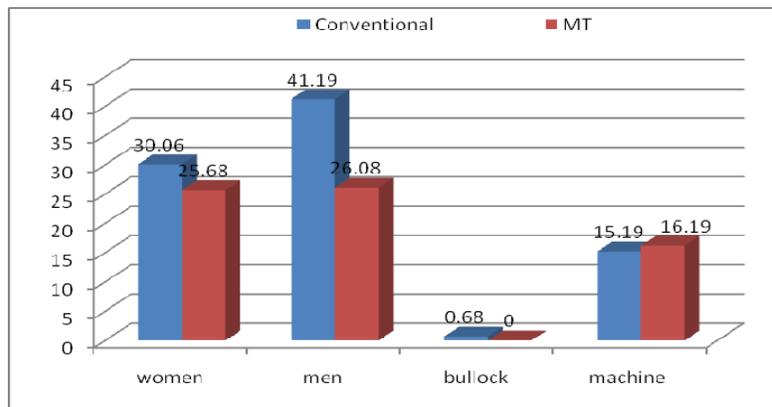


Figure 3: labour use under different methods of rice cultivation

Water utilization

Water is another critical input in rice cultivation. Of all the major cereal crops grown in India, rice constitutes 24% of the total food grains produced contributing 96 million tonnes. The projected climate scenarios for mid (2021-2050) and end centuries (2071-2100) in the Krishna River Basin of India shows a change in the future water availability, where farmers need to adapt for the new technologies (Palanisami et al. 2011). Results presented in the Figure 4 indicate that about 16 per cent reduction is observed with the adoption of Machine transplanting method in case of water utilization. In Machine transplanting 2127 litres was used for kg of paddy production while 2524 litres was used with conventional method.

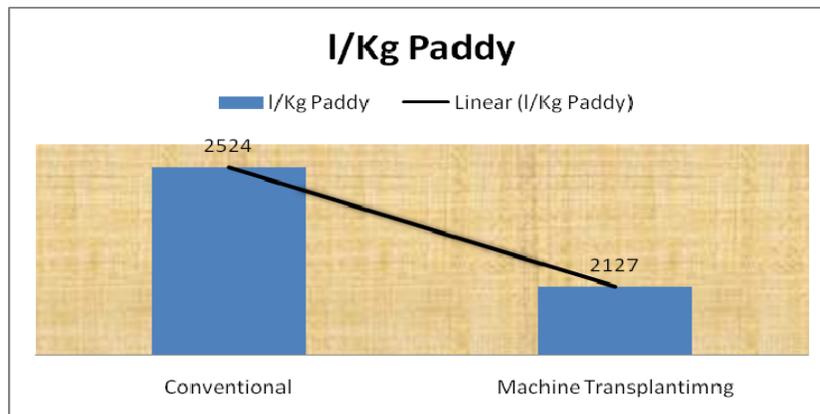


Figure 4: Water productivity for Machine transplanting and conventional

Seed requirement

Seed rate is also drastically reduced with adoption of Machine Transplanting method. In conventional method 66Kg per hectare seed is required where it is only 38 Kg with Machine transplanting method.

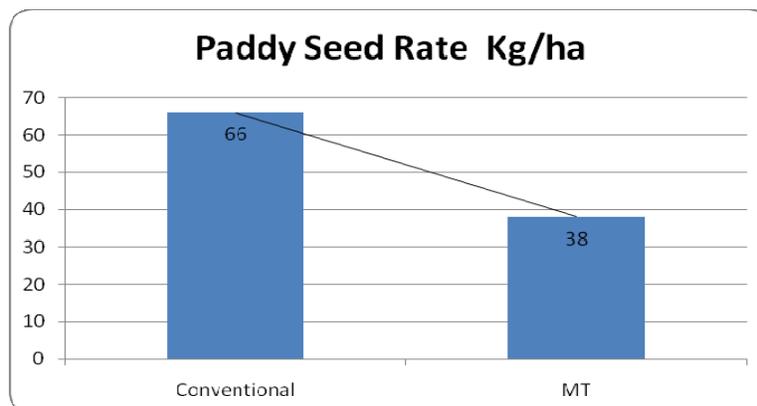


Figure 5: Seed rate under different practices

Production Economics

Whatever the technologies adapted but for different reasons, the Net gains for the farmers would be the major driving force in further upscaling the technologies. Total operational costs of the farmers and yields were recorded and based on the observations cost of unit production was arrived. Lesser will be cost of production more will be profit for farmer. Figure 6 concludes that that per kilogram paddy production in machine transplantation cost Rs 7.01/- in contrast to Rs 7.84 with conventional method. Yield in machine transplanting method is 6134 Kg/ha as against 5498 Kg/ha in conventional method. The reduction is mainly due to the higher yield but not due to lower cost of cultivation.

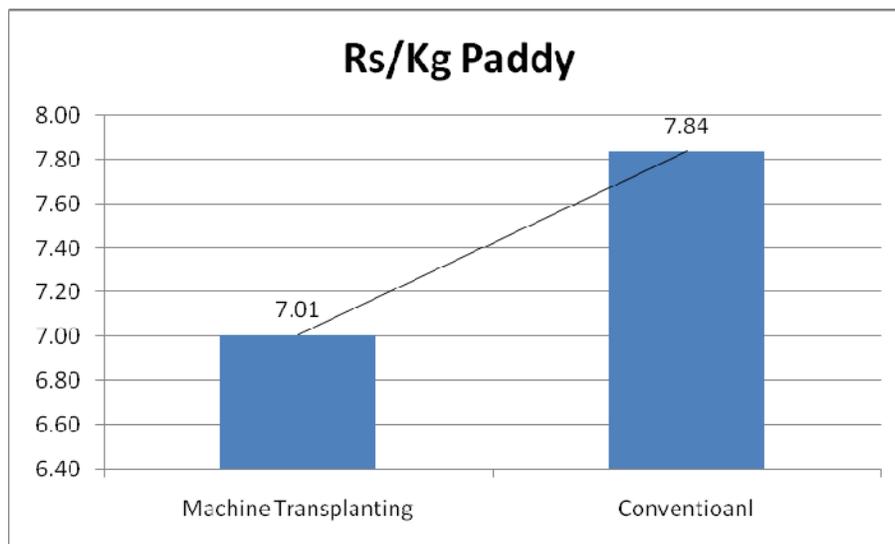


Figure 6: cost of production in machine transplanting vs conventional

Benefits from the Machine transplantation

- The crop growth will be advanced by 2-3 days.
- Farmers experienced that the seedlings that are planted last year haven't fallen off due to the heavy rains.
- Yield advantage (6-7 q/ha) over the conventional method of transplantation
- Water use efficiency is comparatively higher in machine transplantation

Disadvantages in Machine Transplantation:

- Seedlings older than 18 days are not suitable for machine transplantation.
- Growing of the seedlings in the nursery requires a lot of skill.
- While transplanting in the field there should not be any standing water which means the field has to be properly leveled.
- Machines transplants 4-6 seedlings in a single place, instead if the machine is altered to transplant 2-3 seedlings then there will also be reduction in the cost incurred.
- Non availability of the machines on time.
- Cost of the transplantation is also higher with the machines due to higher initial cost.

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