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Machine Transplantation: Labour and Water Saving Technology in Paddy Cultivation

CLIMARICE II: "Sustaining rice production in a changing climate"

K. R. Kakumanu, K. Gurava Reddy, K. Palanisami, Udaya Sekhar Nagothu

Paddy is a labour-intensive crop and requires about 90 labour days during one season. Timely availability of labour for various activities is becoming a problem for farmers in Andhra Pradesh. 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 changes (droughts and floods), people in rural areas find it more secure to get a job in urban areas. Another factor are the ongoing government welfare programs such as the National Rural Employment Guarantee Act (NREGA) that hire rural people. The government of India has also passed a number of laws in order to promote the standard of labour in agriculture. These laws concern issues such as minimum wage fixing, equal remuneration, discrimination (employment and occupation), minimum age convention, safety and health in agriculture convention.

On the other hand, the rural population has decreased from 82.7 % in 1951 to 68.8% in 2011 (Population census, 2011). The number of cultivators is also decreasing due to a decline of the rural population and a shift towards the other labour and business activities. Water shortage due to the changing climate and monsoons is another challenge to the farmers.

Hence, to overcome labour shortage and sustain rice production with less water, the recent phenomenon observed in Andhra Pradesh and Tamil Nadu states is the use of machine transplanters and harvesters brought into the market by private firms. The transplanters for paddy cost about Rs 2.5 to 13 lakhs and the harvesters cost about Rs 23-27 lakhs, an expense not many of the small-scale farmers can afford. In addition, high technical skills are needed to operate them. However, the main advantage of machine transplantation is that it tackles the problem of labour shortage, and that it reduces the nursery preparation costs and time. The ClimaRice II project has initiated machine transplantation on a pilot basis in Doppalapudi, Ponnur Mandal during Kharif 2010, and Rangareddy palem, Narasaraopet Mandal during Kharif 2010 and 2011.

Machine transplantation in paddy

Preparation for Machine Transplantation

Seedling and land preparation are important when using machine transplantation. To raise the seedlings, a growing medium has to be prepared containing soil, vermicompost, molasses - sugarcane byproduct and major nutrients containing urea, phosphorus and

potassium. About 4-5 kg of this soil-mix is required per tray and 70-75 trays are required per acre. Per tray, 165 g of seed are required totaling to 12-15 kg of seed per acre. In the pilot villages, the BPT 5204 variety (Samba Masuri) was selected for sowing. Water has to be sprinkled on the seedling trays for 15-18 days and then carry them to the main field for transplanting. The cost for a farmer to raise the seedlings amounts to 30 Rs per tray.

Machine transplantation at Rangareddypalem, Guntur District

Famers have to puddle and level the main field with a thin film of water before transplanting the seedlings (Picture 1). This helps the transplanter to mark the margins and move easily in the wet fields. The transplanter chosen for the pilot area was manufactured by Kubota and cost about Rs 10 lakhs. Syngenta Pvt. LTD hired the machinery for the ClimaRice fields. The planting space selected is 25 x 16 cm with 4-6 seedlings per each hill. The machine transplantations represent a modification of the System of Rice Intensification method with a specified spacing and younger seedlings for transplantation.

Field observations

Machine transplantation was taken up for Kharif 2011 in 21 fields, each covering 1 acre, at Rangareddypalem village, Narasaraopet Mandal, Guntur district. Field observations show that machine transplantation requires a lower seed rate and reduces labour by 50%. Nursery costs for machine transplantation are higher compared to traditional transplantation methods (by Rs 2330). Other major observations made during the validation of this technology were that the number of hills per sq.m and tillers in a hill were higher compared to the manual transplantation technique and resist to lodging during heavy floods due to more tillers (*Table 1*). The number of 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 technique (Praveen, 2011 and field observations). Machine transplantation does not show any difference in its total variable cost compared to manual transplating (*Table 1*).

Water measurements

RBC flumes were fixed in farmers fields for both the mechanical and the traditional transplanting methods. Two flumes were installed in the fields where machine transplantation was used and two flumes in the control fields (traditional transplantation). The RBC flume has the capacity to discharge 50 lps at its maximum point. The farmers were asked to observe the flume point and period of water applied during each irrigation. The applied water was computed with the flumes discharge capacity chart. The machine transplantation practice reduced water consumption by 20 to 135 mm (table 1). Water use efficiency was also found to be higher for machine transplantation.

Table 1: **Field observation for Kharif 2010-11 and 2011-12** **(per ha)**

S No	Item	2010-11		2011-12	
		Traditional	MT	Traditional	MT
1.	Seed rate (Kg)	60-75	35-40	60-75	35-40
2.	Days to transplant	30-35	15-18	30-35	15-18
3.	Cost of nursery including seed (Rs)	10170	12500	10170	12500
4.	Labour required for transplanting/ seeding operations	25	3	25	3
5.	Spacing (cm)	30 X15 (Zigzag)	25 X16	30 X15 (Zigzag)	25 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	121	123
9.	Days to maturity	149	144	144	141
10.	Water utilized (mm)	1510	1490	1265	1128
11.	Yield recovered (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) @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

Measuring irrigation water through RBC flume:

Water applied in ltr/ha (Li) = (Water height in flume per irrigation x Discharge in ltrs from annexure chart) X (No of hours x 3600) *equation (1)*

Effective rainfall ltr/ha L2= Rainfall in mm X 10000 X 70/100 *equation (2)*

Total water utilised mm/ha = (Li + L2)/ 10000 *equation (3)*

The machine transplanting practice needs to be further validated in more areas with differing soil textures. Farmers in Guntur district were quite enthusiastic to promote machine transplantation (discussions with farmers and regional scientist in August 2011) in their villages. Some farmer groups also expressed their interest to contribute financially to the purchase of transplanters, in partnership with the government department, and operate them on their own. The main outcome of this initiative is to develop a public-private partnership model, in this case the farmer-private agro-industry partnership can be tried out in the areas. Further up-scaling is possible with the cooperation of the State Agriculture Department, farmer groups and private agro-industries. ClimaRice II can act as a moderator to develop such partnership models. Several models can be worked out with the active involvement of farmers.

Implications to upscale the machine transplantations

The machine transplantations are performing better to overcome the labour scarcity in the villages. Though there is not much difference in the cultivation cost with the traditional practice the machine method

is helping to produce additional yields and income. Scheduling irrigations in water management practices can add advantage to it and need to focus more on it. To upscale the machine transplantations in the region or province more attention is required on training the farmers in field preparation and seedling preparations in trays. Machine subsidies to the farmers groups at the village level can be encouraged to sustain the practice. Nonetheless, attention can also be given on the public-private partnership for preparing the nursery mats at farmers gate by providing trainings to them through industries working on the machine transplantations.

RBC flume water measurement in fields with machine transplantation at Rangareddy palem

References

Population Census. 2011. http://censusindia.gov.in/

ClimaRice II Project (2009-2012)

ClimaRice II is an integrated project that aims to test and validate climate change adaptation techniques related to rice production, in close co-operation with farmers and local agencies in two study areas in the Cauvery River Basin, Tamil Nadu, and Krishna River Basin, Andhra Pradesh, in India.
The overall goal is to contribute to the regional and national adaptation strategies to sustain rice production and ensure food security amidst changing climate.

The partners are:

- Bioforsk - Norwegian Institute for Agricultural and Environmental Research (Project Co-ordinator)
- Tamil Nadu Agricultural University, Coimbatore, India
- International Pacific Research Institute, Hawaii, USA
- International Water Management Institute, Hyderabad, India

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