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Resource Conservation through Direct Seeded Rice

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Abstract

A study to compare the sustainability features of growing rice by direct seeding (DSR) and traditional transplanting (TPR) was carried out in the tail-end of irrigation commands in north-eastern Karnataka State in India. Thirty farmers grew paddy using both management practices during a single monsoon season. It was found that significant savings in seeding rate, water consumption, fertilizer, fuel use and labour were achieved in the fields that employed direct seeding. This led also to a 65% greater income for DSR management. Weed control remains as a significant challenge for direct seeding but, overall, DSR shows evidence of being cost-effective while having strong sustainability benefits.

Mini Review

Rice is a major staple food for the people of Asia and the Pacific, where 90 per cent of the world's supply is produced and consumed. In India, rice is cultivated on about 43 million hectares producing more than 150 million tonnes annually with yields ranging from 3.2 to 3.7 tonnes per hectare over the past decade. With the growing population, consumer demand is bound to increase and this will have to be met with declining resources.

Rising demand is not the only challenge. There are other issues as well that speak to the need for improving the sustainability of cultivation practices. The inputs of energy, water and human labour are all limited resources, and with their limited supply, costs of each of these are increasing. This then raises the issue of evaluating current management practices in order to conserve both natural and financial resources.

In the majority of irrigated command areas of India, rice is cultivated by transplanting into puddled fields, consuming up to 1500 or more mm of water, besides labour, time, fuel and chemical inputs. In addition, crop diversification becomes difficult as puddling forms a compacted layer leading to restricted percolation of water, with water logging and poor root growth of succeeding crops.

As an alternative to transplanted rice (TPR), direct seeding of rice (DSR), an age-old practice, is still followed in high rainfall areas of the Western Ghats of southern India and adjoining places outside, and occasionally within, well-irrigated command areas. In the absence of herbicides, however, failure to manage weeds efficiently reduces the DSR yields considerably, and this has led to unacceptability of this practice in command areas and subsequent domination of transplanting practices.

With the advent of selective and highly effective herbicides, direct seeding is taking its root in the command areas with many benefits. For DSR, there is no need of a nursery and its care, and no requirement for puddling of main fields, which requires at least 14-15% of the total water required for the crop.

In the Tungabhadra (TBP) and Upper Krishna project (UKP), the two major irrigation commands of north-eastern Karnataka, India, canal water is released during the month of July or sometimes well into August. Even then, in the tail-end commands, water release is further delayed and release is for only one week or ten days once every three weeks. When the release finally occurs, there is an immediate demand for the water as well as for scarce agricultural labourers and machinery for puddling and transplanting. Tail-end farmers then have to complete the transplanting within the short period; otherwise they have to wait another two to three weeks to receive the next allotment of water. This tricky situation has prompted researchers and farmers to think of reintroducing DSR management in the command areas. Scientists at the University of Agricultural

Science (UAS), Raichur have been suggesting to farmers that they raise the crop with the receipt of monsoon rains in June-July by direct seeding followed by a combination of pre- and post-emergent weedicides. In this way, farmers avoid many agricultural operations - nursery raising and its care, puddling of the main field and transplanting.

Weed management requires careful attention as both pre- and post-emergent applications should be done at optimal time and under optimal moisture conditions. A effective method is to seed after receipt of rains and use traditional blade harrowing to eliminate most weeds. This is then followed by use of pre-emergent (24 to 49 hours before germination) and post-emergent (18 to 22 days after seeding) weedicides for complete control of weeds.

With the introduction of these new practices, to convince farmers of the benefits of DSR, there is a need to comprehensively and quantitatively evaluate the benefits of DSR compared to the still-common transplanted rice. For this we carried out a study in the tail-end command areas of both the TBP and UKP areas in north-eastern Karnataka, India.

For our study, during the monsoon season of 2012 we commissioned 30 farmers to grow paddy where they employed well-established transplanted rice management in some fields and direct seeded management in others. During this season, rainfall in the area was lower than 150mm and this was supplemented by periodic irrigation as available and required. Average areas cultivated by each farmer using TPR and DSR respectively were 5.0ha and 5.8ha. In the case of TPR, nurseries were seeded with pre-germinated rice and raised for approximately 35 days before transplanting into the puddled main fields. Direct seeding was done, typically after the first monsoon rains in June, using a multi-crop zero-till seed drill or, when not available, traditional seed drills. Some of the key features of the comparative study are shown in the Table, which averages data from all the farmers. It is clear that this study has shown major benefits in the shift to Direct Seeding for rice management (Table 1).

Table 1:

		DSR	TPR
Seeding rate	(kg/ha)	34.5	60.7
Water consumption	(m3/ha)	8130	12500
	(mm)	813	1250
Virtual water value (VWV)	(L/kg)	1130	2160
Fuel use	(L/ha)	57	79.4
Labour time	(h/ha)	432	646
Total fertilizer	(kg/ha)	428	609
Yield	(t/ha)	7.21	6.59
Net income	(Rs/ha)	79100	48200

Flexibility in planting time is a big advantage of DSR. Instead of waiting until well into the rainy season when canal water becomes available to maintain flooded fields, farmers are able to sow after even a few early rains, using the monsoon showers to maintain a sufficient level of soil moisture until it can be supplemented by water from the canals. Early sowing usually means better yields. On top of this, sowing is done on well- spaced rows to allow for good tillering and this means that the seed requirements are significantly lower than those for preparing a nursery. There were some cultivar differences in the seed requirements. The cultivar with smaller seed (Sriramgold) required less seed (as low as 20kg/ha) compared to the more widely cultivated Sona Mussoori.

Sri Ramalingappa a farmer from Virupapur village in Sindhanur Taluka, in the TBP command says "I can sow as and when I wish with ease in the season and relax after that. For transplanting I have to wait for water, puddling, nursery, labourers etc. Once the crop is germinated I am relatively free for 30 days. I am getting the same or better yield than the transplanted with less cost of cultivation".

Being able to forgo the nursery stage also eliminates the energy consumption and financial expense associated with heavy fuel use in some aspects of land preparation, especially puddling and planking. Add to this the removal of a transplanting step, and labour costs are also significantly reduced.

Clearly, reduced water requirement is a big plus connected with DSR. This is especially important in these parts of the central subcontinent, where rainfall is limited to 500mm or less. And this advantage could be multiplied many fold for the country as a whole where currently about 80% of water consumption is directed to agriculture. Each year there are increasing demands for industrial, commercial and domestic uses as well as in other parts of the agricultural sector. Virtual water values (VWV) are a measure of the water required for producing a kilogram of grain, and direct seeding can bring these values nearer to those for dry land cereals, while maintaining productivity that is comparable to TPR.

Fertilizer values shown in the table are totals for N, P2O5 and K2O, with nitrogen typically making up about half of the total. There is higher fertilizer use efficiency in DSR as compared to TPR in these command areas, due to the reduced leaching losses associated with standing water in the TPR fields. Further, the aged seedlings, which many farmers use, require more intensive nutrient management than does the dry seeded rice in the DSR system.

Weed control has been the biggest challenge and impediment when encouraging a switch to direct seeding management. To be successful, stage-wise weed management is crucial. Before sowing, existing weeds should be eliminated with a non-selective weedicides or by light harrowing after proper land preparation. After sowing when the soil is moist, pendimethalin, properly applied, can control a large range of weeds. Later, post-emergent weedicides like bispyribac and 2,4-D can be used to control grasses and broad-leaf weeds. With proper residue management, use of herbicides reduces significantly over the

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years. As with TPR, especially in the initial years, some manual weeding is always required.

As most Indian farmers are well versed with traditional transplanted rice, there continues to be hesitation among some to switch over to DSR. The environmental benefits of energy and water savings are clear. After one or two seasons of success, many farmers are also finding major financial benefits as well, something that was clearly demonstrated in this study where an average 65 % financial gain was achieved. Sri Sai Babu of Maddarki in Yadagir District is typical in saying "I am saving Rs 17 500 per hectare without any yield penalty, in fact I get 4 to 5 quintals more in DSR as compared to TPR". The extent of saving depends on how efficiently farmers manage weeds.

Personnel at the various research stations of the UAS, Raichur are actively involved in the village communities in capacity-building regarding nutrient management, weed control and use of new machinery. At the research stations, the machines are available for rent at modest cost. The need for a good planter has stimulated initiatives to design and manufacture a zero-till multi crop seed drill in the local area. A prototype has already been made and is being used alongside currently available models manufactured in the Punjab.

All these initiatives have resulted in a rapid growth of DSR throughout the command areas. Direct seeding was first introduced in 2009 when 20 hectares were planted in the UKP. The area covered has risen steadily to about 20 000 hectares in the current season.

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