

Direct Seeded Rice (DSR) Sustainable Rice Cultivation Practice for the Madhya Pradesh State

Hemu shanishre¹, Praveen Nayak¹, D S Thorat², Dushyant Singh³ and Manish Kumar²

¹Young Professional-I, ²Scientist, ³Principal Scientist, ²Scientist

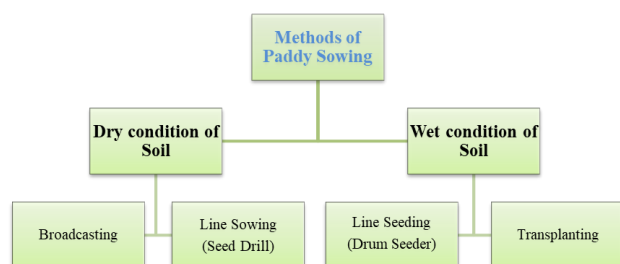
Agricultural Mechanization Division, ICAR-Central Institute of Agricultural Engineering, Bhopal, M.P.

*Corresponding Author: deepakthorat7980@gmail.com

Paddy is the main food grain crop of the country. India holds the second place in the world's largest paddy producing countries. Paddy is cultivated in the country over area of about 43 million hectares. About 40 percent of the food grain production in India is comes from paddy and about 75 percent of the people's food in the country is also rice. Paddy crop has an important role in food security. Most of the country's agriculture is rain-fed agriculture, and it is difficult to do agriculture in the rain-fed sector since there is a lack of awareness among farmers. Being the major source of food after wheat, it meets 43 % of calorie requirement of more than two third of the Indian population. West Bengal, Uttar Pradesh, Andhra Pradesh, Punjab, Chhattisgarh, Bihar, Tamil Nadu, Madhya Pradesh are the major paddy growing states in India. Total production of Rice during 2022-23 is estimated at record 1357.55 Lakh tonnes. The major paddy growing districts in Madhya Pradesh states are Balaghat, Vidisha, Damoh, Singrauli, Hoshangabad, Raisen, Satna, Shahdol, Anuppur, Seoni, Mandla, Katni, Rewa, etc.

Paddy sowing



Rice is grown either by direct seeding i.e. broadcasting, drilling in dry soil, sowing in wet soil or by transplanting. As per power availability (manual, animal, power tiller, and tractor) on farms there are plenty of sowing implements developed and most of them are for dry direct sowing of rice including self-propelled seeder, power tiller and tractor drawn seed drill etc. For wet direct sowing of rice manual operated drum seeder are popular. The manual drum of 4-rows and 6-rows seeder being light in weight are available commercially. For transplanting of rice manual operated transplanter and self-propelled transplanters are commercially available.



Broadcasting

The broadcasting method is suitable in areas where the soil is not fertile and lands are dry. This method requires minimum labour and inputs. However, it produces very less yield when compared to other sowing methods.

Table 1

Dry DSR	Wet DSR
In Dry-DSR, sowing of paddy is done by scattering seeds on soil without puddling or in well prepared field using seed-cum-fertilizer drill (line sowing) or power tiller driven seeder or advanced equipment like Turbo Happy Seeder.	When pre-germinated seeds are sown on the surface of puddled soil, the seed environment is mostly aerobic and this is known as aerobic Wet-DSR. When pre-germinated seeds are sown /drilled into puddled soil, the seed environment is mostly anaerobic and this is called as anaerobic Wet-DSR.
	
Tractor drawn seed cum fertilizer drill	Drum Seeder

Direct Sowing of Rice (DSR)



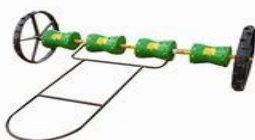
DSR probably the oldest method of crop establishment, is gaining popularity because of its low-input demand. It offers certain advantages viz., it saves labour, requires less water, less drudgery, early crop maturity, low production cost, better soil physical conditions for following crops and less methane emission, provides better option to best fit in different cropping systems. Comparative yields in DSR can be obtained by adopting various cultural practices viz., selection of suitable cultivars, proper sowing time, optimum seed rate, proper weed control and water

management. It can also be stated that soil problems related to rice and following crops can be solved with direct seeding. There are several constraints associated with shift from transplanted rice (TPR) system to DSR, such as high weed infestation, evolution of weedy rice, increase in soil borne pathogens (nematodes), nutrient disorders, poor crop establishment, lodging, incidence of blast, brown leaf spot etc. By overcoming these constraints DSR can prove to be a very promising, technically and economically feasible alternative to TPR. The various reasons responsible for the shift from TPR to DSR are due to increasing demand and competition of water from non-agricultural sector, rising cost and scarcity of labour at peak periods, rising interest in resource conservation and conservation agriculture, best fit in the cropping system.

Some Benefits of DSR

- **Water-saving:** DSR reduces the need for continuous flooding, which saves groundwater.
- **Labour-saving:** DSR eliminates the labour-intensive step of transplanting.
- **Sustainable:** DSR can help mitigate greenhouse gas emissions and adapt to climate risks.
- **Efficient:** DSR offers increased efficiency and sustainability compared to traditional rice farming practice.
- **Improved farm production:** DSR makes double cropping of rice possible.
- **Faster crop maturity:** DSR allows for crop maturity 7–10 days earlier than traditional practice

Table 2: Machinery for direct sowing of paddy

Name of machine	Tractor drawn seed cum fertilizer drill	Happy Seeder	Drum Seeder
Description	It is tractor drawn drill consists of frame, seed box, fertilizer box, seed metering mechanism, fertilizer metering mechanism, seed tubes, furrow openers, seed adjusting lever and transport cum power transmitting wheel.	The happy seeder technology offers a solution to the problem of direct drilling into heavy stubbles, enabling the stubble to be retained on the surface as mulch. The equipment is the combination of straw handling unit and sowing unit.	In drum seeding, pre-germinated paddy seeds are sown through drums. With this, seeds can be easily sown in the paddling field at a distance of 200 mm from row to row.
Field Capacity(ha/h)	0.20-0.25	0.28-0.41	0.037 -0.004
Field efficiency(%)	60-80	50-80	60-80
Cost, (Rs.)	40000/-	150000-170000/-	4000-6000 /-
			

Rice Transplanting

Transplanting is the dominant crop establishment practice in Asia particularly in tropical part. In this method, the land is puddled and seedlings raised in nursery are transplanted. Transplanting is the most common and

elaborative method of crop establishment for rice in India. Rice seedlings grown in a nursery are uprooted and transplanted into puddled and levelled fields 15 to 40 days after seeding (DAS). Rice seedlings can either be transplanted manually or by machine. This is done in order to get higher yields and less weeding. Transplanting ensures

a uniform plant stand and gives the rice crop a head start over emerging weeds. Further, seedlings are established even if the field is not levelled adequately and has variable water levels. Transplanting may also allow crop intensification as the crop is in the main field grown with shorter time. Manual transplanting does not require costly machines and is most suited for labour-surplus areas and for small rice fields. Manual transplanting can be done in fields with less than optimal levelling and with varying water

levels. Seedlings are raised in a wet, dry, or modified mat nursery. Proper nursery management will produce healthy and vigorous seedlings.

Performance of different types of direct seeding methods (DSR) of paddy compared to conventional puddling transplanted paddy based on the following parameters:

Table 3: Direct sown rice v/s transplanted rice

S.no.	Criteria	Direct Sown Rice (DSR)	Transplanted Rice (TPR)
1.	Irrigation water efficiency	It requires less water	It requires more water than DSR.
2.	Production	In DSR, with good management techniques, yields similar to or higher than TPR can be obtained.	In TPR the yield can be obtained as per the cost.
3.	Economic	Due to its low cost, the farmer gets higher net economic returns.	Due to its high cost, the net economic return to the farmer is less.
4.	labor shortage	It requires less workers.	It requires more workers than DSR.
5.	Impact on upcoming crops	In this the crop ripens quickly so that the next crop can be harvested at the right time.	In comparison to directly sown paddy, the crop ripens a few days late.

Case Study

Department of Biotechnology (DBT), Government of India has launched the project “DBT Kisan Hub Phase II” with the objective of promoting conservation and resource conservation agricultural practices. One of the beneficiaries of this project, farmer Mr. Durgesh Rathod, village Kulua, District Damoh (M.P.) used DSR technology for paddy cultivation in one acre area. Guidance and information on DSR technology of paddy cultivation has been received from ICAR-Central Institute of Agricultural Engineering, Bhopal and Hub (Manthan, Bhopal). Due to which paddy was sown through Direct Sowing of Paddy (DSR) method using sowing machinery instead of traditional methods of puddling and transplanting. The crop sown using direct seeding (DSR) technique of paddy with tractor-drawn seed-cum-fertilizer drill (seed cum fertilizer drill) is shown in the pictures below.



a) Direct Seeded Rice Drilling



(b) Direct Seeded Rice Crop

DSR technology resulted in an average yield (6 tonnes/hectare) which was higher than the average yield (4.75 tonnes/hectare) in transplanted rice. At the same time, land preparation cost (40%), seed sowing cost (77.9%) and

seed price (10.6%) were reduced in DSR, making the total cost 23.34% less as compared to transplanted paddy. Due to all these features, there is a strong possibility of farmers adopting this method in future.

Table 4: The comparative cost of both DSR and TPR methods of paddy cultivation

S.no	Particular	DSR (Rs./acre)	TPR (Rs./acre)	Net saving (%)
1.	Land preparation	1800/-	3000/-	40.0
2.	Nursery and transplanting/seed and sowing	1250/-	5650/-	77.9
3.	Cost of Seeds	2950/-	3300/-	10.6
4.	Interculture	6150/-	5150/-	-19.4
5.	Harvesting	1500/-	1500/-	0.0
6.	Fertilizer	2600/-	2600	0.0
	Total Input Cost	16250/-	21200/-	23.3

Conclusion

DSR is feasible both technically and economically compared to transplanted rice (TPR). Moreover, with proper conservation and management strategies, DSR adoption will likely increase in Madhya Pradesh state in coming future, provided weed control in DSR, especially the control of weedy rice, should be at the centre of any strategy aiming to improve the sustainability of rice production in the long run. Eco-friendly, cost-effective DSR package offers sustainable rice production systems with fewer resources and lower emissions. DSR is a more resource-efficient, climate-resilient, and sustainable alternative agricultural system, but many agronomic DSR practices have become inefficient because of the lack of mechanization, precision application, and proper knowledge. So, adopting adequate management practice is very important for the successful implementation of DSR technology at local ground conditions.

References

- Kaur, J. and Singh, A., 2017. Direct seeded rice: Prospects, problems/constraints and researchable issues in India. *Current agriculture research Journal*, 5(1), p.13.
- Pathak, H., Tewari, A.N., Sankhyani, S., Dubey, D.S., Mina, U., Singh, V.K. and Jain, N., 2011. Direct-seeded rice: potential, performance and problems-A review. *Current Advances in Agricultural Sciences (An International Journal)*, 3(2), pp.77-88.
- Anjali Chaudhary, V. Venkatramanan, Ajay Kumar Mishra, Sheetal Sharma. Agronomic and Environmental Determinants of Direct Seeded Rice in South Asia. *Circular Economy and Sustainability* (2023) 3:253–290
- Suraj Mishra, Anand Kumar Chaubey and Jagannath Pathak. Direct seeded rice: Prospects, constraints and future research work. *Indian Farming* 73 (09): 11-14; September 2023
- Nirmala Bandumula, Gulshan Mahajan, R. Mahender Kumar. *Journal of Experimental Biology and Agricultural Sciences*, February - 2018; Volume – 6(1) page 253 – 257
- Rajbir Singh, Gulshan Mahajan and M.S. Bhullar. 2016. Direct Seeded Rice in North West India – Opportunities, Scope and Research Gaps. ICAR-Agricultural Technology Application Research Institute, Ludhiana. Pages:52
- Press Information Bureau (<https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1968931#:~:text=Total%20production%20of%20Rice%20during,production%20of%201203.90%20Lakh%20tonnes.>), accessed on date 10.12.2023
- Madhya Pradesh Rajya Beej Evam Farm Vikas Nigam accessed on date 12.09.2023 (http://mpssfdc.mp.gov.in/Modules/Web/Frm_Paddy_Details.aspx)
- Indian Institute of Rice Research, Hyderabad (https://www.icar-iirr.org/index.php/en/?option=com_content&view=article&layout=edit&id=13), accessed on date 10.10.2023
- ICAR-National Rice Research Institute (<https://icar-nrri.in/agricultural-implements/>), accessed on date 10.12.2023.
- ICAR-Central Institute Of Agricultural Engineering (<http://14.139.59.149:84/Home/MachineryPackage>), accessed on date 12.12.2023
- Indian Agricultural Research Institute, New Delhi (<https://www.iari.res.in/en/index.php>), accessed on date 12.12.2023
- Ministry of agriculture and farmers welfare. (https://agricoop.gov.in/en/Agricultural_Statistics_at_a_Glance), accessed on date 12.12.2023

Gopal, R., Jat, R. K., Malik, R. K., Kumar, V., Alam, M. M., Jat, M. L., Mazid, M. A., Saharawat, Y. S., McDonald, A. and Gupta, R.. Direct Dry Seeded Rice Production Technology and Weed Management in Rice Based Systems. Technical Bulletin. International Maize and Wheat Improvement Center, New Delhi, India, 28pp (2010)

Mahajan, G., Sarlach, R. S., Japinder S. and Gill, M. S. Seed priming effects on germination, growth and yield of dry directseeded rice. *Journal of Crop Improvement* 25:409–417 (2011).

Gill, M. S., Kumar, A. and Kumar, P. Growth and yield of rice (*Oryza sativa* L.) cultivars under various methods and times of sowing. *Indian Journal of Agronomy* 51: 123-27 (2006).

* * * * *