

# DIRECT SEEDED RICE: A CLIMATE-SMART AND ECONOMICALLY VIABLE SUBSTITUTE FOR PUDDLED TRANSPLANTED RICE IN GUNTUR DISTRICT

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Date of Receipt : 29.09.2025

Date of Acceptance : 28.11.2025

## ABSTRACT

Direct seeding is becoming a key alternative transplanting in rice and has spread quickly in Andhra Pradesh, where unpredictable weather, fewer rainy days, lack of labor and higher production costs are common. This study looks at how changes in climate, such as variations in rainfall and temperature, recommend the use of Direct-seeded rice (DSR) as a farming method. DSR involves planting rice seeds directly into the field instead of growing them in water and then transplanting them. The results show that using DSR options greatly improves rice productivity and resilience, while also saving labor, water, and energy. It also helps get the next crop started 15 days earlier than the traditional puddled transplanted rice method. The study suggests that adopting DSR can help maintain food security and crop resilience even in tough weather conditions.

**Key words:** Direct Seeded Rice, Climate-smart agriculture, Economics, Rice cultivation, Resource conservation

## INTRODUCTION

Agricultural production is likely to be affected by increasing temperatures, changes in rainfall pattern, and more frequent and severe weather events like floods and droughts (Prasanna, 2014). To produce food sustainably, there needs to be a decrease in greenhouse gas emissions from farming and improved ability to handle the challenges brought by climate change. Globally, rice is grown on more than 164 million hectares, with about 90% of that area in Asia. In India, rice is grown on over 44 million hectares with an annual production of around 109 million tonnes. Although India is the largest in terms of area and the second

largest in terms of production, it is not performing as well as other countries in terms of productivity. Rice is a vital crop in Andhra Pradesh, especially in the Guntur district. More than half of the cultivated land during the *kharif* season in Guntur is used for rice, which is grown on about 4.2 lakh hectares with a productivity of 2.2 tonnes per hectare. This productivity is lower than both the state and national averages, which is a big concern for farmers. Some of the main reasons for low rice yields in this area are the lack of reliable irrigation, delayed release of canal water, poor soil fertility, abiotic stress such as drought during the early growth stages and floods

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during later stages of the crop and emerging biotic stresses. The traditional method of growing rice by transplanting is labour intensive, needs a lot of tilling, and uses more energy, water, and labor. It also harms the soil structure. In transplanting, about 30 to 40 percent of the total cost of growing rice comes from important field operations. Because of decreasing benefits and lower productivity, farmers are still using this traditional method even in areas with good irrigation. To cut down on the need for labor and lower production costs, it's important to shift from manual transplanting to a better method that is scientifically sound, practical, cost-effective, and safe for the environment. Dry direct sowing uses less water and labor than manual transplanting. (Alam *et al.* 2019). Dry seeding is a cost-effective and environmentally friendly option compared to the traditional puddled transplanting method. Farmers are now moving from the old puddled transplanting system to modern methods like dry and wet direct sowing. (Pandey and Velasco 2002). This paper, thus, highlights the benefit of Direct sown rice over transplanting.

#### **Major advantages of DSR**

DSR offers several agronomic, economic, and environmental benefits over the conventional transplanted rice system:

- \* Reduction in labour requirement due to elimination of nursery raising and transplanting operations.
- \* Lower irrigation water consumption because puddling and continuous flooding are avoided.
- \* Reduced cost of cultivation through savings in labour and energy.
- \* Earlier crop maturity, enabling timely sowing of subsequent crops.

- \* Reduced methane emissions compared to flooded rice cultivation.
- \* Better suitability for mechanization and conservation agriculture practices.
- \* Lower production risk under water-scarce conditions.

Studies have shown that DSR can save 12–35% irrigation water and significantly reduce production costs while maintaining comparable yields. (Kumar and Ladha, 2011).

#### **TYPES OF DIRECT SEEDED RICE**

DSR systems can be broadly classified into three categories:

##### **1. Dry Direct Seeded Rice**

Dry seeds are drilled or broadcast into dry or moist soil after minimum tillage or zero tillage.

##### **2. Wet Direct Seeded Rice**

Pre-germinated seeds are sown on puddled or saturated soil.

##### **3. Water Seeding**

Sprouted seeds are broadcast into standing water.

Among these methods, dry DSR is becoming increasingly popular due to reduced labour and water requirements.

#### **CROP MANAGEMENT UNDER DIRECT SOWN RICE SYSTEM**

Crop management under Direct Sown Rice includes all activities from planting the seed to harvesting the crop. This covers choosing the right variety of rice, selecting the right field, deciding when to plant, how to plant, spacing between plants, using water, managing nutrients, controlling weeds, protecting the crop, and finally harvesting. In the Direct Sown Rice System, choosing the right location, soil

type, leveling the land, and managing weeds are the most important factors. Establishing the crop quickly and making sure the plants grow fast helps reduce water loss and the number of weeds. This is done by planting the right number of seeds, using good quality rice varieties, and ensuring the seedlings are strong and healthy. This helps solve one of the biggest problems in Direct Sown Rice, which is weed growth.

### **WEED MANAGEMENT**

Weeds are a big challenge for successful rice farming, especially in Direct Sown Rice (DSR). They compete with the rice plants not only for nutrients but also for space, light, and water throughout the growing season. Weeds are a bigger problem in DSR than in the traditional puddled transplanting method. This is because (1) young DSR seedlings are not as good at competing with weeds that come up at the same time, and (2) in both wet and dry DSR systems, the early growth of weeds is not controlled due to the lack of flooding. This has led to significant yield loss: 96% in dry DSR, 61% in wet DSR, and 40% in rice planted using machines, all because of uncontrolled weeds. Aerobic systems, like DSR, face more weed pressure than the continuously puddled transplanted rice (CPTR), where weeds are naturally controlled by the anaerobic environment created by flooded conditions (Singh *et al.*, 2013). The seedbed should be free from weeds and properly leveled before planting. To control existing weeds, herbicides like paraquat or glyphosate may be used. These herbicides are most effective when applied to weeds that are already growing.

Managing weeds is very important for high productivity in Direct Sown Rice. For DSR, a pre-plant herbicide such as glyphosate (a

systemic herbicide) is applied at a rate of 10 mL per liter of water per hectare. Around 18 to 23 days after sowing, a mixture of pyrazosulfuron (20 grams of active ingredient per hectare) and bispyribac-sodium (25 grams of active ingredient per hectare) is applied. In mechanically transplanted rice, the same herbicides are used, but the pre-plant herbicides are not used. Choosing a rice variety that grows quickly, has strong early growth, and develops a dense canopy early can also help reduce weed problems. It is important to use clean paddy seeds and prepare the land using machines (Kumar and Ladha, 2011). Keeping the bunds (field boundaries) and irrigation canals clean is also necessary. Practices like off-season tillage (summer plowing) and stale seedbed sowing (which depends on the initial water availability) are also beneficial. Direct Sown Rice requires more nutrients and is more efficient in terms of water and carbon use compared to traditional methods (Jat *et al.*, 2020; Kaur and Singh, 2017). Puddled transplanted rice also leads to higher greenhouse gas emissions. In a study conducted in Punjab, direct seeding helped reduce the total global warming potential by about 33%. Puddled transplanted rice suffers from delays in growth and development after the puddling process. This can lead to poor rooting due to soil compaction and poor soil structure. The DSR method is more cost-effective, energy-efficient, and requires fewer inputs than traditional planting methods (Gangwar *et al.*, 2008).

### **NUTRIENT MANAGEMENT**

Rice farming now requires more intensive methods due to climate change, land degradation, and the rapid growth of cities. Factors like soil acidity, erosion, low organic matter, high costs and low use of nitrogen (N) fertilizers, low efficiency in N use, imbalanced

fertilizer application, and infestations of insects, diseases, or weeds have led to significant N deficiency in upland rice farming. Even though rice uses more than 50% of all fertilizers produced worldwide, crop yields are stable and not profitable. The production of rice is now a major cause of water pollution, greenhouse gas emissions, algal blooms, and reduced soil productivity. Therefore, it is essential to regulate the amount of fertilizer used to ensure sustainable rice farming. The production of rice can be affected in terms of both quantity and quality by factors such as global climate change, extreme weather, water shortages, soil salinity, and low soil fertility (Pathak *et al.*, 2018). The recommended fertilizer dose for upland rice is 90:60:60 (N:P:K) per hectare. For hybrid rice, the recommendation is 120–150 kg N, 60 kg P<sub>2</sub>O<sub>5</sub>, 60 kg K<sub>2</sub>O, and 25 kg ZnSO<sub>4</sub> (zinc sulfate) per hectare. ZnSO<sub>4</sub> is also applied at 25 kg per hectare along with

the second split of nitrogen. Research has shown that treatment involving Sesbania, farmyard manure (FYM), and vermicompost helped build up the highest amount of soil organic carbon and increased the rate of carbon sequestration (Pradhan *et al.*, 2015; Akhilesh and Nandan, 2016). Higher SOC levels were recorded when chemical fertilizers were combined with organic manure, compared to using fertilizers alone (Pathak *et al.*, 2011). Similarly, FYM used with or without fertilizers increased SOC compared to soil that was not fertilized (Moharana *et al.*, 2012).

#### CASE STUDY OF DSR IN GUNTUR DISTRICT

A comparative economic analysis of DSR and transplanted rice cultivation was conducted in Guntur district of Andhra Pradesh. Two farmers fields, each of 2 acres in Jonnalagadda village of Guntur district were studied. Vanga Naveen Reddy had taken up

**Table 1. Comparison of Cost of Cultivation**

Particulars	Transplanted Rice (Rs./ha)	Direct Seeded Rice (Rs./ha)
Land preparation	8,750	9,750
Labour	8,500	4,250
Seed cost	3,750	4,000
Water cost	14,000	11,000
Fertilizers & pesticides	9,500	9,500
Plant protection	8,500	8,500
<b>Total cost</b>	<b>53,000</b>	<b>47,000</b>

**Table 2. Comparison of Yield and Returns**

Parameter	Transplanted Rice	Direct Seeded Rice
Yield (q/ha)	67	66
Gross returns (Rs./ha)	1,21,605	1,19,790
Net returns (Rs./ha)	68,605	72,790
Benefit-Cost Ratio	1.2:1	1.5:1

DSR in two acres of land and Jonnala Srinivas Reddy from the same village had adopted transplanting method in his 2 acres land. The details and economics of both the methods is presented below.

### Cost of Cultivation

The study indicated that DSR substantially reduced cultivation expenses compared to transplanted rice. Elimination of puddling and transplanting operations reduced labour and tillage costs. The total cultivation cost under DSR was approximately 11% lower than the transplanted method.

### Yield and Returns

Although transplanted rice produced slightly higher grain yield, the difference was minimal. DSR recorded greater net returns and a better benefit-cost ratio due to lower input costs. The results clearly demonstrate that DSR can improve farm profitability while conserving resources. The average yield was considerably high in TR (67 q/ha) compared to DSR (66 q/ha) method of cultivation. The actual percentage yield difference is approximately 1.49%, with TR yielding more than DSR. The gross returns obtained were Rs.1,21,605 and Rs.1,19,790 per ha for TR and DSR of rice cultivation respectively. The net returns were higher in DSR (Rs.72,790/ha) than that of Transplanted rice (Rs.68,605/ha). This was due to high cost of cultivation in transplanted rice. The results were in line with the findings of Alam *et al.* 2019, whose results showed that net returns were higher in direct seeded rice when compared to transplanted method of paddy cultivation.

### CONCLUSION

Direct Seeded Rice is emerging as a promising alternative to conventional puddled transplanted rice under changing climatic and economic conditions. The technology reduces

labour dependence, irrigation water use, and greenhouse gas emissions while improving profitability. The findings from Guntur district indicate that DSR provides comparable yields with lower cultivation costs and higher net returns. It also enables timely sowing of subsequent crops and supports climate-resilient agriculture. However, successful adoption of DSR requires proper weed management, precision land levelling, and timely irrigation. Government support through extension services, farmer training, and mechanization assistance will be essential for wider adoption of DSR in Andhra Pradesh and similar rice-growing regions.

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