# Efficient Water Management Practices for Direct Seeded Rice (DSR) Cultivation System

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**ABSTRACT**

The Indian subcontinent is one of the main producers of rice (*Oryza sativa* L.), the most significant staple food crop of southern Asia. Conventional transplanted rice production uses a lot of labor, energy, and irrigation water. Due to diversion of water towards industrial sector and shortage of irrigation water for the crops has compelled the farmers to adopt DSR, an alternative rice production method that is thought to be water-efficient and farmer-friendly. Therefore, it is necessary to investigate alternative, resource-conserving methods that can sustain rice production system.

## INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food for more than half of the world's population, and more than 90% of the world's rice is produced in Asia (FAO, 2009). The production of food in Asia's irrigated rice systems is under danger due to growing water constraint. "Produce more rice with less water" is crucial for food security (Guerra *et al.*, 1998). This is especially the case in the northwest Indo-Gangetic plains (IGP) of India, where the production of irrigated rice and wheat is critical for food security of the country. One way to reduce water input to rice is by improved irrigation management such as reduction in ponded water depth (Kukal and Aggarwal, 2002) and direct seeding of rice (Bhushan *et al.*, 2007).

**Advantage of adaptation of DSR System**

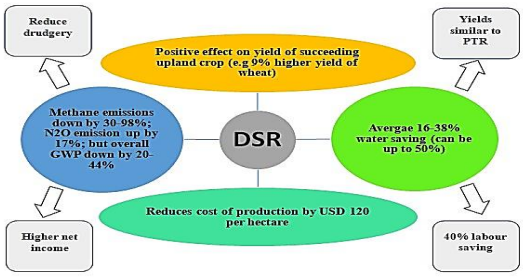


**Fig 1: Advantages of DSR system** (Kumar *et al.*, 2019; Chakraborty *et al.*, 2017)

**Direct seeded Rice (DSR) cultivation system**

Direct seeded rice (DSR) might be a great substitute for water-intensive rice cultivation methods (Pathak *et al.*, 2011). Direct seeding of rice uses well-drained, non-ponded, non-puddled, and non-saturated soils for rice production and thus reduces the amount of water needed for irrigation (Kumar and Ladha, 2011).

Types of DSR:

a) Dry-DSR
b) Wet- DSR
c) Water seeding

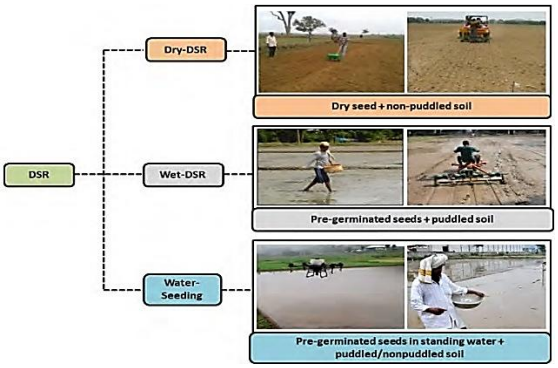


**Fig. 2: Types of DSR** (Source- NRRI Research Bulletin No. 50)

## 1. Water management in DSR

DSR and puddled rice soils have very different physical, chemical, and biological characteristics due to differences in moisture content and puddling methods. A primary goal of DSR is to guarantee increased water productivity in rice production. Irrigation scheduling for DSR is typically done using the following methods:

a) saturated soil culture (SSC)
b) alternate wetting and drying (AWD)
c) tensiometer-based irrigation
d) critical stage-based life-saving irrigation

To improve water production under DSR, researchers at ICAR-NRRI, Cuttack, have developed sensor-based irrigation scheduling tools. The Eco-friendly Irrigation Alert System developed by ICAR-NRRI uses a sensor that is affixed to a perforated pipe and is positioned at appropriate depth in the rice field. It has the potential to save around 30% of irrigation water without having any negative impact on rice grain yield. Thus, it increases the water productivity by 40%. It increases net return for farmers by reducing the pumping costs and fuel consumption for lifting water. It also curtails the methane emission from rice fields by approximately 37% (Kumar *et al.*, 2022). The water productivity of the flooded irrigation treatment was the lowest at 0.25 kg/ $m^3$, compared to all the climate-smart water management methods implemented in DSR (Nayak *et al.*, 2021).

**Table 1. Water productivity of rice under different irrigation management**

| Treatments | Grain yield (t/ha) | Water used (mm) | Water productivity ($kg/m^3$) | % water saved over flooding |
|---|---|---|---|---|
| Flood | 4.14 | 1610 | 0.25 | - |
| AWD | 4.63 | 1099 | 0.42 | 31.73 |
| Tensiometer | 4.14 | 1140 | 0.36 | 29.19 |
| SRI | 5.35 | 1119 | 0.47 | 30.49 |

(Source: Nayak *et al.*, 2021)

**1.1. Improvement of Rice water use efficiency:** The economy in use of agricultural water resources in rice must be sustainable in order to support global food security (Du *et al.*, 2015). Water scarcity in a region can be addressed by

importing water in the form of food through virtual water commerce. Water use efficiency can be enhanced by adopting the following:

a) Increasing water availability through waste water recycling,

b) Improving water productivity through higher yields or better water usage, or both (Fereres *et al.*, 2011).

**Research Gap in DSR Water management**

The primary problem of rice's low to moderate nutrient-use efficiency in DSR varied between 25% and 40% for both nitrogen (N) and phosphorus (P) needs to be resolved. One of the most crucial mechanisms in DSR is water mining, or the maximization of water uptake from deeper soil layers. Future research work on DSR should focus on root zone studies to improve lodging resistance and root zone growth under limited soil moisture condition.

## CONCLUSION

The study focuses on ways for managing irrigation water economically to boost agricultural water productivity. Although direct planting of rice reduces the need of water, but grain output also depends on time of sowing, rainfall pattern, crop management practices adopted, and soil types. Additionally, supporting technologies like mechanized seeding, proper water-nutrient-weed management, mechanized harvesting and threshing may make it possible for expanded adoption of DSR technologies by the farmers on a broad scale.

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