



FROM FIELDS TO FUTURE: RETHINKING RICE CULTIVATION IN PUNJAB FOR SUSTAINABLE AGRICULTURE

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Abstract

Rice (*Oryza sativa L.*) holds a vital position in the global food system, sustaining over half of the world's population. In India, its significance extends beyond nutrition—rice is a lifeline. As the second most consumed grain after wheat, it provides approximately 43% of the caloric intake for more than two-thirds of India's population, highlighting its essential role in national food security. In a country where agriculture is a key pillar of the economy, rice remains indispensable. India, the second largest rice producer, produced an estimated 138 MMT—about 26% of global output—with a projected productivity of 4.3 metric tons per hectare (INFORMICS, 2023). This underscores India's crucial role not only in meeting domestic demand but also in supporting global food supplies. Yet, beyond these impressive figures lie pressing challenges. Boosting production is one goal, but doing so sustainably—in the face of climate change, depleting water resources, and deteriorating soil health—is another matter entirely. Here, agricultural policy must evolve to prioritize not only yield increases but also environmental sustainability and farmer well-being. While the 2024 statistics are encouraging, the pressing question remains: can our current model of rice cultivation support future generations?

Punjab holds a vital position in India's agricultural sector, contributing approximately 25–30% of the country's rice and 35–40% of its wheat to the central pool over the past decade. In the 2023–2024 season, rice was cultivated on 3.1 million hectares, yielding 14.44 million tonnes with a high productivity rate of 4.5 tonnes per hectare, despite growing concerns such as limited irrigation water and deteriorating soil health. However, the expansion of paddy cultivation has significantly impacted groundwater resources, with 136 out of 153 water blocks in the state classified as over-exploited. Additionally, the rising electricity demand for irrigation places



considerable pressure on the power sector, particularly since electricity for agriculture is fully subsidized. To curb excessive groundwater extraction, the Punjab government, under the Punjab Preservation of Subsoil Water Act, 2018, mandated a delay in rice transplanting until after June 20. This regulation has further narrowed the interval between rice harvesting and wheat sowing.

The dominance of paddy cultivation has severely depleted groundwater reserves, with 136 out of 153 water blocks classified as critical (GWR, 2022). The heavy dependence on groundwater for irrigation has also driven up electricity consumption, which, being fully subsidized, exacerbates the overuse of both water and energy resources. In response to this escalating crisis, the Government of Punjab introduced the Punjab Preservation of Subsoil Water Act, 2018. This legislation prohibits rice transplanting before June 20th in an effort to conserve groundwater by limiting early-season irrigation. While the act is a step toward sustainability, it has further reduced the already tight turnaround time between rice harvesting and wheat sowing, creating additional hurdles for farmers.

Although Punjab's productivity figures for 2023–2024 remain impressive, the long-term sustainability of its agricultural system is under severe strain. Groundwater depletion, deteriorating soil health, and increasing energy demands underscore the pressing need for transformative changes. Key strategies such as crop diversification, the promotion of less water-intensive crops, and the adoption of sustainable farming practices are no longer optional—they are imperative to safeguard Punjab's agricultural future while preserving its natural resources (Barman *et al.* 2022). Achieving sustainable production will require more resource-efficient approaches that minimize the use of water, energy, and agro-chemicals. Direct Seeded Rice (DSR) offers a promising alternative, particularly in the face of water scarcity and climate-related challenges. By reducing water usage and greenhouse gas emissions, DSR aligns with both environmental and productivity goals. Research has shown that DSR can enhance both yield and grain quality. However, despite its potential, DSR adoption in Punjab remains limited (Ranguwal *et al.* 2024). For a state grappling with serious groundwater and climate issues, widespread adoption of DSR is essential. In Punjab, the promotion and dissemination of DSR have been led by key institutions such as Punjab Agricultural University (PAU), Krishi Vigyan Kendras (KVKs), the International Rice Research Institute (IRRI), and organizations like Manav Vikas Sansthan (MVS). Manav Vikas Sansthan (MVS) has emerged as a significant force in promoting Direct Seeded Rice (DSR) in Punjab, recognizing the urgent need for sustainable alternatives to conventional paddy



cultivation. MVS actively supports the transition by empowering farmers through awareness campaigns, field-level demonstrations, technical training, and resource mobilization. Their efforts have led to the successful adoption of DSR on approximately 2,166.65 hectares of agricultural land across Punjab—an important step toward addressing the twin challenges of water scarcity and environmental degradation.

Despite this progress, several barriers continue to impede the widespread adoption of DSR in the state. One of the primary challenges is the availability of cheap and readily accessible manual labor for traditional rice transplanting, which discourages farmers from exploring mechanized alternatives like DSR. Additionally, many farmers lack adequate technical knowledge about the DSR method, including soil preparation, weed management, and irrigation scheduling, which can result in suboptimal outcomes when the practice is poorly implemented. A general reluctance to shift from conventional practices—rooted in risk aversion, cultural familiarity, and concerns over yield stability—also hinders adoption. Moreover, the lack of access to specialized machinery such as zero-till seeders or drum seeders further discourages small and marginal farmers from transitioning to DSR.

To accelerate the adoption of DSR and unlock its full potential, a multi-pronged strategy is essential:

1. **Awareness and Capacity Building:** Expanding outreach through farmer field schools, village-level training sessions, and success stories can demystify DSR techniques and build farmer confidence. MVS and other stakeholders must continue to emphasize DSR's benefits, including reduced water use, lower labor dependency, and enhanced long-term sustainability.
2. **Strengthening Custom Hiring Services:** Ensuring the timely availability of DSR-specific machinery through village-level Custom Hiring Centres (CHCs) is crucial. These centers allow farmers—especially those with limited capital—to rent equipment as needed, lowering the entry barrier for mechanized sowing.
3. **Demonstration Plots and Peer Learning:** Establishing demonstration plots in each agro-climatic zone of Punjab allows farmers to witness the performance of DSR firsthand. Coupled with farmer-to-farmer interactions, this helps overcome skepticism and builds trust in the technology.



4. **Research and Development Support:** Continued R&D is vital to refine DSR agronomy, especially in relation to Punjab's soil types, weed profiles, and climatic conditions. Tailored recommendations for weed control, nutrient management, and water-saving techniques can significantly improve adoption rates and outcomes.
5. **Policy Incentives and Institutional Support:** Government subsidies for DSR equipment, performance-based incentives, and integration of DSR into broader climate-smart agriculture schemes will reinforce adoption. MVS can play a facilitative role in connecting farmers with these institutional benefits.

By addressing these challenges holistically, MVS and its partners can scale up DSR adoption, helping Punjab transition toward a more water-resilient, energy-efficient, and environmentally sound agricultural future.

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