Smart Rice Planting Systems: A Pathway to Higher Seed Yield and Superior Seed Quality

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ABSTRACT

Rice continues to play a central role in global food security, particularly in Asia, where it serves as a staple food for millions. Enhancing both yield and seed quality has therefore become a major priority in rice production systems. Although puddled transplanting has been widely adopted for decades, its sustainability is increasingly questioned due to high water requirements, labour shortages, and negative impacts on soil structure. In recent years, alternative establishment methods such as direct dry seeding, direct wet seeding, aerobic rice cultivation, and drum seeder sowing have gained attention. This article discusses how different rice planting systems influence seed yield and key seed quality attributes. By drawing upon recent research findings, it highlights the potential of alternative planting systems to support efficient, climate-resilient, and sustainable rice seed production.

INTRODUCTION

Rice is not only a staple cereal but also a major source of income and employment for farming communities across Asia, especially in India. Traditionally, rice cultivation has depended on puddled transplanting, a method known for good seedling establishment and weed suppression. However, this practice requires large volumes of water and intensive labour and often leads to long-term deterioration of soil physical properties.

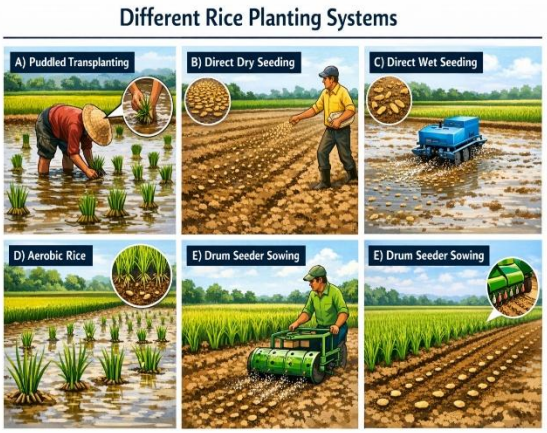
From an agricultural and seed science perspective, the method of crop establishment strongly affects plant growth, yield formation, and the quality of seeds produced. Seed quality—measured through germination capacity, seedling vigour, purity, and seed health—plays a decisive role in crop establishment and yield realization. Even high-yielding varieties fail to perform well in farmers' fields if seed quality is poor.

With increasing climate variability, declining water availability, and labour scarcity, farmers are exploring alternative rice planting systems. Understanding how these systems influence seed yield and seed quality is essential for recommending suitable approaches for rice seed production without compromising productivity or sustainability.

Recent Advances in Rice Planting Systems and Their Impact on Seed Yield and Seed Quality

Recent research has clearly demonstrated that the method of rice establishment plays a decisive role in determining crop performance, seed yield, and seed quality. Studies conducted during the early 2020s reported that conventional puddled transplanting often results in higher biomass accumulation and more stable yield attributes, largely due to uniform seedling establishment and better early crop vigour (Gill *et al*., 2021; Singh *et al*., 2022). At the same time, several researchers emphasized that well-managed direct-seeded rice systems are capable of producing yields comparable to transplanted rice, while substantially reducing water use and labour requirements, making them attractive under resource-limited conditions (Kumar *et al*., 2022; Chauhan, 2023).

More recent investigations have shifted attention from grain yield alone to seed quality performance. Research published in 2023 demonstrated that aerobic rice and direct-seeded systems often produce seeds with higher germination percentage and improved seedling vigour, even when seed yield is marginally lower than that obtained from transplanted rice (Snigda *et al*., 2023; Zhang *et al*., 2025). These findings reinforced the importance of evaluating seed yield and seed quality together, particularly for seed production programmes, rather than relying solely on grain yield performance.



Field experiments carried out during 2024 further highlighted the role of precision establishment techniques. Studies on precision direct seeding and optimized seeding rates under mechanized systems reported improved crop uniformity, stronger seedling growth, and enhanced final yield (Feng *et al*., 2024; Li *et al*., 2024). Additionally, these systems shortened the crop establishment period, allowing timely planting of subsequent crops and improving overall cropping system efficiency.

Under climate-stress scenarios, especially water-limited environments, research reported during 2024 and 2025 indicated that direct-seeded and aerobic rice systems showed greater adaptability compared to conventional transplanting (Su *et al*., 2025; Rahman *et al*., 2024). These systems were able to maintain acceptable levels of seed germination, field emergence, and seedling vigour despite fluctuations in moisture availability,

highlighting their potential under changing climatic conditions.

Comparative evaluations published in 2025 further revealed that drum seeder sowing and wet direct seeding could perform on par with transplanted rice in terms of grain yield, while offering additional benefits such as reduced production costs, lower labour demand, and improved resource-use efficiency (Zhang *et al*., 2025; ICAR-NRRI, 2025). Overall, the recent body of literature consistently confirms that rice planting systems influence not only grain yield but also the physical and physiological quality of seeds, underscoring their critical role in sustainable rice seed production.

CONCLUSION

Rice cultivation in the present era must balance productivity with efficient use of natural resources. Evidence from recent research clearly indicates that alternative planting systems such as direct dry seeding, direct wet seeding, aerobic rice, and drum seeder sowing can produce seed yields and seed quality comparable to those obtained under conventional puddled transplanting.

From a seed science viewpoint, planting systems that promote high germination, strong seedling vigour, and reliable field emergence are essential for strengthening rice seed production programs. Establishing clear relationships between yield attributes and seed quality parameters further supports the selection of suitable planting systems for large-scale adoption.

In conclusion, the adoption of smart rice planting systems offers a promising pathway towards sustainable seed production, reduced dependence on water and labour, improved farm profitability, and long-term food security under changing climatic conditions.

REFERENCES

Ahmed, G. J. U., & Bhuiyan, M. K. A. (2010). Performance of weed management practices for different establishment methods of rice (*Oryza sativa* L.) in the dry season. *Pakistan Journal of Weed Science Research, 16*(4), 392–402.

Chauhan, B. S. (2023). Direct-seeded rice systems: Challenges, opportunities, and future prospects. *Field Crops Research, 293*, 108850.

Feng, Y., Li, T., Zhang, H., & Wang, P. (2024). Optimizing seeding rate improves seedling quality and yield of hybrid rice under mechanized establishment. *Frontiers in Plant Science, 15*, 1427972.

Gill, M. S., Kumar, A., & Kumar, P. (2021). Growth and yield performance of rice cultivars under different crop establishment methods. *Indian Journal of Agronomy, 66*(2), 123–129.

ICAR–National Rice Research Institute. (2025). *Technologies for water-saving rice cultivation under changing climate*. ICAR-NRRI, Cuttack, India.

Kumar, V., Singh, S., & Ladha, J. K. (2022). Productivity and resource-use efficiency of direct-seeded rice under conservation agriculture. *Agricultural Systems, 196*, 103323.

Li, M., Zhao, X., Chen, Y., & Huang, M. (2024). Precision direct seeding enhances crop uniformity and yield stability in rice. *Rice Science, 31*(2), 101–110.

Rahman, M. A., Islam, M. S., & Hossain, M. B. (2024). Performance of aerobic and direct-seeded rice under water-stress

environments. *Agricultural Water Management, 287*, 108424.

Singh, R. K., Singh, A. K., & Kannaujia, S. K. (2022). Effect of planting methods on yield attributes and productivity of rice under irrigated conditions. *Indian Journal of Agricultural Sciences, 92*(6), 742–747.

Su, Y., Zhang, L., Wang, J., & Chen, S. (2025). Comparative evaluation of rice planting patterns under global warming scenarios. *Plants, 14*(23), 3593.

Snigda, S., Swarnalatha, V., Pallavi, M., & Prabhavathi, K. (2023). Influence of different planting systems on seed yield and quality in rice (*Oryza sativa* L.). *International Journal of Environment and Climate Change, 13*(8), 1120–1129.

Zhang, Q., Liu, X., & Yang, Y. (2025). Economic and agronomic assessment of drum-seeded and wet direct-seeded rice systems. *Land, 14*(3), 382.