



Crop Residue Management: A Sustainable Approach for the Rice–Wheat Cropping System

Raju Gupta¹
Sudhakar Dwivedi²
Vipin Tanwar³

¹Field Officer, Cost of Cultivation Scheme, Sher-e-Kashmir University Technology, Jammu, Jammu and Kashmir (India) - 180009

²Director Student Welfare Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, Jammu and Kashmir (India) - 180009

³Research Scholar, Division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology Jammu, Jammu and Kashmir (India) - 180009



Open Access

*Corresponding Author
Vipin Tanwar*

Article History

Received: 23.09.2026

Revised: 28.09.2026

Accepted: 03.10.2026

This article is published under the terms of the [Creative Commons Attribution License 4.0](https://creativecommons.org/licenses/by/4.0/).

INTRODUCTION

The rice–wheat cropping system is one of the most important agricultural production systems in northern India and supports the livelihoods of millions of farmers. The harvesting of rice particularly with combine harvesters, leaves considerable quantities of straw and crop residues in the field. The short interval between rice harvesting and wheat sowing makes residue management a major challenge for farmers. In many areas, farmers have traditionally burned the remaining straw to quickly clear the field and prepare it for the succeeding wheat crop. However, residue burning results in the loss of valuable plant nutrients and organic matter and contributes to smoke and air pollution. The crop residues should not be considered merely as waste, as they can be valuable resources for maintaining soil health and improving resource-use efficiency. In-situ residue management provides an opportunity to retain crop biomass within the field and return organic material to the soil. The technologies such as the Straw Management System (SMS) and Super Seeder have provided practical options for managing rice residue without burning. The SMS, attached to a combine harvester, cuts, chops and distributes straw uniformly across the field during rice harvesting. However, the Super Seeder subsequently manages the retained residue and simultaneously establishes the succeeding wheat crop. This integrated approach helps farmers manage rice straw within the field while reducing the need for repeated tillage and residue removal. As the retained residues can provide soil cover, conserve moisture and contribute to nutrient cycling as they decompose. At the same time, avoiding residue burning helps reduce smoke and associated environmental pollution. Therefore, the integration of SMS during rice harvesting and Super Seeder during wheat sowing represents a practical step towards sustainable residue management, resource conservation and environmentally responsible rice–wheat production (ICAR, 2017).

Straw Management System: Managing Rice Residue

The Straw Management System (SMS) is a residue-management attachment fitted to a combine harvester. During rice harvesting, it cuts, chops and spreads the straw and chaff uniformly behind the combine. The uniform distribution is important because uneven accumulation of straw can interfere with subsequent wheat sowing. The SMS therefore

makes the residue easier to manage during establishment of the succeeding wheat crop as shown in Fig. 1. As instead of burning the straw after combine harvesting, farmers can retain it in the field and subsequently use residue-management machinery for wheat sowing. The technology is particularly useful for maintaining a smooth transition between rice harvesting and wheat establishment (ICAR, 2017).



Fig.1: Straw Residue Management (SMS) in Rice Field

Super Seeder: Sowing Wheat with Rice Residue

The Super Seeder is a tractor-operated machine designed for direct sowing of wheat in rice fields containing crop residues. It combines residue-management and seed-placement operations in a single pass. The machine cuts and manages the standing and loose residue while placing wheat seed into the soil. The use

of this technology reduces the need to completely remove rice straw before wheat sowing as shown in Fig. 2. Consequently, farmers can save time between rice harvesting and wheat establishment and reduce the number of conventional tillage operations. Therefore, it provides an effective option for in-situ residue management and direct establishment of wheat (ICAR, 2025).



Fig.2: Sowing of Wheat seed by Super Seeder

Effect of crop residue management

1. Effects on Crop

The residue retention can influence the succeeding wheat crop in several ways. The straw remaining on the soil surface provides soil cover and reduces direct exposure of the soil to sunlight and wind. This can help reduce evaporation and conserve soil moisture. The direct sowing with residue-management machinery also helps reduce the time required for field preparation. This is particularly important in the rice–wheat system, where timely wheat sowing is important for proper crop establishment and productivity. The combining residue management and sowing operations can therefore improve operational efficiency (ICAR, 2022). As retained residue decomposes, nutrients are gradually released back into the soil. This contributes to nutrient cycling and may support soil biological activity and organic-matter accumulation over time.

2. Effects on Soil

This provides an additional source of organic material to the soil. Unlike burning, which results in the loss of biomass and nutrients from the field, residue retention keeps a substantial

portion of the organic material within the production system. As regular residue retention can contribute to soil organic matter, improve soil aggregation and support soil biological activity. The residue layer can also protect the soil surface from direct raindrop and wind action, thereby helping to reduce soil degradation.

3. Effects on Water

The residue retained on the soil surface acts as a protective cover. It can reduce direct evaporation from the soil and help conserve available soil moisture. Better moisture conservation can be particularly useful during the early establishment of wheat. The residue-management-based direct sowing can also reduce the number of field operations and, consequently, the fuel and water requirements associated with repeated land preparation. Such practices can improve resource-use efficiency in the rice–wheat system (ICAR, 2022).

4. Effect on Environment

The major effect on environmental by this approach is the avoidance of crop-residue burning. As burning releases smoke and pollutants into the atmosphere and removes

valuable organic material from the agricultural system. In contrast, retaining rice straw in the field supports nutrient recycling and keeps organic material within the soil–plant system. This reduced field operations can also lower fuel consumption and associated emissions.

Major Benefits

- Reduces rice-residue burning
- Retains valuable organic material in the field
- Facilitates timely wheat sowing
- Promotes uniform distribution of rice straw
- Reduces repeated tillage operations
- Saves time, labour and fuel
- Helps conserve soil moisture
- Increase farmer income and economics
- Supports nutrient recycling
- Contributes to soil organic matter
- Reduces smoke and air pollution.

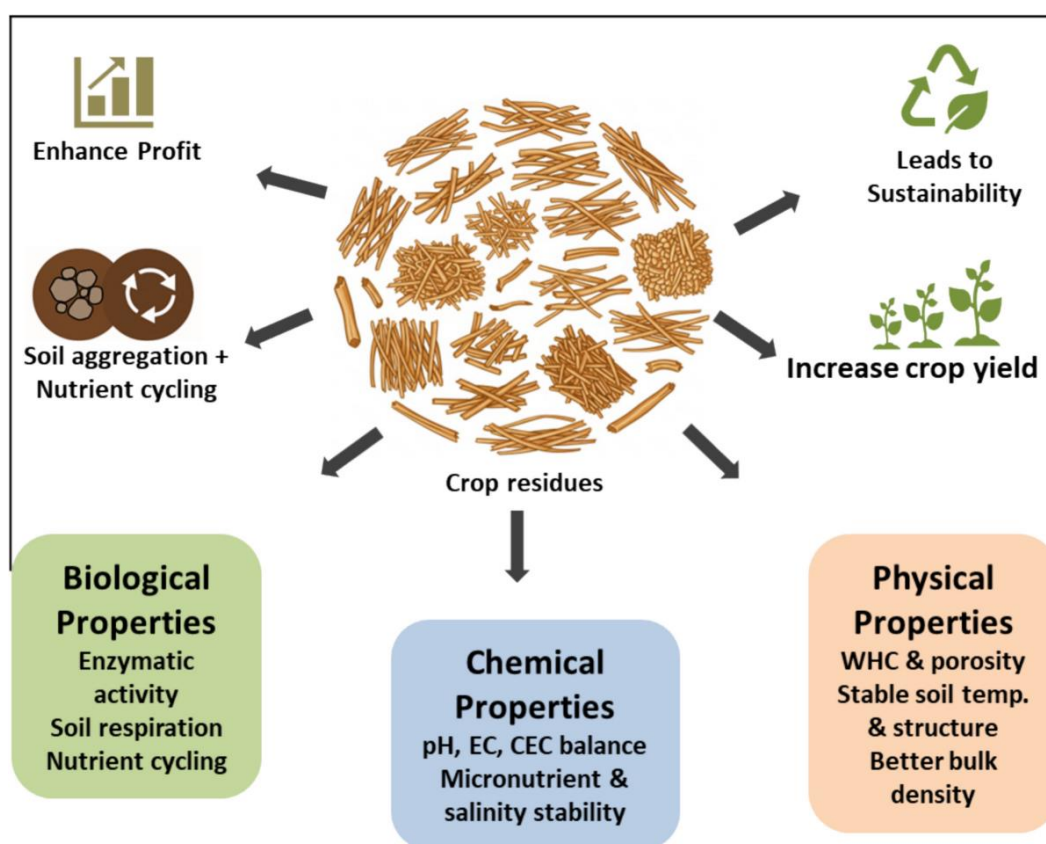


Fig.3: Major Benefits of Crop Residue Management

CONCLUSION

The integration of the Straw Management System during rice harvesting and the Super Seeder for wheat sowing provides a practical and sustainable approach to crop-residue management in the rice–wheat cropping system. The SMS facilitates better distribution and management of rice straw, while the Super Seeder enables wheat establishment without the

need for residue burning. The retaining crop residues in the field can support soil organic matter, moisture conservation and nutrient cycling while reducing repeated tillage operations. The wider adoption of these technologies, along with farmer awareness, machinery availability and appropriate technical guidance, can help transform crop residue from a management problem into a valuable resource for sustainable agriculture.

REFERENCES

- Baloch, S.B., Ali, S., Bernas, J., Konvalia, P., Naveed, M., Baloch, F.B. et al. (2025). Crop residue management for soil health and environmental sustainability: A comprehensive review. *Journal of Soil Science and Plant Nutrition*, 25(3): 7808-7828
- ICAR. (2017). Crop residue management in rice–wheat systems. Indian Council of Agricultural Research, New Delhi.
- ICAR. (2022). Ex-situ Crop Residue Management Options. Indian Council of Agricultural Research, New Delhi.
- ICAR. (2025). Farm machinery involved in paddy residue management. Indian Farming.
- ICAR. (2023). National Dialogue on Stubble Management for Circular Economy. Indian Council of Agricultural Research, New Delhi.