

Super Seeder

Advancing climate-resilient agricultural technology

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Adoption of Super Seeder, increases overall productivity and reduces cultivation costs. Many farmers burn crop residues after harvesting, causing environmental pollution and soil fertility depletion. The Super Seeder addresses this issue by managing crop residues, preparing land, and sowing seeds in a single pass, saving time and enhancing efficiency.

Keywords: Crop residue management, Precision farming, Super seeder technology

Super Seeder is an innovative agricultural machine designed to sow crops directly into fields with standing crop residues, especially wheat and rice. This advanced technology addresses the critical challenges of crop residue management (CRM), soil preparation, and timely sowing, all in a single operation. Traditionally, farmers burn crop residues to clear fields quickly for the next crop. However, this practice depletes soil nutrients, reduces soil fertility, and releases harmful gases into the environment, contributing to severe air pollution.

The Super Seeder is an innovative agricultural tool that combines a rotavator and a zero-till drill, enabling efficient CRM. By cutting and incorporating standing stubbles and loose straw into the soil, the rotavator enriches the soil with organic matter. This integrated process reduces the time and labour required compared to traditional methods, facilitating timely sowing within the narrow sowing window, which is crucial for optimal yields. The technology enhances overall productivity and lowers cultivation costs. By eliminating the need to burn crop residues, the Super Seeder helps mitigate environmental

pollution and soil fertility depletion.

Reduction in residue burning

The highest crop residue is generated by Uttar Pradesh (60 Mt), followed by Punjab (51 Mt) and Maharashtra (46 Mt). Among different crops, cereals generate maximum residues (352 Mt), followed by fibres (66 Mt), oilseeds (29 Mt), pulses (13 Mt) and sugarcane (12 Mt). Specifically, during post-monsoon season, the efficacy of reducing burning was greatest in Punjab and Haryana, with a 0.57% and 0.065% reduction respectively in total India-wide impacts from crop residue burning per 1% reduction in burning emissions. The machine's ability to perform multiple functions in a single pass not only saves time and labour but also lowers the overall cost of cultivation, making it an economically viable solution for farmers.

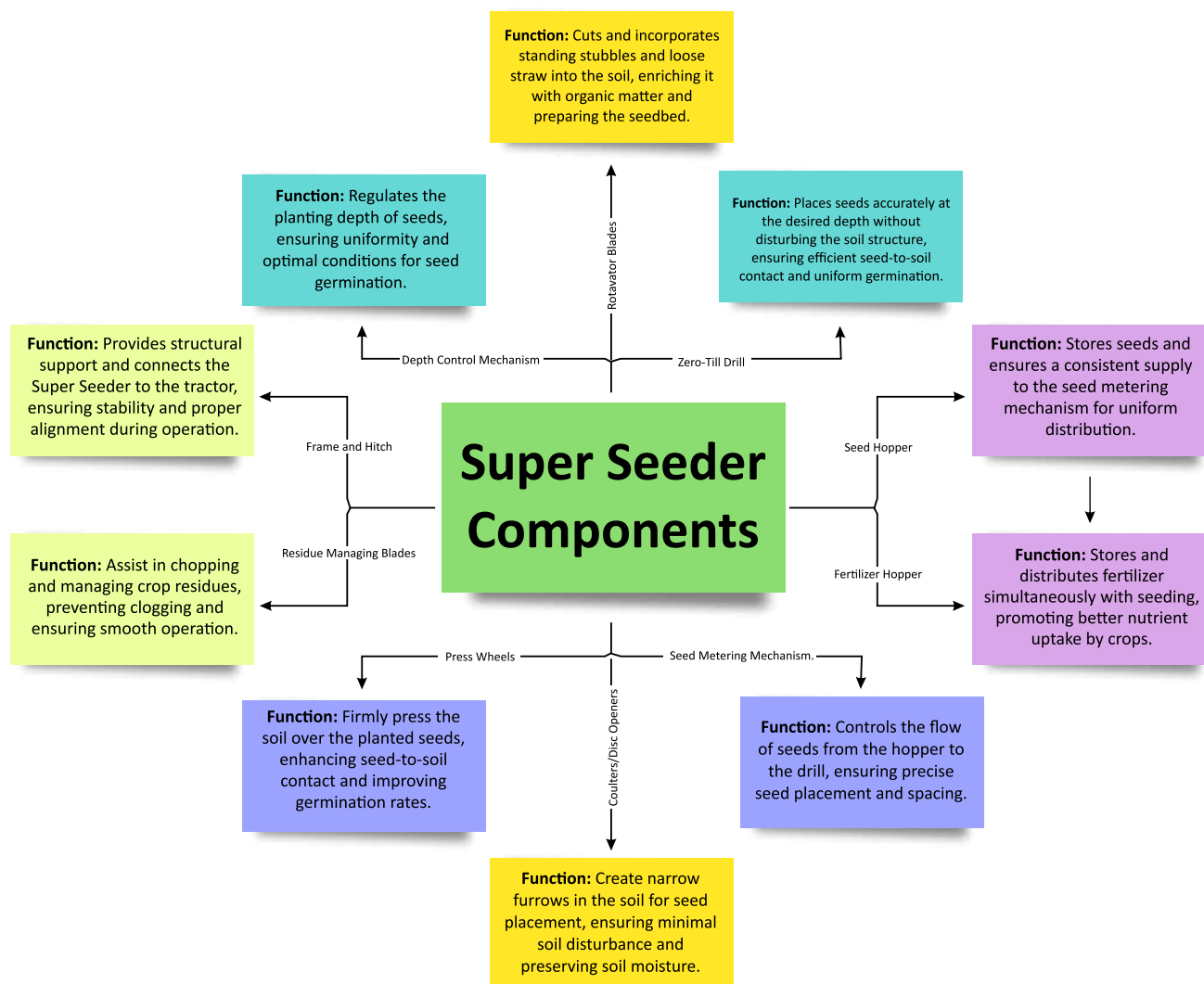
Role of Super Seeder in addressing residue management issues

The Super Seeder plays a crucial role in addressing the challenges of crop residue management, particularly in regions with intensive rice-wheat cropping systems.

- *Eliminates residue burning* – Traditional residue management

often involves burning paddy straw, causing air pollution and nutrient loss. The Super Seeder chops and incorporates residues into the soil, reducing air pollution and enhancing soil health.

- *Combines multiple operations* – The Super Seeder combines straw management, land preparation, and sowing into a single pass, saving time and labour. This efficiency enables farmers to quickly transition from paddy harvesting to wheat sowing within the narrow sowing window.
- *Improves soil fertility* – By incorporating crop residues into the soil, the Super Seeder enhances organic matter content and improves soil structure. This process helps retain soil moisture, boosts microbial activity, and contributes to long-term soil fertility.
- *Conserves soil moisture* – The Super Seeder helps to maintain soil moisture levels by incorporating residues that act as mulch, reducing evaporation. This is especially beneficial in regions with limited water availability, supporting better crop growth and yield.



Components of Super Seeder

- *Reduces cost of cultivation* – By performing multiple functions in one pass, the Super Seeder reduces the need for multiple machinery and labour inputs, lowering overall cultivation costs. Farmers save diesel, time, and labour, making the farming process more economical.
- *Enhances crop yields* – Efficient residue management and improved soil conditions lead to better crop establishment and growth. The timely sowing of wheat and other crops using the Super Seeder can result in higher yields compared to traditional methods.
- *Environmentally friendly* – The reduction in residue burning decreases the emission of greenhouse gases and particulate matter, contributing

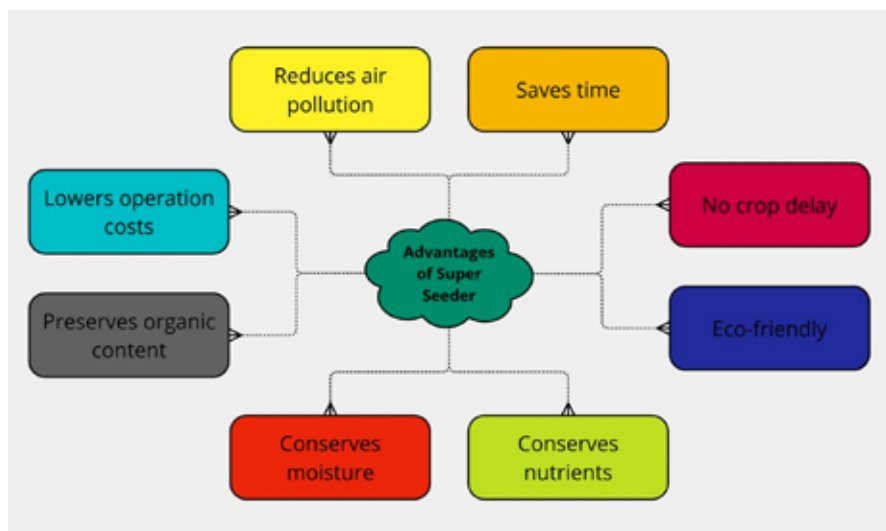
- to a cleaner environment. This eco-friendly approach aligns with sustainable agricultural practices and mitigates the adverse effects of climate change.
- *Promotes sustainable farming* – The Super Seeder supports sustainable farming by reducing dependency on chemical fertilizers through improved nutrient recycling from crop residues. This holistic approach helps maintain ecological balance and ensures long-term agricultural sustainability.

Advantages of Super Seeder and using technology

This technology avoids stubble burning before sowing wheat, significantly reducing air pollution. It performs crop residue

management, land preparation, and sowing operations in a single pass, saving time and labour. This efficiency ensures no delay in planting the second crop, promoting timely agricultural cycles. As an eco-friendly technology, the Super Seeder minimizes soil disturbance, conserving more nutrients, moisture, and organic content. Additionally, it reduces the cost of operation, making it a sustainable and economically viable option for farmers.

The Super Seeder integrates straw management, soil preparation, and sowing in a single pass, eliminating the need for residue burning. It enhances soil fertility, conserves moisture, reduces cultivation costs, and improves crop yields. This eco-friendly technology supports sustainable farming practices,



Advantages of Super Seeder

wheat yields and a 24% increase in rice yields compared to conventional tillage practices.

Economic and environmental benefits

Super Seeder technology offers significant economic and environmental advantages. Economically, it reduces labour costs and fuel consumption by integrating multiple operations—straw management, soil preparation, and sowing—into a single pass. This efficiency saves time and lowers overall cultivation expenses. Environmentally, the technology eliminates the need for crop residue burning, thereby reducing air pollution and preserving soil nutrients. By enhancing soil health and moisture retention, Super Seeder contributes to sustainable farming practices, promoting long-term agricultural productivity and environmental stewardship.

Location of study area

On-farm demonstrations were conducted at Village Badgo, Haiser Bazar Block, Sant Kabir Nagar along District by Krishi Vigyan Kendra, Sant Kabir Nagar.

reduces air pollution, and helps farmers efficiently transition between crops within a narrow sowing window.

Scientific reasoning for yield increase

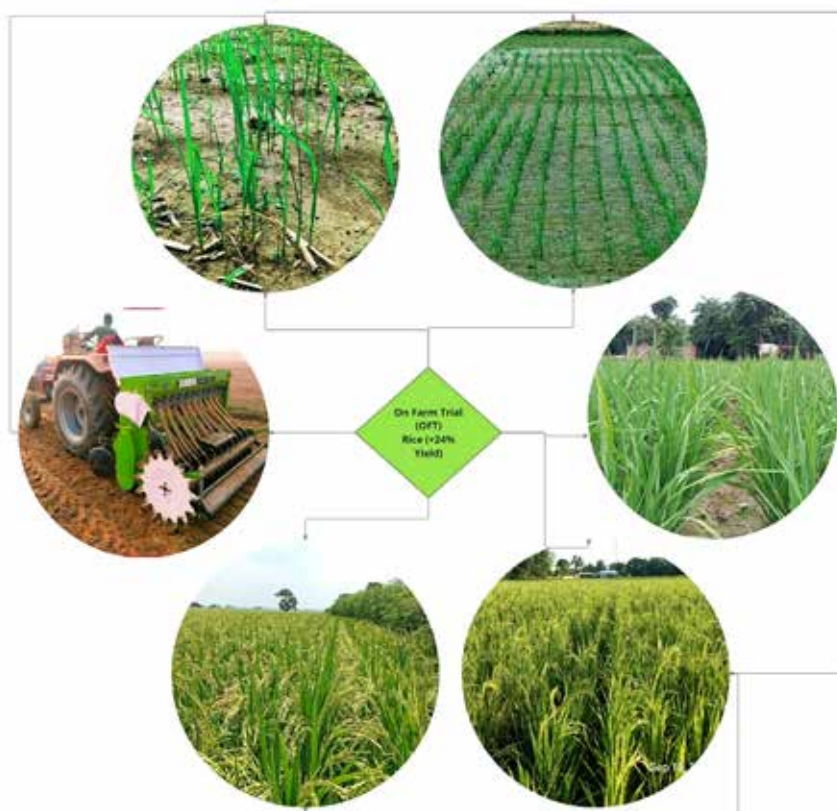
The use of a Super Seeder facilitates timely sowing of wheat and rice crops, thereby enhancing their yield potential through several scientific mechanisms. Timely sowing aligns planting with optimal environmental conditions, minimizing the impact of terminal heat stress on wheat. This ensures that the crops enter crucial growth stages during favourable temperatures, optimizing photosynthetic activity and biomass accumulation. Additionally, timely sowing reduces susceptibility to pest and disease pressures, promoting healthier plant growth and development. Moreover, the advanced technology of Super Seeders improves seed-to-soil contact and uniformity in seed placement, enhancing nutrient uptake efficiency and root development, crucial for both rice and wheat crops. These combined factors contribute to increased yield and resilience in agricultural production systems.

Impact

Study examined the economic viability and environmental benefits of employing the super seeder machine in rice-wheat cultivation. Based on on-farm experiments with 25 rice and wheat -growing farmers,

the study compared conventional and super seeder techniques.

The Super Seeder, an advanced agricultural tool, simultaneously ploughs, mixes crop residues, and sows seeds, streamlining multiple operations into one. With support from government subsidies, five entrepreneur farmers received the Super Seeder machines and provided services to others, significantly reducing both costs and labour time. The use of the Super Seeder resulted in an approximate 19% increase in



On-farm experiments of rice at different stage



On-farm experiments of wheat at different stage

Productivity and profitability of rice-wheat crops

The Super Seeder technology significantly improved rice yields over 2022-24, with grain yields rising from 48.10 to 49.36 q/ha and straw yields from 61.51 to 66.67 q/ha, compared to local checks (Table 1). Despite a slight decrease in the harvest index, the technology showed notable grain yield increases of 18.79% and 18.51% in consecutive years, demonstrating its consistent and superior performance.

The cost of cultivation decreased from ₹31,900/ha in 2022-23 to ₹30,650/ha in 2023-24, while local

check costs were higher. Gross returns increased from ₹96,921/ha to ₹112,294/ha, leading to net returns rising from ₹65,021/ha to ₹81,644/ha. The Benefit-Cost (B:C) ratio improved from 2.03 to 2.66, highlighting the economic viability and profitability of the Super Seeder technology (Table 2).

In 2022-23, the Super Seeder increased wheat grain yield by 15.76% (44.40 q/ha vs. 37.40 q/ha) and straw yield (58.10 q/ha vs. 51.60 q/ha), with a consistent harvest index of 43%. In 2023-24, grain yield rose by 17.75% (50.81 q/ha vs. 46.40 q/ha) and straw yield (57.60 q/ha vs.

51.50 q/ha), maintaining the 43% harvest index (Table 3).

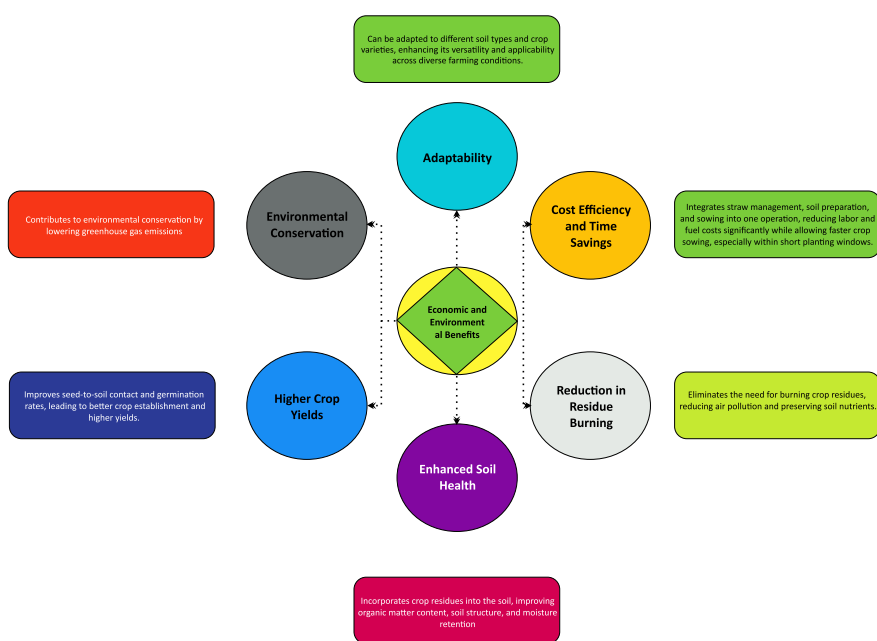
In 2022-23, the Super Seeder reduced cultivation costs to ₹29,800/ha and increased gross returns to ₹88,800, yielding a net return of ₹59,000 and a B:C ratio of 2.97. In 2023-24, costs were ₹30,800/ha with gross returns of ₹1,11,934, netting ₹81,134 and a B:C ratio of 2.63, outperforming local checks each year (Table 4).

Climate resilience with Super Seeder

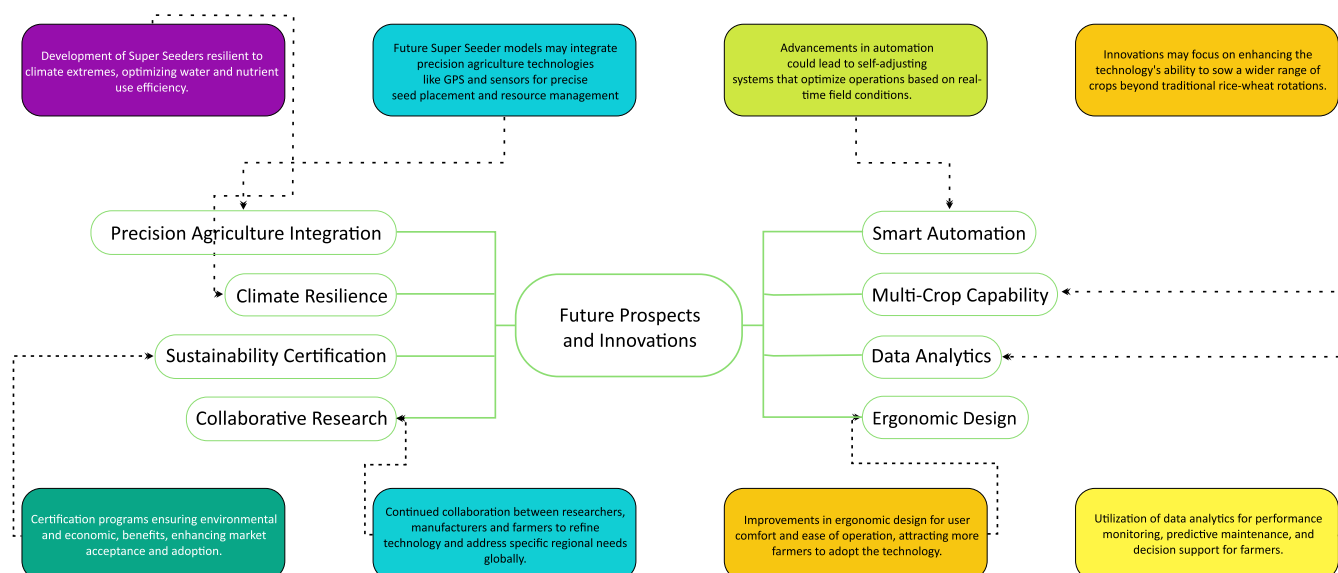
The Super Seeder technology significantly enhances climate resilience in agricultural systems, particularly under adverse climatic conditions. By enabling timely sowing, the Super Seeder ensures that crops are planted within optimal windows, thereby avoiding the detrimental effects of extreme weather events such as terminal heat stress in wheat and excessive moisture in rice fields. This precision in planting schedules leads to better synchronization with climatic patterns, reducing the risk of crop failure and ensuring stable yields.

Furthermore, the Super Seeder's efficient residue management capability aids in soil moisture retention and temperature regulation, which are critical under variable climatic conditions. The retained residues act as mulch, reducing soil evaporation rates, enhancing water use efficiency, and maintaining cooler soil temperatures during heatwaves. This not only conserves water resources but also supports robust root development and nutrient uptake, ultimately leading to healthier crops and higher productivity.

Economically, the use of Super Seeders reduces the need for multiple field operations, lowering labour and fuel costs. This makes farming more economically sustainable, particularly for smallholder farmers. By mitigating the risks associated with climate variability and improving yield stability, the super seeder contributes to long-term agricultural sustainability and resilience. Overall, the adoption of Super Seeder technology aligns well with the principles of climate-smart



Economic and environmental benefits of Super Seeder



Future prospects and innovations options for Super Seeder

Table 1. Impact of Super Seeder on rice productivity

Year	Grain yield (q/ha)		Straw yield (q/ha)		Harvest index (%)		Yield change (%)
	Demo	Local check	Demo	Local check	Demo	Local check	
2022-23	48.10	40.49	61.51	51.51	39.46	40.58	+18.79
2023-24	49.36	41.65	66.67	53.47	41.48	42.24	+18.51

Table 2. Impact of Super Seeder on rice productivity

Year	Cost of cultivation (₹/ha)		Gross return (₹/ha)		Net return (₹/ha)		B:C Ratio	
	Demo	Local Check	Demo	Local check	Demo	Local check	Demo	Local check
2022-23	31900	37642	96921	81587	65021	43945	2.03	1.16
2023-24	30650	35550	112294	94753	81644	59203	2.66	1.67

Table 3. Impact of Super Seeder on wheat productivity

Year	Grain yield (q/ha)		Straw yield (q/ha)		Harvest index (%)		Yield change (%)
	Demo	Local check	Demo	Local check	Demo	Local check	
2022-23	44.40	37.40	58.10	51.60	43.00	42.00	+15.76
2023-24	50.81	46.40	57.60	51.50	43.00	42.00	+17.75

Table 4. Impact of Super Seeder on wheat profitability

Year	Cost of cultivation (₹/ha)		Gross return (₹/ha)		Net return (₹/ha)		B:C Ratio	
	Demo	Local check	Demo	Local check	Demo	Local check	Demo	Local check
2022-23	29800	35900	88800	74800	59000	38900	2.97	2.08
2023-24	30800	34700	111934	95059	81,134	60359	2.63	1.73

agriculture, promoting increased productivity, economic efficiency, and sustainability in the face of changing climatic conditions.

Future prospects and innovations

Future advancements in Super

Seeder technology promise to revolutionize agriculture. Integration with precision agriculture tools such as GPS and sensors will enable precise seed placement and efficient resource management. Automation will

evolve to optimize operations based on real-time field data, enhancing efficiency and yield. Innovations will expand the Super Seeder's capability to sow diverse crops and adapt to climate challenges, improving resilience. Further developments in data analytics, ergonomic design, and sustainability certifications will drive widespread adoption, supporting sustainable farming practices and global food security initiatives.

CONCLUSION

Adopting Super Seeder technology offers a transformative solution to enhance agricultural efficiency and sustainability. By integrating straw management, soil preparation, and sowing into one operation, it reduces costs, saves time, and promotes soil health. To maximize its benefits, governments should offer subsidies and training programs to make the technology accessible to small-scale farmers. Continued research and development in precision agriculture and climate-resilient designs will further improve its effectiveness. Embracing Super Seeder technology not only boosts farm productivity but also contributes significantly to environmental conservation and long-term food security.

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