Direct Seeding of Rice with Drum Seeder in Visakhapatnam District of North Coastal Zone of Andhra Pradesh

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Abstract— *Rice is the major predominant crop during Kharif in Visakhapatnam district of Andhra Pradesh, cultivated in an area of 1,10,008 ha with a productivity of 2624 kg/ha. Farmers traditionally grow rice using methods involving high seed rates, close spacing, and late transplanting with over-aged seedlings—practices exacerbated by erratic rainfall and climate change. Scarcity of labor, escalating wages, and reduced labor efficiency are leading to low net returns. In this context, the DAATTC, Visakhapatnam, in collaboration with the Department of Agriculture, introduced the 'Drum Seeder' technology—a simple, labor-efficient method for direct seeding. This technology saves time and money, enabling harvest 7-10 days earlier than conventional transplanted rice. On-Farm Demonstrations (OFDs) were organized during Kharif 2021 and Rabi 2021-22 across 8 locations. Results showed that drum seeder technology recorded an* ***11.39% higher average grain yield*** *(6245 kg/ha) compared to conventional transplanting (5604 kg/ha). The technology reduced the cost of cultivation by* ***9.35%*** *(Rs. 4,850/ha), primarily through savings on nursery management and transplanting labor. Combined with a* ***7-10 day earlier harvest****, this led to a* ***55.8% increase in net income*** *(Rs. 40,430/ha vs. Rs. 25,950/ha) and a superior cost-benefit ratio (2.03 vs. 1.59). The study concludes that drum seeder technology is a viable, profitable, and labor-saving innovation for rice cultivation in the region.*

Keywords— Direct Seeded Rice, Drum Seeder, Cono Weeder, On-Farm Demonstration, Yield, Economics, Labor Saving.

I. INTRODUCTION

Rice is a staple food crop crucial for India's food security. Although productivity has increased in states like Andhra Pradesh, the compound growth rate at the national level is declining (Krishnaiah, 1999). With limited scope for area expansion and plateauing yields in irrigated ecosystems, increasing production per unit area and time is imperative. India must produce 135-145 million tonnes by 2020 to feed its growing population, requiring a productivity increase to 3.2 t/ha from the current 2.05 t/ha (The Hindu Survey of Indian Agriculture, 2006).

In Visakhapatnam district, rice is cultivated on 1,10,008 ha during Kharif and 2,000 ha during Rabi. Rising cultivation costs—driven by labor scarcity, escalating wages, and increased input prices—threaten profitability. The labor-intensive transplanting operation is a major bottleneck. Direct seeding of rice using a drum seeder offers a promising solution. This technology reduces labor dependency by 30-50% and can increase productivity by 20-30% (Directorate of Rice Research, 2003). It eliminates the need for nursery raising, pulling, and transplanting, allowing earlier crop establishment and maturity. However, successful adoption requires appropriate field selection, irrigation management, suitable varieties, and effective weed control.

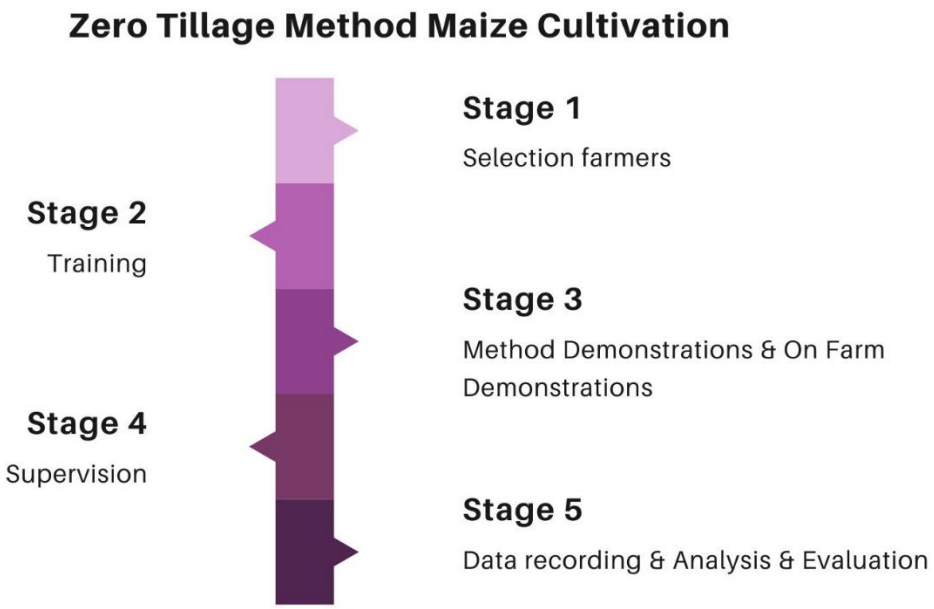
To address these challenges and promote sustainable intensification, the DAATTC, Visakhapatnam, conducted on-farm demonstrations with the following objectives:

Objectives:

1. To evaluate the feasibility and agronomic performance of drum seeder technology in Visakhapatnam district through On-Farm Demonstrations (OFDs).
2. To compare the grain yield and yield attributes of drum-seeded rice with conventionally transplanted rice.
3. To analyze the economics of drum seeder technology, including labor savings and profitability.

II. MATERIALS AND METHODS

The study was conducted by scientists from DAATTC, Visakhapatnam, in collaboration with the District Department of Agriculture. On-Farm Demonstrations (OFDs) were established in 8 locations during Kharif 2021 (3 locations) and Rabi 2021-22 (5 locations).



2.1 Technology Description: The Drum Seeder and Cono Weeder:

The drum seeder (Fig. 1) is a manually operated implement made of plastic, designed to sow pre-germinated paddy seeds directly in puddled fields. It sows 8 rows simultaneously with a row spacing of 20 cm. The cono weeder (Fig. 2) is used for inter-row weed control, incorporating weeds into the soil.

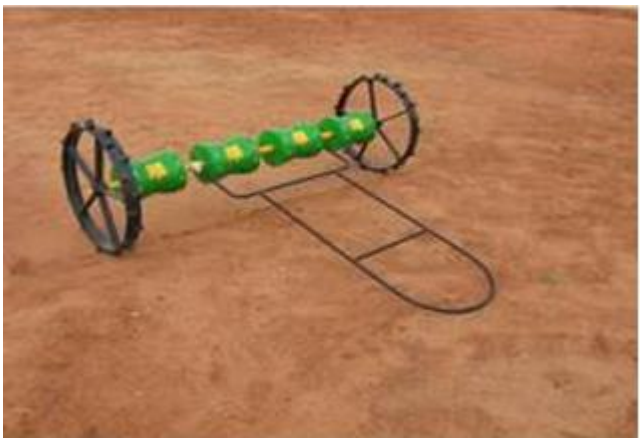


FIGURE 1: The eight-row drum seeder used for direct seeding.

FIGURE 2: The cono weeder used for intercultivation and weed management.

2.2 Salient Features of Drum Seeder Technology:

- Eliminates costs associated with nursery raising, pulling, and transplanting.
- Reduces seed requirement (12-18 kg/acre vs. 30 kg/acre in transplanting).
- Ensures uniform plant population and spacing.
- Enables earlier crop maturity by 7-10 days.

- Lightweight, easy to operate; can cover 1 hectare per day.

2.3 Agronomic Management:

Paired demonstrations were set up on each farm, comparing drum-seeded plots with adjacent farmer-managed transplanted plots (check). Popular varieties MTU-1001 (Kharif) and MTU-1010 (Rabi) were used. In drum-seeded plots, pre-germinated seeds were sown directly into well-puddled fields. Recommended fertilizer doses were applied. Weed management combined the use of the cono weeder (twice at 20 and 40 days after sowing) with need-based herbicide applications. The crop was maintained using recommended package of practices.

2.4 Data Collection and Analysis:

Observations on yield attributes (productive tillers/m², grains/panicle) and grain yield (kg/ha) were recorded from both treatments. A detailed account of labor utilization (men/women days) and cost of cultivation was maintained. Simple mean comparisons were used to analyze the data across locations. Percentage changes and cost-benefit ratios were calculated to assess economic performance.

III. RESULTS AND DISCUSSION

3.1 Crop Duration and Yield Attributes:

The performance of drum-seeded rice compared to conventional transplanting is summarized in Table 1.

TABLE 1
YIELD AND YIELD ATTRIBUTES OF DRUM-SEEDED VS. TRANSPLANTED RICE (AVERAGE OF KHARIF 2021 & RABI 2021-22)

Season & Locations	Parameter	Drum Seeder (Demo)	Conventional (Check)	% Change
Kharif 2021 (n=3)	Crop Duration (days)	124	134	-7.50%
	Productive Tillers / m²	227	190	19.50%
	Grains / Panicle	213	198	7.60%
	Grain Yield (kg/ha)	6580	5680	**15.80%**
Rabi 2021-22 (n=5)	Crop Duration (days)	113	121	-6.60%
	Productive Tillers / m²	230	212	8.50%
	Grains / Panicle	171	153	11.80%
	Grain Yield (kg/ha)	5910	5528	6.90%
Average (n=8)	Crop Duration (days)	119	128	-7.00%
	Productive Tillers / m²	229	201	13.90%
	Grains / Panicle	192	176	9.10%
	Grain Yield (kg/ha)	6245	5604	11.40%

Drum-seeded rice matured **7-10 days earlier** (average 9 days) than transplanted rice, reducing exposure to terminal stresses and enabling earlier harvest. This earlier establishment likely contributed to better tiller production, with drum-seeded plots showing **13.9% more productive tillers per m²** and **9.1% more grains per panicle**. These superior yield components resulted in an **average yield advantage of 11.4%** (6245 vs. 5604 kg/ha). The results corroborate findings by Chandrasekhara Rao et al. (2013), who reported that direct seeding facilitates better root development and tiller production.

3.2 Labor Utilization and Cost of Cultivation:

A detailed comparative cost analysis is presented in Table 2. The drum seeder technology significantly altered the labor and cost structure.

TABLE 2

COMPARATIVE ANALYSIS OF LABOR AND COST OF CULTIVATION (Rs./ha) FOR DRUM-SEEDED vs. TRANSPLANTED RICE

Cost Component	Drum Seeder Technology	Conventional Transplantation
1. Nursery Management	Rs. 0	Rs. 1,100 (2 M Labor + FYM)
2. Seed & Treatment	Rs. 1,200 (40 kg seed)	Rs. 2,250 (75 kg seed)
3. Land Preparation	Rs. 6,600 (10 M Labor)	Rs. 5,600 (8 M Labor)
4. Transplanting/Sowing	Rs. 2,000 (5 M, 3 W Labor)	Rs. 8,700 (15M+3W Pulling + 25W Transplant)
5. Weeding	Rs. 6,500 (3M,20W Labor + Herbicide)	Rs. 4,300 (1M,20W Labor + Herbicide)
6. Fertilizer Application	Rs. 10,400 (8 M Labor + Fertilizers)	Rs. 10,400 (8 M Labor + Fertilizers)
7. Plant Protection	Rs. 4,500 (2M,2W Labor + Chemicals)	Rs. 6,300 (4M,4W Labor + Chemicals)
8. Irrigation	Rs. 2,400 (8 M Labor)	Rs. 3,000 (10 M Labor)
9. Harvest & Post-Harvest	Rs. 13,400 (16M,16W Labor)	Rs. 13,000 (16M,16W Labor)
TOTAL LABOR (Men/Women)	52 M / 68 W	64 M / 93 W
TOTAL COST (Rs./ha)	Rs. 47,000	Rs. 51,850

The drum seeder technology reduced total labor by **12 man-days and 25 woman-days per hectare**. The most significant savings came from eliminating nursery operations and reducing transplanting labor. This resulted in a **9.35% reduction in the total cost of cultivation** (Rs. 4,850/ha).

3.3 Economic Profitability:

The economic advantage of drum seeder technology is clear from Table 3. Calculations are based on average yields and costs, with grain valued at Rs. 14/kg for both treatments for a fair comparison.

TABLE 3

ECONOMICS OF DRUM SEEDER TECHNOLOGY VS. CONVENTIONAL TRANSPLANTING (AVERAGE OF KHARIF & RABI)

Sl. No.	Particulars	Drum Seeder Technology	Conventional Method	Difference (Rs./ha)
1	Grain Yield (kg/ha)	6245	5604	641
2	Gross Returns (Rs./ha)*	87,430	78,456	8,974
3	Cost of Cultivation (Rs./ha)	47,000	51,850	-4,850
4	Net Income (Rs./ha)	40,430	26,606	13,824
5	Cost : Benefit Ratio	2	2	0

Grain price: Rs. 14/kg for both (assuming same market for produce).

The synergy of **higher yield (11.4%) and lower cost (9.35%)** resulted in a **51.9% higher net income** for drum-seeded rice. The cost-benefit ratio was also more favorable (2.03 vs. 1.59). If the earlier harvest from drum seeding commands a premium price, the economic advantage would be even greater.

IV. CONCLUSION

The on-farm demonstrations conclusively demonstrate that direct seeding of rice using a drum seeder is a highly feasible and profitable technology for Visakhapatnam district. It offers a triple advantage: **significant yield increase (11.4%), substantial cost reduction (9.35%), and earlier crop maturity (7-10 days).** The technology directly addresses critical constraints of labor scarcity and high wage rates by saving 37 labor-days per hectare. This translates into a dramatic **51.9% increase in net income** and a better return on investment. For sustainable intensification of rice systems in the region, large-scale promotion of drum seeder technology, coupled with training on proper weed and water management, is strongly recommended.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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