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## Knowledge and adoption levels of drum seeder–based direct seeding among rice farmers in Mahabubabad district, Telangana, India

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### Abstract

Rice (*Oryza sativa* L.) is central to India's food security, but conventional transplanting faces constraints from water scarcity, labour shortages, and climate variability. Drum seeder–based direct-seeded rice offers a resource-efficient alternative. This study assessed farmers' knowledge, adoption, and perceptions of drum seeder technology in Mahabubabad district, Telangana, using an ex-post facto design with 120 farmers. Most respondents (64.16%) exhibited high knowledge, particularly on field preparation and seed practices, though gaps persisted in water and weed management. Adoption was moderate to high, with 51.66% of farmers in the high adoption category. Core practices such as seed sowing and field preparation were widely adopted, whereas water management, nutrient scheduling, and mechanical weeding showed lower adoption levels. Farmers perceived significant benefits, including reduced drudgery and earlier maturity (84.16%), higher yields (82.50%), and savings in water, labour, and costs (80.83%), contributing to improved returns. The findings indicate that while awareness and adoption of drum seeder-based DSR are encouraging, targeted extension efforts and practical training are essential to address technical gaps and enhance full-scale adoption, thereby improving productivity and sustainability of rice systems.

**Keywords:** Adoption, drum seeder technology, knowledge, rice, Telangana

### 1. Introduction

Rice (*Oryza sativa* L.) is the principal staple food for more than half of the global population and occupies a central role in ensuring food and nutritional security. In India, rice is cultivated across diverse agro-ecological regions and remains the dominant crop. To meet growing demand from the increasing population of our country, rice production needs to be enhanced by approximately 3 million tonnes annually (Dass *et al.*, 2016) <sup>[2]</sup>. However, the sustainability and productivity of rice-based systems are increasingly constrained by inefficient use of critical inputs such as water, fertilizers, and labour; escalating costs of cultivation; declining availability of natural resources, particularly water and labour; and emerging challenges associated with climate variability, energy scarcity, and socio-economic transformations including urbanization and labour migration. Addressing these challenges necessitates the adoption of improved agronomic practices and innovative production technologies (Ladha *et al.*, 2009) <sup>[6]</sup>.

Rice cultivation is highly water-intensive, requiring substantial quantities of water during land preparation and crop growth, which often results in low water productivity and reduced economic returns (Kumar *et al.*, 2012) <sup>[5]</sup>. Excessive and inefficient use of groundwater and surface water resources poses a serious threat to the long-term sustainability of rice production in India. It has been estimated that approximately 5,337 litres of water are required to produce one kilogram of rice (Nibber, 2016) <sup>[7]</sup>, highlighting the magnitude of water use and the associated concern of "virtual water" export through rice trade. Therefore, developing and promoting water-efficient rice production systems is critical for ensuring food security while maintaining environmental sustainability (Tuong and Bouman, 2003) <sup>[10]</sup>.

In this context, direct seeded rice (DSR) has emerged as a promising alternative to conventional transplanting. DSR involves the sowing of pre-germinated or dry seeds directly into the field

under puddled or non-puddled conditions. The technique offers several advantages, including reduced water requirement, lower labour and energy use, timely crop establishment, reduced greenhouse gas emissions, and improved system productivity (Joshi *et al.*, 2013) [3]. The availability of short-duration and early-maturing varieties, along with advances in nutrient and weed management, has further facilitated the adoption of DSR in different rice-growing regions. Consequently, DSR is gaining increasing attention as a resource-conserving and climate-resilient production technology.

Direct-seeded rice using drum seeders has been increasingly adopted in several parts of Telangana and Andhra Pradesh. In Mahabubabad district, Telangana rice cultivation is predominantly practiced through conventional transplanting, with farmers largely dependent on tank and groundwater irrigation systems. However, increasing variability in monsoon onset and distribution frequently disrupts transplanting schedules. Farmers typically raise nurseries in anticipation of timely monsoon rains, but delays often result in over-aged seedlings, which are transplanted only after sufficient water becomes available. This leads to a sudden surge in labour demand and causes delays in transplanting operations, ultimately affecting crop establishment and productivity. Under such conditions, limited and erratic water availability further aggravates the problem, making conventional transplanting less reliable.

To address these challenges, the Krishi Vigyan Kendra (KVK), Malyal, has been promoting DSR as a viable alternative to conventional methods. Drum seeder-based direct seeding technology has been disseminated through on-farm trials, frontline demonstrations, and capacity-building programmes in the district. In this backdrop, the present study was undertaken during 2023-24, to assess the knowledge and adoption levels of farmers regarding drum seeder-based direct seeded rice cultivation.

## 2. Research Method

An ex-post facto research design, combined with an exploratory approach, was adopted since the phenomena under study had already occurred and were beyond the control of the researcher. Familiarity with the local language enabled the investigators to establish quick rapport with the respondents and facilitated an in-depth investigation.

The Mahabubabad district was purposively selected, as the investigators were working at Krishi Vigyan Kendra (KVK),

Malyal, Mahabubabad under Professor Jayashankar Telangana Agricultural University (PJTU), Telangana, India during the study period. Accordingly, four villages were selected randomly based on potentiality of direct-seeded paddy. From each of the selected villages, 30 farmers were chosen, making a total sample of 120 farmers for the study.

Primary data were collected using an open-ended interview schedule designed to capture farmers' knowledge and adoption of direct-seeded paddy practices. The responses were systematically categorized and analyzed using frequency and percentage distributions.

## 3. Results and Discussion

### 3.1 Knowledge level of rice farmers on Drum seeder technology

Analysis of knowledge levels on drum seeder technology indicated that farmers possess generally high level of knowledge among farmers (Table 1), though variation exists across specific components. Among all practices, the highest level of knowledge was observed for draining of standing water before sowing pre-germinated seeds (88.33%, Rank 1), indicating strong awareness of critical field preparation requirements. This was closely followed by knowledge on the benefit of drudgery reduction and ease of operation (87.50%, Rank 2) and knowledge on weed management through weedicide application (86.66%, Rank 3), knowledge on water-saving benefits (85.00%, Rank 4) and seed soaking and incubation (82.50%, Rank 5). Knowledge on the requirement of well puddled and levelled fields was also high (81.66%). Comparatively low level of knowledge was recorded for aspects like seed filling in the drum (68.33%), maintenance of thin layer of irrigation water in the field till seeds germinate (67.50%) and intermittent irrigation scheduling (71.66%), presowing settling of puddled field (74.16%). Such high level of knowledge was also exhibited by Khammam district farmers in the study conducted by Shaker, *et al.*, 2020 [9].

High knowledge levels of the farmers on the technology revealed that On-farm trials, FLDs, training programmes, field days and exposure visits organized by the Krishi Vigyan Kendra, Malyal, Mahabubabad in the district has created positive impact among farmers on the technology. Though, farmers are well informed about the major benefits and key operational practices, there are notable gaps in precise technical and water management practices, which may affect the optimal performance of the technology.

**Table 1:** Knowledge level of rice farmers on Drum seeder technology

| S. No.            | Recommended practice for Drum Seeder-Based Direct Seeding                                                                                                     | Knowledge level |            | Rank |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------|------|
|                   |                                                                                                                                                               | Frequency       | Percentage |      |
| Field Preparation |                                                                                                                                                               |                 |            |      |
| 1                 | Well puddled and levelled fields                                                                                                                              | 98              | 81.66      | 6    |
| 2                 | Leaving the field for 1-2 days for settling of puddled soil, if there is more standing water in the field                                                     | 89              | 74.16      | 11   |
| 3                 | Draining of standing water before sowing of Pre-germinated seed with drum seeder                                                                              | 106             | 88.33      | 1    |
| Seed sowing       |                                                                                                                                                               |                 |            |      |
| 4                 | Soaking of seeds in water for 24h & incubation in gunny bags for 24-48 h                                                                                      | 99              | 82.50      | 5    |
| 4                 | Germination length of seeds should not be more than 1-2mm to avoid mechanical injury of pre-germinated seeds and to ensure flow of seeds with the drum seeder | 91              | 75.83      | 10   |
| 5                 | Filling of germinated seed up to 2/3 <sup>rd</sup> of the drum                                                                                                | 82              | 68.33      | 14   |
| 6                 | Sowing of sprouted seed with row to row spacing of 20 cm which facilitates good tillering                                                                     | 87              | 72.50      | 12   |
| Weeding           |                                                                                                                                                               |                 |            |      |
| 7                 | Weedicide application in puddled fields                                                                                                                       | 104             | 86.66      | 3    |
| Water management  |                                                                                                                                                               |                 |            |      |
| 8                 | Maintenance of thin layer of irrigation water in the field till seeds germinate                                                                               | 81              | 67.50      | 15   |
| 9                 | Intermittent irrigation at 2-3 days interval up to PI stage to enhance tillering                                                                              | 86              | 71.66      | 13   |

| Knowledge on benefits |                                                                                                                |     |       |    |
|-----------------------|----------------------------------------------------------------------------------------------------------------|-----|-------|----|
| 10                    | Use of drum seeder is easy to operate and 3acres can be sown in a day by one man labour                        | 99  | 82.50 | 5  |
| 11                    | Drum seeder is a drudgery reducing tool, easy to use, convenient and resulted in shift of work of women to men | 105 | 87.50 | 2  |
| 12                    | Sowing with drum seeder saves time and reduces the crop period by 7 days                                       | 95  | 79.16 | 7  |
| 13                    | Drum seeder reduces labour requirement                                                                         | 89  | 74.16 | 11 |
| 14                    | Saves irrigation water compared to conventional method of transplanting                                        | 102 | 85.00 | 4  |
| 15                    | Net profit is more using drum seeder than transplanting                                                        | 94  | 78.33 | 8  |
| 16                    | Use of drum seeder helps in timely sowing of crop                                                              | 93  | 77.50 | 9  |

### 3.2 Adoption level of recommended practices of Drum seeded technology

The adoption pattern of recommended drum seeder-based rice cultivation practices revealed varying levels of acceptance among farmers across different components (Table 2).

#### Field preparation practices showed moderate to high adoption

A majority of the farmers fully adopted field preparation practices like levelling of the field with a plank before sowing (60.00%), maintaining well puddled and levelled fields (56.66%), draining excess water before sowing (50.00%) of respondents. However, only 45.83% of respondents fully adopted the practice of leaving the field for 1–2 days for soil settling. About 29.16 to 41.67% of the respondents adopted these practices partially. 8.34 to 16.66% of the respondents did not adopt the field preparation practices of drum seeder technology.

#### Seed sowing practices showed comparatively higher adoption

Recommended seed rate (30–37.5 kg/ha) was completely adopted by 75% of the respondents, followed by sowing of pre-germinated seeds using a drum seeder (67.50%), filling the drum up to two-thirds capacity (59.16%) and soaking and incubation of seeds (55.00%) while 20.83% partially adopted this. However, technical aspects like maintaining optimal germination length (1–2 mm) and seed treatment had relatively lower full adoption levels of 40.83% and 41.66%, respectively, with a significant proportion of farmers partially adopting these practices.

Weed management practices exhibited mixed adoption levels. Herbicide application 3–5 days after sowing had relatively higher full adoption (57.50%), followed by post-emergence herbicide application (55.00%). Pre-emergence herbicide use

was fully adopted by 44.16% of farmers. In contrast, mechanical weeding using cono or power weeders showed the lowest full adoption (19.16%) and the highest non-adoption rate (48.33%), indicating constraints in its use

Under nutrient management, only 38.33% of farmers fully adopted the recommended basal nitrogen application at 15 days after sowing, while 35.00% partially adopted and 26.67% did not adopt it, indicating moderate acceptance.

Water management practices recorded relatively low full adoption levels. Only 33.34% of farmers maintained a thin layer of water during germination, and 34.16% practiced intermittent irrigation at 2–3 day intervals up to panicle initiation stage. A larger proportion of farmers were in the partial adoption category for these practices.

In pest management, 50.00% of farmers fully adopted recommended pest and disease management practices, while 38.33% partially adopted them, indicating moderate awareness and implementation.

The results indicated that seed sowing practices had the highest level of adoption, followed by field preparation practices, whereas weed management (especially mechanical weeding), nutrient management, and water management practices showed comparatively lower adoption levels, highlighting areas that require focused extension efforts. Similar results were reported by Chinnam Naidu, *et al.*, 2018<sup>[1]</sup>, who found that farmers from Srikakulam district of Andhra Pradesh felt difficulty in weed management practices with drum seeder technology while more than 50% of the farmers adopted leveling of the fields, pre and post emergence herbicide and 80% farmers adopted seed sowing practices like seed rate, seed soaking, sowing sprouted seeds. Weed Management, difficulty in operating cono weeder, were the major constraints faced by farmers of Nalgonda district, Telangana in adoption of drum seeding technology in rice (Pallavi *et al*, 2025)<sup>[8]</sup>.

**Table 2:** Adoption level of recommended practices of Drum seeded technology by farmers

| S. No.            | Recommended practice                                                                                         | Extent of adoption |            |                  |            |             |            |
|-------------------|--------------------------------------------------------------------------------------------------------------|--------------------|------------|------------------|------------|-------------|------------|
|                   |                                                                                                              | Full adoption      |            | Partial adoption |            | Not adopted |            |
|                   |                                                                                                              | Frequency          | Percentage | Frequency        | Percentage | Frequency   | Percentage |
| Field Preparation |                                                                                                              |                    |            |                  |            |             |            |
| 1                 | Levelling the field with plank before sowing                                                                 | 72                 | 60.00      | 35               | 29.16      | 13          | 10.84      |
| 2                 | Well puddled & levelled field                                                                                | 68                 | 56.66      | 42               | 35.00      | 10          | 8.34       |
| 3                 | Leave the field for 1-2 days for settling of puddled soil                                                    | 55                 | 45.83      | 50               | 41.67      | 15          | 12.50      |
| 4                 | Draining out excess water before sowing                                                                      | 60                 | 50.00      | 39               | 32.50      | 21          | 16.66      |
| Seed sowing       |                                                                                                              |                    |            |                  |            |             |            |
| 1                 | Seed rate @ 30-37.5 kg/hectare                                                                               | 90                 | 75.00      | 25               | 20.83      | 05          | 4.16       |
| 2                 | Seed treatment                                                                                               | 50                 | 41.66      | 40               | 33.34      | 30          | 25.00      |
| 3                 | Soaking of seeds in water for 24h & incubation in gunny bags for 24-48 h                                     | 66                 | 55.00      | 34               | 28.33      | 20          | 16.66      |
| 4                 | Sowing of pre-germinated seeds with drum seeder                                                              | 81                 | 67.50      | 31               | 25.83      | 08          | 6.67       |
| 5                 | Germination length of seeds should not be more than 1-2mm to avoid mechanical injury of pre-germinated seeds | 49                 | 40.83      | 51               | 42.50      | 20          | 16.67      |
| 6                 | Filling of germinated seed up to 2/3 <sup>rd</sup> of the drum                                               | 71                 | 59.16      | 35               | 29.16      | 14          | 11.68      |
| Weed management   |                                                                                                              |                    |            |                  |            |             |            |
| 1                 | Application of pre-emergence herbicide                                                                       | 53                 | 44.16      | 42               | 35.00      | 25          | 20.83      |
| 2                 | Herbicide application 3-5 days after sowing                                                                  | 69                 | 57.50      | 39               | 32.50      | 12          | 10.00      |

|                            |                                                                                            |    |       |    |       |    |       |
|----------------------------|--------------------------------------------------------------------------------------------|----|-------|----|-------|----|-------|
| 3                          | Application of post-emergence herbicide 20-25 days after sowing                            | 66 | 55.00 | 34 | 28.34 | 20 | 16.66 |
| 4                          | Weeding with cono weeder or power weeder                                                   | 23 | 19.16 | 39 | 32.50 | 58 | 48.33 |
| <b>Nutrient management</b> |                                                                                            |    |       |    |       |    |       |
| 1                          | basal dose of nitrogen fertilizer application has to be made 15DAS to suppress weed growth | 46 | 38.33 | 42 | 35.00 | 32 | 26.67 |
| <b>Water management</b>    |                                                                                            |    |       |    |       |    |       |
| 1                          | Maintenance of thin layer of irrigation water in the field till seeds germinate            | 40 | 33.34 | 53 | 44.16 | 27 | 22.50 |
| 2                          | Intermittent irrigation at 2-3 days interval up to PI stage to enhance tillering           | 41 | 34.16 | 52 | 43.33 | 27 | 22.50 |
| <b>Pest management</b>     |                                                                                            |    |       |    |       |    |       |
| 1                          | Pest and disease management                                                                | 60 | 50.00 | 46 | 38.33 | 14 | 11.66 |

### 3.3 Perception of Farmers on the Benefits of Drum Seeder Technology in Rice Cultivation

Farmers perceived multiple advantages of drum seeder technology (Table 3) over conventional transplanting. The most prominent benefit is *reduction in drudgery along with earlier crop maturity (7–10 days)*, reported by 84.16% of respondents, indicating that labour comfort and timeliness are the primary drivers of adoption. This is followed closely by higher yield (82.50%) and savings in irrigation water, seed, labour, and

overall production costs (80.83%), suggesting that farmers recognize both productivity and resource-use efficiency gains.

A substantial proportion (70.83%) also reported higher net economic returns, confirming that the technology is perceived as financially beneficial. However, comparatively fewer farmers (59.16%) identified low input demand as a benefit, implying that while cost savings are evident, the perception of reduced input requirement is less pronounced. The results are in uniformity with the results of Chinnam Naidu, *et al.* (2018) <sup>[1]</sup>.

**Table 3:** Perceived Benefits of Drum Seeder Technology in Rice Cultivation

| S. No. | Benefit of drum seeder technology over conventional transplanting | Frequency | Percentage |
|--------|-------------------------------------------------------------------|-----------|------------|
| 1      | More yield                                                        | 99        | 82.50      |
| 2      | Savings in irrigation water, seed, labour & production costs      | 97        | 80.83      |
| 3      | Higher net economic returns                                       | 85        | 70.83      |
| 4      | Low input demand                                                  | 71        | 59.16      |
| 5      | Less drudgery, early crop maturity by 7-10 days                   | 101       | 84.16      |

### 3.4 Categorisation of farmers based on knowledge and adoption level of the technology

Among the respondent farmers, 64.16 per cent had high level of knowledge on recommended practices for drum seeder technology (Table 4), suggesting that awareness and understanding of recommended practices are well established in the study area. 27.50 per cent of the farmers had medium level of knowledge. This shows that a considerable proportion still requires further strengthening of knowledge. Only 8.33 per cent had low level of knowledge indicating minimal knowledge gaps at the base level. Medium to high levels of knowledge about the technology indicate the effectiveness of extension efforts and prior exposure to the technology. However, targeted interventions such as training and demonstrations are still needed to upgrade medium-level farmers to a high knowledge category for better adoption and optimal utilization of drum seeder technology. Kumar, *et al.* (2018) <sup>[4]</sup> reported that 54.17% of respondents had medium knowledge on rice drum seeder technology in Khammam district, Telangana and in the present study majority of the respondents had high level of knowledge.

field level. However, a notable proportion of farmers (28.34%) exhibit a medium level of adoption, indicating partial implementation of recommended practices. This suggests that while farmers are aware of the technology, they may not be adopting all components fully. The presence of 20.00% of farmers in the low adoption category highlights existing constraints, such as limited technical knowledge, resource availability, or risk perception. Though adoption is encouraging, focused extension efforts, capacity building, and field demonstrations are needed to bridge the gap between partial and full adoption, thereby enhancing the overall effectiveness of direct-seeded rice technologies

**Table 5:** Categorization of Farmers by Adoption Level of Drum Seeder Technology

| S. No. | Items      | Low   | Medium | High  |
|--------|------------|-------|--------|-------|
| 1.     | Frequency  | 24    | 34     | 62    |
| 2.     | Percentage | 20.00 | 28.34  | 51.66 |

### 4. Conclusion

The study clearly indicates that drum seeder technology in rice cultivation has achieved substantial awareness and acceptance among farmers. A majority of respondents exhibited high levels of knowledge (64.16%), reflecting the positive impact of extension activities such as trainings, demonstrations, and field visits. However, specific gaps persist in technical aspects, particularly in water management and precision practices, which may limit the full potential of the technology. Adoption patterns revealed that while more than half of the farmers (51.66%) fall under the high adoption category, a considerable proportion still practice partial adoption. Core operations like seed sowing and field preparation are widely adopted, whereas practices related to water, nutrient, and mechanical weed management lag behind,

**Table 4:** Categorization of Farmers by Knowledge Level on Drum Seeder Technology

| S. No. | Items      | Category             |                            |                       |
|--------|------------|----------------------|----------------------------|-----------------------|
|        |            | Low<br>(up to 33.33) | Medium<br>(33.33 to 66.66) | High<br>(above 66.66) |
| 1.     | Frequency  | 10                   | 33                         | 77                    |
| 2.     | Percentage | 8.33                 | 27.50                      | 64.16                 |

Relatively high level of adoption of drum seeder direct-seeded rice technologies was noticed among the farmers in the study area. A majority (51.66%) of respondents fall under the high adoption category, suggesting that the technology has gained substantial acceptance and is being practiced effectively at the

indicating operational and resource-related constraints. Farmers strongly perceived the benefits of drum seeder technology, especially in terms of reduced drudgery, earlier crop maturity, higher yields, and cost savings. These perceived advantages are key drivers of adoption and demonstrate the technology's potential to improve productivity and profitability in rice cultivation.

Thus the findings suggest that although drum seeder technology is well recognized and increasingly adopted, bridging the gap between knowledge and full adoption is essential. Strengthening targeted extension interventions, promoting hands-on training, and addressing practical constraints—particularly in water and weed management—will be crucial for enhancing the effective and widespread use of this technology.

53–67.

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