Adoption, perception and constraints of direct seeded rice cultivation of the farmers of Guntur district, Andhra Pradesh

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ABSTRACT

During the year 2022-23, the extension department of the Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh undertook a study to analyse the adoption pattern of ANGRAU recommended direct seeded rice (DSR) production technology among farmers in the Guntur district, Andhra Pradesh. The study sampled one hundred DSR farmers and found that a great majority were adhering to recommendations concerning soil management, sowing method, harvesting and water management. However, significant gaps were identified in the adoption of other practices. Specifically, the majority of the farmers were not following recommended practices for weed management (92.00%), fertilizer management (86.00%), seed rate (82.00%), pest management (77.00%), disease management (74.00%) and main field preparation (68.00%). Farmers' perception of DSR highlighted its benefits, particularly the reduction in water, labour and fertilizer usage, which facilitated the timely completion of crop activities. The study identified that extension contact and training sessions attended by the farmers had a highly significant relationship with adoption at 1 per cent level of significance. Despite the advantages, several constraints were noted by the farmers practicing DSR cultivation. These included severe weed incidence, rat damage, yield loss due to lodging and increased harvesting costs due to lodging. These challenges pointed out at the clear extension gaps in the adoption of DSR technology. To enhance the adoption of DSR technology, it is crucial to address these extension gaps. This involves focusing on improved weed and pest management strategies, proper fertilizer application, appropriate seed rate and better field preparation techniques. By addressing these areas, farmers can achieve higher net return and contribute to a more sustainable agricultural environment.

Keywords: Direct seeded rice; adoption; perception; correlation; constraints

INTRODUCTION

Rice (*Oryza sativa* L) is staple food for more than 60 per cent of the global population (Bista 2018). Rice stands as the primary crop across the nation, cultivated in nearly every state. India is the second largest producer and consumer of rice and also ranking first in rice exports. In India, during the kharif season, almost 55 per cent of the total cultivated area (39.54 million hectares) is dedicated to paddy production as per the Government of India report (GOI) 2022 (Anon 2022).

In India, rice is cultivated in traditional way where 20-25 days old seedlings are transplanted in main field. This method of rice cultivation has deleterious effects on the soil environment as well as succeeding crops and atmospheric environment through emission of methane gas. Additionally, this technique uses a lot of energy and is expensive, which makes the production system less economical. The conventional puddled transplanting of rice (PTR) is water, capital, energy and labour intensive practice (Bhatt et al 2019, Singh et al 2020, Bhatt et al 2021).

Hence, there is a suggestion to embrace alternative planting techniques, like direct seeding over the conventional transplanting method. This switch aims to alleviate water and labour demands, leading to a reduction in production costs. As water scarcity intensifies each day, compounded by the water intensive nature of rice farming and escalating labour expenses,

the quest for alternative crop establishment methods that enhance water productivity becomes imperative. Farmers should switch over to climate-smart agriculture practices that conserve resources and increase efficiency instead of conventional practices that harm the environment (Dey et al 2024).

Direct seeded rice (DSR) is the only viable option to reduce the wasteful water flows. DSR is seen to be most productive, environmental friendly and financially feasible rice production system used today (Bista 2018, Mishra et al 2023). Simultaneously, the availability of high yielding and short duration varieties and chemical weed control methods made such a switch technically viable.

Globally, 23 per cent of rice cultivation is under DSR and 29 million hectares in Asia which is approximately 21 per cent of the total rice area in the region (Rao et al 2007, Pandey and Velasco 2002).

Direct seeding is becoming an important alternative of rice transplanting and spreading rapidly in Andhra Pradesh due to unforeseen weather conditions with reduced rainy days and labour shortage along with escalating cost of production. The adoption of a dry direct seeding system for rice-based cropping offers the opportunity to increase cropping diversity, intensity and ultimately, the farm income. Furthermore, dry direct seeding can yield comparable or even higher crop yields than traditional puddle transplanted rice (Rahman 2019, Bhagavathi et al 2020, Shrestha et al 2021).

Direct seeding of the paddy crop is being practiced in the state of Andhra Pradesh in an area of 3,21,415 ha accounting for 20.61 per cent of the total paddy area in the state during kharif season (15.59 lakh ha). Dry direct seeding with seed drill is prevalent widely in the districts of Bapatla, Guntur and Krishna. Area under dry direct seeding of paddy crop by seed drill in Guntur is 51,443 ha (Srinivas et al 2023).

This study thoroughly examined the adoption of recommended DSR technology among farmers. It investigated the reasons behind non-adoption, explored farmers' perceptions of the advantages of DSR over traditional practices like puddled transplanted rice (PTR), analysed the factors influencing DSR adoption and identified the farmers' constraints hindering DSR adoption.

METHODOLOGY

The study was conducted during 2022-23 in Guntur district of Andhra Pradesh by the extension department of the Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh. A multistage sampling procedure was employed. Initially, five Mandals viz Tenali, Ponnuru, Chebrolu, Repalle and Ponnuru were purposively selected due to the significant area under DSR cultivation. From each Mandal, two villages with the highest DSR cultivation were chosen. Subsequently, ten farmers engaged in DSR cultivation were randomly selected from each village, resulting in a total sample size of 100 for the study. Primary data were collected through personal interviews with farmers, utilizing a well prepared and pre-tested schedule. The study focused on the adoption of DSR, considering various aspects of the ANGRAU recommended package of practices, including suitable soil, seed rate, field preparation and sowing method and fertilizer, weed, water, pest and disease management and harvesting techniques.

Instances of deviations from these recommended practices were documented and reasons behind such deviations were gleaned from the farmers. The perceptions of the farmers regarding DSR cultivation were assessed using a schedule developed to highlight the proven advantages of this cultivation method. Correlation analysis was conducted to ascertain any relationships between farmers' personal, socio-economic and psychological characteristics and their adoption of the recommended package of practices. Moreover, prominent constraints in DSR cultivation were identified through open-ended questions posed to farmers with their responses categorized and tabulated using frequency and percentage analysis. This comprehensive approach aimed at providing insights into the factors influencing the adoption of DSR cultivation and to address any challenges faced by the farmers in implementing recommended practices.

RESULTS and DISCUSSION

Adoption of ANGRAU recommended DSR cultivation by the farmers

It can be inferred from Table 1 that all the farmers were adopting soil, sowing method and harvesting as per the recommendation. Great majority of the farmers were adopting water management

(83.00%) as recommended. However, the majority fell short in certain areas, notably weed management (92.00%), fertilizer management (86.00%), seed rate (82.00%), pest management (77.00%), disease management (74.00%) and main field preparation (68.00%). Bhatt and Singh (2021) reported higher seed rate and more fertilizer use by the DSR farmers in their study. With respect to water, fertilizer, pest and disease management, similar results were reported by Shaker et al (2020). Kamboj et al (2022) reported that many respondents were found to be using more than recommended doses of herbicides. To delve deeper into the reasons behind this deviation from recommendations, insights on non-adoption were gathered directly from the farmers themselves.

Reasons for non-adoption of ANGRAU recommended DSR cultivation by the farmers (Table 2)

Seed rate: Eighty six per cent of the farmers cited severe rat infestation as the primary reason for using

Table 1. Adoption of ANGRAU recommended direct seeded rice cultivation by the farmers

Component	Respondents (n = 100)			
	Adopted		Not adopted	
	f	%	f	%
Soil	100	100.00	0	0.00
Seed rate (12-15 kg/acre)	18	18.00	82	82.00
Main field preparation	32	32.00	68	68.00
Sowing method	100	100.00	0	0.00
Fertilizer management	24	14.00	86	86.00
Weed management	8	8.00	92	92.00
Water management	83	83.00	17	17.00
Pest management	23	23.00	77	77.00
Disease management	26	26.00	74	74.00
Harvesting	100	100.00	0	0.00

Table 2 . Reasons for non-adoption of ANGRAU recommended direct seeded rice cultivation by the farmers

Technology recommendation	Reason	Respondents (n = 100)	
		f	%
Seed rate	Rat damage	86	86.00
	Heavy rains	73	73.00
	Poor germination	66	66.00
	To get good yields	58	58.00
	To avoid gap filling	45	45.00
Main field preparation	Expensive	77	77.00
	Majority of the farmers are tenant farmers	62	62.00
Fertilizer management	Lack of awareness	71	81.00
	Lack of confidence	65	65.00
	Increased cost of K fertilizers	64	64.00
	Non-availability of fertilizers in time	57	57.00
	Fear of getting low yields	53	53.00
	Competition with fellow farmers	49	49.00
	Labour shortage	38	37.00
Weed management	Lack of awareness	76	76.00
	Promotion of combination of weedicides by the dealers	72	72.00
	Influence of neighbouring farmers	56	56.00
	Labour problem	42	42.00
Insect pest management	Dealers and neighbouring farmers influence	76	76.00
	Lack of awareness on recommended chemicals	68	68.00.
Disease management	Dealers' recommendation	73	73.00
	Lack of awareness	61	61.00

higher seed rate, expressing concerns over compromised seed germination. Additionally, three-fourth of the respondents (73.00%) attributed low germination percentage due to heavy rains, prompting the adoption of higher seed rate. Sixty six per cent highlighted poor germination due to improper levelling as a key factor, leading to an increase in seed rate. At the same time, 58.00 per cent believed that higher seed rate was essential for achieving optimum yields. Forty five per cent of the farmers linked poor germination to inadequate plant stand per square meter, necessitating gap filling and subsequently higher seed rate. This trend underscores the critical need for raising awareness among farmers about the importance of proper land levelling and implementing timely measures for effective rat management in DSR cultivation.

Main field preparation: A significant deviation was observed in adoption rate. Over three-fourth of the respondents (77.00%) were not prioritizing perfect levelling as part of their main field preparation, citing its costliness as a deterrent. Moreover, 62.00 per cent of the farmers were neglecting levelling altogether, primarily due to their status as tenants and the uncertainty of retaining the same field in the following year.

Fertilizer management: More than eighty per cent of the farmers (81.00%) did not use fertilizers as recommended because they lacked awareness of the correct dosages. This lead to a lack of confidence in achieving good yields, prompting 65.00 per cent of them to apply higher doses than advised. Additionally, due to the sudden rise in potassium fertilizer prices, 64.00 per cent resorted to using complex fertilizers instead, leading to pest and disease outbreaks and reduced yields. Another challenge was the non-availability of required fertilizers locally and in a timely manner, causing 57.00 per cent of the farmers to compromise on recommended options. Moreover, 53.00 per cent of the farmers opted for more complex fertilizers due to the fear of lower yields, while below fifty per cent (49.00%) were deterred by competition with peers and labour shortage (37.00%). These reasons highlighted farmers' apprehensions about poor yields, underscoring the necessity for state extension officials to organize village level demonstrations to promote recommended practices.

Weed management: More than seventy per cent of the farmers (72.00%) were using a combination of three herbicides as recommended and promoted by local input dealers, primarily due to lack of awareness (76.00%) regarding the exact recommended herbicides for DSR. Fifty six per cent of the farmers deviated from recommendations under the influence of neighbouring farmers, while 42.00 per cent faced labour issues that hindered adherence to recommendations. The indiscriminate use of herbicide combinations not only escalates production costs of the farmers but also contributes to the outbreak of weed species resistant to these herbicides. To address this, it is imperative to regulate input dealers to prevent the sale of unnecessary herbicides. Additionally, creating awareness among the farmers about the correct pre- and post-emergence herbicides for direct seeded rice, is essential. This responsibility particularly lies with the Department of Agriculture, Guntur district, Andhra Pradesh emphasizing the need for concerted efforts in education and regulation within the agricultural sector.

Insect pest management: Over three-fourth of the farmers (76.00%) influenced by dealers and neighbouring farmers, opted for combinations of insecticides to control insect pests in DSR cultivation, straying from recommended practices. Nearly seventy per cent of the farmers (68.00%) used excessive insecticides due to lack of awareness. Insecticide usage significantly impacts the net return of any cropping system, making it a crucial component of production. Therefore, reducing unnecessary expenses associated with incorrect insecticide applications not only improves overall farm finances but also promotes environmental sustainability. Organizing seed to seed field demonstrations involving a maximum number of farmers would be pivotal in changing perceptions and convincing farmers to adhere to ANGRAU insect pest management recommendations. These demonstrations would serve as practical examples, showcasing the effectiveness of recommended practices and highlighting the benefits of judicious insecticide use. This approach would not only foster greater understanding but also encourage sustainable agricultural practices among farmers.

Disease management: Seventy three per cent of the farmers were using excess number of fungicides based on dealers' suggestions, while 61.00 per cent lacked awareness of precise disease management recommendations, resulting in the overuse of fungicides. Therefore, it is imperative to enhance farmers' knowledge regarding accurate disease diagnosis and integrated management of rice

diseases. Capacity building programmes conducted by field extension functionaries at Rythu Bharoasa Kendras would play a crucial role in achieving this objective. These programmes should focus on educating farmers about the identification and diagnosis of diseases as well as promoting integrated disease management practices.

By empowering farmers with the necessary knowledge and skills, they can make informed decisions regarding the appropriate use of fungicides, ultimately leading to improved agricultural productivity and sustainability.

Farmers' perception on advantages of DSR adoption

Data on perception of the farmers on advantages of DSR are presented in Table 3. Great majority of the farmers (96.00%) felt that with the adoption of DSR, overall cost of cultivation was decreased as compared to normal transplanting; dependence on manual labour came down (89.00%); they were able to complete sowings in time (87.00%); availability of effective pre- and post-emergence herbicides made DSR profitable (78.00%); with DSR, crop duration was reduced to 7-10 days (75.00%); crop used to be healthy as compared to normal transplanting (69.00%); there was low insect pest and disease incidence (57.00%), more water use efficiency and less water wastage (55.00%) and more number of productive tillers (52.00%). Less than fifty per cent of the farmers (49.00%) expressed that panicle length was higher as compared to transplanted rice; they were able to get higher yields in DSR (46.00%) and effective fertilizer management was possible with the use of DSR (38.00%).

Perception of the farmers on DSR clearly highlighted the benefits of adopting DSR in terms of completion of crop activities with reduced water, labour and fertilizer resources in time. Hence, it is the need of the hour to develop strategies to expand area under DSR cultivation for maximising the roductivity with efficient resource utilization.

Bandumula et al (2018) reported that adoption of DSR has resulted in lowering cost of cultivation of rice by Rs 14,615 per hectare over the transplanting method. With respect to drudgery reduction, cost, labour, water reduction, increased yields with DSR similar views were expressed by the farmers in the study conducted by Sahana et al (2017), Naidu et al (2018), Kakumanu et al (2019) and Shaker et al (2020). Bhatt and Singh (2021) reported that the number of irrigations applied to rice under DSR technique was lower, compared to the PTR. On an average, 5.3 irrigations were saved under DSR than the PTR in Kapurthala district.

Relationship between profile of DSR farmers with their adoption

To understand the determinant socio-economic and psychological factors for adoption of recommended DSR production technology, correlation coefficient analysis was carried out.

Extension contact and trainings undergone were the only two variables which were having highly significant relationship with adoption at 1 per cent level of significance (Table 4). Remaining variables viz education, landholding, farming experience, economic motivation, social participation and risk orientation of farmers didn't have any significant relation with adoption. This might be because extension contacts and trainings undergone were the factors which really facilitated farmers to understand, develop confidence and practice the recommended package of DSR. Hence, more extension contacts and trainings would lead to more possibility of convincing farmers for enhanced adoption. Bhardwaj and Sidana (2017) concluded that one per cent increase in lectures attended by the respondent lead to increase in the technology adoption by 5.15 times.

Constraints in DSR cultivation as perceived by the farmers

Seventy one per cent of the farmers expressed that severe weed incidence was the major constraint in DSR at initial stages of the crop when alternate wetting and drying were practiced (Table 5). Next was the rat damage (69.00%) followed by lodging (57.00%). Crop cultivated in direct seed method was vulnerable to lodging, further leading to increased cost of harvesting (54.00%). Forty six per cent of the farmers faced problem with erratic rains while practicing DSR cultivation. Maintaining perfect leveling was expensive, hence 39.00 per cent farmers were neglecting leveling of fields which in turn was affecting the germination. Some farmers expressed constraints like increased cost of cultivation due to lodging (37.00%), increased fertilizers prices (35.00%), poor yield due to

Table 3. Farmers' perception on advantages of direct seeded rice adoption

Perception	Respondents (n =100)	
	f	%
Cost of cultivation is reduced when compared to normal transplanting	96	96.00
Dependence on manual labour is reduced	89	89.00
Able to complete sowing on time	87	87.00
Effective pre- and post-emergence herbicides are available	78	78.00
Crop duration is reduced by 7 to 10 days	75	75.00
Crop used to be healthy as compared to normal transplanting	69	69.00
Low pest and disease incidence	57	57.00
More water use efficiency and less water wastage	55	55.00
More number of productive tillers	52	52.00
Panicle length is higher as compared to transplanting rice	49	49.00
Increased yield in direct seeded rice	46	46.00
Effective fertilizer management is possible	38	38.00

Table 4. Relationship between profile of direct seeded rice farmers with their adoption level

Independent variable	Correlation coefficient (r)
Education	0.101^{NS}
Land holding	0.160^{NS}
Farming experience	0.111^{NS}
Economic motivation	0.129^{NS}
Social participation	0.146^{NS}
Extension contact	0.278**
Risk orientation	0.109^{NS}
Trainings undergone	0.364**

**Significant at 0.01% LoS, NS = Non-significant

Table 5. Constraints in direct sown rice cultivation as perceived by the farmers

Constraint	Respondents (n =100)	
	Frequency	%
Severe weed incidence	71	71.00
Rat problem	69	69.00
Yield loss due to lodging	57	57.00
Increased harvesting cost due to lodging	54	54.00
Erratic rains	46	46.00
Poor germination due to improper leveling	39	39.00
Increased cost of cultivation due to lodging	37	37.00
Increased fertilizers prices	35	35.00
Poor yields due to harvesting losses	32	32.00
Late canal water release	28	28.00

harvesting losses (32.00%) and late canal water release (28.00%).

Constraints expressed by the farmers clearly emphasized the extension gap existing in DSR cultivation. It is, therefore, needed that awareness and capacity building programmes are conducted focusing on effective weed management with pre- and post-emergence herbicides, using lodging resistant varieties to overcome the problem of yield loss and increased harvesting costs, importance of proper leveling for good germination percentage and

maintaining optimum plant stand even with recommended seed rate. Poor weed control and high weed infestation in the fields (84.16%) and crop lodging (79.16%) were the major constraints recorded in DSR cultivation by Naidu et al (2018) and Shaker et al (2020). Kakumanu et al (2019) and Kumar et al (2023) recorded imperfect levelling and weed infestation as major constraints in DSR.

CONCLUSION

Farmers in the Guntur district, Andhra Pradesh had been successfully adopting key practices recommended for DSR, such as soil management, sowing method, harvesting and water management. This indicated that when farmers saw clear benefits and received adequate guidance, they were willing and able to follow recommended agricultural practices.

Despite the overall positive adoption rate, there were critical areas where farmers were not fully adhering to recommended practices viz weed management (92.00%), fertilizer management (86.00%), seed rate (82.00%), insect pest management (77.00%), disease management (74.00%) and main field preparation (68.00%).

Farmers perceived significant benefits from adopting DSR technology, including reduced water usage, labour and fertilizer requirements, which contributed to more timely and efficient completion of crop activities. These perceived benefits were crucial for promoting the technology. The study highlighted that extension contact and the training sessions undergone by farmers were the only two variables with a highly significant relationship with the adoption of DSR practices.

This underscores the critical role of continuous and effective extension services in facilitating the adoption of new agricultural technologies. To improve adoption rates in the areas where farmers are falling short, targeted extension services and training programmes are needed. These should focus on educating farmers on the benefits of proper field preparation for better crop performance, providing effective, affordable solutions and training for weed and pest control, ensuring farmers understand the importance of proper fertilizer use and seed rates for optimal crop yield and offering comprehensive guidance and support for managing crop diseases.

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