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Assessing farmer preference for direct seeded rice cultivation in upper Assam

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Abstract

The study was conducted to assess the degree of preference for Direct Seeded Rice (DSR) cultivation among farmers in the Upper Brahmaputra Valley Zone of Assam. A total of 120 respondents were selected through the Proportionate Probability Sampling (PPS) method from Jorhat, Golaghat, and Sivasagar districts. Data were collected using a structured interview schedule and analyzed using descriptive statistics, Spearman's rank correlation, and one-way ANOVA (Analysis of Variance). Preferences were assessed across four aspects: climate adaptability, economic utility, resource utility, and behavioural compatibility. Among these, resource utility was most preferred (Mean Weighted Score: 3.53), followed by climate adaptability (3.27), economic utility (3.15), and behavioural compatibility (2.76). The majority (65.83%) of respondents exhibited a medium level of preference. Significant positive correlations were observed between DSR preference and variables such as training exposure, mass media exposure, economic motivation, and awareness of climate-smart technologies. One-way ANOVA showed no significant difference in preference across the three districts. These findings can guide extension agencies and policymakers in designing targeted interventions to promote DSR, focusing on the most valued aspects while addressing the less preferred ones. The study highlights DSR's potential as a sustainable and farmer-friendly alternative to traditional rice cultivation.

Keywords: Direct seeded rice, traditional rice cultivation, farmer preference, resource utility, climate adaptability, correlation

Introduction

Assam, with its rice-focused agricultural landscape, is predominantly reliant on rice as the leading cereal crop in terms of area, production, and yield. It has been instrumental in ensuring the state's food security. Around 90% of the population depends on rice as their staple food. Rice is cultivated throughout the state primarily as winter, summer (boro), and autumn rice, with bao rice also grown in certain low-lying regions (Bhuyan *et al.*, 2024) [1]. Rice is the predominant crop in Assam, occupying 2.54 million hectares of the state's total 4.16 million hectares of gross cropped area. It contributes 96% to the state's total food grain production, and Assam is widely recognized for its rich diversity of rice varieties (Rice Knowledge Bank, Assam., 2024) [2]. In the 2023-24 season, Assam's rice production was estimated at 6.04 million tonnes, with an average yield of 2652 kg/ha-reflecting a notable 37.93% increase from 4.38 million tonnes in 2021-22, when the yield averaged 1886 kg/ha (Economic Survey Report., 2023-24) [3]. In Assam, the transplanting method has been the conventional practice for rice cultivation for generations. However, it is labour-intensive, involving tasks like nursery preparation and manual transplanting, which contribute to increased physical strain and higher overall cultivation costs (Dutta *et al.*, 2021) [4]. Crop establishment involves nursery preparation, seedling raising, uprooting, and transplanting-practices that are labour- and water-intensive and increasingly unprofitable due to rising resource scarcity.

The labour required for transplanting rice has become insufficient as workers are increasingly moving away from agriculture towards employment in industries, public works, and overseas opportunities (Bhandaria *et al.*, 2020) [5]. Additionally, climate change-particularly shifts in rainfall patterns and rising temperatures has further impacted rice cultivation adversely in recent years. By the time 2030, an increase in temperature may cause a 12% reduction in rice yield, and changes in rainfall patterns may cause a 31.3% reduction in yield (Vyankatrao *et al.*, 2017) [6].

Therefore, to address these challenges, DSR may serve as a suitable alternative planting method. Direct seeded rice is seen to be one of the most efficient, sustainable, and economically-viable rice production systems used today. DSR is emerging as a viable alternative to conventional puddled transplanting due to its lower input requirements and multiple benefits, including reduced labour and water needs, early maturity, lower production costs, better soil conditions for subsequent crops, and reduced methane emissions (Kamboj *et al.*, 2022; Tyagi *et al.*, 2020) [7, 8]. In the transplanting method, approximately 3000-5000 liters of water are required to produce 1 kilogram of rice, whereas in the DSR method, approximately 1230 liters of water are required to produce 1 kilogram of rice. Using the DSR method, farmers can conserve water by anywhere between 25% and 35% compared to alternative planting methods (Indian Council of Agricultural Research., 2024) [9]. Kumar *et al.*, (2015) [10] and Choudhary *et al.*, (2016) [11] reported a 7-8% and 9-13% reduction in labour requirements, respectively, for DSR compared to manual transplanted rice (TPR) in Haryana. According to Pandey and Velasco (2002) [12], DSR can reduce labour requirements by up to 50%, depending on the production system. Bhullar *et al.*, (2018) [13] reported that farmers in Punjab were able to save 14 labour days per hectare through the adoption of DSR. Kumar & Batra., 2017 [14] reported that the Benefit-Cost (BC) ratio for DSR was 1.02, indicating a marginal profit. In contrast, the BC ratio for Transplanted Rice (TPR) was 1.00, suggesting a break-even scenario with neither profit nor loss. Despite slightly lower yields, the direct seeded method makes up for it through 20-30% cost savings and reduced resource use (Akhgari & Kaviani., 2017; Naresh *et al.*, 2013) [15,16]. The average paddy yield, total production cost, net economic benefits per hectare, and BC ratio for DSR were 3.09 t/ha, Rs. 1,12,047, Rs. 15,014, and 1.11, respectively, while for transplanted rice, the values were 3.19 t/ha, Rs. 1,34,882, Rs. -8,433, and 0.95. Hence, farmers earned profit from DSR but incurred a loss from transplanted rice cultivation (Younas *et al.*, 2015) [17].

DSR is crucial as it receives funding from the World Bank and the Government of Assam through the APART project. This prioritization of alternative rice cultivation methods aims to increase the B:C ratio and enhance the sustainability of agriculture. Understanding farmers' preference for DSR method can guide targeted demonstrations, enhance farmer capacity, and inform future policies to localize and refine the method effectively. In this context, the present study was undertaken to assess the degree of preference for DSR method compared to traditional method of planting.

Materials and Methods

Ex post facto research design was followed for the present study. The study was conducted during 2024 in three districts namely Jorhat, Golaghat, and Sivasagar of Upper Brahmaputra Valley Zone of Assam. All circles were purposively selected due to their high concentration of DSR farmers. From each of the selected ADO circles, one village was randomly chosen, resulting in a total of ten villages from which 120 DSR growers' sample were drawn using Proportionate Probability Sampling (PPS) method for in the study. The selected villages were- Pirakata bhorulua, Sologuri, Leferagaon, Dholajan, Gowalgaon, Baleshpuri, Upartemera, Ketekibari, Bhagyapur and Dicialgaon.

In alignment with the study's objectives, fifteen independent variables and one dependent variable were identified for analysis. Data were collected using a structured interview schedule. The degree of preference for the DSR method refers to the extent to which respondents favour the DSR approach, based on various factors such as efficiency, cost, labour requirements, environmental impact, and overall benefits.

The farmers were asked to choose the preference level of every statement in each category. The degree of preference was assessed on a four-point scale: not preferred (1) less preferred (2) moderately preferred (3) strongly preferred (4) against each attribute. The preferences were classified into four categories: climate adaptability aspects, economic utility aspects, resource utility aspects and behavioural compatibility aspects. Based on the farmers' responses, frequency distribution and percentages were calculated for each category followed by ranking according to the preference mean weightage score obtained for each attribute. The degree of preference was calculated and used for analysis using frequency, percentage, mean and standard deviation. Spearman's Rank Correlation Coefficient was applied to assess the relationship between the dependent and independent variables, while one-way ANOVA was conducted to identify significant variations in preference patterns among the three selected districts.

Results and Discussion

Degree of preference for DSR method

The data in Table 4.33 highlights the respondents' degree of preference for DSR cultivation practices across four major dimensions: climate adaptability, economic utility, resource utility, and behavioural compatibility.

Climate adaptability

The highest-ranked aspect under climate adaptability was that DSR reduces risks during unfavourable weather conditions, with a mean weighted score (MWS) of 3.79, indicating its reliability under unpredictable climatic scenarios. Respondents also appreciated its role in supporting long-term agricultural sustainability (MWS 3.23, Rank II). On the other hand, less susceptibility to damage from heavy rains and storms was ranked lowest in this category (MWS 3.03, Rank V), reflecting mixed opinions on its effectiveness under extreme weather events.

Economic utility

In terms of economic benefits, reduction in labour and input costs emerged as the most preferred factor (MWS 3.90, Rank I), showcasing its ability to reduce production expenses. Respondents also favoured the high return on investment due to efficiency and quality (MWS 3.74, Rank II). However, aspects like attractiveness for agricultural investors (MWS 2.36, Rank VIII) and potential for stable pricing (MWS 2.66, Rank VII) received relatively lower preferences.

Resource utility

Among resource utility aspects, reduces energy consumption due to fewer irrigation needs was highly preferred (MWS 3.88, Rank I), emphasizing its efficiency in water-scarce environments. Higher fertilizer use efficiency (MWS 3.74, Rank II) and effective rice production during water shortages (MWS 3.32, Rank III) were also positively viewed, highlighting the role of DSR in optimizing resource utilization.

Behavioural compatibility

Respondents ranked compatibility with existing knowledge and skills as the top factor under behavioural compatibility (MWS 3.72, Rank I), demonstrating that DSR aligns well with current farming practices. However, aspects like ease of scalability from small to large farms (MWS 1.60, Rank V) and availability of training (MWS 2.86, Rank III) were less favourably viewed, indicating areas for improvement in adoption support.

Overall, these findings reveal that economic savings, resource efficiency, and climate resilience are key drivers for farmers' preference for DSR, while challenges such as training and large-scale adaptability need to be addressed for broader adoption.

Table 1: Distribution of respondents according to their degree of preference for DSR cultivation practices (n=120)

Sl. No	Category	NP	LP	MP	HP	TWS	MWS	Rank
A	**Climate adaptability aspects**							
1	Reduces the risk in unfavorable weather conditions	3	0	16	101	455	3.79	I
2	Reduces methane emissions benefiting the environment	3	18	64	35	371	3.09	IV
3	Enhances crop tolerance to higher temperatures	0	28	39	53	385	3.21	III
4	Less susceptible to damage from heavy rains and storms	4	23	58	35	364	3.03	V
5	Supports long-term agricultural sustainability	0	20	53	47	387	3.23	II
B	**Economic utility aspects**							
6	Reduction in labour and input costs	0	4	4	112	468	3.90	I
7	Potential for stable pricing due to consistent quality	8	66	5	41	319	2.66	VII
8	Attractive for agricultural investors	3	83	22	12	283	2.36	VIII
9	Lower investment in cost of production	10	20	39	51	371	3.09	V
10	Growing demand for DSR due to depleting water resources and environmental concerns	7	41	38	34	339	2.83	VI
11	Potential for higher crop yields	0	23	50	47	384	3.20	IV
12	Lower losses during harvesting and storage	0	9	50	61	412	3.43	III
13	High return on investment due to efficiency and quality	0	0	31	89	449	3.74	II
C	**Resource utility aspects**							
14	Enhances soil structure and fertility	0	28	40	52	384	3.20	IV
15	Effective rice production method during water shortages	0	23	36	61	398	3.32	III
16	Higher fertilizer use efficiency	0	0	31	89	449	3.74	II
17	Reduces energy consumption due to fewer irrigation needs	0	0	15	105	465	3.88	I
D	**Behavioural compatibility aspects**							
18	Compatible with the existing knowledge and skills	0	0	34	86	446	3.72	I
19	Availability of training for farmers to adopt DSR	7	37	42	34	343	2.86	III
20	Easily scalable from small to large farms	65	38	17	0	192	1.60	V
21	Fits well with existing crop rotation systems	0	57	55	8	311	2.59	IV
22	Can be adapted to different regional practices and conditions	0	38	36	46	368	3.07	II

*Where, NP = Not Preferred, LP = Less Preferred, MP = Moderately Preferred, HP = Highly Preferred, TWS = Total Weighted Score, MWS = Mean Weighted Score

Table 2 summarizes the respondents' preferences for DSR cultivation practices across four key aspects: climate adaptability, economic utility, resource utility, and behavioural compatibility. Among these aspects, resource utility emerged as the most preferred, with a MWS of 3.53, ranking first. This highlights the importance of DSR in optimizing resources such as water, energy, and fertilizer, making it highly appealing in water-scarce and stressed environments. Climate adaptability was the second most preferred aspect (MWS 3.27, Rank II), showcasing farmers' appreciation for DSR's ability to mitigate risks associated with unpredictable weather conditions and its support for sustainable agricultural practices. Economic utility ranked third (MWS 3.15), reflecting the perceived financial benefits of DSR, such as reduced labour and input costs, alongside high returns on investment. Behavioural compatibility was ranked the lowest (MWS 2.76, Rank IV), indicating that while DSR aligns with some existing farming practices, certain factors like scalability and training availability remain areas for improvement to enhance adoption. These results emphasize the significance of resource optimization and climate resilience in driving farmer preferences for DSR, while also pointing to the need for better behavioural and training support for wider adoption.

Table 2: Distribution of respondents according to their preference for DSR cultivation practices under different aspects (n=120)

Sl. No	Aspects	MWS	Rank
1	Climate adaptability aspects	3.27	II
2	Economic utility aspects	3.15	III
3	Resource utility aspects	3.53	I
4	Behavioural compatibility aspects	2.76	IV

*MWS = Mean Weighted Score

Table 3 presents the distribution of respondents based on their degree of preference for DSR cultivation practices. The majority of respondents (65.83%) fell into the medium preference category, and an overall mean score of 69.53 (S.D. 5.75). Respondents with a high degree of preference for DSR practices accounted for 21.67%. Meanwhile, a smaller proportion (12.50%) expressed a low degree of preference. These findings underscore that a substantial portion of farmers have a favourable opinion of DSR cultivation, reflecting its perceived benefits such as resource optimization, economic savings, and adaptability to climatic conditions. The high consistency of preferences within the medium category highlights a strong and growing interest in the adoption of DSR practices.

Table 3: Distribution of respondents according to their degree of preference for DSR method (n=120)

Sl. No	Category	Score range	Frequency	Percentage	Mean	S.D.
1	Low	55 - 63.78	15	12.50		
2	Medium	63.78 - 75.27	79	65.83	69.53	5.75
3	High	75.27 - 78	26	21.67		
		Total	120	100		

Correlation and one-way ANOVA analysis between farmers' profile characteristics and their preference towards the DSR method

Spearman's rank correlation analysis (Table 4) revealed significant positive relationships between several profile characteristics and farmers' preference for the DSR method. Training exposure ($r = 0.539$, $p < 0.01$), mass media exposure ($r = 0.510$, $p < 0.01$), and awareness of climate-smart technologies ($r = 0.501$, $p < 0.01$) showed strong correlations, suggesting that better access to information and knowledge contributes to higher preference for DSR.

Economic motivation ($r = 0.382$, $p < 0.01$) and degree of commercialization ($r = 0.586$, $p < 0.01$) were also significantly correlated with preference, indicating that profit-oriented and market-linked farmers are more inclined towards DSR. Additionally, formal educational experience ($r = 0.218$, $p < 0.05$), operational landholding ($r = 0.224$, $p < 0.05$), labour engagement ($r = 0.190$, $p < 0.05$), and risk-bearing ability ($r = 0.202$, $p < 0.05$) showed moderate but significant positive associations.

Other variables including age, farming experience, income, extension contact, degree of innovativeness, and machinery possession showed no significant correlation. These results suggest that exposure to training and mass media, economic motivation, and progressive attitudes are more influential in shaping farmers' preferences for DSR than demographic or resource-based characteristics.

Table 4: Relationship between the profile characteristics of farmers and their preference towards the DSR method (n=120)

Sl. No	Variables	Spearman's coefficient of correlation (r)	*p* value
1	Age	-0.094	0.309
2	Formal educational experience	0.218*	0.017
3	Farming experience	0.028	0.758
4	Operational land holding	0.224*	0.014
5	Annual income	0.087	0.344
6	Labour engagement	0.190*	0.038
7	Mass media exposure	0.510**	0.000
8	Training exposure	0.539**	0.000
9	Extension contact	0.140	0.128
10	Economic motivation	0.382**	0.000
11	Degree of innovativeness	0.127	0.166
12	Risk bearing ability	0.202*	0.027
13	Degree of Commercialization	0.586**	0.000
14	Possession of agricultural machinery	-0.047	0.609
15	Awareness of climate smart technologies	0.501**	0.000

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

As presented in Table 5, the p-value (0.404) exceeds the 0.05 threshold, indicating no statistically significant difference in the degree of preference for the DSR method among the three districts. This suggests that farmers across the districts share similar preferences. Therefore, implementing uniform interventions such as awareness campaigns, training programs, and support services would be effective in enhancing farmers' preference for DSR across all regions, likely yielding consistent outcomes.

Table 5: Comparison between the extent of adoption of farmers and their preferences towards the DSR method across all three districts (n=120)

One way ANOVA analysis						
Variable		Sum of Squares	d.f	Mean Square	F	Sig.
Degree of Preference	Between Districts	60.501	2	30.251	0.914	0.404
	Within Districts	3871.424	117	33.089		
	Total	3931.925	119			

Conclusion

The study was conducted to assess the degree of preference for DSR over the traditional method of rice planting among farmers in the Upper Brahmaputra Valley Zone of Assam. The findings revealed that more than half of the respondents (65.83%) exhibited a medium degree of preference, followed by 21.67% with high and 12.50% with low preference. Among the four aspects considered for assessing preference, resource utility was the most preferred aspect with the highest MWS (3.53), followed by climate adaptability (3.27), economic utility (3.15), and behavioural compatibility (2.76). These results indicate that farmers prioritize resource utility, climate adaptability and economic utility over behavioural compatibility when adopting DSR. This highlights the potential of DSR as a suitable and sustainable method in rice cultivation, especially in resource-stressed conditions. Spearman's rank correlation analysis revealed significant positive associations between DSR preference and factors such as training exposure, mass media exposure, economic motivation, and awareness of climate-smart technologies. However, variables like age, education, income, and machinery possession were not significantly correlated. The ANOVA results indicated no significant differences in DSR preference across the three districts, suggesting similar attitudes among farmers throughout the region. The study suggests that targeted extension strategies focusing on the most valued attributes of DSR, along with efforts to improve less-preferred aspects, can enhance its wider acceptance and long-term adoption among rice farmers in Assam.

Policy implications

The study highlights that farmers across the Upper Brahmaputra Valley Zone exhibit a moderate and consistent preference for the DSR method, particularly valuing its resource-saving benefits. To enhance this preference and support widespread adoption, policymakers should focus on strengthening farmer training programs, ensuring timely availability of inputs and equipment, and promoting awareness through mass media and local extension networks. Targeted interventions to improve farmers' exposure to climate-smart practices and economic incentives can further support preference for DSR. Given the uniformity of preference across districts, region-wide policy approaches can be effectively implemented for consistent results.

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Conflict of Interest
All authors of this paper declare that there is no conflict of interest.

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