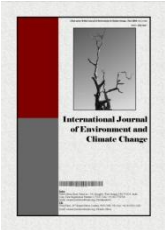

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A Study on Farmers Knowledge and Challenges with Direct Seeded Rice under the Rice-Wheat Cropping System in Eastern Uttar Pradesh, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Aim: To create awareness among the farmers about Direct seeded rice (DSR) which is resource-intensive technology to create a substitute of rice planting in Rice wheat cropping system.
Study Design: Survey method.
Place and Duration of Study: Krishi Vigyan Kendra (ICAR-IIVR) conducted training programs on dry-direct seeded of rice amongst the farming community in Deoria District, Uttar Pradesh, from Kharif 2010 to 2019.
Methodology: The study area of this new technology was undertaken by using a comprehensive questionnaire through a field survey of farmers who had adopted DSR during 2010 to 2019 in five blocks viz. Bhatparrani, Bhatni, Bankata, Salempur and Lar. Five villages were selected from each block and 6 dry-direct seeded of rice practicing farmers were selected purposively for this study.
Results: The research found that the majority of the respondents agreed that the potential advantages of direct seeded of rice technology must include cost savings (97.33 percent) followed by 96 percent of respondents are agreed that no need of puddling in direct seeded of rice technology followed by no need of seed bed preparation (94.66 percent) and 94 percent

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respondents are agreed with direct seeded of rice being a water wise technology, provides the solution, direct seeded of rice saves labor as it avoids nursery raising, uprooting seedlings, transplanting, and puddling (92 percent); 91.33 percent of respondents agreed that the total variable costs of rice were lower in direct seeded of rice (DSR) than in puddled transplanted rice (PTR). The main technical challenges most respondents experienced weed management is major problem 93.33 percent, Non availability of the quality seed and drill machine for direct sowing of rice (89.33 percent). The most effective training and educational barriers were a Lack of communication between the farming communities by the mass media agencies (82 percent), lack of awareness of the farming community regarding calibration of direct seeded of rice machine (74.66 percent). Lack of the cooperation between fellow farming community to share their experiences on direct seeded of rice (88 percent), community pressure (72.66 percent), higher cost of seed drill machine (79.33 percent) and Lack of awareness of farmer about minor adjustments of machine (85.33 percent) were also mentioned as significant constraints under the categories of socio-psychological economic and extension, respectively.

Conclusion: Direct seeded of rice is a desirable choice when the future of rice production is in jeopardy due to worldwide water constraint and rising labour costs.

Keywords: Direct seeded technology; front line demonstration; constraints; rice-wheat cropping system.

1. INTRODUCTION

One of the essential food crops, rice (*Oryza sativa* L.), is a staple diet for more than 50 percent of people worldwide. Being the second-largest food source after wheat, it provides 43% of the daily caloric needs of more than two thirds of Indians. India is the 2nd largest rice producer and the largest exporter of rice worldwide. Total production of Rice during 2021-22 is estimated at record 127.93 million tons. It is higher by 11.49 million tons than the last five years' average production of 116.44 million tons. Uttar Pradesh is second largest producer of paddy in India. In 2020, rice production for Uttar Pradesh was 15.52 million tons. In rice-wheat cropping systems, dry-direct seeded rice can be spread into a prepared seedbed wet (wet seeding) or dry bed (dry seeding), or underwater (water seeding). Rice is mainly cultivated by hand-transplanting in puddled (wet cultivation) fields in the IGP (Indo-Gangetic Plains). It has been demonstrated that puddling damages soil structure and uses water and energy. When agricultural labour was easily accessible and reasonably priced, this strategy of producing rice performed effectively for many years. However, during the past ten years, the Indian economy has seen a significant transition. Farm labour has been migrating throughout this time period to work in industries with better pay and working conditions than the typical employment on farms. This change in the labour force has been reflected in a sharp rise in farm labourer pay, which has reduced the profitability of the region's rice production. Due to over-exploitation of subterranean aquifers, the northern IGP has also seen a rapid fall in ground water levels, which has had a negative impact on the sustainability of irrigated agriculture. The need to create rice production methods that preserve labour, energy, and water has been prompted by the trend of rising labour prices and a drop in the ground water table. In areas like Punjab, certain recent governmental measures have made labour expenses even worse. Punjab's agriculture industry relies significantly on migrant labour. The cost of manually transplanting paddy has escalated from INR 1500 per ha in 2005 to more than INR 5000 per ha in 2012 after the Indian government implemented the MGNREGS (Mahatma Gandhi National Rural Employment Guarantee Scheme) in 2005 [1]. Many farmers in the northern and eastern regions of India switched from puddled transplanted rice to direct seeded rice (DSR) production due to the introduction of improved nutrient management techniques, early-maturing varieties, and expanding accessibility to chemical weed control methods. This modification should considerably reduce crop water requirements, soil organic matter turnover, nutrient interactions, carbon sequestration, weed biota, and greenhouse gas emissions. But weed infestation in direct seeded of rice might cause considerable productivity losses. Recent outbreaks of blast disease, crop lodging, low kernel quality, and steady yields over time are the main challenges in this regard. In this study, we discuss the findings and potential advantages.

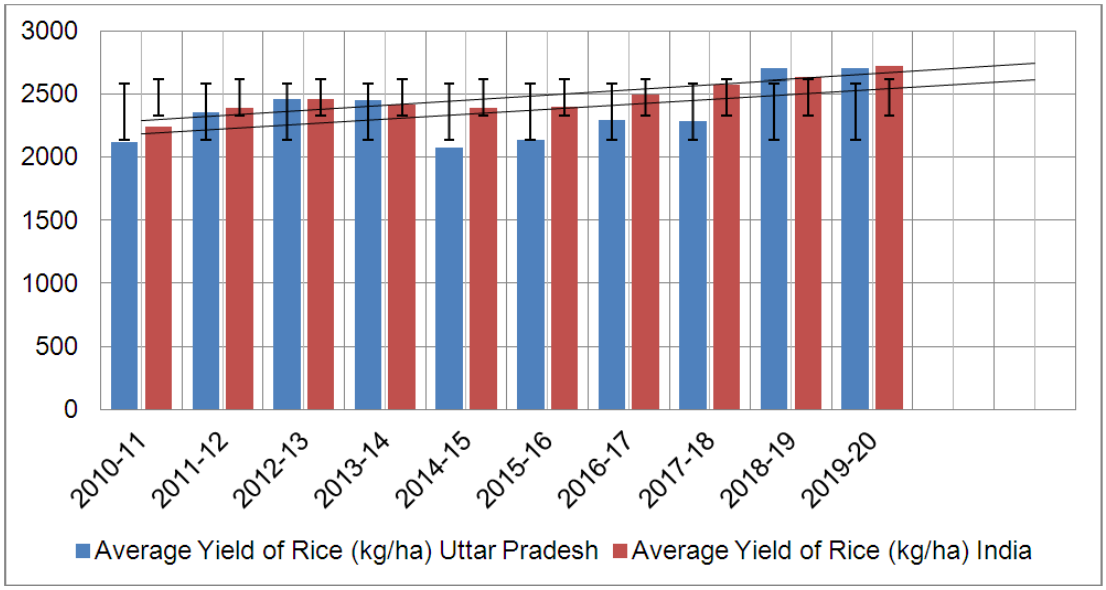

Fig. 1. Average yield of rice in India and Uttar Pradesh during from 2010-11 to 2019-20

2. METHODOLOGY

The Deoria district in Uttar Pradesh is comprised sixteen blocks and out of these, five blocks i.e. Bhatparrani, Bhatni, Bankata, Salempur and Lar were randomly selected for undertaking the agronomic and economic impact assessment of dry-seeded rice technology. Deoria district is located in Uttar Pradesh's North-Eastern Plain Zone. The average annual rainfall is approximately 1210 mm, and the climate ranges from damp to dry sub-humid. 73% of the land is used for agriculture, and tube wells are the primary source of irrigation for nearly half of the cultivated land. All farmers selected for the survey (n=150) in 25 selected villages had already adopted direct seeded of rice (Table 1). In the sampled villages, paddy-wheat crop rotation was adopted by 80% of the sampled farmers; followed by paddy/maize-wheat (12%) and rest of the farmers (8%) practiced others crop rotations. All farmers in this study irrigated their fields with tube-wells (bore wells), using underground water. The data on irrigation water, human labour and cost of cultivation was collected in the survey. Cost of cultivation of dry-direct seeded of rice and puddled transplanted rice was estimated, without taking into account the rental value of land. Gross returns were calculated by taking into account the retail price for rice and wheat by local markets. Returns over variable costs were calculated for assessing the economic viability of this technology.

3. RESULTS AND DISCUSSION

3.1 Knowledge Based Survey of the Farmers

The information in Table 1 showed that farmers are aware of the direct seeded of rice technique usage. Majority (97.33 percent) of respondents agreed that the total variable costs of rice were lower and higher net return in direct seeded of rice. Gill et al., 2013 also previously reported that there are more incredible economic benefits and labour savings in direct seeded rice as compared to puddle transplanted rice. 96 percent of respondents are agreed that no need of puddling in direct seeded of rice technology, No need of seed bed preparation (94.66 percent), 94 percent respondents are agreed with direct seeded of rice being a water wise technology, provides the solution. Direct seeded of rice is more water efficient and has an advantage over puddle transplanted rice [2]. Direct seeded rice save labor as it avoids nursery raising, uprooting seedlings, transplanting, and puddling (92 percent). Amongst variable cost components, in puddled transplanted rice, the planting operation accounted for 40 percent of the total variable cost. In comparison, it was only 19 percent in dry direct seeded of rice. Such significant differences between the two paddy cultivation systems are directly related to labor savings in dry direct seeded of rice just at the time of planting, which has been a big factor in the acceptance of an advanced technique in the state. The higher economic returns and labour savings in direct

seeded of rice as compared to puddled transplanted rice have also been reported earlier [3]. The government is promoting this technology by providing subsidized machines and less requirements of labours (90 percent), Use of pre and post-emergence herbicides is necessary to the success of direct seeded of rice (89.33 percent), Better choice to be the greatest match for various cropping pattern and ground water conservation through direct seeded of rice system (88 percent), There is minimum wear and tear of the tractor in direct seeded of rice technology (87.33 percent), More profitable, especially when using irrigation facilities that are guaranteed (85.33 percent), Due of the potential for more weed problems in direct seeded of rice than in puddled transplanting, prompt weed control practices are required (84.33 percent), Sowing of rice through direct seeded of rice method is suitable for rain fed lowland condition (83.33 percent), The fertilizers are placed at right depth in the soil through dry-direct seeded of rice machine (82 percent), Direct seeded of rice technology conserves natural resources like soil, water and environment as well as improve the soil health (81.33 percent), Increased water stress tolerance and more effective water utilization with direct seeded of rice technology (76.66 percent), The crop vigor is better in direct seeded of rice system than puddled transplanted rice (75.33 percent), Early crop maturity 7-10 days before under direct seeded of rice than puddled transplanted rice (69.33 percent), The more grain yield in direct seeded of rice as compared to puddle transplanted rice (65.33 percent), Requirement of less seed under direct seeded of rice system (62 percent), Drudgery reduction is lower under direct seeded of rice than puddle transplanted rice (61.33 percent), Improvement of soil physical conditions for following crops under direct seeded of rice system(60.66 percent), direct seeded of rice is very simple and does not require any specific skill (54 percent). The seed is placed at the right place and depth under direct seeded of rice system (52.66 percent) and sowing of this method no adverse effect on seed germination (51.33 percent).

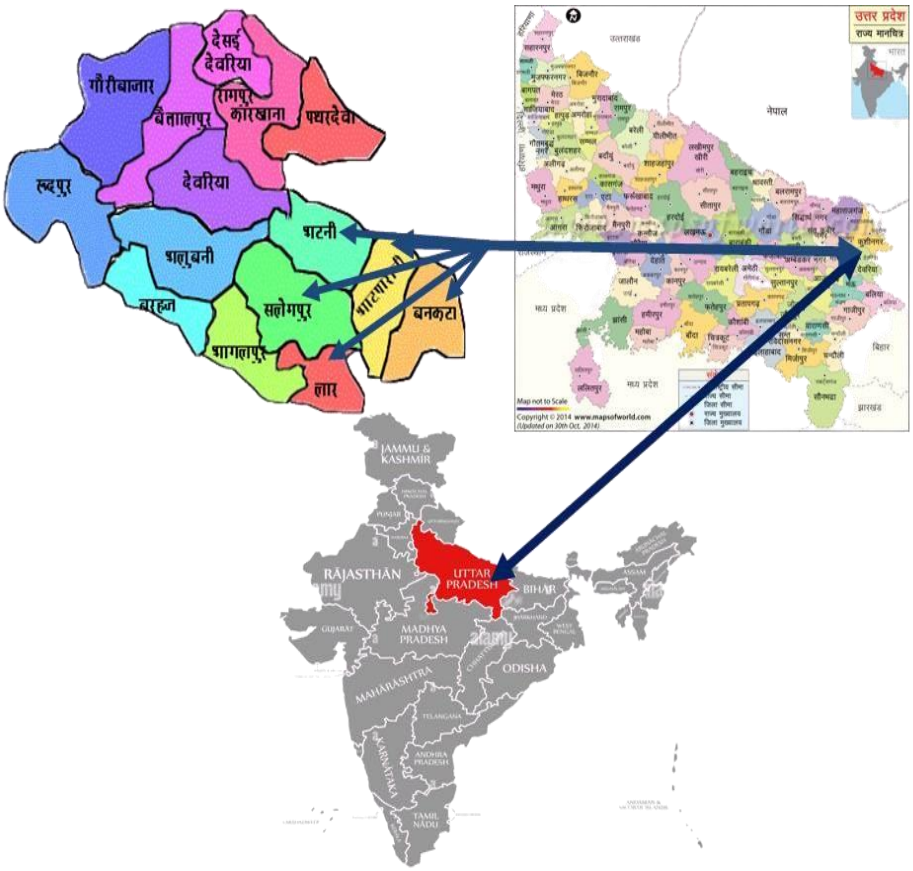

Fig. 2. Location of survey site

Table 1. Farmers knowledge with direct seeded of rice technique (n=150)

Particulars	Frequency	Percentage
No need of seed bed preparation	142	94.66
No need of puddling	144	96.00
Less requirement of seed	93	62.00
Less drudgery	92	61.33
Less requirement of labors	135	90.00
Early crop maturity 7-10 days before than PTR	104	69.33
Low production cost and higher net return	146	97.33
The more grain output of DSR than PTR	98	65.33
Improved soil physical characteristics for subsequent crops	91	60.66
Water saving is very high comparison with PTR	141	94.00
DSR is very simple and does not require any specific skill.	81	54.00
DSR Technology conserves natural resources like soil, water and environment.	122	81.33
Increased water stress tolerance and more effective water utilization.	115	76.66
Financially profitable, especially when using irrigation facilities that are assured	128	85.33
The increasing cost and labor scarcity during peak times	139	92.00
Provides more option to be the perfect suited in different cropping systems.	132	88.00
The fertilizers are placed at right depth in the soil.	123	82.00
The seed is placed at the right place and depth.	78	52.66
The crop vigor is better than PTR.	113	75.33
Timely weed management practice is necessary.	127	84.66
Use of pre and post-emergence herbicides is necessary in DSR	134	89.33
No adverse effect on seed germination	77	51.33
Suitable for rainfed lowland areas	125	83.33
There is minimum wear and tear of the tractor in DSR.	131	87.33
The government agencies are promoting this technology by providing subsidized machines.	135	90.00
Improves the soil health through DSR comparison to PTR	122	81.33
Saving of ground water by DSR	130	88.00

3.2 Constraints Associated with Direct Seeded Rice

Constraints associated with direct seeded rice faced were classified into five categories namely technical constraints, Training and Educational constraints, financial constraints, Socio-Psychological constraints and extension constraints. The expected constraints faced by the trainee farmers in adapting the DSR technique have been presented in Fig. 1 to 4 and Table 2.

3.2.1 Technical constraints

The data pertaining to technical constraints faced by farmers is presented in Fig. 3 that weed management is major problem 93.33 % was the most important problem faced by the farmers as it ranked on first position, Non availability of the quality seed drill machine for direct sowing of rice (89.33%) got second rank, lack of local mechanic to repair the machine (86%) got third rank, Lack of easy availability of machine parts in local markets (78.66% got fourth rank, Poor quality material used in the subsidized drill machines (65 percent) got fifth rank, Problems of crop lodging (51.33%) got sixth rank, Emergence of Weedy Rice in under direct seeded of rice condition (42.66%) got seventh rank, Shift and changes in weed flora under direct seeded of rice condition (40.66%), got eighth rank, Development of Herbicide Resistance in direct seeded of rice (37.33%) got ninth rank, Stagnant of rice yield under direct seeded of rice condition (29.33%) got tenth rank, Yield may be decline in direct seeded of rice (26%) got eleventh rank. According to [4] reported that small yield of rice penalty of 2 to 5% in first year of direct seeded rice adoption in study area. However, after one to two years of adoption and experience, direct seeded rice yields were similar to or slightly higher than puddle transplanted rice. More problem of diseases and insect pests under

direct seeded of rice system (24%) got twelveth rank, Shows the nutrient disorders, especially nitrogen and micronutrients (22.66 percent) got thirteenth rank and more problems of soil-borne pathogens in direct seeded of rice (22.33%) got last rank were also constraints in adopting this technology.

3.2.2 Training and education constraints

Regarding the training and educational constraints as evident from the data presented in Fig. 4. Lack of communication between the farming community by the mass media agencies was observed as the most serious constraints (82 percent) got first rank followed by lack of awareness between the farming community regarding calibration of direct seeded of rice machine was (74.66 percent), lack of training programmes related to direct seeded of rice (61.33 percent) and Inadequate extension literature on direct seeded of rice technology (58.66 percent) got rank II, III and IV respectively.

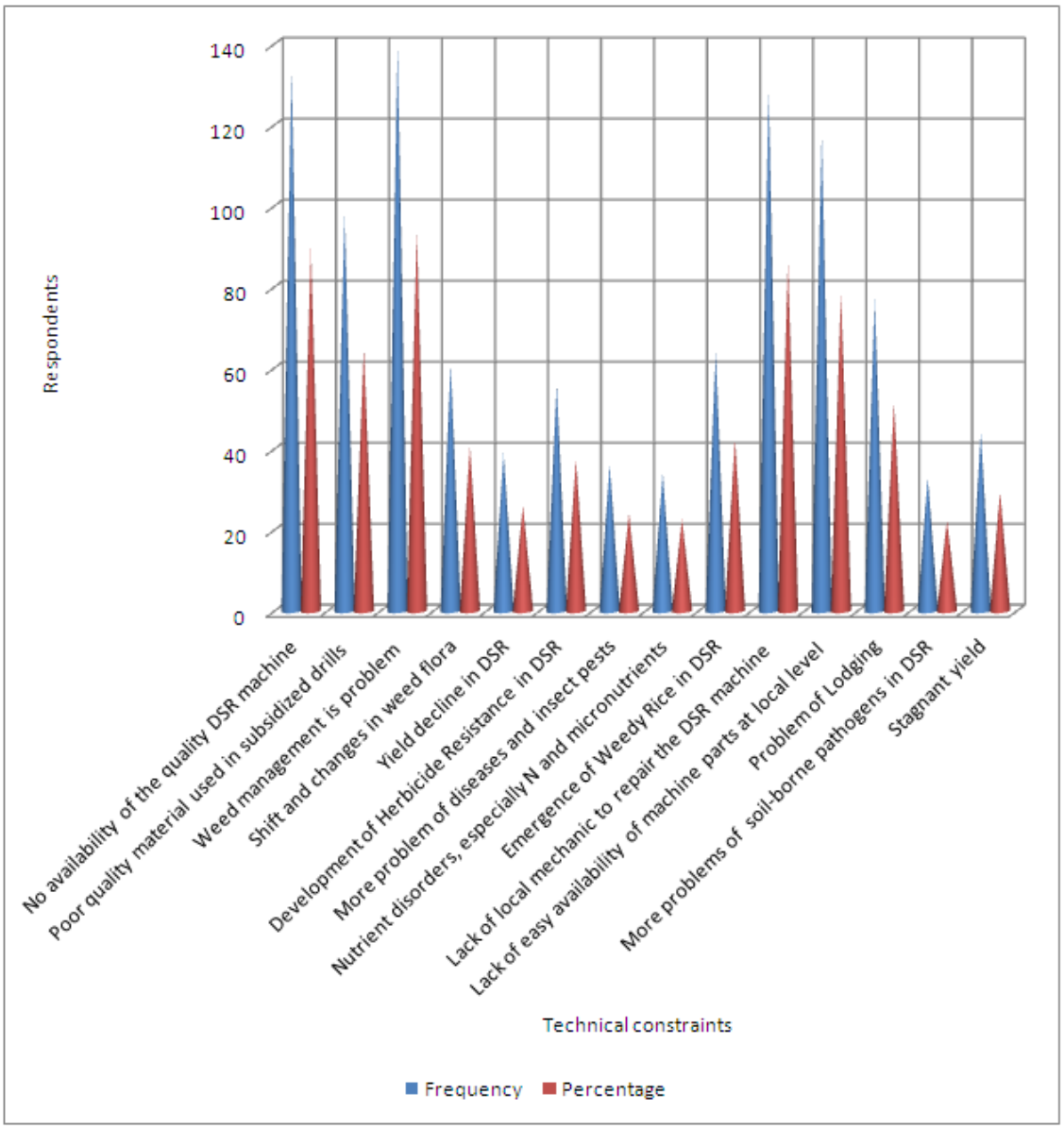

Fig. 3. Shows the numbers of respondents based on technical constraints faced in the adoption of DSR

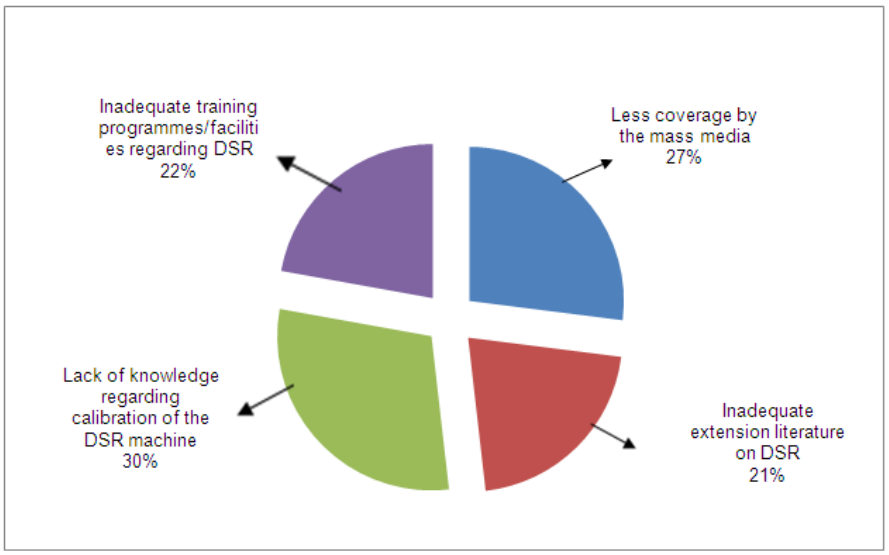

Fig. 4. Shows percentage of respondents based on training and education constraints faced in the adoption of dry-direct seeded of rice

3.2.3 Social-psychological constraints

The data presented in Fig. 5 reveals that among the most serious constraints Lack of the cooperation between fellow farming community to share their experiences on direct seeded of rice (88%) got first rank, community pressure (72.66 %) got second rank, poor field experience (57.33%) got rank III and hearsays and rum ours about direct seeded of rice technology (52.66%) got last rank were also constraints in adoption of direct seeded of rice technology.

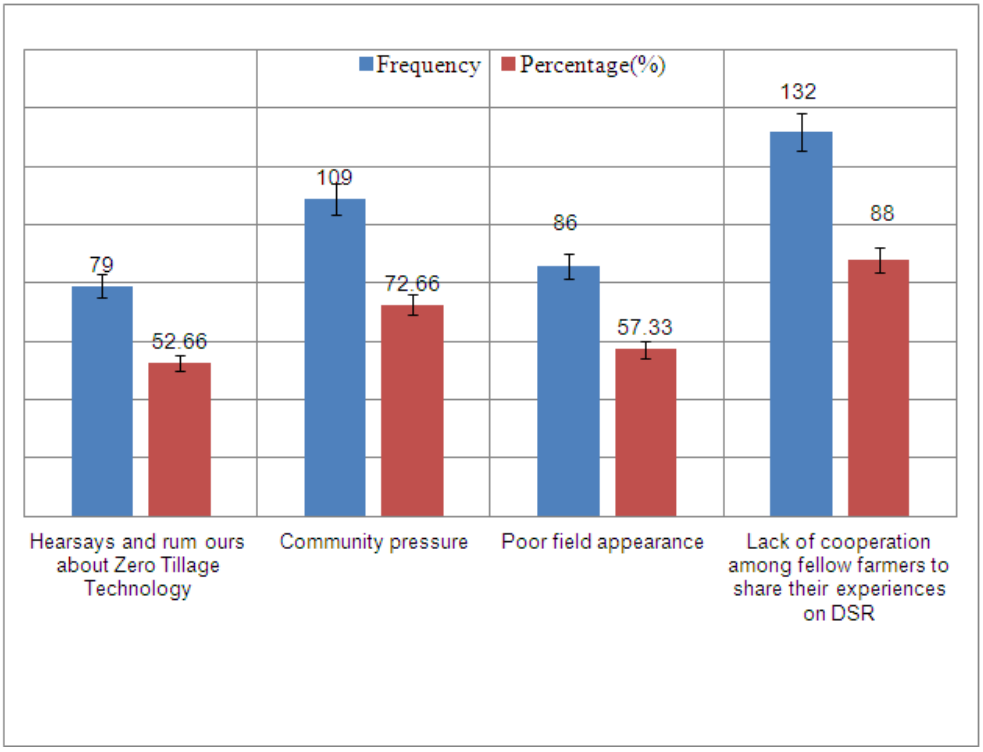

Fig. 5. Shows number of respondents based on the social-psychological constraints faced in the adoption of dry- direct seeded of rice

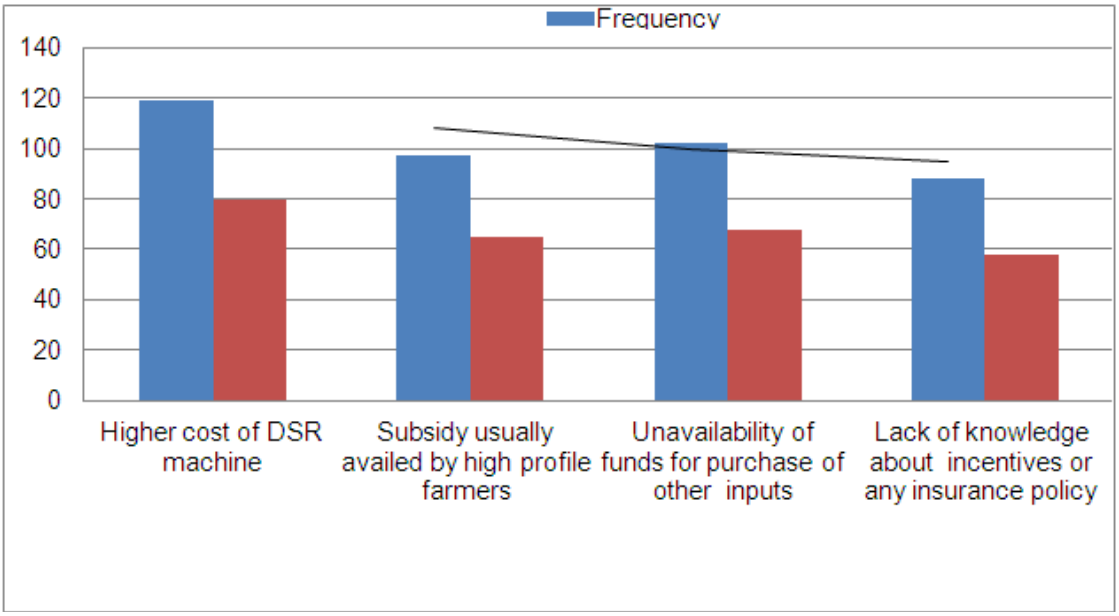

Fig. 6. Shows number of respondents based on the financial constraints faced in the adoption of dry-direct seeded of rice

Table 2. Shows the number of respondents based on the extension constraints faced in the adoption of dry-direct seeded of rice

Extension Constraints	Frequency	Percentage (%)	Rank
Lack of awareness of farmer about minor adjustments of machine	128	85.33	I
Lack of attention of mass media	87	58.00	VI
Lack of extension literature	112	74.66	III
Inadequate extension facility at the disposal of input agencies	103	68.66	IV
Lack of trained field experts who give live demonstration of machine setting at farmers' field	121	80.66	II
Lack of adequate manpower from state extension agencies	96	64.00	V

3.2.4 Financial constraints

Among the Financial constraints higher cost of seed drill machine (79.33 percent) of respondents reported major constraints followed by Unavailability of funds for purchase of other inputs (68.00 percent), Subsidy usually availed by high profile farmers (64.66 percent), and 58 percent of respondents reported that the Lack of knowledge about incentives or any insurance policy as indicated in Fig. 6.

3.2.5 Extension related constraints

The data presented in Table 2 reveals that the most serious constraints like Lack of awareness of farmer about minor adjustments of machine (85.33%) got rank I, Lack of trained field experts who give live demonstration of machine setting at farmers' field (80.66 percent) got rank II, lack of extension literature (74.66%) got rank III, Inadequate extension facility at the disposal of input agencies (68.66%) got rank IV, lack of adequate manpower from state extension agencies (64%) got rank V and lack of attention of mass media agencies (58%) got rank VI got last rank.

The direct seeded of rice method has been shown to be superior than the transplanting system in several research conducted in India and abroad. These studies [5] demonstrate that direct seeded of rice crops are not only more

profitable, but also quicker and simpler to grow, less labor-intensive, and water-efficient, making them amenable to mechanization [6] When compared to transplanted rice, it tends to blossom earlier, resulting in shorter crop duration [7]; mature 7–10 days quicker; and emit less methane [8], (Pandey and Velasco, 1999).To improve the sustainable development of the rice-wheat cropping system and have successful winter crops, especially early sown wheat, additional dry-seeding on flat land or raised beds with successively saturated soil conditions reduces the amount of water needed for land preparation and thus overall water demand [9]; (Ladha et al. 2003).

4. CONCLUSION

Direct seeded rice is a desirable choice when the future of rice production is in jeopardy due to worldwide water constraint and rising labour costs. Despite disagreements, if correctly managed, direct seeded rice and transplanting systems can give yields that are equivalent. If suitable soil types from leveled land are chosen, water use efficiency and production in direct seeded of rice cultivation may rise. In direct seeded rice, further methane gas emissions are greatly decreased.

From the present discussion, it can be inferred that dry-direct seeded of rice technology offers a sizable advantage over the current way of rice farming in terms of both total water usage and financial rewards. Direct seeded of rice prevented the need for more workers than were necessary for paddy transplanting, which was a huge relief for the state's growers of rice crop during the transplanting season. Direct seeding rice saves on additional irrigations by 33 to 40% compared to conventionally planted rice, which is a very good solution to the state's constantly dropping water table.

Thus, the technology of direct seeded rice has to be improved upon and made more widely known on heavy soils in order to address the serious problem of ground water depletion and labour scarcity before the viability of the current system of agriculture in the state. Although challenges to direct seeded of rice include weed flora, NO2 emissions, lodging, and blast assault, biotechnological and genetic techniques may be able to deal with these problems.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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