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An Economic Analysis of Cultivation of Direct Seeded Rice vs. Transplanted Rice in Irrigated Sub-Tropics of Jammu region of J&K (U.T.): Constraints and way forward

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ABSTRACT

Rice is a staple crop in the irrigated subtropics of Jammu and Kashmir (UT). Farmers in this region have always grown rice using the transplanted method. However, because to its ability to save water, labour, and time, the direct seeding method has gained popularity in recent years. This research gives an economic analysis of direct seeded rice vs. transplanted rice farming in the irrigated subtropics of Jammu. The research compares the yield, costs, and profitability of the two techniques. The study also analyses the restrictions and obstacles that farmers encounter while implementing direct seeding and suggests viable solutions to these challenges. In terms of yield, cost savings, and profitability, the results demonstrate that direct seeding can be a viable alternative to transplanting. However, various restrictions, such as weed management, a lack of proper technology, and farmer education, impede direct seeding implementation. To overcome these limits, the study advises promoting extension services, developing appropriate machinery, and implementing proper weed management practises. Overall, the study suggests that, if the constraints are addressed, direct seeding can be a sustainable and profitable method of rice farming in the irrigated subtropics of Jammu.

Keywords: Direct Seeded Rice, Transplanted rice, Sowing, Constraints, Farmers

Rice is cultivated in India in a very wide range of ecosystems from irrigated to shallow lowlands, mid-deep lowlands and deep water to uplands. In India, transplanting is the mostly adopted method of rice establishment. Conventional tillage and crop establishment by transplanting is the most input intensive process in an agro-system and, therefore, more efficient alternatives are urgently needed. Rice culture being the most intense-water-consuming practices, water saving technique for rice culture had long been documented. Conventional flood irrigation technique in the unleveled fields leads to over irrigations (Corey and Clyma, 1973). About 30 per cent of water in world is used to produce rice.

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Water utilization in flood irrigated rice is about 2-3 times more than other crops like wheat and maize. Excessive extraction of groundwater through tube wells to meet the water requirements of transplanted paddy causes groundwater depletion.

DSR method has been used throughout Asia for the past decades and still stands. In traditional rice cultivation, rice was sprouted in a nursery, sprouted seedlings were then transplanted into standing water in the main field. With direct seeding, seed is sown directly into the main field, eliminating the laborious process of planting seedlings by hand and greatly reducing the crop's water requirements. Direct seedling process establishes the crop where seeds are sown directly in the main field rather than by transplanting seedlings from the nursery (Farooq *et al*. 2011).

Direct seeding of rice wherein the crop is established through direct seeding in non-puddled, non-flooded fields, is the most promising approach for saving water and labour (Bhushan *et al*. 2007). Direct seeding of rice and wheat after no tillage performed as well as the conventional practice but with significant savings in water and labour use (Bhusan *et al*. 2007). Direct-seeding is cost-effective, can save water through earlier rice crop establishment, and allows early sowing of wheat (Ladha *et al*. 2003a; Singh *et al*. 2003). The direct seeded method is beneficial as it requires less water, labour and capital inputs as compared to the traditional transplanted method of paddy cultivation. Water productivity in DSR was 0.35 and 0.76, and in transplanting rice was 0.31and 0.57 during 2002 and 2003, respectively, showing better water-use efficiency (Gill *et al*. 2006). In addition, direct seeded rice matures earlier (7-10 days) than the transplanted rice allowing timely sowing of the succeeding wheat crop and other crops (Singh *et al*. 2006). Other benefits of direct seeded rice include faster and easier planting, improvement of soil health, less methane emission and often higher profit in areas with an assured water supply.

The rising in labour cost and need to intensify rice production through double and triple cropping provided the economic incentives for a switch to direct seeding. In the future, rice farmers will have to deal with the anticipated increasing scarcity of irrigation water as the demand for water expands. Under water scarcity condition direct seeded methods, especially dry seeding may help in achieving higher water use efficiency. With increase in scarcity of water, limited area and increasing scarcity of labour influenced the need for technologies, which produce more grain per available limited resources.

Different researchers have their own different opinions about the benefits of direct seeded rice cultivation. In order to analyze the major constraints face by the growers of DSR and Transplanted Rice, present investigation with the following objective was under taken in the irrigated sub- tropics of Jammu region of J&K (UT):

Objective

- To analyse the constraints for adoption of DSR and production of DSR and transplanted rice.

Hypothesis

- Unavailability of seed drill and non-technical knowledge are the major constraints hindering the adoption of DSR.

MATERIALS AND METHODS

The present study was conducted in the irrigated sub-tropics zone of Jammu Region of J&K (UT). The multistage random sampling technique was used. At first stage three districts of Jammu region *viz.* Jammu, Kathua and Samba were selected purposely on the basis of majority number of farmer cultivating direct seeded rice fell in these areas, as per the list provided by the Department of Agriculture and Farmer's Welfare UT of J&K. From the available list of all the three districts a sample of 150 farmers cultivating direct seeded rice were selected randomly (using the technique of simple random sampling without replacement) through proportional allocation and equal number of farmers cultivating transplanted rice were selected randomly from the same area comprising a total sample size of 300 farmers. Both primary and secondary data were used to accomplish the objective of the study. The primary data were collected through survey method by interviewing the farmers with the help of an especially prepared and pre-tested schedule. The secondary data were collected from various authentic sources/ agencies. For achieving the objective of study, the collected data were analyzed using Descriptive statistic and

other relevant statistical techniques were used. To analyze the constraints the garret ranking technique having the following form, was used:

$$Per\ cent\ position = 100*(R_{ij} - 0.5) / N_j$$

Where, R_{ij} stands rank given for the i^{th} factor (i = 1, 2……) by the j^{th} individual (j = 1, 2….) and N_j stands for number of factors ranked by j^{th} individual.

Once the per cent positions will be found, scores will be determined for each per cent position by referring Garrett's table. Then the scores for each factor will be summed over the number of households who will rank that factor. In this way, total scores will be arrived at for each factor and mean scores will be calculated by dividing the total score by the number of respondents, who will give ranks. Finally, overall ranking of the eight factors will be done by assigning rank 1, 2, 3…8 in the descending order of the mean scores. The same procedure will be followed for different areas of Jammu district.

RESULTS AND DISCUSSION

The major constraints faced by farmers in the cultivation of direct seeded rice (DSR) in the irrigated sub-tropics of Jammu region, J&K (UT) were identified using Garret's ranking technique. The results so obtained were presented in tables from table 01 to 08.

(a) Jammu district

The findings, presented in Table 1, revealed that high weed infestation was the most significant constraint (I), with an average score of 77.64. Lack of knowledge about seed rate was ranked second (II) with an average score of 67.32, followed by wrong sowing time ranked third (III) with an average score of 57.58. The moderate level constraints included.

Lack of technical knowledge about land preparation ranked fourth (IV) with an average score of 55.78 and lack of knowledge about first irrigation ranked fifth (V) with an average score of 52.7. Lack of scientific knowledge about using happy seed drill for seed depth was ranked sixth (VI) with an average score of 44.12. Lack of good quality improved varieties, seed, and planting material was ranked seventh (VII) with an average score of 36.69. Lack of suitable equipment at the required time, such as tractors and seed drills, was ranked (VIII) with an average score of 36.5. Lastly, the increase in soil-borne pathogens such as nematodes was identified as the least significant constraint, ranked last (IX) with an average score of 22.12.

Table 1: Garrett's ranking scores of major constraints faced by direct seeded rice growers in Jammu District

Problems	Garret score	Rank
Wrong Sowing time	57.58	3
Lack of knowledge about Seed rate	67.32	2
Increase in soil-borne pathogens such as nematodes	22.12	9
High weed Infestation	77.64	1
Lack of technical knowledge about Land preparation	55.78	4
Lack of knowledge about first Irrigation	52.7	5
Lack of scientific knowledge about using happy seed drill for seed Depth.	44.12	6
Lack of good quality improved varieties, seed and planting material.	36.69	7
Lack of suitable equipments at required time e.g. tractor, Seed Drill etc.	36.50	8

The figures in Table 2, have revealed that the foremost challenge was the unavailability of skilled labour (I), with an average score of 67.16.

Table 2: Garrett's ranking scores of major constraints faced by Transplanted rice grower of Jammu district

Problems	Garret score	Rank
Unavailability of Skilled Labour	67.16	1
Lack of suitable equipments e.g. Tractor etc	65.12	2
Climatic problems e.g. irregular rainfall, storm, climate change etc.	62.48	3
Lack of technical know-how/lack of scientific knowledge about Rice cultivation	62.04	4
Non- availability of desired brand of plant protection chemical	43.84	5
Lack of extension facilities	37.88	7
Inadequate irrigation facilities	36.76	8
Lack of good quality improved varieties, seed and planting material, fertilizer	41.4	6
Crop damage by stray Animals	32.28	9

The second most significant issue was the lack of suitable equipment, such as tractors, with an average score of 65.12. Climatic problems, including irregular rainfall, storms, and climate change, were ranked third (III), with an average score of 62.48. Moderate level constraints included the lack of technical knowledge or scientific expertise in rice cultivation, ranked fourth (IV), with an average score of 62.04, and non-availability of the desired brand of plant protection chemicals, ranked fifth (V), with an average score of 43.84. Additionally, a lack of good quality improved varieties, seed, planting material, and fertilizer was ranked sixth (VI), with an average score of 41.4. Lack of extension facilities was ranked seventh (VII), with an average score of 37.88, followed by inadequate irrigation facilities, ranked eighth (VIII), with an average score of 36.76. Lastly, crop damage by stray animals was identified as the least significant constraint, ranked last (IX), with an average score of 32.28.

(b) Kathua district

The study conducted an analysis of the major constraints faced by farmers in the cultivation of direct seeded rice (DSR) in the irrigated sub-tropics of Kathua region, J&K (UT) using Garret's ranking technique, which is presented in Table 3.

Table 3: Garrett's ranking scores of major constraints faced by direct seeded rice growers in Kathua District

Problems	Garret score	Rank
Wrong Sowing time	56.68	3
Lack of knowledge about Seed rate	34.72	8
Increase in soil-borne pathogens such as nematodes	24.04	9
High weed Infestation	77.88	1
Lack of technical knowledge about Land preparation	53.6	5
Lack of knowledge about first Irrigation	54.38	4
Lack of scientific knowledge about using happy seed drill for seed Depth.	45.42	6
Lack of good quality improved varieties, seed and planting material.	38.76	7
Lack of suitable equipments at required time e.g. tractor, Seed Drill etc.	65.48	2

The results indicated that high weed infestation was ranked as the most significant constraint (I), with an average score of 77.88, followed by lack of suitable equipment at the required time, such as tractors and seed drills, ranked second (II) with an average score of 65.48. Wrong sowing time was ranked third (III) with an average score of 56.68. The moderate level constraints were lack of knowledge about first irrigation ranked fourth (IV) with an average score of 54.38 and lack of technical knowledge about land preparation ranked fifth (V) with an average score of 53.6. Lack of scientific knowledge about using happy seed drill for seed depth was ranked sixth (VI) with an average score of 45.42. Lack of good quality improved varieties, seed, and planting material was ranked seventh (VII) with an average score of 38.76. Lack of knowledge about seed rate was ranked (VIII) with an average score of 34.72, and increase in soil-borne pathogens such as nematodes was ranked last (IX) with an average score of 24.04.

Table 4 revealed that the most pressing challenge was the unavailability of skilled labor (I), with an average score of 70.46. The second most significant issue was the lack of appropriate equipment, such as tractors, with an average score of 65.88. Thirdly, a significant challenge faced by farmers was the lack of technical know-how and scientific knowledge about Rice cultivation, with an average score of 63.78.

Table 4: Garrett's ranking scores of major constraints faced by Transplanted rice grower of Kathua District

Problems	Garret score	Rank
Unavailability of Skilled Labour	70.46	1
Lack of suitable equipments e.g. Tractor etc	65.88	2
Climatic problems e.g. irregular rainfall, storm, climate change etc.	63.04	4
Lack of technical know-how/lack of scientific knowledge about Rice cultivation	63.78	3
Non- availability of desired brand of plant protection chemical	38.16	7
Lack of extension facilities	38.74	6
Inadequate irrigation facilities	35.68	8
Lack of good quality improved varieties, seed and planting material, fertilizer	40.02	5
Crop damage by stray animals	33.98	9

Moderate level constraints included Climatic problems, such as irregular rainfall, storms, and climate change, ranked fourth (IV), with an average score of 63.04, and lack of good quality improved varieties, seeds and planting material, fertilizers, ranked fifth (V), with an average score of 40.02. Furthermore, the absence of extension facilities was ranked sixth (VI), with an average score of 38.74. Non- availability of desired brand of plant protection chemical was ranked seventh (VII), with an average score of 38.16, followed by inadequate irrigation facilities, ranked eighth (VIII), with an average score of 35.68. Lastly, crop damage by stray animals was identified as the least significant constraint, ranked last (IX), with an average score of 33.98.

(c) Samba district

The results presented in Table 5 indicated that high weed infestation was ranked as the most significant constraint (I), with an average score of 74.68, followed by wrong sowing time, ranked second (II) with an average score of 66.94. Lack of knowledge about first irrigation was ranked third (III) with an average score of 60.44.

Table 5: Garrett's ranking scores of major constraints faced by direct seeded rice growers in Samba District

Problems	Garret score	Rank
Wrong Sowing time	66.94	2
Lack of knowledge about Seed rate	37.54	8
Increase in soil-borne pathogens such as nematodes	30.86	9
High weed Infestation	74.68	1
Lack of technical knowledge about Land preparation	51.68	4
Lack of knowledge about first Irrigation	60.44	3
Lack of scientific knowledge about using happy seed drill for seed Depth.	47.32	5
Lack of good quality improved varieties, seed and planting material.	37.72	7
Lack of suitable equipments at required time e.g. tractor, Seed Drill etc.	44.26	6

The moderate level constraints were lack of technical knowledge about land preparation ranked fourth (IV) with an average score of 51.68 and lack of scientific knowledge about using happy seed drill for seed depth ranked fifth (V) with an average score of 47.32. Lack of suitable equipment at required time, e.g. tractor, seed drill, etc., was ranked sixth (VI) with an average score of 44.26. Lack of good quality improved varieties, seed, and planting material was ranked seventh (VII) with an average score of 37.72. Lack of knowledge about seed rate was ranked eighth (VIII) with an average score of 37.54, and increase in soil-borne pathogens such as nematodes was ranked last (IX) with an average score of 30.86.

The research findings, which are presented in Table 6, have demonstrated that the most pressing challenge identified was the unavailability of skilled labor, with an average score of 70.32. This was followed by the lack of appropriate equipment, such as tractors, with an average score of 64.62. Additionally, a significant constraint faced by farmers was the lack of good quality improved varieties, seeds, planting material, and fertilizers, with an average score of 63.86. Moderate level constraints included lack of technical know-how and scientific knowledge about Rice cultivation, ranked fourth (IV), with an average score of 63.86, and Non-availability of desired brand of plant protection chemical ranked fifth (V), with an average score of 40.94.

Table 6: Garrett's ranking scores of major constraints faced by transplanted rice grower of Samba district

Problems	Garretescore	Rank
Unavailability of Skilled Labour	70.32	1
Lack of suitable equipments e.g. Tractor etc	64.62	2
Climatic problems e.g. irregular rainfall, storm, climate change etc.	39.02	6
Lack of technical know-how/lack of scientific knowledge about Rice cultivation	63.86	4
Non- availability of desired brand of plant protection chemical	40.94	5
Lack of extension facilities	36.44	7
Inadequate irrigation facilities	36.32	8
Lack of good quality improved varieties, seed and planting material, fertilizer	63.86	3
Crop damage by stray Animals	34.12	9

Other significant constraints included Climatic problems, such as irregular rainfall, storms, and

climate change ranked VI with an average score of 39.02, lack of extension facilities ranked VII with an average score of 36.44, and inadequate irrigation facilities ranked VIII with an average score of 36.32. Crop damage by stray animals was identified as the least significant constraint, ranked last (IX), with an average score of 34.12.

(d) Study area

The study analyzed the major constraints faced by farmers in the cultivation of direct seeded rice (DSR) in the irrigated sub-tropics of Jammu, Kathua, and Samba regions together, J&K (UT), using Garret's ranking technique, which is presented in Table 7. The results indicated that high weed infestation was ranked as the most significant constraint (I), with an average score of 76.73, followed by wrong sowing time, ranked second (II), with an average score of 66.58. Lack of knowledge about seed rate was ranked third (III) with an average score of 58.23. The moderate-level constraints were lack of technical knowledge about land preparation, ranked fourth (IV) with an average score of 53.69, and lack of knowledge about first irrigation, ranked fifth (V) with an average score of 51.47.

Table 7: Garrett's ranking scores of major constraints faced by direct seeded rice growers of irrigated sub-tropical zone of Jammu region

Problems	Garret score	Rank
Wrong Sowing time.	66.58	2
Lack of knowledge about Seed rate.	58.23	3
Increase in soil-borne pathogens such as nematodes.	25.67	9
High weed Infestation.	76.73	1
Lack of technical knowledge about Land preparation.	53.69	4
Lack of knowledge about first Irrigation.	51.47	5
Lack of scientific knowledge about using happy seed drill for seed Depth.	44.60	6
Lack of good quality improved varieties, seed and planting material.	36.25	8
Lack of suitable equipments at required time e.g. tractor, Seed Drill etc.	37.81	7

Lack of scientific knowledge about using the happy seed drill for seed depth was ranked sixth (VI) with an average score of 44.60. Lack of suitable equipment at the required time, e.g., tractor, seed drill, etc., was ranked seventh (VII) with an average score of 37.81. Lack of good-quality improved varieties, seed, and planting material was ranked eighth (VIII) with an average score of 36.25, and an increase in soil-borne pathogens such as nematodes was ranked last (IX) with an average score of 25.67.

The research findings, as presented in Table 8, have illustrated that the foremost challenge was the unavailability of skilled labor, which was rated with an average score of 69.31. The second most significant issue was the lack of technical know-how and scientific knowledge about rice cultivation, with an average score of 64.86. In addition, the farmers also faced a significant constraint in the form of the lack of suitable equipment, such as tractors, which was rated third with an average score of 63.37. The study also revealed moderate level constraints, including climatic problems, such as irregular rainfall, storms, and climate change, ranked fourth (IV), with an average score of 63.23, and the lack of good quality improved varieties, seed and planting material, fertilizer, ranked fifth (V), with an average score of 40.17.

Table 8: Garrett's ranking scores of major constraints faced by transplanted rice growers of irrigated sub-tropical zone of Jammu region

Problems/ Constraints	Garret score	Rank
Unavailability of Skilled Labour	69.31	1
Lack of suitable equipments e.g. Tractor etc	63.37	3
Climatic problems e.g. irregular rainfall, storm, climate change etc.	63.23	4
Lack of technical know-how/lack of scientific knowledge about Rice cultivation	64.86	2
Non-availability of desired brand of plant protection chemical	38.55	7
Lack of extension facilities	33.46	9
Inadequate irrigation facilities	37.74	8
Lack of good quality improved varieties, seed and planting material, fertilizer	40.17	5
Crop damage by stray Animals	38.61	6

Other significant constraints included crop damage by stray animals, ranked sixth with an average score of 38.61, non-availability of desired brands

of plant protection chemicals, ranked seventh with an average score of 38.55, and inadequate irrigation facilities, ranked eighth with an average score of 37.74. Lastly, lack of extension facilities was identified as the least significant constraint, ranked last (IX), with an average score of 34.12.

SUMMARY & CONCLUSION

The present investigation was undertaken in the irrigated sub-tropical zone of Jammu region of UT of J&K with an objective of analysing the constraints for adoption of DSR and production of DSR and transplanted rice. As per traditional agricultural practices the transplanted rice was earlier grown in almost all of the study area, but nowadays the direct seeded rice growing practices are also becoming familiar in the region. Three districts viz. Jammu, Samba and Kathua were purposively selected for the present study.

A multistage random sampling technique was used wherein three districts of Jammu region *viz*. Jammu, Kathua and Samba were selected purposely first stage, at the second stage 150 farmers cultivating direct seeded rice were selected randomly (through SRSWOR) through proportional allocation and equal number of farmers cultivating transplanted rice were selected randomly from the same area thereby resulting in the selection of 300 farm families as a total sample. For achieving the objective of study, both primary and secondary data collected were analyzed using suitable statistical techniques. For ranking the constraints, Garret ranking technique was used. The results obtained were presented in tables. It was seen that in Jammu district 'high weed infestation' was the most significant constraint on DSR farms while increase in soil-borne pathogens such as nematodes was identified as the least one. Whereas, in the case of transplanted rice, unavailability of skilled labour ranked number one among different major constraints while, crop damage by stray animals scored the lowest rank. As far as Kathua district was concerned, it was brought out that foremost challenge in cultivation of DSR was the 'high weed Infestation', while the constraint which ranked last was that of 'increase in soil-borne pathogens such as nematodes'. On the other hand, in transplanted rice, the major obstacle was observed to be 'unavailability of skilled labour' and 'crop damage by stray animals' had the lowest impact from among all the constraints'. Like Kathua district, on DSR farms of Samba district, 'high weed infestation' and 'Increase in soil-borne pathogens such as nematodes' scored the highest and the lowest ranks respectively. Again on transplanted rice farms the constraint of 'unavailability of skilled labour' remained the first and 'crop damage by stray animals' scored the last. In the case of study area as whole, among the major constraints faced by the growers of direct seeded rice, the constraint of 'high weed infestation' and 'increase in soil-borne pathogens such as nematodes' were seen scoring the highest and the lowest scores, while, in transplanted rice cultivation, the 'unavailability of skilled labour' ranked the first, while 'lack of extension facilities' was seen to be the last. Hence, it could be safely concluded that in irrigated areas of Jammu sub-tropics, 'high weed infestation' was the major constraint for growing the direct seeded rice, while unavailability of skilled labour was the major constraint in transplanted rice.

Policy suggestions

- Extension functionaries to be trained and deployed in order to train maximum possible farmers for taking up DSR cultivation.
- When paddy is to be grown through DRS method then after harvesting of wheat, the land should be irrigated and left fallow for some time so that the weeds could grow which then should be weeded out before sowing the seed.
- Spraying of weedicide especially at pre-emergence stage be done.

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