Original Research Article

Impact of Front Line Demonstrations in Improving Rice Productivity and Profitability in Jaunpur District of Uttar Pradesh, India

ABSTRACT

A study was carried out during *Kharif*, 2019 to assess the impact of Frontline Demonstrations (FLDs) on productivity and profitability of rice crop in Jaunpur district of Uttar Pradesh. The FLDs were conducted by the ICAR-Indian Agricultural Research Institute, Regional Station Pusa, Samastipur, Bihar, under the IARI-Outreach Programme to know the yield gap, technology gap, extension gap, economic return, extent of farmer's satisfaction, and constraints faced by the farmers, especially paddy growers. The critical inputs were identified in existing production technology through personal interaction, group meetings, and discussions with farmers and scientists. Improved variety, soil testing, seed treatment, integrated nutrient management, weed management, and pest and disease management are among the improved technologies. The result showed that switching from traditional farming methods to more advanced production technologies can result in yields of 30.00 percent and net returns of 27.00 percent. The extension gap of 1.20 t/ha, technological gap (0.55 t/ha), and technology index (9.57%) were registered for the Pusa Sugandha-5 variety. An additional returns of ₹ 16884.33/ha was obtained with an additional investment of ₹ 8395.67/ha, coupled with scientific monitoring of demonstrations and the use of rice varieties during investigations, which also influenced the economic returns per unit area. The constraint that was found to be the most difficult to overcome was the lack of improved, high-yielding rice varieties. In order to increase their yield and increase the production and productivity of rice in Uttar Pradesh, farmers in the area are advised to adopt new rice varieties as well as a recommended improved package of practices and technologies.

Keywords: Economics, Extension Gap, FLDs, Improved Technology, Rice.

1. INTRODUCTION

More than half of the world's population relies on rice (*Oryza sativa* L.) as a staple food and a major source of dietary energy. Rice is a principal source of food for more than half of the world population, and more than 90% of rice worldwide is grown and consumed in Asia (Mahajan and Chauhan, 2015). India has the largest area under rice production next to China. In India, paddy is the top-ranked food crop due to its high mineral, salt, and vitamin (thiamine and riboflavin) content. The record production in the country during the last few decades has enabled India to attain the position of second-largest producer of rice after China in the world. mIt is being cultivated on an area of 46.38 mha with 130.29 mt of production and an average productivity of 2.81 t/ha in India (Agricultural Statistics at a Glance, 2022). Out of this, the contribution of Uttar Pradesh state with its report to area production and productivity is 5.70 mha (12.29% to all India), 15.27 mt (11.72% to all India), and 2.68 t/ha, respectively (Agricultural Statistics at a Glance, 2022). In the light of production and productivity in Uttar Pradesh, India, front-line demonstrations play a very important role in reducing the yield gap as well as the technological gap in the farmer's field.

The average productivity of rice in Uttar Pradesh is less than 3.0 t/ha, which is significantly lower than the national average. Uttar Pradesh is the second-largest producer of rice after West Bengal (Agricultural Statistics at a Glance, 2022). The low rice productivity in Uttar Pradesh is a result of poor extension of improved agronomic practices, non-availability of seed of newly released varieties, poor quality of seeds, high cost of inputs, untimely rain, erratic power supply, lack of irrigation facilities, high customs hiring rate of land leveling, and poor plant protection measures. Along with these, other factors such as multi-nutrient deficiencies in the soil, declining factor productivity, soil salinity and alkalinity, the menace of wild animals, and a lack of knowledge among the farmers about recent technologies are also having a negative impact on rice productivity. Due to weather abnormalities and the uneven distribution of rainfall in most parts of Uttar Pradesh, the sowing and transplanting of the rice crop were delayed, resulting in a substantial loss in grain yield. A wide gap exists in rice production with the use of available technologies and their actual application by farmers, which is reflected in the poor yield of rice crops on farmers' fields. To overcome this problem, the adoption of improved production technologies is the best option in that area. Due to the aforementioned limiting factors, farmers in the Jaunpur district of Uttar Pradesh frequently fall short of the desired yield potential for rice. Frontline demonstration is the concept of field demonstration evolved by the ICAR. Demonstrations in the farmer's field help to identify the constraints and potential of the crop in a specific area, as well as the socio-economic aspects of farmers. Adoption of new technologies by farmers will lead to the replacement of old technologies and varieties and narrow down the technological gap. Therefore, it is very essential to demonstrate the latest technologies in the farmer's field so that the farmers see the results and adopt the technology. Rice productivity is still very low as a result of inadequate technology transfer. By using suitable, high-yielding varieties along with the advised scientific and sustainable production techniques, rice productivity and farmer income could be increased. Keeping in mind the importance of FLDs, the ICAR-Indian Agricultural Research Institute, Regional Station, Bihar, laid out demonstrations of rice crops on farmers' fields during the *Kharif* season of 2019 at village Gosawa under the Kerakat sub-division of Jalalpur Block in Jaunpur district of Uttar Pradesh under the IARI Outreach Programme.

Comment [OC1]: Only two literatures to support all these, a little more is better

2. METHODOLOGY

A total of 50 farmers were selected from village Gosawa under Kerakat sub-division of Jalalpur Block in Jaunpur district of Uttar Pradesh to conduct the frontline demonstrations (FLDs) on farmer's fields with an area of 12 ha and a plot size of 0.25 ha. To reduce the yield gap and to demonstrate the production potential and economic feasibility of improved technologies in farmers' fields, 50 FLDs were laid out on rice crops. Frontline demonstrations were conducted during the *Kharif*season of 2019 to assess how well the improved Pusa Sugandha-5 variety of rice performed as part of the IARI Outreach Program. The demonstrations were conducted under the strict supervision of the Scientists and technical staff of IARI, RS Pusa, Bihar. The soil at the demonstration site was low to medium fertility status. The improved package of practices includes improved variety (Pusa Sugandha-5), seed treatment with fungicide (2.0 gm carbendazim), and inoculation with bio-fertilizers (*Azospirillum* and PSB). The biofertilizers, including *Azospirillum* and PSB, were purchased from a local agriculture shop. A total of 50 demonstrations (FLDs) were laid out on the farmer's field, which had an assured irrigation facility. The distribution of seed and other inputs to the selected farmers served to confirm the viability and effective execution of FLDs. Farmers were given additional technical assistance regarding the suggested package of practices by IARI, RS. Pusa Bihar. The scientists and technical staff of our institute regularly monitor the farmer field demonstrations, from nursery sowing to till harvesting. Data were collected from each FLD farmer as well as from non-FLD farmers for comparison. For the calculation of yield, cost of cultivation, gross returns, net returns, and the B: C ratio, mean values were taken from 50 farmers. The analysis of the extension gap, technology gap, and technology index led to the drawing of final conclusions (Samui*et al*., 2000). The following analysis tools are used for assessing the performance of the FLDs on rice crop:

- Extension gap (t/ha) = Demonstration yield – Farmer's practice yield

$$\text{Yield gap (\%)} = \frac{\text{Demontartion yield} - \text{Control yield}}{\text{Control yield}} \times 100$$

- Technology gap (t/ha) = Potential yield – Demonstration yield
- $\text{Technology index (\%)} = \frac{\text{Potential yield} - \text{Demonstarion yield}}{\text{Potential yield}} \times 100$

- Additional cost (₹) = Demonstration cost (₹ /ha) – Farmer's practice cost (₹ /ha)
- Additional returns (₹) = Demonstration returns (₹ /ha)–Farmer's practice returns (₹ /ha)
- Effective gain (₹) = Additional returns (₹ /ha) – Additional cost (₹ /ha)
- Incremental B: C ratio = Additional returns (₹ /ha) ÷ Additional cost (₹ /ha)

For impact assessment of FLDs on Paddy, data were collected through personal interview with the help of questionnaire. The data were analyzed using suitable statistical tools

3. RESULT AND DISCUSSION

The comparison of the technology gap between frontline demonstrations (FLDs) and current farmer's practices (FP) at village Gosawa under the Kerakat sub-division of Jalalpur Block in Jaunpur district of Uttar Pradesh is presented in Table 1. Farmers of adopted villages were using local varieties; late sowing of nursery, high seed rate, transplanting without maintaining proper spacing, no seed treatment, low fertilizer rate, and no use of bio-fertilizer were common practices. According to the information collected from the demonstrated village, there was a complete gap in the use of HYVs, seed rate, nursery raising, transplanting and spacing, seed treatment, fertilizer dose, use of bio-fertilizer, harvesting, and threshing. However, there was a partial gap observed in the management of water and weeds, as well as nursery sowing times. No gap was observed with respect to field preparation. The farmers in the adopted village were not very familiar with the recommended rice crop production techniques. The low yield potential of the rice crop in the demonstration village and the surrounding area was primarily due to these gaps in improved technology.

3.1 Yield analysis and yield gap

The yield data of the rice crop obtained during *Kharif* 2019 of FLD is presented in Table 2. The findings suggested that, in comparison to 4.00 t/ha under farmers' practice, imparted technology could result in average yield levels of 5.20 t/ha. In these demonstrations, the maximum yield was 5.20 t/ha. It is revealed that the adoption of improved production technology for rice cultivation is capable of enhancing productivity by 30.0% over farmer practices. Similar yield enhancement in various crops in front-line demonstration has been extensively documented by Pandey *et al.* (2017), Meena*et al.* (2018), Mandavkar*et al.* (2012), Basediya*et al.* (2023), Girish *et al.* (2020), Singh *et al.* (2018), Suthar*et al.* (2016),

Table 1.Comparison of technology gap between frontline demonstrations (FLDs) and

existing farmer's practice (FP)

Particulars	**FLDs**	**Farmers practice (FP)**	**Technology Gap**
Field preparation	Timely	Timely	No gap
Variety	PusaSugandha- 5	Local varieties	Full
Time of nursery raising	Timely	Late sowing (Up toJuly)	Partial
Seed rate	25 kg/ha	High seed rate i.e. 35-40 kg/ha	Full
Nursery raising	Scientific method used	Non-scientific	Full
Transplanting and Spacing	Line sowing and maintaining row to row spacing of 20 cm and plant to plant 10 cm (20 × 10)	Not maintaining proper spacing	Full
Seed treatment	Seed treatment with fungicides i.e. Carbendazim @ 2 g/kg seed	No seed treatment	Full
Fertilizer application	Recommended fertilizer dose (Fertilizer application @ 150 kg N, 60 kg P_2O_5 and 40 kg K_2O per hectare)	Lower rate of fertilizer application without considering the recommended rate	Full
Use of bio-fertilizers	Use of *Azospirillum* and PSB	No use of *Azotobactor* and PSB	Full
Water management	5 irrigations	2 or 3 irrigations	Partial
Weed management	Pre-emergence application of Pendimethaline and post emergence application of bispyribac sodium (Nomini Gold) @ 25 g/ha	No chemical weed control measures followed	Full

Harvesting and threshing	Harvesting and threshing at the right time	No timely harvesting and threshing was done	Full

Kumar *et al.* (2020), Sharma *et al.* (2016), Singh *et al.* (2020), and Hashim*et al.* (2022). It was discovered that the improved variety performed better than the local check.

The adoption of a high-yielding improved variety, the recommended seed rate, line sowing, biofertilizer, improved production technology, weed control, and plant protection measures may all have contributed to the higher yield of rice. These results are supported by Hashim et al. (2022).

3.2 Extension gap

Data showed a significant extension gap between the demonstrated technology and farmers' practices (Table 2). Results showed that an extension gap of 1.20 t/ha was recorded during 2019. To reverse this trend of a wide extension gap between the demonstrated technology and farmer's practices, it is necessary to educate farmers and provide training and awareness programs to encourage early adoption of improved agricultural production technologies for rice and other varieties. Farmers will eventually be convinced to abandon the old practices and adopt the new ones by this new technology. The results of Singh *et al.* (2020), Meena*et al.* (2018), Mandavkar*et al.* (2012), Girish *et al.* (2020), Bhupenchandra*et al*. (2021), Kumar *et al.* (2020), Basediya*et al.* (2023), and Hashim*et al.* (2022) are in agreement with this finding.

3.3 Technology gap

The difference between the demonstration yield and the potential yield is represented by the technology gap. The data on the technology gap from Table 2 exhibited that the technological gap registered for PusaSugandha 5 during *Kharif* 2019 was recorded at 0.55 t/ha. The lower technological gap observed suggests that it has an inverse relationship with crop yield since a smaller gap led to greater adoption of the demonstrated technology. It should be emphasized that in order to reduce this widening gap, farmers must be persuaded to adopt better agricultural technologies through education and persuasion. The variation in the technology gap may be attributed to dissimilarities in soil fertility status, agricultural practices, and local climatic situations (Thakur et al., 2019). Our results are also in conformity with the findings of Singh *et al.* (2020), Meena*et al.* (2018), Mandavkar*et al.* (2012), Basediya*et al.* (2023), Girish *et al.* (2020), and Hashim*et al.* (2022).

3.4 Technology Index

The feasibility of a technology in a farmer's field is indicated by a technology index. The lower the value of technology index more is the feasibility of the technology (Table 2).In 2019, the technology index for the PusaSugandha 5 variety was 9.57%. It may be due to variations in soil fertility status, irregular and uneven rainfall and local weather patterns. The same results were also reported by Singh *et al.* (2020), Meena*et al.* (2018), Mandavkar*et al.* (2012), Basediya*et al.* (2023), Girish *et al.* (2020) and Hashim*et al.* (2022).

Table 2. Performance of improved rice variety (PS-5) against local variety on farmer's field

Name of variety	Potential yield (t/ha)	No. of demonstrations	Grain yield (t/ha) Improved technology (FLDs)		Farmer's practice (Average yield t/ha)	Extension gap (t/ha)	Increase in yield over farmer's practice (%)	Technology gap (t/ha)	Technology Index (%)
			Max.	Avg.					
PusaSugandha- 5	5.75	50	5.45	5.20	4.00	1.20	30.0	0.55	9.57

Table 3. Detailed comparative analysis of the demonstrated technology and farmer's practice on economic performance of rice

Cost of cultivation (₹ /ha)		Net returns (₹ /ha)		B: C ratio		Additional cost (₹ /ha)	Additional net returns (₹ /ha)	Additional gain (₹)	Incremental B: C ratio
FLDs	Local check	FLDs	Local check	FLDs	Local check				
50931.50	42535.82	79448.51	62564.18	1.56	1.47	8395.67	16884.33	8488.66	2.01

Table 4. Comparative economics of rice improved technology and farmer's practices

Particulars	Farmer's practice	Improved technology	Actual increase over farmer's practice	Increase over farmer's practice (%)
Average yield (t/ha)	4.0	5.20	1.20	30.00

Cost of cultivation (₹ /ha)	42535.82	50931.50	8395.68	19.74
Net return (₹ /ha)	62564.18	79448.51	16884.33	27.00
B: C ratio	1.47	1.56	0.09	6.12

3.5 Economic analysis

The economic evaluation made on the basis of the prevailing market prices of inputs and outputs. Tables 3 and 4 demonstrate that the demonstration produced higher net returns per hectare of improved technology of 79448.51 ₹ /ha than the farmer's practice of 62564.18 ₹ /ha. The incremental benefit-cost ratio of 2.01 resulted in additional net returns of 16884.33 ₹ /ha. The additional cost generated from the demonstrated field was 8395.67 ₹ /ha. The net returns of 79448.51 ₹ /ha were obtained in the demonstration, which was 16884.33 ₹ /ha (27.00%) higher than the farmer's practice (62564.18 ₹ /ha), and the B: C ratio of improved technologies (1.56) was also higher than the farmer's practice (1.47). The incremental benefit-cost ratio (2.01) is sufficiently high to motivate the farmers to adopt the technology. This finding is in concordance with the findings of Mandavkar et al. (2012), Pandey *et al*. (2017), Singh *et al*. (2020), Meena*et al*. (2018), Basediya*et al*. (2023), Kumar *et al*. (2020), Girish *et al*. (2020), Singh *et al*. (2018), Suthar*et al*. (2016), and Hashim*et al*. (2022).

3.6 Feedback of the farmers and extent of farmer's satisfaction

The farmers in the adopted village were persuaded to adopt the precise technologies that had been tested and found to be beneficial to their fields. They are eager to adopt new technologies and varieties. In comparison to the old/check varieties, the proven improved variety was advantageous. The neighboring farmers responded favorably to the technology that was demonstrated and the level of yield satisfaction. The majority of farmers believe that if input support is stopped, they will adopt proven technologies. The level of satisfaction with the support provided was also satisfactory (Table 5). The extent of farmer satisfaction with front-line demonstrations presented in Table 6 showed that the majority of the respondent farmers expressed a high (80%) and medium (14%) level of satisfaction regarding the performance of FLDs, whereas very few (6%) of respondents expressed a lower level of satisfaction, indicating stronger conviction and physical and mental involvement in the front-line demonstrations, which would then result in higher adoption.

Table 5. Feedback of the farmers

Particulars	**Feedback**
Benefits of the demonstrated variety in comparison to local check	Beneficial
Response of the neighbouring farmers to the FLDs	Positive
Level of satisfaction with yield	Very high

Will the farmer adopt the demonstrated technologies if input support is discontinued	Yes
Level of satisfaction with the support provided	Satisfactor1y

Table 6.Extent of Farmer's Satisfaction about Front Line Demonstration (N= 50)

Satisfaction Level	Frequency	Percentage
Low	3	6
Medium	7	14
High	40	80

A preferential ranking assigned in descending order to identified issues or restrictions faced by the farmers in paddy cultivation is presented in Table 7. The awareness and lack of suitable high-yielding varieties were the very serious constraints that ranked first (I) both by FLD farmers and non-FLD farmers. Unavailability of disease resistance varieties (rank II), unavailability of efficient manpower (rank III), inadequate infrastructure (rank IV), lack of proficiency in using insecticides and others (V), inadequate supply of inputs (VI), low level of technical expertise in paddy cultivation (VII), and higher cost of input (VIII) were the constraints of FLD farmers. However, non-FLD farmers' constraints in descending order were: lack of proficiency in using insecticides and other pesticides (II), unavailability of disease resistance varieties (III), unavailability of efficient manpower (IV), inadequate infrastructure (V), higher cost of input (VI), adequate supply of inputs (VII), and low level of technical expertise in paddy cultivation (VIII).

Table 7: Distribution of FLDs farmers and non-FLDs farmer's constraints faced in rice cultivation

FLDs farmers (N= 50)				**Non-FLDs farmers (N= 50)**		
Constraints	**Frequency**	**Percent**	**Rank**	**Frequency**	**Percent**	**Rank**
Low level of technical expertise in paddy cultivation	**41**	82.0	**VII**	**42**	84	**VIII**
Inadequate infrastructure	**44**	88.0	**IV**	**45**	90	**V**
Awareness and lack of suitable high yielding variety	**49**	98.0	**I**	**50**	100	**I**

Unavailability of disease resistance variety	**48**	96.0	**II**	**47**	94	**III**
In adequate supply of inputs	**42**	84.0	**VI**	**43**	86	**VII**
lack of proficiency in using insecticides and other	**43**	86.0	**V**	**48**	96	**II**
Higher cost of input	**40**	80.0	**VIII**	**44**	88	**VI**
Unavailability of efficient manpower	**47**	94.0	**III**	**46**	92	**IV**

4. CONCLUSION

The farmer's attitudes changed as a result of the FLD program. Additionally, this strengthened the bond between scientists and farmers and improved their relationship. Overall, the study's findings suggest that improved technologies are more profitable and productive than farmers' traditional methods. By implementing the suggested production technologies, crop yields under FLDs could be further increased over time. The FLD demonstration farmers served as the main source of information regarding the more advanced methods of rice farming. They served as a source of pure, high-quality seeds for the following crop in their community and the surrounding area. The FLDs significantly reduced the extension and yield gap, which will help the farmers' financial issues as well as their standard of living. The removal of cross-sectional barriers within the farming community will be aided by this. Therefore, it is essential to share the new production technologies with farmers through efficient extension methods in order to raise their standard of living and financial situation.

REFERENCES

Agricultural Statistics at a Glance, 2021. Directorate of Economics & Statistics, DAC&FW. www.agricoop.nic.in& http://desagri.gov.in.

Basediya AL, Bhargava MK, Kumar P, Singh YP, Gupta R. Impact of Front Line Demonstrations on mustard productivity and profitability in Shivpuri District of Madhya Pradesh, India. Journal of Experimental Agriculture International. 2023; 45(10): 22-29.

Bhupenchandra I, Kamei G, Chongtham SK, Kumar A, Singh R, Babu S, Gupta G, Singh LK, Devi EL, Sinyorita S, Devi SR, Devi YP, Devi CP. Impact study of front line demonstration on performance, yield and economics of field pea (*Pisumsativum*) in Tamenglong District of Manipur. Annals of Agriculture Research, New Series. 2021; 42 (2): 214-221.

Girish R, Bharath Kumar, TP, Shruthi HR, Shivakumar L, Praveen KM. Frontline demonstration on paddy variety KPR 1 by KVK in Chikkamagaluru district of Karnataka, India: An impact study. Journal of Pharmacognosy and Phytochemistry. 2020; 9(2): 303-305.

Hashim M, Singh KK, Dhar S. Impact of front line demonstration on performance of wheat (*Triticumaestivum*L.) in Muzaffarpur, Bihar. Annals of Agricultural Research, New Series. 2022; 43(2): 142-147.

Kumar A, Kumar G, Singh R, Ravi AK, Mandal D, Hussain J. Impact of front line demonstration on yield and economics of wheat. International Journal of Current Microbiology and Applied Sciences, Special Issue. 2020; 10: 65-69.

Mahajan G, Chauhan BS. Weed control in dry direct seeded rice using tank mixtures of herbicides in South Asia. Crop Protection, 2015; 72: 90–96.

Mandavkar PM, Sawant PA, Mahadik RP. 2012. Evaluation of Front Line Demonstration trials on rice in Raigad district of Maharashtra. Rajasthan Journal of Extension Education. 2012; 20: 4-6.

Meena K, Kumari AR, Sharma RP, Srivastava R. Study on production potential of rice through Front Line Demonstration in Deoria District of Uttar Pradesh, India. International Journal of Current Microbiology and Applied Sciences. 2018; **7**(1): 328-331.

Pandey NK, Indu. Impact assessment of FLDs on paddy in North Eastern Himalayan Region. Indian Journal of Extension Education. 2017; 53(1): 140-142.

Samui SK, Maitra S, Roy DK, Mandal AK, Saha D. Evaluation of front line demonstration on groundnut. Journal of Indian Society of Coastal Agricultural Research. 2000; 18(2): 180-183.

Sharma V, Kumar V, Sharma SC, Singh S. Productivity enhancement and popularization of improved production technologies in wheat through frontline demonstrations. Journal of Applied and Natural Science. 2016;8(1): 423-428.

Singh DP, Chandra V, Tiwari T. Impact analysis of Front Line Demonstration on rice (*Oryza sativa* L.) yield, economics and farmer's knowledge in Eastern Uttar Pradesh, India. International Journal of Current Microbiology and Applied Sciences, Special Issue. 2020; 10: 308-313.

Singh NK, Kumar S, Hasan W, Kumar A. Impact of Frontline Demonstration of KVK on the yield of paddy (Sahbhagidhan) in Nalanda District of Bihar, International Journal of Current Microbiology and Applied Sciences. 2018;7(3):48-51.

Suthar JV, Chawda SK, Patel AT, Pastagia JJ, Patel BB. Impact of front line demonstration on the yield of poha rice (*Oryza sativa*) in Surat district. Journal of Bio Innovation. 2016; 5(4): 588-593.

Thakur CL, Sahu B, Markam S, Nag U. Impact of front line demonstration on yield and economics of chickpea (*Cicer arietinum*) in Uttar-BastarKanker District of Chhattisgarh. International Journal of Current Microbiology and Applied Sciences. 2019; **8**(06): 2,337- 2,341.