Impact of front line demonstration on yield and economicsof Hybrid Rice Varieties (JRH-5 and JRH-19)

ABSTRACT

The objective of the present investigation was to assess the performance of two hybrid rice varieties namely, JRH-5 and JRH-19 under irrigated ecosystem by conducting Frontline demonstrations (FLDs) in three consecutive kharif seasons of the year 2016, 2017, and 2018, in the farmer's fields located in the agro climatic zone of the Chhattisgarh plains.The FLDs were carried out using scientific package and practices of rice. The yield and economic data of the plots compared with the existing farmer practices and variety-MTU-1010 revealed that theFLDs with hybrid rice varieties JRH-19 and JRH-5 performed better. With the enhanced production technologies in FLDs with JRH-5 and JRH-19 and with only an additional input cost of Rs. 2742/ha, the mean grain yield increased by 28.21% over current farmer practices. The average extension gap (12.27 q/ha) and average IBCR (6.14) were high enough to encourage farmers to use the introduced rice production technology with the hybrids JRH-5 and JRH-19.

Key words: Front line demonstration, Hybrid rice, Technology gap, Extension gap, Yield.

Introduction:

Rice, serving as the primary staple food for humans globally, provides essential nutrition to millions of people every day (Gaur et al, 2020).Almosthalf of the world's population consumes rice on a daily basis.About 20% of the world's dietary energy comes from rice, while the remaining 19% and 5% come from wheat and maize, respectively. In some Asian countriesincluding India,over 70% of the total calories is provided by rice (Rahman and Zhang, 2023). Similar to the global rice consumption trends, rice is also consumed by more than half of the Indian population (Saxena, 2004; Muthayya, 2014).In terms of area and production, rice is ranked second in India, behind wheat. Approximately, rice is grown under 43.90 million hectares of land, which yields 114.45 million tonnes with 2607 kg/ha of productivity (Agricultural Statistics at a Glance, 2022). However, the amount of land planted to rice varies annually depending on the amount of rainfall received.

Madhya Pradesh, which is located in the central part of India, is the second-largest producer of food grains. About 44% of the state's GDP comes from agriculture and related services, while 78% of its labour force is employed directly in the agriculture sector.

According to Agriculture Statistics 2020–21, Madhya Pradesh's paddy acreage, production, and productivity was 3.40 million hectares, 12.31 million tonnes, and 3617 kg/ha, respectively. Compared to only 5.36 million tonnes in 2013–14, the state has been predicted to produce 13.18 million tonnes of rice in 2022–2023 (advance estimates; Madhya Pradesh Economic Survey 2022-23).Of the many states of the state Madhya Pradesh, the quadrilaterally shaped "Balaghat" district of Madhya Pradesh located in the Chhattisgarh plain agroclimatic zoneis an important rice producing area. It has an area of 0.31 million ha under rice cultivation annually that has a productivity of 3305 kg/ha. The district is the second-largest rice producer in the state, producing 1.02 million tonnes, or 8.29% of the overall production (Agriculture Statistics 2020-21).Balaghat is distinguished by a variety of soil types, from low water-holding capacity shallow and relatively deep soil layers to a mixed red and yellow soil. The soils have a pH range of 6.4 to 7.2 and are low in accessible phosphorus and nitrogen but medium to high in available potassium(Patle et al., 2023).

Although India produces 149 million tonnes of rice on 29.92 million hectares of land, it lags behind China, which is the world's largest producer of rice. This is mainly due to the occurrence of pests and diseases, imbalanced and insufficient usage of fertiliser, and irregular and unpredictable rainfall. In addition to this, low yield in the farmers' fields is a reflection of the large disparity between the available techniques and their actual adoption by the farmers. Although, the agricultural universities and research stations have developed a variety of methods for rice cultivation, but inadequate technology transfer from research farms to farmers' fields has resulted in low rice output. Thereexists a big gap between the production and use of information, since very little new knowledge finds its way into farmers' fields. The situation is expected to become more challenging due to the issues arising from climate change. Therefore, modern plant protection measuresand agricultural practices along with early duration and high yielding hybrids must be adopted by the farmers to increase their production, productivity and to minimize yield losses. One such agriculture practice known as System of Rice Intensification has been successfully shown to increase the rice yield significantly (Laulanie, 1993).Application of this technology may be beneficial in the Front Line Demonstrations (FLD) of rice in farmers' fields, particularly in the FLDs of the recently released high yielding varieties with INM, IWM, and IPM. In this report we highlight the results of riceFLDs in the villages of Balaghat district of Madhya Pradesh and compare the relative yield advantage and cropping intensity, weed control, and plant protection measures to current farmer practices.

Material and Methods:

Crop growing period, field diagnostic visits, farmer meetings, training programmes, and participatory approaches were used to identify the production restrictions. Low rice yield was thought to be caused by an inappropriate rice variety, excessive fertiliser use, old seeds, drought, weed infestation, and incorrect crop geometry. Based on the issues raised by the farmers, the College of Agriculture, Waraseoni (Balaghat) conducted field experiments (FLDs) on early-maturity hybrid rice varieties JRH-5 and JRH-19, developed by Jawaharlal Nehru Agriculture University, Jabalpur, under irrigated ecosystems at two blocks in the Balaghat District of Madhya Pradesh during three consecutive Kharif seasons in 2016, 2017, and 2018 (Table 1).The hybrid rice types JRH-5 and JRH-19 have medium-slender grains, a crop length of 100-105 days, and a short plant height of 100-105 cm. Each demonstration covered 0.4 hectares.The farmers that were chosen for the demonstrations came from disparate socioeconomic backgrounds with land holdings ranging from 2.5 to 5 acres of rice.

Table 1: Front line demonstrationexperimental site.

Year	**Variety**	**Check**	**No. of FLD**	**Area (ha)**	**Village**	**Block**
2016	JRH-5	MTU-1010	25	10(0.4ha/FLD)	Aanwlajhari	Balaghat
2017	JRH-19	MTU-1010	25	10(0.4ha/FLD)	Nevergaon	Lalburra
2018	JRH-19	MTU-1010	60	24(0.4ha/FLD)	Phogaltola Pathri Sonbatola	Lalburra

In order to address the issues identified, farmers were given JRH-19 and JRH-5 variety seeds as essential inputs, and during the front-line demonstration experiments, the scientific technologies (Table 2) were implemented as an interventions.

Table 2: Technological intervention and farmer's practices under FLD.

Particulars	**Technological intervention**	**Existing practices**
Variety	JRH-5, JRH-19	MTU-1010
Seed rate (kg/ha)	15	35-40
Seed treatment	Carbendazim + Mancozeb (2g/kg seed)	No seed treatment
Age of Seedling	15-18	20-30
Transplanting Method	SRI/Line transplanting	Local practices
Fertilizer (NPK)	100:60:40 + 20 (Zinc sulphate 21%)	100:60:30/60:40:00
Weed management	Spray of 0.75kg/ha Pendimethalin herbicide + one hand weeding	Only one hand weeding
Insects	Stem borer, gall midge,	Stem borer, gall

		midge
Diseases	Sheath blight, Blast	Sheath blight, Blast
Insecticides	Chlorpyrifos 50% EC	Chlorpyrifos 50% EC
Fungicides	Hexaconazole 5% SC, Propiconazole 25% EC	Tricyclazole 85% WP
Harvesting	Reaper	Manually/Reaper
Threshing	Thresher	Thresher/ Manually
Labour saving	55 man-day /ha	68 man-day /ha

Nursery was raised every year during the second week of June with the onset of monsoon. During the middle of July every year, the fields 15-18-day-old rice seedlings were transplanted. From planting to harvesting, the farmer's field demonstrations were routinely observed. The farmers adhered to the established farming procedures in the event of local inspection (control plots). Each year, a training curriculum was arranged for the chosen farmers from the individual villages to provide them with technological knowledge related to rice producing practices, well in advance of the demonstrations. All other steps like site selection,layout of demonstrations, farmers' participation etc. were followed as suggested by Choudhary (1999). The grain yield of demonstrations as wellas farmers' practice (local check) were recordedand analysed according to different parameterssuggested byBisen et al. (2020). The details of these parameters are as:

Extension gap = Demonstration yield–Farmer's yield

Technology gap = Potential yield - Demonstration yield

$$\text{Technology index (\%)} = \frac{\text{Technology gap}}{\text{Potential yield}} \times 100$$

Additional Cost = Demonstration cost of cultivation - Farmer's cost of cultivation

Additional Return = Demonstration return - Farmer's return

Effective Gain = Additional return - Additional cost

$$\text{Increment B: C ratio} = \frac{\text{Additional return}}{\text{Additional cost}}$$

Result and Discussion:

Grain yield: Compared to farmers' local methods, the demonstration's increased grain output,which ranged from 26.29 to 29.36 percent. In comparison to farmers' traditional methods of paddy farming, demonstrations using better cultivation technology resulted in a yield advantage of 28.21 percent over a three-year period time.

Gap analysis: Between farmer behaviours and shown technology across three distinct years, there was an extension gap ranging from 11.50 to 13.05 q/ha; on average, this difference was 12.27 q/ha (Table 3). In kharif 2016, the extension gap was at its lowest point (11.50 q/ha), whereas in kharif 2018, it reached its highest point (13.05 q/ha). This discrepancy may be related to demonstrations of better technology that produced higher grain yields than conventional farming methods. A significant difference in technology was noted in different years; it was lowest (7.50 q/ha) in kharif 2018 and greatest (10.50 q/ha) in kharif 2017. The technology gap of all 110 demonstrations was found to be 9.25 q/ha on an average basis across three years. The variation in the technology gap between years may be the result of proposed technologies being more feasible in that year. In a similar vein, every demonstration's technology index across various years matched the technology gap. A higher technology score was indicative of both insufficient extension services and insufficiently tested technology to be transferred to farmers. The viability of the variety in the farmer's field is indicated by the technology index. The more feasible something is, the lower its technology index value is. Table 3 showed that the value of the technology index was 14.23. The results of this investigation are consistent with those of Singh et al. (2012) and Meena et al. (2015).

Table 3: Gap in grain yield production of Hybrid JRH-5 and JRH-19 under FLD.

Season-Year variety	Potential Yield (q/ha)	Demonstration Yield (q/ha)	Farmer`s practice Yield (q/ha)	Increase over Farmer`s practices (%)	Extension gap (q/ha)	Technology gap (q/ha)	Technology index (%)
Kharif - 2016 JRH-5	65.00	55.25	43.75	26.29	11.50	9.75	15.00
Kharif-2017 JRH-19	65.00	54.50	42.25	28.99	12.25	10.50	16.15
Kharif-2018 JRH-19	65.00	57.50	44.45	29.36	13.05	7.50	11.54
Average	**65.00**	**55.75**	**43.48**	**28.21**	**12.27**	**9.25**	**14.23**

Table 4: Economic impact of Hybrid JRH-5 and JRH-19 under FLD

Season-Year Variety	Cost of cultivation	Additional cost in	Sale price	Net Return (Rs/ha)	Additional return in	Effective gain	IBCR

	(Rs/ha)		Demo. (Rs./ha)	(MSP) of (Rs./q)			Demo. (Rs./ha)	(Rs./ha)	
	Demo.	FP			Demo.	FP			
Kharif -2016 JRH-5	36875	34375	2500	1470	44343	29938	14405	11905	5.76
Kharif-2017 JRH-19	38400	35625	2775	1550	46075	29863	16213	13438	5.84
Kharif-2018 JRH-19	39650	36700	2950	1770	62125	41977	20149	17199	6.83
Average	38308	35567	2742	1597	50848	33926	16922	14180	6.14

Economic analysis: In addition to farmer practices, many factors like as seed, fertilisers, bio-fertilizers, and pesticides were taken into consideration as cash inputs for the demonstrations. On average, an extra expenditure of Rs. 2742 per hectare was made under the demonstrations. The relationship between the MSP sale price and grain yield determined the economic returns in a given year. The year kharif 2018 yielded the maximum profits (Rs. 20149 per hectare) because of a higher grain output. These outcomes agree with the conclusions made by Singh et al. (2012). Higher effective gains and increased returns under demonstrations may be the result of scientific monitoring, timely crop production, non-monetary factors, and improved technology. Based on generated grain production and MSP sale rates, the lowest and highest incremental benefit: cost ratios (IBCR) were 5.76 & 6.83 in kharif 2016 and kharif 2018, respectively (Table 4). The average IBCR across the board was 6.14. Singh et al. (2018) and Girish et al. (2020) also reported similar results.

Conclusion:

The front-line demonstration programme was successful in altering participant's attitudes, abilities, and understanding of better and suggested paddy cultivating techniques, including adoption. Additionally, this strengthened the trust and relationship between scientists and farmers. In addition to serving as the main source of information on better paddy cultivation techniques, the farmers under the demonstration experiment supplied high-quality, pure seeds following harvest to their community as well as the nearby farmers. In comparison to current farmer practices, the rice hybrids JRH-5 and JRH-19 and production technology used in demonstrations boosted grain yield by an average of 28.21%. The cost of the yieldincrease was only Rs. 2742/ha. Since this amount is very low, the marginal and small farmers can easily afford it.IBCR (6.14) and the mean extension gap (12.27 q/ha) are both large enough to encourage farmers to use hybrid JRH-5 and JRH-19. A favourable benefit-cost ratio persuaded the farmers to accept the intervention by itself and explained the demonstration's economic viability. The idea of "front line demonstration" can be used by progressive farmers as well as other types of farmers to quickly and widely introduce the suggested techniques to other farmers. This will facilitate the dismantling of the farming population's cross-sectional barrier.Paddy can close the yield gap if improved practices are widely publicised. This can be done by using a variety of extension approaches, with Front Line Demonstrations being one of the most crucial ways to illustrate the benefits of improved practices.

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