Evaluation of rice varieties under front line demonstrations in the agro-climatic zone of the Chhattisgarh plains of Madhya Pradesh, under irrigated condition

ABSTRACT

Frontline demonstrations were conducted with recommended scientific package and practicesatfarmer's fieldsin the Chhattisgarh plain agro-climatic zone of Balaghat district, Madhya Pradesh to evaluate the performance oftworice varieties*viz.*, JR-81 and JRB-1under irrigatedconditions during *Kharif* 2019.The data on yield and economics of demonstrated under FLD, when compared withfarmer's practices on popular rice variety MTU-1010 revealed that both the rice varieties performed superior to MTU-1010. JR-81 and JRB-1with improved production technologies showed increasedmean grain yield by 17.17% over existing farmers practice with Rs. 2450ha^{-1} extra expenditureon inputs. The mean extension gap (7.80 q ha^{-1}) and mean IBCR (4.78)recorded weresufficiently high, which may motivatethe farmers to adoptJR-81 and JRB-1 varieties with the improved rice production technology.

Key words: Front line demonstration, Rice, Technology gap, Extension gap, Yield

Introduction:

Over half of the Global population consumes rice daily as stable food, accounting approximately 20% of the World's dietary energy. while, wheat and maize contribute 19% and 5%, respectively, in certain Asian nations, rice provides over 70% of their total calories (Rahman and Zhang, 2023). In India, rice ranks second in both area and production, and cultivated over 43.90 million hectares, yielding 114.45 million tonnes with a productivity of 2607 kgha^{-1}(Agricultural Statistics at a Glance, 2022).The central Indian state of Madhya Pradesh is the second-largest food grain producer in India. It derives 44% of its GDP from agriculture, employing 78% of its workforce in agriculturesector. In 2020–21, the state paddy acreage, production and productivity were 3.40 million hectares, 12.31 million tonnes, and 3617 kg ha^{-1}, respectively. It has been predicted that in the year 2022-23 the production would rise to 13.18 million tonnes from 5.36 million tonnes in 2013–14 (advance estimates; Madhya Pradesh Economic Survey 2022-23). The Balaghat district of Madhya Pradesh has 0.31 million ha under rice, which is the state's second-largest producer of rice, yielding 1.02 million tonnes or 8.29% of overall production (Agriculture Statistics, 2020-21). Balaghat has diverse soil types with pH ranging from 6.4 to 7.2. The soils are low innitrogen and phosphorus but has medium to high potassium levels.

During 2021-2022 period, China's milled rice production amounted to 149 million metric tons, surpassing India's output of 129 million metric tons.The lower production in India is attributed to the higher incidences of pests and diseases, fertilizer misuse, irregular rainfall, and a yield gap due to limited adoption of available techniques. The climate change further exacerbates the situation. Therefore, deployment of modern plant protection measures and agricultural practices has become a necessity. Fortunately, the agricultural universities offer various rice cultivation methods, but inadequate technology transfer hampers the output. One of such technologies known as The System of Rice Intensificationhas shown to increase the rice yields significantly (Laulanie, 1993), could benefit Balaghat district's farmers. As the farmers of the Balaghat district are resource poor, traditional farmers,Front Line Demonstrations (FLD) of improved varieties with improved agriculture practices could significantly increase the farm income. This present report compares the FLD results in Balaghat villages, emphasizing relative yield advantages, cropping intensity, weed control, and plant protection measures compared to current farmer practices.

Material and Methods:

The identification of production constraints involved a participatory approach, including farmer meetings, training programs, and field diagnostic visits throughout the crop period. Factors contributing to the low rice yield were recognized as the absence of suitable rice varieties, imbalanced fertilizer use, aged seedlings, drought, weed infestation, and improper crop geometry. Addressing these challenges, the College of Agriculture, Waraseoni (Balaghat), conducted 45 Farmer Field Demonstrations (FLDs) on rice during Kharif 2019. The trials were conducted on early maturing rice varieties (115 - 125 daysduration) viz., JR-81 and JRB-1, developed by Jawaharlal Nehru Agriculture University, Jabalpur. These FLD's were implemented in 18 hectares across two Blocks of Balaghat District, Madhya Pradesh, under irrigated ecosystem. Balaghat district, located in the Chhattisgarh plains, falls under the Rice zone. Both rice varieties, JR-81 and JRB-1, exhibit characteristics such as medium slender grains, a crop duration of 115-125 days, and short plant height (100-105 cm). Each demonstration covered an area of 0.4 hectares, and participating farmers represented diverse social backgrounds with rice areas ranging from 2.5 to 5 acres.

Table 1: Front line demonstrationsite

Variety	Check	FLDs	Area (ha)	Village	Block
JR-81	MTU-1010	20	8(0.4ha/FLD)	Botta Hajari	Lalburra
JRB-1	MTU-1010	25	10(0.4ha/FLD)	Koste	Waraseoni

To address the identified challenges, the farmers were equipped with seeds of JR-81 and JRB-1 varieties along with essential inputs critical to manage the identified issues. Additionally, the front-line demonstration program involved the implementation of scientifically recommended technologies, as outlined in Table 2.

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

Particulars	Technological intervention	Existing practices
Variety	JR-81, JRB-1	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^{-1} 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^{-1}	68 man-day ha^{-1}

The nursery initiation coincided with the onset of monsoon in latter part of June annually. Subsequently, rice seedlings aged between 15-18 days were transplanted into the fields around mid-July each year. Continuous monitoring of the front-line demonstrations on farmers' fields occurred, spanning from nursery to harvesting stage. For the local check (control plots), farmers adhered to their existing practices with varieties.Before initiating the demonstrations, an annual training program was conducted for the selected farmers in their respective villages. This training aimed to impart technological knowledge on rice production techniques. Following the guidelines suggested by Choudhary (1999), various steps such as site selection, demonstration layout, and farmers' participation were meticulously executed. Grain yield data from both the demonstrations and farmers' practices (local check) were systematically recorded and analyzed based on diverse parameters as recommended by Bisen *et. al.* (2020). The details ofthese parameters are as follows:

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

The enhancement in grain yield within the demonstrations ranged from 16.13% to 18.22%, surpassing the yields achieved through farmer’s practices. On an average, a substantial *ie*., 17.17% yield advantage was observed in demonstrations employing improved cultivation technology compared to traditional paddy cultivation methods adopted by farmers.

Gap analysis

In a year, there was an extension gap ranging from 7.32 to 8.28 quintals per hectare observed between demonstrated technology and farmers' practices. On an average, this extension gap amounted to 7.80 quintals per hectare (refer to Table 3). Notably, JRB-1 exhibited the smallest extension gap (7.32 q ha^{-1}), while JR-81 had the highest gap (8.28 q ha^{-1}). This gap is likely attributed to the adoption of improved technology during demonstrations, resulting in a higher grain yield compared to traditional farmer practices.Examining the technology gap, JR-81 had the lowest gap (11.28 q ha^{-1}), whereas JRB-1 had the highest gap (12.29 q ha^{-1}). On an average, the technology gap across all 45 demonstrations was 11.79 quintals per hectare. Discrepancies in the technology gap may be due to the varying feasibility of recommended technologies. Correspondingly, the technology index for all demonstrations aligned with technology gap. A higher technology index indicated inadequate proven technology for farmer adoption and insufficient extension services for technology transfer. The technology index, reflecting the feasibility of variety at farmer's field, had a value of 18.13, indicating lower feasibility. These findings are consistent with studies by Singh *et. al*. (2012) and Meena *et. al*. (2015).

Economic analysis

Various variables, including seeds, fertilizers, biofertilizers, and pesticides, were regarded as monetary inputs for both demonstrations and farmers' practices. On average, an additional investment of Rs. 2450 per hectare was allocated to the demonstrations. The maximum returns, amounting to Rs. 12,578 per hectare, were achieved for JR-81, primarily attributable to its higher grain yield. These findings align with those of Singh *et. al*. (2012). The increased returns and effective gains observed in demonstrations may be attributed to improved technology, non-monetary factors, timely crop cultivation operations, and scientific monitoring.The incremental benefit-to-cost ratios (IBCR) varied, with the lowest and highest values being 4.42 and 5.13 for JR-81 and JRB-1, respectively (Table 4). These ratios depend on produced grain yield and Minimum Support Price (MSP) sale rates. The overall average IBCR was determined to be 4.78. Similar results were reported by Singh *et. al.* (2018) and Girish *et. al*. (2020).

Table 3: Gap in grain yield production of paddy verities under FLD's

Season-Year variety	Potential Yield (q ha^{-1})	Demonstration Yield (q/ha)	Farmer`s practice Yield (q ha^{-1})	Increase over Farmer`s practices (%)	Extension gap (qha^{-1})	Technology gap (q ha^{-1})	Technology index (%)
Kharif - 2019 JR-81	65.00	53.72	45.44	18.22	8.28	11.28	17.35
Kharif- 2019 JRB-1	65.00	52.71	45.39	16.13	7.32	12.29	18.91
Average	65.00	53.22	45.42	17.17	7.80	11.79	18.13

Table 4: Economic impact of JR-81 and JRB-1 under FLD

Season-Year variety	**Cost of cultivation (Rs/ha)**		**Additional cost in Demo. (Rs. ha^{-1})**	**Sale price (MSP) of (Rs. ha^{-1})**	**Net Return (Rs/ha)**		**Additional return in Demo. (Rs. ha^{-1})**	**Effective gain (Rs. ha^{-1})**	**IBCR**
	Demo.	FP			Demo.	FP			
Kharif - 2019 JR-81	40750	38300	2450	1815	56752	44174	12578	10128	5.13
Kharif- 2019 JRB-1	40750	38300	2450	1815	54919	44083	10836	8386	4.42
Average	40750	38300	2450	1815	55835	44128	11707	9257	4.78

Conclusion:

The Front-Line Demonstration program effectively influenced the attitudes, skills, and knowledge related to improved or recommended practices in paddy cultivation, fostering adoption. It also enhanced the relationship between farmers and scientists, fostering mutual confidence. During the demonstrations, farmers emerged as primary sources of information on improved paddy cultivation practices and served as new suppliers of high-quality pure seeds in their locality and neighbouring areas for subsequent crops.The JR-81 and JRB-1 paddy varieties, along with production technologies demonstrated, contributed to an average increase in grain yield of 17.17% compared to the existing practices of farmers. The cost of this yield increment was a nominal of Rs. 2450 per hectare, an amount affordable even by small and marginal farmers. The mean extension gap (7.80 q ha^{-1}) and Incremental Benefit-to-Cost Ratio (IBCR) of 4.78 provided strong motivation for farmers to adopt JR-81 and JRB-1. The favourable benefit-cost ratio serves as a clear indicator of the economic viability of the demonstration, convincing farmers to embrace the interventions.The Front-Line Demonstration concept can be extended to all farmer categories, including progressive farmers, facilitating swift and widespread dissemination of recommended practices throughout the farming community. This approach aids in breaking down cross-sectional barriers among the farming population. Overcoming the yield gap in paddy cultivation involves extensive promotion of improved practices, utilizing various extension methodologies, with Front Line Demonstrations being a pivotal method to showcase the results of these enhancements.

References:

Agricultural Statistics at a Glance 2022. Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture & Farmers WelfareEconomics & Statistics Division.

Agriculture Statistics 2020-21. Government of Madhya Pradesh,Farmers Welfare and Agricultural Development Department, District wise Area, Production & Yield - Crop wise 2020-21.

Bin Rahman, A. N. M., and Zhang, J. (2023). Trends in rice research: 2030 andbeyond. *Food and Energy Security*, Wiley, 12, e390. https://doi.org/10.1002/fes3.390.

Bisen, N. K. Singh, N.K. and Solanki, R. S. (2020). Productivity Enhancement of Rapeseed-Mustard through Front Line Demonstration in Seoni District of Madhya Pradesh, India. *International Journal of Current Microbiology and Applied Sciences*, 9(04): 1983-1989.

Choudhary, B.N. (1999). KrishiVigyan Kendra-A guide for KVK managers. Publication, *Division of Agricultural Extension*, ICAR: 73-78.

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

Laulanié, H de. (1993). System of rice intensification. *Tropicultura (Brussels)*, 13: 110–114.

Madhya PradeshEconomic Survey2022-23. Government of Madhya Pradesh, Madhya Pradesh State Policyand Planning Commission.

Meena, V.K., Edison, S.J. and Subramani, S. (2015). Frontline demonstration an effective way of popularization of system of rice intensification (SRI). *Agricultural Science Digest.*, 35(3): 215-217.

Singh, N.K., Kumar, S., Hasan, W. and Kumar, A(2018). Impact of frontline demonstration of KVK on the yield of paddy (Sahbhagidhan) in Nalanda District of Bihar,India. *International Journal of Current Microbiology and Applied Sciences,* 7(03): 3606-3610.

Singh, T., Singh, R and Soni, R.L. (2012). Performance of rice variety P 1460 in front line demonstrations under rainfed conditions in Southern humid region of Rajasthan. *Annals of Agricultural Research New Series*. 33(3) : 121-125.

World agriculture production 2023. United StatesDepartment ofAgriculture, ForeignAgriculturalService, Circular Series, WAP 7-23, July 2023.