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On Farm Evaluation of Urd Bean and Mung Bean for Climate Change Adoption in Bundelkhand

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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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ABSTRACT

In the villages of Prathvipura, Karguwan, and PuraBadaura in the district of Jhansi, in the Bundelkhand region, the study was conducted by Rani Lakshmi Bai Central Agricultural University during the Kharif of 2021.Total ten front line demonstrations were conducted on Urd bean and Mung bean in 10 hectare area by the active participation of the farmers with the objective of improved technologies of Urd bean and Mung bean production potentials. The improved technology consisted of improved varieties viz. Virat (Mung bean) and IPU 2-43 **(**Urd bean), balanced fertilizers (based on soil testing) application and integrated weed, diseases and insect pests management, etc. Under FLDs of Urd bean and Mung bean, the average additional yield of the crops was obtained at 25kg/ha and 165kg/ha, while the increased yield over the local check was 23.86 % and 23.10% from respective varieties. The mean extension gap, technology gap, and technology index for Urd bean crop were recorded as 25kg/ha, 870kg/ha & 87.0% where, in the case of Mung bean, it was 165kg/ha, 357.5kg/ha, and 32.5%, respectively. Average and maximum net returns of Rs. 1890 & Rs. 21910.63 and the cost-benefit ratio were recorded as 0.30 and 1.56 from FLD of Urd bean and Mung bean, respectively, followed by local checks.

Keywords: Bundelkhand; front line demonstration; mung bean; urd bean; economics.

1. INTRODUCTION

According to the Ministry of Agriculture & Farmers Welfare, 2021-22, pulses are being produced in India on an area of 28783.32 thousand hectares and thereby 25463.12 thousand tonnes were produced (Fig. 1). Madhya Pradesh has the first place in the production of pulses in India, whereas Rajasthan is in terms of area. Uttar Pradesh is at fifth place on the basis of area of pulses and fourth on the basis of production. According to the year 2020-21, after studying the last ten years, there has been an increase in the area under Mung bean (Fig. 2), According to the area planted with the urad crop over the past ten years, the yield has also been impacted (Fig. 3). But the production capacity in the hair of both the pulses has been achieved more than last year. At the state level, Mung bean and Urd bean are grown the most in Rajasthan and Uttar Pradesh region. On the basis of Mung bean production, Madhya Pradesh ranks first and Rajasthan in Urd bean (Fig. 4).

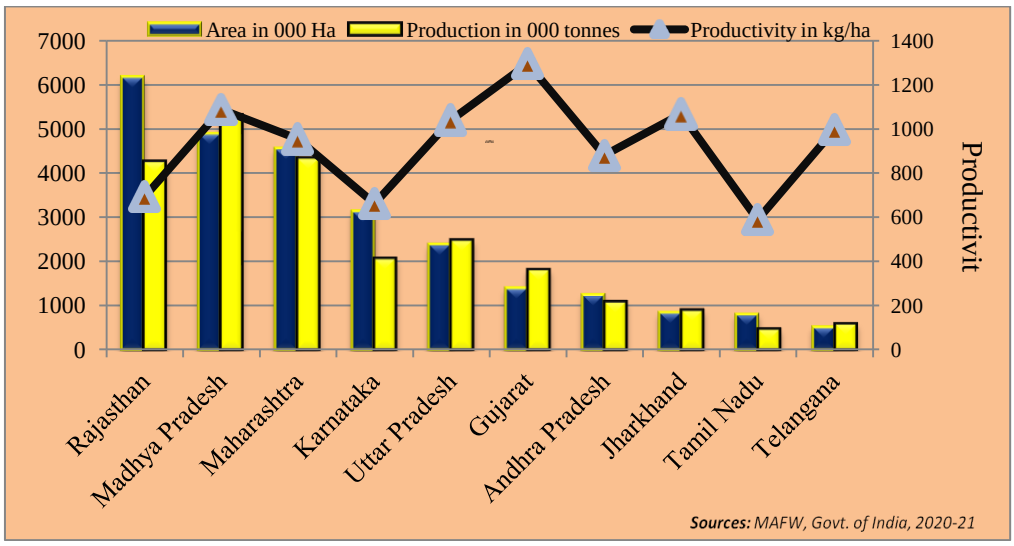

Fig. 1. Area, production and productivity under the top ten states of India, 2020-21

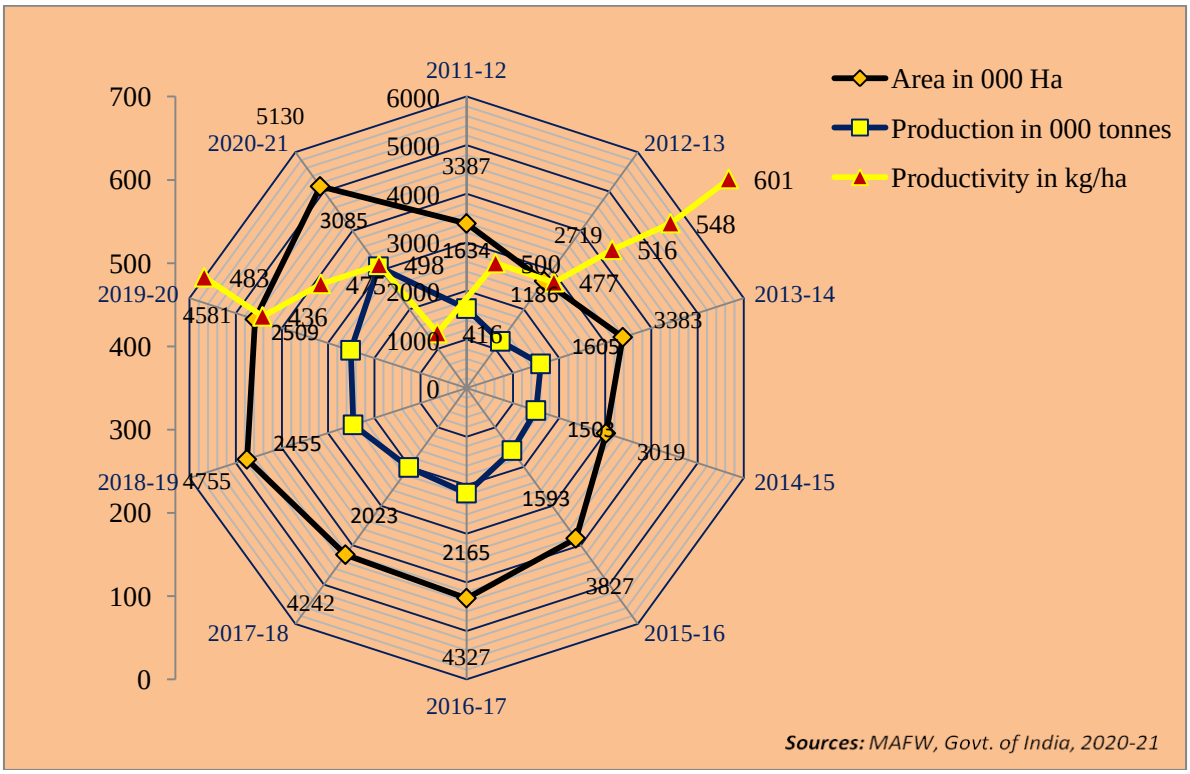

Fig. 2. Area, production and productivity under moong during 2011-12 to 2020-21

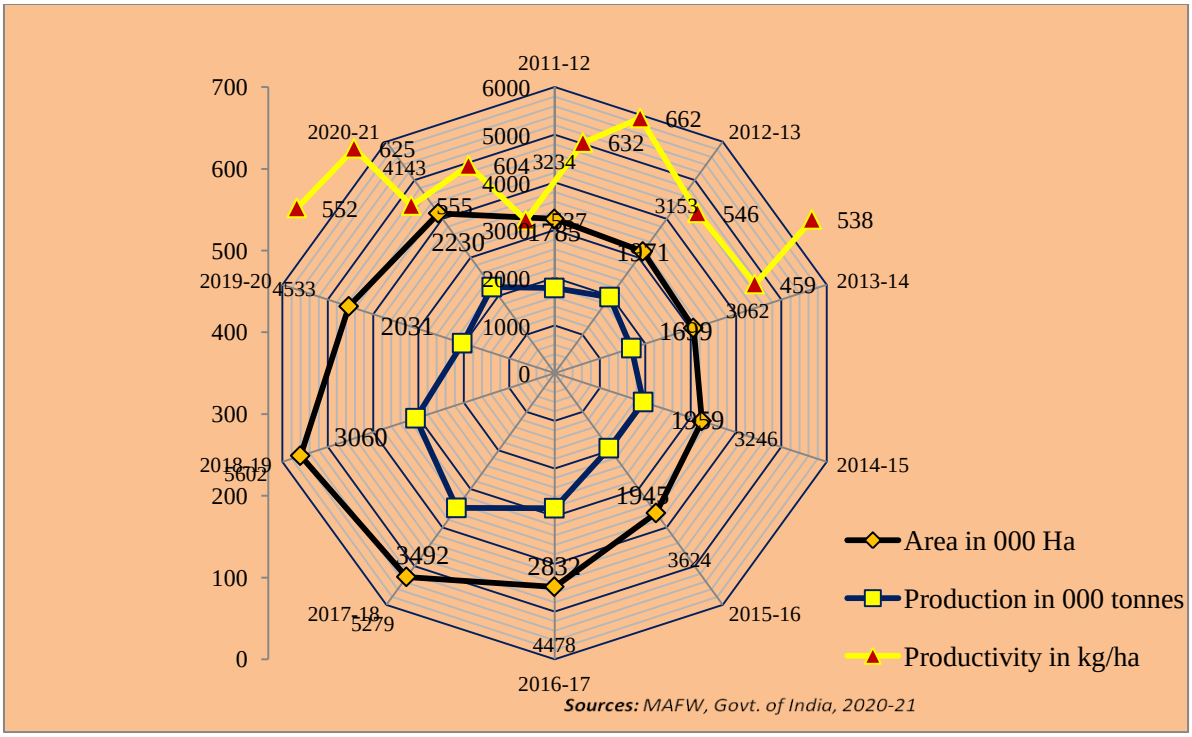

Fig. 3. Area, production and productivity under urad during 2011-12 to 2020-21

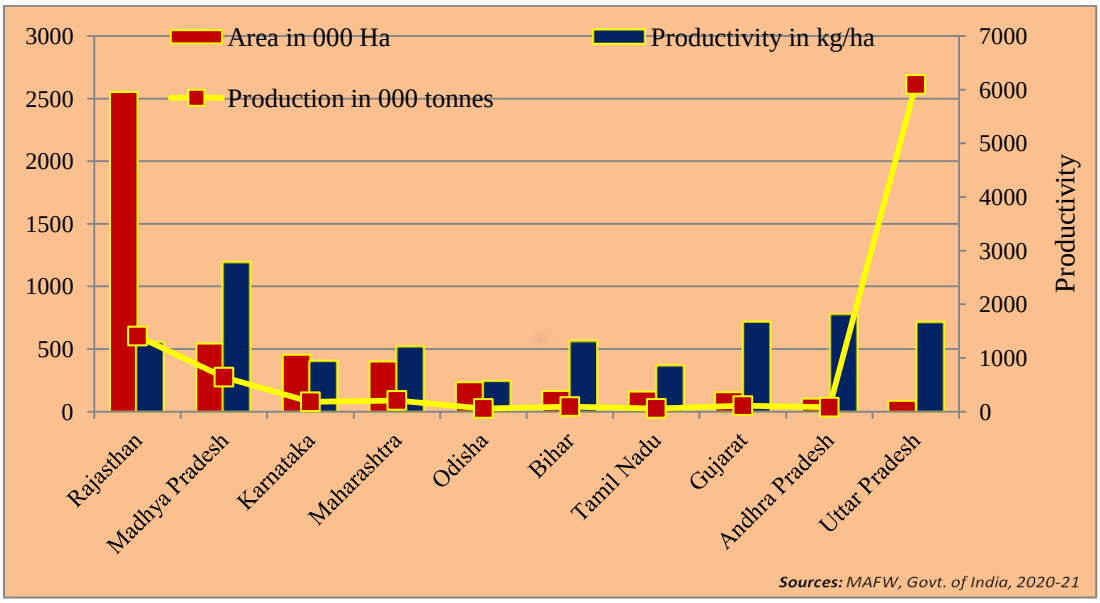

Fig. 4. Top ten states of India under moong cultivation, 2020-21

Bundelkhand region of Uttar Pradesh is a central semi-arid plateau of India that spans seven districts in Uttar Pradesh state comprising Jhansi, Jalaun, Lalitpur, Hamirpur, Mahoba, Banda, and Chitrakoot districts and covering over 7.1 million hectares area. The living difference is widely disparity in terms of condition in different districts of Bundelkhand region. Northern part is more developed as compared to southern part [1]. In the summer, the area experiences a hot environment with highs of up to 46^{o}C and undulating topography. The zone receives about 867 mm of average annual rainfall. Despite its complexity, rainfed nature, risk, under-investment, vulnerability, and socioeconomic heterogeneity, the region is ethically distinctive, agrarian, and backward [2]. Agriculture is the mainstay of this drought-frequented region. The average irrigation intensity in the zone is approximately 108 percent, with the gross irrigated area accounting for 48 percent of the gross area sown. The Bundelkhand region is among the most vulnerable regions of India concerning climate change [3]. Variability in temperature and rainfall has adversely affected the livelihoods of farmers in this region [4].

The village Babina is located in Jhansi tahsil of Jhansi in Bundelkhand region of the state of Uttar Pradesh in India, and the Babina Gram Panchayat governs it. It comes under Babina Community Development Block. The nearest town is Jhansi, about 27 kilometers away from Babina (Rural). The area under the Babina block is 885.9 km^{2}. The population was 528654 in 2020, and the density was 597 people per km^{2}. The sex ratio was 1:1.12. In this region, deep soil, Rakar, Parwa, Kabar, and Maar are the type of soil, while some are un-irrigated, and somewhere irrigated land is available. Black gram, green gram, groundnut, sesame, pigeon pea, sorghum, and paddy are major crops grown in the Kharif season, while wheat, barley, chickpea, field pea, vegetable pea, lentil, mustard, and linseed are grown during rabi season. More than half of the total pulse area in Uttar Pradesh comes from Bundelkhand. However, productivity remains below the state average, which requires technological interventions, infrastructure development, and marketing strategies. Additionally, the region's production, processing, and marketing of pulses are constrained. Therefore, policies should embrace technology and infrastructure to keep balance and keep the interest of both consumers and producers [5].

Field demonstrations, called front-line demonstrations, are a new concept aimed at demonstrating newly released varieties in farmer's fields in different agroclimatic regions and under different farming situations with improved practices, technologies, and management practices. By selecting a suitable variety with technology, Mung bean and Urd bean productivity per unit area can be increased through feasible, scientific, and sustainable management practices. Systematically, front-line demonstrations were conducted in farmer's fields to demonstrate high-yielding new varieties and

convince them of the potential of improved production technologies to enhance urd bean and mung bean yields.

2. MATERIALS AND METHODS

The frontline demonstrations were conducted by Rani Lakshmi Bai Central Agricultural University, Jhansi, Uttar Pradesh, India under the ICAR-PC, AICRP, MULLARP, Kanpur. During Kharif, 2021. A total of 10 frontline demonstrations and in which, five for each on Mung bean and Urd bean of variety Virat and IPU 2-43, respectively, were conducted at farmer's fields in three villages viz., Prathvipur (Nayakheda), Karguwan, and PuraBadaura in Babina block district Jhansi (UP). Five farmers were selected based on recommended area (one hectare), soil fertility, irrigation source, required machineryand farmer interested, from the village Prathvipur, four from Karguwan, and one from Pura Badaura. The team members selected the farmers by visiting the identified villages, meeting the farmers, and visiting their fields. Under these FLDs, the cost of critical inputs like 15kg seed of variety, bio-fertilizers, plant protection chemicals, and herbicides (Table 1) for a one-hectare area is provided to selected farmers. At the time of seed distribution, the scientists gave the farmers all kinds of information related to the crop. The problems related to the farmers' crops were also heard, and their solutions were discussed. During the crop season, the team members visited selected farmers' fields and assessed the crop.

Along with this, the members kept in constant touch with the farmers through mobile, communicated from time to time, and kept getting information about the crop status. Furthermore, the yield and economic performance of frontline demonstrations and the data on output were collected from fields and a local cultivar of the same crops. Finally, the grain yield, cost of cultivation, and net returns with the benefit-cost ratio were worked out.

A well-structured interview schedule was used to collect data from personal contacts. Then, according to the study's objectives, the gathered data were processed, tabulated, classified, and analyzed in terms of mean percent scores and ranks. There was a significant difference between beneficiaries and non-beneficiaries of more than 10 percent. The extension gap, technology gap, and technology index were calculated using the formula suggested by Samui et al. [6].

Table 1. Details of recommended package of practices for Urd bean and Mung bean

S. No.	Technological intervention	Recommended packages of Practice followed in FLDs	
		Urd bean	**Mung bean**
1.	Variety	IPU-2-43	Virat
2.	Field preparation	First week of June, 2021	First week of June, 2021
3.	Sowing time	Second fortnight 2021	Second fortnight 2021
4.	Seed rate	15kg/ha	15kg/ha
5.	Seed treatment	Thiram @3gm/kg seed	Thiram @3gm/kg seed
6.	Sowing method	Line sowing at 5cm deep	Line sowing at 5cm deep
7.	Spacing	30cm x 10cm R xP	30cm x 10cm R x P
8.	Nutrient management	15kgN; 50kg P_2O_5; 30kg K_2O	15kgN; 50kg P_2O_5; 30kg K_2O
9.	Weed management	Application of weedicide (Pendimethalin @1.0 kgha-1) immediately after sowing	Application of weedicide (Pendimethalin @1.0 kgha-1) immediately after sowing
10.	Irrigation	One light irrigation at flowering stage	One light irrigation at flowering stage
11.	Insect-pests management	Emamectin Benzoate 5% SG foliar spray @ 88gm/acre at the time of insect infestation	Emamectin Benzoate 5% SG foliar spray @ 88gm/acre at the time of insect infestation
12.	Disease management	Imidacloprid 17.8% SL @ 1.5ml/L and Mancozeb 75% WP @ 2.0gm/L water	Imidacloprid 17.8% SL @ 1.5ml/L and Mancozeb 75% WP @ 2.0gm/L water

Extension gap (qha^{-1}) = Demonstration yield - Farmer's yield:

Technology gap (qha^{-1}) = Potential yield- Demonstration yield

Technology index (%)
$= \frac{\text{Potential yield} - \text{Demonstration yield}}{\text{Potential yield}} x100$

3. RESULTS AND DISCUSSION

A comparison of the productivity level between front-line demonstrations and local checks is shown in Table 2. The result shows that under the demonstrated plot, the performance of Urd bean and Mung beanbean yield was sustainable and higher than that in the local check-in in both villages. Yield in Urd bean and Mung bean under demonstration ranged from 125-135 kg/ha and 235-1250kg/ha, respectively, during the crop season. The technological intervention, thus, enhanced Urd bean and Mung bean yield to a tune of 23.86 to 25 percent and 14.63 to 31.58 percent, respectively, over the local check. The yield in the front-line demonstration and the crop's potential yield were compared to estimate yield gaps. These gaps were different categories as technology and extension gaps. The technology gap indicates a gap in demonstration Urd bean yield over the potential yield, which was 875 and 865kg/ha, where it was 865 and -150 kg/ha (Table 3). The technology gap was observed due to the change in the weather at the time of sowing. As a result, the crops of Urd bean were greatly affected this year. The farmers of villages Prathvipur and Karguvan could not sowed their crops on time due to excessive moisture in the fields due to rain and could not prepare the fields properly with the help of machinery. Some farmers sowed only in wet soil; in some places, there was heavy rain immediately after sowing, due to which the germination of seeds was hampered; due to heavy rains, the soil fertility appeared low in sloping fields and was in leveled fields. Due to the accumulation of water, farmers faced problems in crop production.

Additionally, some farmers could not sow the crop in the fields identified by the team due to excess rainfall, so they had to sow it on another field. The farmers could not benefit from a good crop due to the soil needing to be more fertile. The farmers of PuraBadaura village had rains at the time of sowing, but from the time of sowing till the maturity stage of the crop, there was less rainfall. Rainfall fall did not have any harmful effect on crop production.

For black gramme, both villages measured an extension difference of 25 kg/ha, whereas for green gramme, the difference ranged from 30-300 kg/ha (Table 3). There is a significant acceptance gap for more efficient production methods, which enables farmers to use crop sowing techniques recommended by science, choose seeds from improved species, and plant their crops at vital times when they require water or fertiliser the most. Crop production can increase profit if crucial factors are taken into account. This demonstrates the necessity of educating farmers for effective agricultural production. It may be possible to bridge the gap between demonstration and farmer's yields if new, improved production technologies are applied to high-yielding varieties. Farmers may eventually discontinue obsolete varieties due to new technologies. The technology index indicates the feasibility of a variety in the farmer's field. With the Urd bean crop, the technology index value was 86.5-87.5, while the Mung bean crop was 78.64 from Prathvipura village and -13.64 percent from PuraBadaura village.The high technology index value suggests that the farmers' efforts to produce quality crops are crucial for this particular region of black gramme. Farmers are to produce enough urad and moong to meet or exceed the crop output on a countrywide scale through FLD.

The exhibition yield of the Mung bean crop was additionally significant than the potential yield. The technology gap was documented at -150kg/ha, and the technology index was recorded at -13.64 percent (Table 2), which generated additional potential due to farmer approaches with advanced technology. The furnished technology enabled the refinement of the Mung bean crop exhibition. Additionally, Singh and Singh [7] find that by bridging the technology gap, using the latest varieties and improved packages of practices under cluster frontline demonstration significantly increases pulse productivity and profitability in the field (Dwivedi et al. [8]; Singh et al. [9]; Mitnala et al. [10]; Saikia et al. [11], Singh et. al. [12] and Ola et al. [13]). The conclusions align with the investigation by Udhad et al. [14]. These outcomes are even pursuing the determinations of Dhaka et al. [15], Mitnala et al. [10] and Singh et al. [9]. Therefore, higher benefit-cost ratios demonstrated the economic viability of the

technological interventions and convinced farmers that they were helpful. Increasing farmers' income and self-sufficiency in pulses production could be achieved through large-scale cluster frontline demonstrations for other pulse crops.

Table 2. Yield and yield difference of Urd bean and Mung beanbean under front line demonstrations

Name of village	Yield (kg/ha)		Additional yield over local check (kg/ha)	Per cent increase yield over local check
	FLD	Local check		
Urd bean				
Prathvipur	125	100	25	25
Karguwan	135	110	25	22.73
Mean	130	105	25	23.86
Mung bean				
Prathvipur	235	205	30	14.63
PuraBadaura	1250	950	300	31.58
Mean	742.5	577.5	165	23.10

Table 3. Yield gap and technology index in front line demonstrations

Name of village	Technology gap (kg/ha)	Extension gap(kg/ha)	Technology index (%)
Urd bean			
Prathvipur	875	25	87.5
Karguwan	865	25	86.5
Mean	870	25	87.0
Mung bean			
Prathvipur	865	30	78.64
PuraBadaura	-150	300	-13.64
Mean	**357.5**	**165**	**32.50**

**Potential yield: Mung bean-12q/ha and Urd bean-10q/ha*

Table 4. Economics of front line demonstrations

Name of village	Cost of cultivation (Rs/ha)		Gross return (Rs/ha)		Net return (Rs/ha)		Benefit cost ratio	
	FLD	Local check	FLD	Local check	FLD	Local check	FLD	Local check
Urd bean								
Prathvipur	6200	7500	7875	6300	1675	-1200	0.27	-0.16
Karguwan	6400	7800	8505	5335	2105	-2465	0.33	-0.32
Mean	6300	7650	8190	5817.5	1890	-1832.5	0.30	-0.24
S.dev	12068.84	9470.52	4491.37	3204.59	16555.05	12663.33		
S.Em	3816.50	2994.84	1420.30	1013.38	5235.17	4004.50		
Mung bean								
Prathvipur	5800.00	8650.00	17096.25	14913.75	11296.25	6263.75	1.95	0.72
PuraBadaura	28100.00	24550.00	60625.00	69112.50	32525.00	44562.5	1.16	1.82
Mean	16950.00	16600.00	38860.63	42013.25	21910.63	25413.13	1.56	1.27
S.dev	12344.72	9183.27	24820.68	31293.78	27076.34	18791.34		
S.Em	3903.74	2904.01	7848.99	9895.96	8562.29	5942.34		

The assessed economics of unwinding Urd bean and Mung bean crops under front-line demonstrations and consequences are presented in Table 3. Economic analysis of outcome implementation publicized that excluding more increased production, participating agriculturalists in FLDs recognized a more elevated price than produce corresponded to local checks during the study period in the FLDs because of the better quality of the crop. Consequently, front-line demonstrations resulted in higher gross returns of Rs. 7875 and Rs. 8505 (Urd bean) and Rs. 17096.25 and Rs. 60625.0 (Mung bean), and net returns of Rs. 1675 and Rs. 2105 (Urd bean) and 11296.25 & Rs. 32525.0 (Mung bean) with benefit-cost ratios of 0.27 & 0.33 and 1.95 & 1.16 (Table 4) compared to our local check. These findings are consistent with those of Kumar et al*.* [16] and Singh et al*.* [17]. As Singh et al*.* [18] reported, the improved technology gave higher gross and net returns with a higher benefit-cost ratio than farmers' practices when studying FLD's impact on pulse yields. In their study, Raj et al*.* [19] and Singh et al*.* [20] reported similar findings.

4. CONCLUSION

According to the findings of the current study, a significant amount of the technological divide has been closed, by the front-line demonstrations directing the productivity of urd bean and mung bean expansion in Babina block, district Jhansi, Bundelkhand. The yield of urd bean and mung can be easily boosted if cultivation practices are scientific. Farmers were instructed scientific methods to grow quality crops by Front Line Demonstration. It helped farmers understand the differences between conventional technology and new technology and is crucial in raising the yield obtained through improved practices and variety. Frontline Demonstrations also emphasizesin ensuring the safety and improvement of fertility in farming, and it teaches how innovative farming methods can help farmers double their crop yields and revenue.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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