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Pulse Productivity and Profitability as Influenced by Cluster Frontline Demonstrations in Kupwara District of Jammu and Kashmir, India

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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

The cluster frontline demonstrations (CFLDs) on Rajmash and Greengram were conducted by Krishi Vigyan Kendra, Kupwara, J&K at farmers' fields during the year 2021. Through farmer meetings and group discussions, the crucial inputs in the production technology were identified. The results for Rajmash and Greengram showed that overall yield trends of demonstrations varied from 7.00 q/ha to 11 q/ha and 6.00 q/ha to 9.00 q/ha, respectively, with yield increase of 57.14% and 50% over the yield of local practices. Due to significant heterogeneity in the extent of adoption of recommended technology based on the level of risk associated in terms of cost,convenience, skill, and information regarding the concerned practise, the yield levels were much lower under local practices. Rajmash and greengram's average extension gap, technology gap, and technology

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index, respectively, were found to be 4.00, 1.00 q/ha and 8.33 percent and 3.00, 1 q/ha and 10.00 percent. The demonstration's average gross and net returns for the rajmash and greengram crops, respectively, were 44.44 and 145.33 percent, 70.00 and 289.55 percent greater than the farmer's practices. In rajmash and greengram, the average benefit-cost ratio was higher with 44 and 145 percent respectively. Variations in agro-climatic factors, soil fertility, biotic stresses, economic status, and management practices were found to cause variations in the technology gap and index percentage. By encouraging farmers to use sustainable technical practices for increasing the yield and productivity of pulse crops, this variation can be reduced. With the application of pesticide, the performance of enhanced technology was shown to be most successful in controlling the smallest number of afflicted plants/m^2 as well as the smallest number of pods/plants. Under demonstrations, production was higher than local practice. In order to increase the area and production of pulses in the Kupwara District of Jammu and Kashmir, pulse production and protection technology has a wide range of potential applications.

Keywords: CFLD; pulses; rajmash; greengram technology; extension gap.

1. INTRODUCTION

The main source of protein for vegetarians in India is found to be pulses, which range in protein content from 20 to 24 percent, depending on the crop variety. Additionally, vital vitamins, minerals, and dietary fibres are found in pulses. It is second important constituent of Indian diet after cereals. They can be grown on all types of soil and climatic conditions. Additionally, they are crucial to crop rotation, mixed farming, and intercropping since they keep the soil's fertility. They enrich the soil with organic material by incorporating leaf mould. Because pulses have greater leafy growth and close spacing and provide additional calf feed, their cultivation aids in reducing soil erosion. Pulse plants are harvested, breakdown in the soil, and produce green manure crops. Most pulse crops have short growing seasons, making it possible to harvest a second crop on the same land within a year. Pulses can be processed and given added value, which increases their market worth and creates significant opportunities in the dal, roasted grain, papad, and other culinary industries. India is the world's greatest producer of pulses, contributing 26% of the total production on an area of 29.99 million hectares, generating 25.23 million tonnes. In comparison to the global average of 1023 kg/ha, the country's average production is roughly 841 kg/ha [1]. According to APR Pulses ATTARI Ludhiana, the productivity of pulses in the Union territory of J&K is approximately 9.00 q/ha. The important pulse crops are Chickpea, Pigeon pea,Urdbean, Mungbean, Lentil and Field pea. Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, Karnataka, Andhra Pradesh, Gujarat, Jharkhand, Tamilnadu, and Telangana are the largest pulse-producing states, accounting for over 91% of global pulse production [1].

Average productivity of pulses in Kashmir valley is very low but it forms an important part of the diet of the people particularly during winters when the valley remains snow covered and there is hardly any freshvegetable available in the market. Among the pulses mostly rajmash and greegram are cultivated by thefarmers of the valley. In Kashmir valley there isa good scope for further improving the pulse production as farmers cultivating pulses as intercrop in Apple orchards and as an intercrop/ mixed crop along with maize production.Some of the areas in district Kupwara like Machil,Budnambal, Jumgund and other rainfed areas of lolab, Karnah and Keran are famous for quality pulse production particularly rajmash.

The main causes of the potential yield of pulse crops declining are the scarcity of improved varieties, the continued use of traditional farming practices, the non-adoption of recommended production technologies, a lack of knowledge and confidence in new technologies, and significant abiotic and biotic stresses. The cluster front-line demonstration is a successful extension strategy to show farmers the increased production potential of pulse crops.As a result, it is advised that extension agencies involved in the transfer and application of agricultural technologies at farmers' fields give priority to taking frontline demonstrations on a cluster basis for maximising the productivity potential of pulse crops, minimizing the technology gap, accelerating technology adoption, and reducing disease and insect infestation in major crops.

2. MATERIALS AND METHODS

One of the most effective extension strategies is cluster front line demonstrations since farmers in general rely heavily on visual cues. Cluster frontline demonstrations main goal is to show off newly released superior varieties, crop production and protection technology, and its management techniques at farmer's field.The Krishi Vigyan Kendra Kupwara, J&K,conducted 88 cluster frontline demonstrations (CFLDs) on Rajmash (50) and Greengram (38) during the Kharif season of 2021.To determine the crucial inputs in the production technology now in use, meetings with farmers and group discussions were held. The cluster front line demonstrations on pulse crops were undertaken by KrishiVigyan Kendra, Kupwara , SKUAST-K. In various locations throughout the Kupwara District, the Krishi Vigyan Kendra had taken 50 CFLDs on rajmash and 38 CFLDs on greengram. For the rajmash and greengram cluster demonstrations, the total area covered were 10.00 ha and 8.00 ha, respectively. Following a group discussion, a list of farmers was created, and those who were chosen, received specialised trainings in various parts of suggested production and protection technologies. The technological interventions on pulse crops included appropriate improved varieties of rajmash Var. Shalimar Rajmash -1 and greengram Var. KM-331 and demonstrated with a full package of practises, including proper tillage, proper seed rate, time of sowing, and sowing method, balanced dose of fertiliser (18 kg Nitrogen 46 kg P_2O_5/ha), proper irrigation, weed management, and improved plant protection measure.Rajmash and greengram plots next to demonstration plots were chosen as control plots, where farmers' practices (use of regional varieties, broadcast sowing technique, use of unbalanced fertiliser, one-handed weeding and indiscriminate use of plant protection measures) were put into practice. Scientists from KrishiVigyan Kendra in Kupwara kept an eye on the demonstrations taking place on farmers' crops from planting to harvesting. These visits were also used to gather feedback data for future research and extension programme improvements. The following formulae were used to analyse the yield data from the demonstration and control plots using the appropriate statistical methods for the individual parameters: -

$$TR(IT) - TR(FP > TC(IT) - TC(FP)$$

$$DR(IT) > DC(FP); TR = \Sigma\, \mathrm{Pi.Yi}$$

$$TC = \Sigma\, \mathrm{Pj.Xj}$$

Where, TR (IT) = Total return from the improved technological intervention (IT),TR (F) = Total returns from farmers' practice plot; TC(F)=Total cost recorded in farmers practice plot; DR(IT) =Change in the revenue due to improved technology; DC(FP) = Change in the revenue due to farmers' practice; TR (IT) =Total return from the improved technology plot; TC(IT) = Total cost from the improved technology plot;Pi=Price of the ith output (i=1,….,n); Yi=quantity of the ith output (i=1,….,n); Pj=Price of the jth input (j=1,….,n)and Xj=quantity of the jth input (j= 1,….,n).

The yield gap also has at least two other components, known as Yield Gap I and Yield Gap II. Yield Gap II, which reflected the effects of biophysical and socioeconomic constraints,was the difference between yield obtained at the demonstration plot and actual yield obtained on farmers' fields. Yield Gap I refers to the difference between potential yield and farm yield obtained at demonstration plots.

The yield attributes of the checks and demonstrations including agricultural practices were noted. According to recommendations made by Samui et al. in 2000 and Dayanand et al. in 2012, the extension gap, technology gap, and technology index were determined by using following formulas.

$$ExtensionGap = Demonstratedyield(DY) - Farmers'practiceyield\ (Fpy)$$

$$TechnologyGap(Tg) = PotentialYield(Py) - DemonstratedYield$$

$$TechnologyIndex(Ti\ \%) = Py - \frac{DY}{Py} \times 100\ Additionalcostinimprovedtechnology\left(ACIT\frac{in}{ha}\right)$$

$$= Costofimprovedtechnology(Cit) - CostoffermerspracticeCfp)$$

$$Additional returns (Area) = Net returns of improved technology (Nrit) - Net returns of farmers practice (Nrpf) Effective gain = Additional returns of improved technology (Arit) - Additional cost of improved technology\ (Acit)$$

$$Benefit Cost Ratio (BCR) = Gross returns / Gross expenditure$$

3. RESULTS AND DISCUSSION

According to the present study, full technological gaps were found for the technological interventions that included variety, seed rate, sowing method, and fertiliser dose, while partial technological gaps were found for the technologies of land preparation, irrigation, weed management, and plant protection measures. However, there was no technological gap found for the timing of sowing for rajmash and greengram. Due to a lack of awareness and farmers' use of local varieties of pulses with low yielding potential due to a lack of high-quality seed of improved varieties, there may be full or partial gaps in the data. This may explain the low production of pulses in the UT of J&K in general and district Kupwara in particular.The prevalence of the anthracnose disease in rajmash and the prompt supply of high-quality seeds caused great concern among farmers. According to Burman et al. [2], there is a gap in the adoption of technology in both irrigated and rain-fed cropping systems for main pulse crops.

3.1 Technology Gap

The difference between the potential yield of the variety and the yield of the demonstration is known as the technology gap. According to the statistics, the technological gap between rajmash and greengram was 1q/ha (Table 2). It suggests that there is a little gap in technological demonstration, which prevented farmers from realising the full output of the improved practices. This might be explained by variations in farming techniques, meteorological conditions, and soil fertility levels. Singh, et al.[3] and Vijaya Lakshmi et al. [4], both reported the same results.

3.2 Extension Gap

The extension gap is the variation in yield between farmer practice plots and demonstration plots. Rajmash and greengram, respectively, had extensions gaps of 4 q/ha and 3 q/ha (Table 2).The average extension gap was noted; various extension techniques ought to be modified to further close this gap. Training initiatives and awareness campaigns should be used to spread information on better practises. Farmers would adopt better practices as a result of the enhanced awareness that the extension functionaries had helped to develop, which would close the extension gap. These results are in agreement with those of Singh et al. [5].

3.3 Impact of Technological Interventions on Productivity of Pulse Crops

The use of technical interventions in pulse crops included high yielding seed varieties, recommended seed rates, seed treatment, timing and sowing techniques, recommended fertilizer doses, weed control, and appropriate plant protection techniques. Table 3 displays the effects of technological interventions on the production of pulse crops. When the yield parameter was also evaluated for district, state, and national productivity, it showed significantly greater productivity for both crops overall. The outcome made it very evident that the average rajmash productivity from the sample plot is 11 q/ha. The demonstrated technology of rajmash yielded average productivity by 57.14, 69.23,37.5 and 22.22 per cent more over existing practice, district, state and national yield, respectively. The results of demonstrated technologies of greengram elicited in Table 3that greengram yielded average productivity i.e.9.00q/ha from demonstrated plot. The demonstrated technology of greengram gave average productivity by 50.00,100,80.00and 28.87percent more over existing practice, district, state and national yield,respectively. Dwivedi et al. [6] and Singh et al. [3] also reported similar findings in chickpea crop.

3.4 Economic Performance

The estimates for the economics of producing pulse crops under the cluster frontline demonstration are shown in Table 4. As a technological intervention, various factors including high yielding kinds of seed, fertilisers, vermicompost, bio-fertilizers, and chemical fertilizers were taken into consideration. In

Table 1. Technological adoption gaps between farmers practices and front line demonstrations

S.No.	Particulars	Technologicalinterventions		ExistingPractice	TechnologicalGap
		Rajmash	Greengram		
1	Land Preparation	Three ploughings with cultivator and one rotavator	Three ploughingswith cultivator and one rotavator	Onetottwocultivator Ploughing	Partial Gap
2	Time of sowing	From Mid Mayto Mid June	From Mid May To Mid July	As per recommendation	No gap
3	Variety	Shalimar rajmash-1	Virat	Local	Fullgap100%
3	Seed rate (Kg/ha)	65kg/ha	25kg/ha	Higherseedrate	Fullgap100%
4	Sowing method	Line Sowing	Line Sowing	Broadcasting	Fullgap100%

Table 2. Gap in grain yield production of pulse crops under cluster frontline demonstration (CFLD)

Name ofcrop	Technology Demonstrated	Potential yield of variety(q/ha)	Under CFLDProgramme		Average yield(q/ha)		Impact (%change)	TG (q/ha)	EG (q/ha)	TI(%)
			No. of Demo.	Area(ha)	DP	FP				
Rajmash	Variety (Shalimar Rajmash-1) +INM (75% N,P and full dose of K + Rhizobium, PSB and vermicompost)+Sowing Method (Line sowing)	12	50	10	11	7	57.14	1	4	8.33
Greengram	Variety (Virat)+INM (75% N,P and full dose of K + Rhizobium, PSB and vermicompost) +Sowing Method (Line sowing)	10	38	8	9	6	50.00	1	3	10

Table 3. Impact of technological interventions in terms of productivity enhancement in pulse crops

Crop Name	Average	Yield(q/ha)	District Yield (DY)	StateYield(SY) q/ha	National Yield(NY) q/ha	Impact(% Change overEP)	Impact(% Change overDY)	Impact(% Change overSY)	Impact(% change overNY)
	Demo.Plot(DP)	Existing Practice							
Rajmash	11	7	6.5	8.00	9.00	57.14	69.23	+37.5	22.22
Greengram	9	6	4.5	5.00	7.00	50.00	100	80.00	28.57

Table 4. Impact of cluster frontline demonstrations on pulses productivity and profitability in farmer's field

Crop	Cost of Cultivation (Rs/ha)		% Increase in CoC over FP (Rs/ha)	GR (Rs/ha)		% increase in GR(Rs/ha)	NR (Rs/ha)		% increasein NR (Rs/ha)	BCR		Percent increase over FP
	DP	FP		DP	FP		DP	FP		DP	FP	
Rajmash	90000	45000	100	130000	90000	44.44	85000	50000	70.00	1.88	1.25	44.00
Green- gram	35567	22513	57.98	88320	36000	145.33	52953	13487	289.55	1.45	0.59	145.00

DP=Demo Practice, FP=Farmers Practice, CoC=Cost of cultivation, GR=Gross\returns.NR=Net returns, BCR=Benefit cost ratio comparison to farmers' practices, the average cost of cultivation increased by 100% and 57.98% in rajmash and greengram, respectively, with improved technology interventions. The comparative profitability of other pulse crops also showed that rajmashrealised the highest gross return, or Rs. 130000/ha, followed by greengram with Rs. 88320/ha. The net returns of demonstration for rajmash was 85000/ha as compared to farmers practices with ` Rs.50000/ha whereas in greengram net return was Rs.`52,953/ha as compared to farmers practice with`Rs.13487/ha. Rajmash's net returns of the demonstration were 85,000/ha as opposed to farmers' practices of 5,000/ha, while greengram's net returns were 52,953/ha as opposed to farmers' practices of 13487/ha. In the rajmash and greengram crops, respectively, the average gross financial return grew by 44.4% and 145%, highlighting the significance of newer technology. The farmers' better gross financial returns demonstrate the technology's viability from an economic standpoint. The information in Table 4 also showed that the demonstrated plot's cost of cultivation was higher than the farmer's field's cost, but that the demonstrated plot's yield was also higher, which is supported by the comparison result from the cost-benefit ratio calculation. The average benefit-cost ratio was 1.88 for the rajmash demonstration plots and 1.25 for the greengram plots, compared to 1.25 and 0.59 for farmer practice. Similar results were also found in frontline pulse crop demonstrations by Dwivedi et al. in [7,8]. In comparison to local practices, Singh et al. [3] and Singh, et al. [5] also reported higher yield and net returns as well as benefit cost ratios [9,10].

4. CONCLUSION

It is wise to use the cluster strategy when demonstrating new technologies in order to impact not only the participating farmers but also the farmers nearby. The demonstrations are more authentic because they are carried out in farmers' fields under the scientist's supervision, and the results may be extrapolated to the surrounding area. When compared to farmers' practices, the improved practices that have been demonstrated are superior. Through their opinions of the technology, the farmers demonstrated a favorable attitude towards the demonstrations. Due to ignorance and lack of confidence in more advanced technologies, there existed a technological gap between technological intervention and current practices in pulse production technology. The farmers' lack of knowledge of improved packages and methods for producing pulses was shown by the technology and extension gap, thus it is advised that they be made aware of the need to adopt upgraded technologies by various extension aids (training, demonstration, etc.). The technology index demonstrates if the technology used in the farmer's field is practical. The lower technology index demonstrated the successful use of technology. In order to reduce the extension gaps, technology gaps, technology index gaps, adoption gaps, and therefore yield gaps and raise the income of farmers, it is concluded that technology needs to be popularized. The demonstrations' financial specifics give us the go-ahead to further popularize them among farmers in preparation for widespread adoption. As a result, in this scenario, extension organizations can also play a big part in helping farming communities transmit improved technology for sustainable output and productivity. This leads to the conclusion that adopting a better set of pulse production technology practices may increase productivity per unit area.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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