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Summer Mung (*Vigna radiata* L.) Promotion by Cluster Front Line Demonstration in Irrigated Agro-Ecosystem: A Case Study

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ABSTRACT

Background: The marginalization of pulse crops in irrigated agro-ecosystem has been among the most negative facets of green revolution technologies. Integration of summer mung in the irrigated agro-ecosystems within rice-wheat and alternate systems is feasible and remunerative. This crop facilitates the crop intensification by adding a third crop to the crop sequence and there is a large area to intervene. This crop holds the key to increase the income of the farmers and to achieve self-sufficiency in pulse production.

Methods: This study was carried out at farmers' fields under irrigated farming situations during the period from 2017 to 2022 using cluster frontline demonstration (CFLD) as farmer participatory intervention. In total 425 demonstrations were conducted within rice-wheat and alternate systems on an area of 170 ha, covering 18 villages and 425 farmers. By comparing farmers' practices in local checks with suggested technologies in demonstrations, a gap analysis was carried out and data on various technical and economic factors were recorded.

Result: The CFLD programme mitigated the gaps and increased the adoption of summer mung from 4 per cent of the farmers in 2017 to 22 per cent in 2022. The yield increase in a demonstration over local check was by 17.6 per cent with favourable economics generating net additional returns of Rs. 5488 ha^{-1}. The extension gap, technology gap and technology index recorded in the study were 1.44 q ha^{-1}, 5.48 q ha^{-1} and 36.53 per cent. The market price was less than the minimum support price (MSP) in all the years of study. The summer mung intensifies the cropping systems as a third crop and its cultivation is remunerative and climate resilient.

Key words: Alternate cropping system, Cluster frontline demonstration, Economics, Extension gap, Minimum support price, Summer mung, Technology gap, Technology index.

INTRODUCTION

Pulse crops are the restorer of soil fertility, provide dietary proteins to the large vegetarian population of the country and thus are an integral part of the food and nutritional security. The pulses in India are grown in 28.83 mha area with production and productivity of 25.72 million tonnes and 892 kg ha^{-1}, respectively (Anonymous, 2021). There is a need to increase the production and productivity of pulses with an average annual growth of 4.2% to reach the target of 32 million tonnes by the year 2030 (Singh *et al*., 2016).

The marginalization of pulse crops in irrigated agro-ecosystem has been among the most negative facets of green revolution technologies. The cultivation of pulses in Haryana state is now confined to rainfed and resource-poor conditions covering an area of 69660 ha with production and productivity of 64380 tonnes and 924 kg/ha, respectively (Anonymous, 2022).

The summer mung in the irrigated agro-ecosystems fits well in the number of cropping systems *viz*., rice-mustard-summer mung, rice-potato-summer mung, Sugarcane ratoon-summer mung, rice-pea-summer mung and rice-wheat- summer mung. The cropping systems other than rice-wheat are agronomically termed as alternate cropping systems as signifying the diversification from the pre-dominant rice-wheat cropping system. The summer mung is a high potential remunerative crop with its duality as a grain crop and also as a green manure crop for the succeeding rice crop.

In order to demonstrate the production potential of new technologies in the cultivation of pulses, Krishi Vigyan Kendras (KVKs) are conducting cluster front-line demonstrations (CFLDs) of pulses at farmers' fields as part of the National Food Security Mission (NFSM). This study was conducted to evaluate and assess their efficacy and impact in terms of horizontal expansion of the crop, productivity gain and increasing the income of the farmers.

MATERIALS AND METHODS

This study was carried out at farmers' field in the district Panipat of Haryana, India under irrigated farming situation during the period from 2017 to 2022 using CFLD as a farmer participatory intervention. The district Panipat is among the high-potential core district of Haryana being dominated by

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rice-wheat cropping system. In total 425 demonstrations were conducted on an area of 170 ha, covering 18 villages and 425 farmers. The farmers were selected from all these villages as per their ecological niche respective to the cultivation of summer mung. The gap analysis was done in 2017 and 2022 by comparing the farmers' practice of cultivating summer mung with the recommended production technology. All assistance was provided to the selected farmers in the system mode. The demonstration and local check treatments were accommodated in the adjacent fields of 0.4 ha (1 acre) each. The farmers followed their cultivation practices in the local check and recommended production package was followed in the case of demonstration plots. Soils of the experimental fields were sandy loam to loam in texture, low in organic carbon, low to medium in P and high in K. The data on various technical and economic indicators like yield, cost and market price was recorded in respective years and was analyzed in the framework of standard indices for such case studies. The yield of 15 q ha^{-1} was applied as the potential yield of mungbean variety MH 421 for this study. The extension gap, technology gap and technology index were calculated as per the formula given by Samui *et al*. (2000):-

a) Extension gap (EG) =Demonstration yield - Local check yield.

b) Technology gap (TG) = Potential yield - Demonstration yield.

c) Technology index (TI) =

$$\frac{\text{Potential yield - Demonstration yield}}{\text{Potential yield}} \times 100$$

RESULTS AND DISCUSSION

Gap analysis

The gap analysis was done in 2017 at the pre-implementation stage of CFLD programme and then in the year 2022 and the results are presented in Table 1. The gaps for different components ranged from 84 per cent to 100 per cent in the year 2017; thus indicating that farmers had nearly no exposure to the new technologies in the cultivation of summer mung. The corresponding figures in the year 2022 ranged from 14 per cent to 54 per cent. The CFLD- based farmer interface facilitated the dissemination of new technologies among the farmers. The major gaps in the cultivation of pulses were also reported by Kumar and Boparai (2020) and Meena *et al*. (2022).

The proportion of the farmers cultivating summer mung increased from 4% in 2017 to 22% in 2022. The average plot size of summer mung among adopters increased from 0.18 ha to 0.56 ha. However, 78% of farmers are still out of the fold of this desirable technology and even the adopters have adopted it on a limited scale.The desirable shift in cropping systems was observed in 2022 wherein 13% of adopters integrated the summer mung in an alternate cropping system with optimized sowing time. Ram *et al.* (2016) also reported that timely sowing of summer mung plays an important role to get higher productivity.

The substantial gaps persisted even in 2022 in certain components like the use of fertilizers, bio-fertilizers, seed treatment, sowing time and plant protection measures (Ram *et al.,* 2013). The non-availability of inputs like bio-fertilizers, farmers' leaning for wheat crop in Rabi season and delayed sowing are the other reasons for the persisting gaps in the production technology. The gap analysis study established the worth and efficacy of the CFLD programme generating a visible impact.

System analysis of demonstrations

Out of total of 425 demonstrations, 266 were in the rice-wheat-summer mung sequence and the remaining 159 were in alternate systems. Out of 266 demonstrations in the rice-wheat-summer mung sequence, 96 demonstrations (16 in 2019 and 80 in 2020) recorded no significant grain recovery and a standing crop was incorporated for green manuring in rice crop (Table 2). The failure of 80 % demonstrations in 2020 may be attributed to the Covid pandemic and lockdown which delayed the sowing of summer mung to May.

Grain yield

Adoption of improved practices in demonstration plots increased the grain yield of summer mung over local check in all the years of study (Table 3). The yield gain in a demonstration over local check ranged from 10.4% in 2022 to 22.8 % in 2019 with a mean value of 17.6 per cent. The mean grain yield recorded in demonstrations was 9.5 q ha^{-1} with a range of 6.5 q ha^{-1} in 2017 to 11.5 q ha^{-1} in 2021. The corresponding figures for the local check were 8.08 q ha^{-1}, 5.40 q ha^{-1} and 9.7 q ha^{-1}, respectively. The increase in grain yield in demonstration plots over local check could be attributed to the adoption of recommended technology package in demonstrations. The yield gain in demonstrations plots over the local check plots has also been reported by Kumar and Kispotta (2017); Meena and Singh (2017) and Singh *et al*. (2021).

The data on yield range in respective years of the study is also a material fact in this study. The lowest yield in each year of study was obtained in the rice-wheat-summer mung sequence and conversely, the highest yield was recorded in alternate systems. The difference in maximum and minimum yield in demonstrations decreased from 300.0% in 2017 to 39.5% in 2022 which concludes that the recommended technology package of summer mung with optimized sowing time in alternate systems is more productive and also stable.

Extension gap

The extension gap ranged from 0.93 q ha^{-1} in 2022 to 1.84 q ha^{-1} in 2020 with an average of 1.44 q ha^{-1} (Table 3). The extension gap may be attributed to gaps in the adoption of recommended technology as revealed in the gap analysis presented in Table 1. The optimization of the sowing time of summer mung by accelerating alternate cropping systems (rice-mustard-summer mung, rice-potato-summer mung, sugarcane ratoon- summer mung and rice-pea-summer mung) and its cultivation by the individual farmers on larger plot size with strong commercial attitude will diminish the extension gap. Otherwise, this crop is largely cultivated as a minor crop and the attitude of yield maximization and profit realization is grossly weak in comparison to the principal crops like rice and wheat. The wide extension gap may be reduced through the collective interface between researchers, extension workers and farmers (Meena *et al*., 2020).

Technology gap

The technology gap is the key indicator of the efficacy, efficiency and performance of any technology in location-specific agro-ecological niche. The wide gap between the potential yield and the demonstration yield is indicative of the fact that the technologies flowing from the researchers need refinement and adaptation. The technology gap in the present study ranged from 3.50 q ha^{-1} in 2021 to 8.5 q ha^{-1} in 2017 with an average of 5.48 q ha^{-1} (Table 3). These findings are in agreement with that of Sandhu and Dhaliwal (2016).

The technology gap recorded in the present study is substantial. The comparatively lower yield in the rice-wheat-summer mung sequence is the primary cause of such high

Table 1: Gaps between demonstration package and farmers' practices in the cultivation of summer mung and its adoption pattern.

Parameter	Demonstration package	% Gap	
		2017	2022
Variety	MH-421, MH-318, MH 1142	91	14
Seed rate	20-25 kg ha^{-1}	84	18
Seed treatment	carbendazim (4 g kg $^{-1}$ seed)	100	43
Sowing time	20th March-20th April	93	34
Fertilizers	15 kg N and 40 kg P_2O_5 ha^{-1} (87.5 kg DAP ha^{-1})	89	42
Biofertilizers	Innoculation with *Rhizobium* and PSB	100	48
Weed management	Pre-application of pendimethalin @ 3.3 l ha^{-1}	100	31
Plant protection	Need-based use of recommended pesticides	96	54
Adoption pattern			
Adoption of the cultivation of summer moong		4%	22%
Average holding of adopters		3.6 ha	3.4 ha
Average plot size of summer moong among adopters		0.18 ha	0.56 ha
Integration in rice-wheat cropping system		4%	18%
Integration in alternate cropping systems		0%	13%

Table 2: System analysis of demonstrations.

Year	No. of demonstrations			Date of sowing	
	Rice-wheat	Alternate system	Total	Rice-wheat	Alternate systems
2017	44	6	50	18th April to 26th April	29th March to 5th April
2018	36	39	75	24th April to 29th April	24th March to 4th April
2019	93 (16)	7	100	23rd April to 18th May	25th March to 6th April
2020	100 (80)	20	100	2nd May to 10th May	28th March to 11th April
2021	13	37	50	23th April to 3rd May	20th March to 3rd April
2022	0	50	50	-	21th March to 13th April
Total	266 (96)	159	425	18th April to 18th May	20th March to 13th April

The figures in parentheses indicate the no. of demonstrations with no grain recovery.

Table 3: Comparative grain yield and gap indices in cluster front line demonstrations on summer mung.

Year	Yield (q ha^{-1})		% increase	Extension gap (q ha^{-1})	Technology gap (q ha^{-1})	Technology index (%)
	Local check	Demonstration				
2017	5.40 (1.20-9.30)	6.5 0 (3.50-10.40)	16.9	1.1	8.5	56.67
2018	9.50 (4.20-12.90)	11.10 (5.70-13.80)	11.7	1.6	3.9	26.00
2019	5.92 (2.80-7.20)	7.27 (3.37-9.68)	22.8	1.35	7.73	51.53
2020	9.06 (6.5-9.9)	10.9 (8.0-12.8)	20.3	1.84	4.1	27.33
2021	9.70 (6.3-13.5)	11.5 (7.50-14.80)	18.5	1.8	3.5	23.33
2022	8.92 (7.90-10.0)	9.85 (8.6-12.4)	10.4	0.93	5.15	34.33
Mean	8.08 (1.20-13.50)	9.50 (3.50-14.80)	17.6	1.44	5.48	36.53

The figures in parentheses indicate the range of yield from minimum to maximum.

technology gap. The technology gap got mitigated and moderated in alternate crop sequences with optimized sowing time from 18th March to 6th April. The yield of 14.80 q ha^{-1} was also realized in demonstration in the year 2021 which is at par with the potential yield of 15.0 q ha^{-1}. The solution lies in accelerating alternate cropping systems, the swift action of straw reaping in wheat for sowing latest by 20th April and also by developing short-duration varieties (50-55 days) for both systems. Location-specific technology package are necessary to reduce the technology gap (Malik *et al*., 2021).

Technology index

The technology index is a crucial parameter in extension studies as to appreciate the feasibility of improved technologies under real farming situations. The lower the technology index, the more appropriate the technology is for the specific agro-ecological scenario. With a mean value of 36.53% (Table 3), the technology index in this study ranged from 56.67% in 2017 to 23.33% in 2018. The diminishing trend in the technology index during the period of study speaks about the impact of CFLD activities. The decline in technology index as a consequence of CFLD interventions was also recorded by Singh *et al*. (2018), Reager *et al*. (2020) and Meena *et al*. (2021).

Economics

The economic analysis of any technology inteface is most critical in its adoption because no farmer would accept any technology unless it has favourable economics. The cost of cultivating summer mung increased in each successive year of the study which may be attributed to the increase in the cost of seed, fertilizers, agro-chemicals, tillage and other farm operations. The cost incurred in demonstrations (Rs.18504 ha^{-1}) was more than the local check (Rs. 16818 ha^{-1}) in all the years of study but the cost escalation was more than offset by higher grain yield (Table 3) in demonstration than local check. The gross returns were comparatively higher in demonstrations (Rs. 47537 ha^{-1}) than the local check (Rs. 40363 ha^{-1}) in all the years of study. The net returns also followed the same trend to the extent that net additional returns of Rs. 5488/ha were obtained in demonstrations over and above the local check. The benefit-cost ratio was also more favourable in a demonstration (2.57) than local check (2.40) in all the years of study (Table 4). It implied that CFLD domain activity not only increased the yield but also fetched a higher benefit-cost ratio (Singh *et al*., 2022). The summer mung provides income to the farmers as an additional crop and not by replacing any crop. These results are in agreement with the findings of Meena *et al*. (2021).

Table 4: Comparative economics of demonstration and local check under CFLD on summer moong.

Year	Local check				Demonstration				Net additional returns (Rs. ha^{-1})
	Cost (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	Benefit-cost ratio	Cost (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	Benefit-cost ratio	
2017	14520	21600	7080	1.49	15900	26000	10100	1.64	3020
2018	16108	42750	26642	2.65	18267	49950	31683	2.73	5041
2019	15364	26640	11276	1.73	16564	32715	16151	1.98	4875
2020	16050	41812	25762	2.61	17720	50304	32584	2.84	6822
2021	19257	57667	38410	2.99	21713	68368	46655	3.15	8245
2022	19607	57088	37481	2.91	20858	63040	42182	3.02	4701
Mean	16818	40363	23545	2.40	18504	47537	29033	2.57	5488

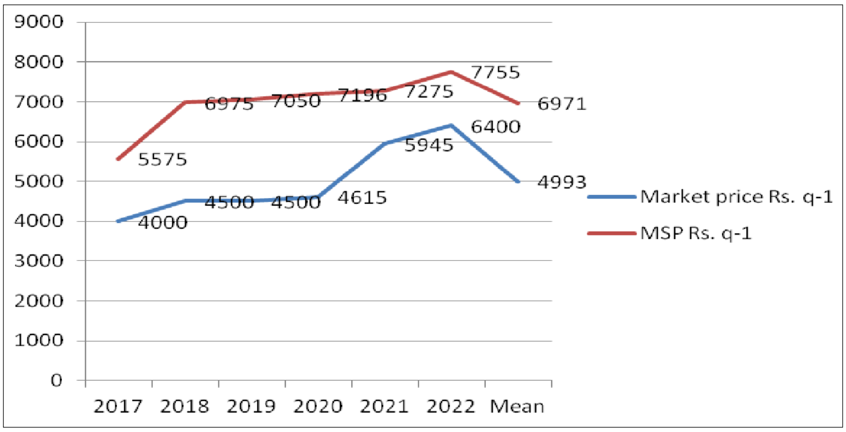

Fig 1: Comparison of market price and MSP of mungbean.

The prevailing market price showed an increasing trend from Rs. 4000 q^{-1} in 2017 to Rs. 6400 q^{-1} in 2022 with a mean value of Rs. 4993 q^{-1}. The minimum support price (MSP) of mungbean was higher than the market price in all the years of the study (Fig 1). The difference between the mean value of MSP and the market price is 39.6 per cent. This is a grey area wherein strong policy support and favourable terms of trade are required to ensure MSP to the farmers.

CONCLUSION

The present study established that the CFLD interface is among the most effective farmer participatory extension tools. The rice-wheat-summer mung cropping system provided additional returns to the farmers in comparison to a rice-wheat system with the added benefit of green manuring. The system productivity may be further improved with short-duration varieties (50-55 days) of mungbean. Rice-wheat cropping system practised in 1.4 million ha in the state of Haryana provides ample opportunity to augment pulse production in the state through summer mung. Rice-mustard-summer mung, rice-potato-summer mung, rice-pea-summer mung and sugarcane ratoon-summer mung cropping systems optimise the sowing time, mitigate the damage to the crop from monsoon rains, provide much higher yield and returns. System- based studies are required to evaluate the feasibility of alternate systems. The study also reflected on the policy paradigms for evolving a mechanism to ensure MSP to the farmers. The CFLDs are a worthwhile public investment with a much larger impact through synergy among all other stakeholders. The findings of this study as to the crop intensification through summer mung are replicable in other areas with the same or similar farming situation.

Conflict of interest: None.

REFERENCES

Anonymous. (2021). Agricultural Statistics at a Glance. Directorate of Economics and Statistics, Govt. of India.

Anonymous. (2022). Statistical Abstract of Haryana. Directorate of Economics and Statistical Analysis, Govt. of Haryana.

Kumar, P. and Boparai, A.K. (2020). Impact of summer mung through improved technology in Jalandhar district of Punjab, India. International Journal of Current Microbiology and Applied Sciences. 9(5): 3495-3501.

Kumar, S. and Kispotta, W. (2017). Impact of frontline demonstration on summer mung through improved technology in Bhadohi district of Uttar Pradesh, India. Plant Archives. 17: 423-426.

Malik, D.P., Bishnoi, D.K., Pawar, N., Kumar, N. and Sumit (2021). Additional income generation from cultivation of summer mungbean in rice-wheat system of Haryana. Legume Research. 44: 952-955.

Meena, M.L. and Singh, D. (2017). Technological and extension yield gaps in greengram in Pali district of Rajasthan, India. Legume Research. 40: 187-190.

Meena, K.A., Gupta, J.K., Dular, R.K., Bhinchhar, B.K., Meena, R.K., Meena, M.D. and Meena, R.K. (2022). Impact of cluster front line demonstrations on the yield and economics of chickpea under national food security mission in Bharatpur District of Rajasthan, India. Legume Research. 45: 1161-1166.

Meena, R.K., Singh, B., Shinde, K.P. and Meena, R.K. (2020). Cluster front line demonstrations of green gram under national food security mission in Sriganganagar district: An evaluation of production and productivity of green gram. International Journal of Current Microbiology and Applied Sciences. 9: 984-990.

Meena, R.K., Singh, B., Chawla, S., Meena, R.K. and Shinde, K.P. (2021). Evaluation of frontline demonstrations of chickpea under irrigated North Western Plain Zone-1b of Rajasthan. Journal of Pharmacognosy and Phytochemistry. 10: 1240-1244.

Ram, H., Aggarwal, N., Singh G. and Singh S.P. (2016). Heat and water use efficiency in summer mungbean (*Vigna radiata* L. Wilczek) under different thermal and moisture regimes. Journal of Agrometeorology 18: 196-200.

Ram, H., Singh, G., Aggarwal, N., Buttar, G. S. and Singh, O. (2013). Standardization of rate and time of application of imazethapyr weedicide in soybean. Indian Journal of Plant Protection. 41: 33-37.

Reager, M.L., Kumar, U., Mitharwal, B.S. and Chaturvedi, D. (2020). Productivity and sustainability of green gram as influenced by improved technology of CFLD under hyper arid partially irrigated zone of Rajasthan. International Journal of Current Microbiology and Applied Sciences. 9: 1778-1786.

Samui, S.K., Mitra, S., Roy, D.K., Mandal, A.K. and Saha, D. (2000). Evaluation of frontline demonstration on groundnut. Journal of Indian Society Coastal Agricultural Research. 18: 180-183.

Sandhu, B.S. and Dhaliwal, N.S. (2016). Evaluation of Front Line Demonstration Programme on Summer mung in south Western Punjab. Journal of Food Legume. 29: 245-248.

Singh A.K., Gautam, U.S., Chahal, V.P., Singh, N.P., Singh, A., Dubey, S.K. and Yemul, S.N. (2016). Demonstrational performance of pulses in India: Experiences of KVKs under NFSM (2015-16). pp. 122.

Singh, J., Singh, K., Hemender and Premdeep. (2021). Impact assessment of front line demonstrations on summer mung productivity under irrigated agro-ecosystem of Haryana. Legume Research. 44: 1470-1474.

Singh, O., Singh, D.K., Singh, A., Singh, R.P., Pandey, S. and Bajpai, A.K. (2022). Increasing productivity of lentil (*Lens culinaris*) using improved varieties under alluvial soil of uttar pradesh by cluster front line demonstrations. Legume Research. 45: 492-496.

Singh, S.P., Paikra, K.K. and Patel, C.R. (2018). Performance of cluster frontline demonstration on productivity and profitability of Blackgram (*Vigna mungo*) in Raigarh District of Chhattisgarh, India. International Journal of Current Microbiology and Applied Sciences. 7: 1325-1330.