International J. of Ext. Educ. Vol. XXI : 17-24, 2025 ISSN : 2319-7188

Cluster Front Line Demonstrations for Productivity Enhancement in Lentil Crop: Insights from Madhya Pradesh

A.A. Raut, S.R.K. Singh, Harish M.N. and Shalini Chakraborty
ICAR-Agricultural Technology Application Research Institute, Madhya Pradesh-82 004, India
Corresponding author's email: 2022srksingh.icar@gmail.com

ABSTRACT

The study aimed at assessing the impact of cluster frontline demonstrations (CFLDs) in terms of productivity gains, extension gap,technological gap and economic gains in lentil crop in Madhya Pradesh from 2018-2022. Across 15 Krishi Vigyan Kendras, 1387 demonstrations were implemented, introducing high-yielding varieties like IPL 316, RVL-31 and Shekhar Masoor 3, along with best practices such as seed treatment, line sowing, balanced nutrient application and integrated pest management. Results revealed substantial yield enhancements, with demonstration plots achieving an average increase of 16-125% compared to farmers' traditional practices. Agro-climatic zones like Kymore Plateau and Satpura Hills demonstrated transformative gains, while regions such as Vindhyan Plateau and Central Narmada Valley also recorded notable improvements, underscoring the potential of CFLDs to address productivity challenges in lentil cultivation. The findings clearly demonstrate that the adoption of latest lentil varieties and improved technologies through Cluster Frontline Demonstrations significantly boosts both productivity and profitability of lentil cultivation in the region, while effectively narrowing the technologygaps and bridging yield gaps.

Lentil, Pulses, CFLD, yield gap, technology index

INTRODUCTION

Traditionally pulses have been considered important elements of cropping systems India as a source of protein and ability to fix atmospheric nitrogen and thus improve soil fertility. Pulses are a vital source of high-quality proteins, along with essential vitamins and minerals play a crucial role in enhancing the nutritional security of the nation. For India's predominantly vegetarian population, pulses complement cereal-based diets by providing a balanced protein intake, making them indispensable in addressing dietary needs and improving overall health.

To unlock the full potential of the agricultural sector, it is imperative that farmers have access to cutting-edge technologies, essential inputs and timely information. Since 2015, the Government of India has been actively promoting increased pulse production through targeted schemes, with a significant initiative being the "Cluster Frontline Demonstration on Pulses (CFLD)" under the National Food Security Mission (NFSM). This programme, spearheaded by the Ministry of Agriculture and Farmers Welfare in collaboration with ICAR, aims to address the critical need for enhancing pulse productivity in the country. The CFLD programmeserves as a cornerstone in this mission, fostering innovation and resilience in India's pulse production landscape. The CFLD programmefocuses on popularizing advanced agricultural technologies, including high-quality seeds, micronutrients, soil amendments, weed management practices, Integrated Pest Management, modern farm machinery, micro-irrigation systems, and capacity-building initiatives for farmers. These efforts are implemented through Krishi Vigyan Kendras (KVKs) across India, ensuring localized support and effective technology dissemination to improve the production of various pulse crops.

Lentil is believed to be the earliest grain legume to undergo domestication (Bahl et al., 1993).Lentil-growing countries of the world areIndia, Canada, Turkey, Bangladesh, Iran, China, Nepal andSyria (Ahlawat 2012). Lentil (Lens culinarisMedikus) is one of the important pulse crops during the rabi season in India cultivated in 1.64 million hectares with a total production of 1.56

million tonnes (DACFW,2023). Lentil crop contributes about 4.9% of the total pulse area and 5.03% of total pulse production in the country (2021-22). Uttar Pradesh, Madhya Pradesh and Bihar amongthemselves command 84-90% of total lentil area in Indiasince the last 20 years, with 86-90% of production(Singh etal. 2016).

Lentil is an important rabi pulse crop of Madhya Pradesh, is mainly cultivated in Dindori, Rewa, Narsinghpur, Sagar, Vidisha, Satna, Mandla, Panna, Jabalpur, Anuppur, Seoni, Ashoknagar, Raisen, Rajgarh, Damoh, Katni and Shajapur(Kumar V., et al., 2019). In Madhya Pradesh. It is being grown on an area of about 6.55 lakh ha with annual production of 6.36lakhtonnes. Madhya Pradesh has largest share of production, about 40.79 % of the all-India production. (DACFW,2023).It is primarily cultivated as a sole crop following the harvest of kharif crops, relying on residual soil moisture. Lentil crop is valued for its role in providing affordable dietary protein for both humans and animals. Lentil seeds are nutrient dense containing high levels of protein, complex carbohydrates, essential minerals and vitamins, photochemical and dietary fibers (Joshi et al. 2017, Dhullet al. 2022).It is estimated that lentil crop can fix free nitrogen up to 107 kg/ha (Abraham 2015),the economic value of which was computed to be about2361 Rs/ha (Chand et al. 2015). Moreover, lentils are knownfor their water efficiency compared to other protein sourcesand are considered as drought-resistant crop (Abraham 2015). In recent years, its cultivation area has expanded significantly due to its growing popularity in various cropping systems. However, farmers often grow lentils on marginal lands with minimal management practices, resulting in low yields.

There has been a high degree of risk in pulses production in general and lentil production in particular. More than 87% of the area under pulses is presently rain fed. Moisture stress is the often cited reason for crop failures. Terminal drought and heat stress results in forced maturity with low yields. Drought stress alone may reduce seed yields by 50% in the tropics (Reddy 2009). Lack of knowledge, non-availability of improved seed, poor technical guidance werefew socio economic institutional constraints (Subbarao et al. 2001). The targeted area, production and productivity in new cultivation area is possible by way of harnessing pulses in new niches, quality inputs, soil test based INM, timely weed management and mechanized method of pulse cultivation complemented with generous governmental policies and appropriate funding support to implementing states/stake holders (Tiwari and Shivhare, 2017). Concerted efforts in intensifyingthe technology transfer, capacity building and convergence of resources among the stakeholders can impact theproductivity of lentils, thereby developing strategies for optimizing its import and export dynamics (Sah et.al. 2024).

METHODOLOGY

The present study was the part of cluster frontline demonstrations (CFLDs) on pulses being implemented by Indian Council of Agricultural Research (ICAR), rabi 2018-22. The analytical framework for the present investigation constituted the CFLDs conducted by 15 Krishi Vigyan Kendras in Madhya Pradesh at farmer's field. Before conducting CFLDs, a list of identified farmers was prepared and training on package of practices and technologies to be demonstrated was imparted to the selected farmers regarding improved lentil cultivation techniques before the sowing of the crop. In case of farmer's practice, existing practices conventionally used by the farmers were recorded. In demonstration plots, critical inputs were provided according as per recommended scientific package of practices with seed of improved variety RVL-31, IPL 316, Shekhar Masoor 3 along with h seed treatment, improved sowing methods like line sowing, timely weeding, use of balanced fertilizers and bio-fertilizer was ensured. Visit of farmers and agriculture dept. officials was organized at demonstration plots during field days. The farmers having demonstration plot were facilitated scientists from KVKs in different operations like sowing, nutrient management, pest management, weed management, harvesting etc. The primary data were utilized to calculate yield advantages, profitability, and the benefit-cost (B:C) ratio. Additionally, both primary and secondary data were employed to evaluate the extent to which various yield gaps were

reduced through the Cluster Frontline Demonstrations for lentil.The extension gap, technology gap,technology index, along with benefit-cost ratio wereworked out (Samui et al. 2000) by applying the following formula:

$$\text{Technology Index} = \frac{\text{Potential Yield} - \text{Demonstration Yield}}{\text{Potential Yield}} \times 100$$

$$\text{Benefit-Cost Ratio (BCR)} = \frac{\text{Gross Returns (Rs/ha)}}{\text{Cost of Cultivation (Rs/ha)}}$$

Technology gap = Potential yield - Demonstration yield

Extension gap = Demonstrated yield – Yield under existing practice

RESULTS AND DISCUSSION

Under CFLD-Pulses, total 1387 demonstrations under lentil crop were conducted by 15 KVKs in Madhya Pradesh during 2018-19 to 2021-22 toshowcase potentials of improved varieties andperformance recommended package ofpractices in agro-climatic zones.

Table 1
Cluster frontline demonstrations in lentil crop in Madhya Pradesh

District	2018-19		2019-20		2020-21		2021-22		Total	
	Area (ha)	Demo (No.)	Area (ha)	Demo (No.)	Area (ha)	Demo (No.)	Area (ha)	Demo (No.)	Area (ha)	Demo (No.)
Shajapur	10	25	-	-	-	-	-	-	10	25
Ratlam	20	50	-	-	-	-	20	50	40	100
Rajgarh	-	-	-	-	-	-	10	25	10	25
Raisen	20	50	10	25	10	25	10	25	50	125
Sagar	20	50	10	25	10	25	20	50	60	150
Damoh	-	-	-	-	-	-	10	25	10	25
Shahdol	30	75	20	50	10	25	10	25	70	175
Anuppur	10	23	10	25	10	25	10	25	40	98
Jabalpur	10.4	26	10	25	10	25	-	-	30.4	76
Panna	20	31	-	-	-	-	-	-	20	31
Rewa	-	-	-	-	-	-	10	25	10	25
Seoni	10	25	10	25	10	25	10	25	40	100
Katni	30	75	30	75	20	50	20	50	100	250
Satna	20	35	20	25	10	22	10	25	60	107
Chhindwara	-	-	10	25	10	25	10	25	30	75
Total	200.4	465	130	300	100	247	150	375	580.4	1387

The summary in Table 1 highlights the implementation of cluster frontline demonstrations in lentil cultivation across various districts of Madhya Pradesh, detailing the area covered and the number of demonstrations conducted. Over the four years, districts like Katni and Shahdol stood out with the highest cumulative areas of 100 ha and 70 ha, involving 250 and 175 demonstrations, respectively. Sagar followed with 60 ha and 150 demonstrations. Other districts, such as Raisen, Ratlam, and Seoni, also showed significant participation, with total areas ranging from 40 to 60 ha and 100 to 125 demonstrations. Some districts, including Damoh and Rewa, participated only in the later years, while Shajapur and Panna had limited involvement. The table highlights the widespread adoption of CFLDs in the state, promoting improved lentil cultivation practices across diverse agroclimatic zones in Madhya Pradesh.

Table 2
Varietal replacement under Cluster frontline demonstrations in lentil crop

ACZ	KVK	Previously grown varieties	New varieties demonstrated
Malwa Plateau	Shajapur, Ratlam, Rajgarh	JL-3, L4076	IPL 316, Kota Masoor 2
Vindhya Plateau	Raisen, Sagar, Damoh	Malika (K-75)	RVL-31, L 4727
North Hills of Chhattisgarh	Shahdol, Anuppur	JL-3,	IPL 316
Kymore Plateau and Satpura Hills	Jabalpur, Panna Seoni,Katni, Satna Rewa	JL-3, Pant L 209, Malika (K-75)	IPL 316, RVL-31, Shekhar Masoor 3
SatpuraPlateau	Chhindwara	Local/ Mixed seed	IPL 316

Under the Cluster Frontline Demonstrations in lentil, varietal replacement was undertaken to introduce improved varieties under across various Agro-Climatic Zones as depicted in Table 2 to enhance productivity and profitability. In the Malwa Plateau, varieties like JL-3 and L-4076 were replaced with IPL 316, Kota Masoor 2, while in the Vindhya Plateau, Malika (K-75) was replaced with RVL-31 and L 4727. In the North Hills of Chhattisgarh, traditional varieties such as JL-3 and local/mixed varieties were replaced with IPL 316. Similarly, in the Kymore Plateau and Satpura Hills varieties like JL-3, Pant L 209, and Malika (K-75) were replaced with IPL 316, RVL-31 and Shekhar Masoor 3. In the Satpura Plateau, IPL 316 was introduced. These replacements aim to improve yield potential, disease resistance and adaptability contributing to enhanced lentil productivity in the target regions.

Results of cluster front line demonstration conducted by KVKs during 2018-2022 indicate that differences between demonstration package and localfarmer' s practice regarding improved variety,proper seed rate, seed treatment, improved sowingmethod, integrated nutrient management and plantprotection measures.

Table 3
Impact of Cluster frontline demonstrations Lentil crop during 2018- 2022

District	Average District Yield (q/ha)	Average State Yield (q/ha)	Potential yield (q/ha)	Demonstration Avg Yield (q/ha)	Local Check Farmers Yield (q/ha)	% Increase in demo w.r.t. Farmers Yield
Shajapur	9.00	8.99	20.00	16.10	13.3	21.05
Ratlam	8.90	8.99	20.00	12.28	9.50	29.26
Rajgarh	11.07	8.99	20.00	11.09	8.95	23.91
Raisen	10.97	8.99	20.00	13.59	9.66	40.68
Sagar	10.70	8.99	20.00	13.28	9.85	34.82
Damoh	10.67	8.99	20.00	18.13	15.65	15.84
Shahdol	7.90	8.99	20.00	12.09	7.41	63.15
Anuppur	5.16	8.99	20.00	7.09	3.15	125.08
Jabalpur	13.10	8.99	20.00	16.67	12.12	37.54
Panna	11.32	8.99	20.00	12.82	10.09	27.05
Seoni	7.07	8.99	20.00	14.18	11.08	27.97
Katni	9.27	8.99	20.00	14.83	11.79	25.78
Satna	8.13	8.99	20.00	13.85	9.91	39.75
Chhindwara	8.43	8.99	20.00	15.02	9.75	54.05

The findings of the impact of CFLDs on yield enhancement in lentil from Table 3 across districts between highlights the percentage increase in yield achieved through the demonstrations compared to the yields of local check farmers. In Shajapur, the demonstration yield was 16.10 q/ha, a 21.05% improvement over the local check yield of 13.3 q/ha, indicating the efficacy of demonstrated practices in improving productivity. Ratlam showed a 29.26% increase, with demonstration yields (12.28 q/ha) significantly outperforming local yields (9.50 q/ha). Shahdol and Anuppur displayed remarkable results, with percentage increases of 63.15% and 125.08%, respectively. These gains are particularly noteworthy as they stem from the relatively low baseline yields of 7.41 q/ha and 3.15 q/ha in local checks, suggesting a transformative impact in underperforming areas.

Districts like Raisen (40.68%), Sagar (34.82%) and Jabalpur (37.54%) also achieved substantial improvements, demonstrating the scalability of the demonstrated practices. In Chhindwara, a 54.05% increase was observed, with demonstration yields reaching 15.02 q/ha compared to the local check yield of 9.75 q/ha. Other districts, such as Panna, Seoni, Katni, and Satna, showed consistent yield enhancements ranging from 25% to 39%.

Several studies reported wide yield gap of30-105 per cent with an average value of 42 per cent invarious production zones of India (Reddy and Reddy2010; Ali and Gupta 2012). Singh et al., (2016) reported yield gap in lentil to the extent of 15.0–22.5 per cent in selected lentil-growing states, namely Bihar,Madhya Pradesh, Uttar Pradesh, and West Bengal. Across all districts, the demonstration yields indicated the effectiveness of the demonstrated technologies and practices. The data highlights the significant potential for bridging the yield gap in lentil production, particularly in regions with lower baseline productivity. These results emphasize the importance of adopting improved agricultural practices and technologies to enhance productivity, profitability, and sustainability in lentil cultivation.Potential yield is still the great challenge to beachieved for pulses in India as indicated by the wider gap with respect to the reported yield at all level i.e. state, national and farmers' yield(Dubey et. al. 2022)

Table 4
Agro-climatic zonewise technology gap, extension gap and Technology index in Lentil under CFLD on pulses

Agro-climatic zone	KVK	Extension gap (q/ha)	Technology gap (q/ha)	Technology index (%)
Malwa Plateau	Shajapur	2.8	3.9	19.5
	Ratlam	2.78	7.72	38.6
	Rajgarh	2.14	8.91	44.55
Vindhya Plateau	Raisen	3.93	6.41	32.05
	Sagar	3.43	6.72	33.6
	Damoh	2.48	1.87	9.35
North Hills of Chhattisgarh	Shahdol	4.68	7.91	39.55
	Anuppur	3.94	12.91	64.55
Kymore Plateau and Satpura Hills	Jabalpur	4.55	3.33	16.65
	Panna	2.73	7.18	35.9
	Seoni	3.1	5.82	29.1
	Katni	3.04	5.17	25.85
	Satna	3.94	6.15	30.75
Satpura Plateau	Chhindwara	5.27	4.98	24.9

Evaluation of findings of the study depicted in Table 4 highlights agro-climatic zone-wise technology and extension gaps, along with the technology index for lentil cultivation under CFLD on pulses. In the Malwa Plateau, extension gaps range from 2.14–2.8 q/ha, with technology gaps of 3.9–8.91 q/ha and technology indexbetween 19.5–44.55%. The Vindhya Plateau shows moderate extension gaps (2.48–3.93 q/ha), technology gaps of 6.5 q/ha and technology index(9.35–33.6%), indicating variable adoption level of technology. The North Hills of Chhattisgarh report the highest technology index, particularly in Anuppur (64.55%), reflecting significant gaps. In the Kymore Plateau and Satpura Hills, extension gaps range from 2.73–4.55 q/ha, with technology index of 16.65–35.9%. The Satpura Plateau shows the highest extension gap (5.27 q/ha) in Chhindwara, with a technology index of 24.9%.Overall, the data reveals significant variation in extension and technology gaps across agro-climatic zones, emphasizing the need for tailored interventions to bridge these gaps and improve lentil productivity.According to Raj et al. (2013), variations in soil fertility and weather conditions contribute to technological gaps in agricultural productivity.A higher technology index indicates a gap in effectively transferring proven technologies to growers and reluctance among farmers in adoption of the technological interventions.Production risks of pulses in view of climate change and vulnerabilities of rainfed agriculture could be marginalized by selection of suitable technological options across the region (Gudadeet al.2018).

The economic analysis of lentil cultivation under CFLD across different agro-climatic zones highlights substantial economic benefits for farmers adopting improved practices. Table 5 presents a comparison of key economic indicators, including cost of cultivation, gross returns, net returns, and the benefit-cost (B:C) ratio, between demonstration plots and local checks.The average cost of cultivation was marginally higher for demonstration plots, ranging from Rs15,422 to Rs.22,383 per hectare, compared to Rs.14,613 to Rs.20,288 per hectare for local checks. This increase in cost reflects the investment in better inputs and improved practices. Despite higher cost, demonstrationsyielded significantly higher gross returns, ranging from Rs.60,756 to Rs.73,955 per hectare, compared to Rs.40,201 to Rs.54,111 per hectare for local checks.

Table 5
Economic Impact of Lentil crop under CFLD

Agro-climatic zone	**Average Cost of Cultivation (Rs/ha)**		**Average Gross Return (Rs/ha)**		**Average Net Return (Rs/ha)**		**B:C Ratio**	
	Local Check	Demo plot	Local Check	Demo plot	Local Check	Demo plot	Local Check	Demo plot
Malwa Plateau	19363	20804	54111	67808	34748	47004	2.79	3.26
Vindhya Plateau	14613	15422	44319	63474	29706	48052	3.03	4.12
North Hills of Chhattisgarh	17977	19958	40201	60756	22224	40798	2.24	3.04
Kymore Plateau and Satpura Hills	20288	22383	53321	68906	33033	46523	2.63	3.08
Satpura Plateau	15437	17682	51791	73955	36354	56273	3.35	4.18

Net returns, also demonstrated substantial improvements in demonstration plots. For instance, in the Vindhya Plateau, the net return increased from (Rs.29,706 /ha) in local checks to (Rs.48,052/ha) in demonstration plots, reflecting a gain of (Rs.18,346/ha). Similarly, the Satpura Plateau recorded the highest net return improvement, with farmers earning (Rs.56,273/ha) in demonstration plots compared to (Rs.36,354/ha) in local checks, an increase of Rs.19,919 per hectare. The B:C ratio, a critical indicator of economic efficiency, further underscores the benefits of CFLD interventions. The B:C ratio for demonstration plots ranged from 3.04 to 4.18 across zones, significantly outperforming local checks, which ranged from 2.24 to 3.35. Notably, the Satpura Plateau achieved the highest B:C ratio of 4.18 followed by Vindhya Plateau 4.12. These findings clearly demonstrate the economic advantages of adopting CFLD practices for lentil cultivation.

CONCLUSION

Result shows that CFLD programme underscore the transformative potential of improved agricultural practices and technologies in bridging the yield gap and boosting lentil productivity. Demonstrations across Madhya Pradesh achieved notable yield improvements, with yield increases ranging from 16% to over 125% compared to traditional practices. This can be attributed to the demonstration of high-yielding varieties along with the improved package of practices. The improved practices not only enhance productivity and profitability but also provide a compelling case for scaling up such interventions to achieve sustainable agricultural growth and economic empowerment for farmers in diverse agro-climatic zones. The integration of an effective technological strategy and robust extension services also helped bridge the technological and extension gaps. This not only contribute to economic benefits for farmers but also strengthen food security and sustainability in lentil production.

ACKNOWLEDGEMENTS

Authors are grateful to the Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India; ICAR, New Delhi and ICAR-ATARIs for providing financial and technical support for undertaking this study. We are highly grateful to associated KVKs for contribution and cooperation for conducting CFLD in lentil.

Paper received on 04/05/2025
Accepted on 14/07/2025

REFERENCES

Abraham, R. 2015. Lentil (Lens culinaris Medik): Current status and future prospect of production in Ethiopia. Advances in Plants and Agriculture Research, 2(2), 2–9.

Ahlawat, I. P. S. 2012. Agronomy – rabi crops, Lentil. Division of Agronomy, Indian Agricultural Research Institute, New Delhi.

Ali, M. and Gupta, S. 2012. Carrying capacity of Indian agriculture: Pulse crops. Current Science, 102, 874–881.

Bahl, P., Lal, N. S. and Sharma, B. M. 1993. An overview of the production and problems in Southeast Asia. In W. Erskine & M. C. Saxena (Eds.), Lentil in South Asia: Proceedings of the Seminar on Lentils in South Asia (pp. 1–10). ICARDA, Aleppo, Syria.

Chand, R., Raju, S. S. and Reddy, A. A. 2015. Assessing performance of pulses and competing crops based on market prices and natural resource valuation. Journal of Food Legumes, 28(4), 335–340.

DAC&FW. 2023. Agricultural Statistics Yearbook. Department of Agriculture & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India.

Dhull, S. B., Kinabo, J. andUebersax, M. A. 2022. Nutrient profile and effect of processing methods on the composition and functional properties of lentils (Lens culinaris Medik): A review. Legume Science, 5(1), e156.

Dubey, S. K., Gautam, U. S. and Singh, A. 2022. Yield gap minimization: Consequences of CFLD-Pulses in India. Indian Journal of Extension Education, 58(3), 65–69.

Dubey, S. K., Gautam, U. S., Singh, A. K., Singh, A., Chahal, V. P., Singh, A. K., Singh, C. and Srivastava, A. 2018. Quantifying the yield gap minimization in lentil (Lens culinaris) under Cluster Frontline Demonstrations (CFLD) conducted in Uttar Pradesh. The Indian Journal of Agricultural Sciences, 88(6), 851–859. https://doi.org/10.56093/ijas.v88i6.80628

Gudade, N., Raut, A. A., Thanki, J. D., Bodke, P. S. and Imade, S. R. 2018. Agronomic technologies for enhancing pulse production ahead of climate change. In A. K. Srivastava &Yogranjan (Eds.), Climate risks management: Sustainable pulse production (pp. 27-52). Astral International Pvt. Ltd.

Joshi, M., Timilsena, Y. and Adhikari, B. 2017. Global production, processing and utilization of lentil: A review. Journal of Integrative Agriculture, 16, 2898–2913.

Kumar, V., Ninama, A., Khande, D., Amrute, S., Pandey, S. K. and Pandey, S. 2019. Current scenario of lentil production in Madhya Pradesh. International Journal of Agriculture Sciences, 11(18), 9061–9063.

Raj, A. D., Yadav, V. and Rathod, J. H. 2013. Impact of front-line demonstrations (FLD) on the yield of pulses. International Journal of Scientific & Research Publication, 3(9), 1–4.

Reddy, A. A. 2009. Pulses production technology: Status and way forward. Economic & Political Weekly, 44(52), 73–80.

Reddy, A. A. and Reddy, G. P. 2010. Supply-side constraints in production of pulses in India: A case study of lentil. Agricultural Economics Research Review, 23, 129–136.

Sah, U., Rani, R., Kumar, H., Devraj, Ojha, J., Singh, V., Dubey, S. K and Dixit, G. P. 2024. Dynamics of lentil (Lens culinaris) production and trade: Global scenario and Indian interdependence. Indian Journal of Agricultural Sciences, 94(3-S1), 102–108. https://doi.org/10.56093/ijas.v94i3.148602

Singh, A. K., Singh, A. K., Mishra, A., Singh, L. and Dubey, S. K. 2016. Improving lentil (Lens culinaris) productivity and profitability through farmer participatory action research in India. Indian Journal of Agricultural Sciences, 86(10), 1286–1292.

Subbarao, G. V., Kumar Rao, J. V. D. K., Kumar, J., Deb, U. K., Ahmed, I. and Harris, D. 2001. Spatial distribution and quantification of rice-fallows in South Asia: Potential for pulses. International Crops Research Institute for Semi-Arid Tropics (ICRISAT), National Remote Sensing Agency (NRSA), and Department for International Development (DFID). pp. 74–80. ISBN 92-9066-436-3.

Samui, S. K., S. Maitra, D. K. Roy, A. K. Mondal and D. Saha2000. Evaluation on front line demonstration ongroundnut (Arachis hypogea L.). Journal of Indian Society of Coastal Agriculture Research, 18 : 180-183.

Tiwari, A. K. and Shivhare, A. K. 2017. Pulses in India: Retrospect & prospects. Directorate of Pulses Development, Vindhyachal Bhavan, Bhopal.

.....