RESEARCH ARTICLE Legume Research- An International Journal, Volume 49 Issue 4: 629-633 (April 2026)

Lentil Cultivation in Rice Fallow for Maximizing Productivity, Profitability and Resource Conservation

Khumlo Levish Chongloi[1], A. Ameeta Devi[1], B.S. Hmannihring Anal[2], K. Sonamani Singh[1], Ningthoukhongjam Soranganba[2], Laishram Kanta Singh[3], A.K Mohanty[4]

10.18805/LR-5574

ABSTRACT

Background: Lentil, a popular pulse in the daily diet on Indian population, is a highly potential crop in the rice fallow. In Manipur, a large part of the rice area remains fallow after harvest of *kharif* rice. Lentil has a very good potential for increasing farm income as well as cropping intensity in these areas. It is obvious that the resources found in rice fallows give a chance to introduce a pulse crop. Those fallow lands can be effectively transformed into productive ones if the location-specific constraints are effectively managed. In addition to increasing system production, it will also improve soil quality, enhance farmers' income and most importantly, guarantee farmers nutritional security. Since the system uses the residue moisture for growth and development, crop productivity can be even doubled or tripled under rice fallow conditions. Keeping these in mind, these demonstrations are thoughtfully planned, with objectives to boost productivity and production by ICAR-Krishi Vigyan Kendra Chandel.

Methods: The study was conducted in Chandel district of Manipur state during 2022-23, 2023-24 and 2024-25 to maximise the productivity of lentil under rice fallow. Sample consisted of randomly selected 75 farmers who were growing lentil under cluster front line demonstrations with an area of 30 hectares with all the scientific package of practices.

Result: The results revealed that improved technology recorded a mean yield of 952 kg/ha which was 22.38 per cent higher than the mean yield obtained under farmers' practice (675 kg/ha). The mean technological and extension gap were 448 kg/ha and 276 kg/ha respectively. The study also showed that reduction in technology index from 34.29 per cent during 2022-23 to 29.64 per cent during 2024-25 exhibited the feasibility of demonstrated technology. The lower the value of technology index, the more is the feasibility of technology. The average benefit cost ratio of 2.62 was obtained under demonstration, while it was only 1.93 under farmers' practices. Hence, for maximizing productivity, profitability and resource conservation there is a need to disseminate the improved technologies amongst the farmers with effective extension methods like training and demonstrations and also by using High Yielding Verities of seeds and proven technologies in farmers' field. The farmers should be encouraged to adopt the recommended package of practices for realizing higher returns.

Key words: Lentil, Production, Profitability, Rice fallow.

INTRODUCTION

Rice is the staple food in our nation and India is the most significant rice-growing country in the world because of its geographic location and climate. Although it is primarily grown during the *kharif* season (June-September), due to various constraints such as biotic, abiotic and socioeconomic constrains, about 11.7 million hectares of land remain fallow after harvest of *kharif* rice (Ghosh *et al.*, 2012). Making effective use of this fallow land could make the system sustainable and remunerative. It is evident from the climate and soil conditions that a short-duration crop can be grown there with ease. Apart from rice, pulses also play a significant role in Indian. In addition to offering premium protein, it has multiple advantages for the cropping system. Those fallow lands can be effectively transformed into productive ones through location-specific management options. Since the system uses the remaining moisture for growth and development, crop productivity can be doubled or tripled under rice fallow conditions. The cropping system that uses a minimum of resources is a better choice and pulse crop like lentil (*Lens culinaris*) can be a very good option. Lentils are high in protein and contain high concentrations of essential amino acids like isoleucine and lysine, along with other nutrients like dietary fibre, folate, vitamin B1 and minerals. They originated

[1]ICAR-Krishi Vigyan Kendra, Chandel, ICAR-Research Complex for NEH Region, Manipur Centre, Imphal-795 004, Manipur, India.
[2]ICAR-Krishi Vigyan Kendra, Churachandpur, ICAR-Research Complex for NEH Region Manipur Centre, Imphal-795 004, Manipur, India.
[3]ICAR-Krishi Vigyan Kendra, Imphal West, ICAR-Research Complex for NEH Region Manipur Centre, Imphal-795 004, Manipur, India.
[4]ICAR-Agricultural Technology Application Research Institute, Zone VII, ICAR-Research Complex, Umiam-793 103, Meghalaya, India.

Corresponding Author: Khumlo Levish Chongloi, ICAR-Krishi Vigyan Kendra, Chandel, ICAR-Research Complex for NEH Region, Manipur Centre, Imphal-795 004, Manipur, India.
Email: levischongloi@gmail.com

How to cite this article: Chongloi, K.L., Devi, A.A., Anal, B.S.H., Singh, K.S., Soranganba, N., Singh, L.K. and Mohanty, A.K. (2026). Lentil Cultivation in Rice Fallow for Maximizing Productivity, Profitability and Resource Conservation. *Legume Research.* **49(4):** 629-633. doi: 10.18805/LR-5574.

Submitted: 20-09-2025 **Accepted:** 24-11-2025 **Online:** 13-12-2025

in South Western Asia as early as 6000 B.C. (Rozan *et al*., 2001). India leads the world in both production and acreage, but its average productivity is much lower (714 kg/ha) than the global average of 1008 kg/ha (Afzal *et al*., 2012). With the right crop management techniques, even using residual soil moisture can increase the productivity and profitability of second crops grown in rice fallow. Growing pulses can also help achieve the dual goals of improving productivity and enhancing the sustainability of cereal-based cropping systems. It is also a useful strategy for repairing damaged soils (Yadav *et al*., 2015). With the aim of establishing the pulse crop (lentil) in the rice-fallow system, a cluster front line demonstration on *Rabi* pulses was conducted at a farmer's field in the Chandel district.

The front-line demonstration (FLD) is a crucial technique for giving farmers access to the most recent set of practices in every aspect. Furthermore, these demonstrations are thoughtfully planned, with objectives in place to quickly disseminate the technology being shown to the farming community through the preparation of additional extension activities that support it, like farmers' meetings and field days (Meena and Dudi, 2018).

MATERIALS AND METHODS

KVK Chandel conducted the study in the fields of 75 farmers on 30 hectares of land that had been left fallow after rice cultivation during *Rabi* 2022-23, 2023-24 and 2024-25. The demonstrations employed a scientific package of techniques, including line sowing, nutrient management, seed treatment and whole package and the lentil seed variety HUL-57 was taken under CFLD. The details of improved package of practices and farmer practice followed are presented in Table 1. The geographic location of the areas is 24°40′N Latitude and 93°50′E Longitude and 966 m above MSL altitude. Monthly average minimum and maximum temperature varied from 11.83°C to 26.63°C during 2022-23, 13.01°C to 25.63°C during 2023-24 and 13.05°C to 26.11°C during 2024-25 respectively while average minimum and maximum relative humidity varied from 42.69% and 84.80% during 2022-2023, 49.02% and 89.49% during 2023-24 and 49.07% and 89.90% during 2024-25 respectively. The average rainfall recorded during 2022-23, 2023-24 and 2024-25 was 39.27, 50.29 and 43.41 respectively during the crop period. The details are shown in the Fig 1. In general, soils of the area under study were clay loam and medium to low in fertility status. The study area's soils were mostly clay loams with medium to low fertility levels.

Since an excessive number of plants negatively impacts crop growth and yield, the lentil seeds were sown to ensure the recommended plant spacing within a row. 40 kg of seed per hectare was sown between the middle week of October and the first week of November. Using techniques developed by Samui *et al*. (2000) and Meena and Dudi (2018), the yield data and economics from the farmers' and demonstration's practices were documented and their technology gap, extension gap and technology index were calculated as follows:

$$\text{Tech. gap} = \text{Potential yield} - \text{Demo. plot yield}$$

$$\text{Ext. gap} = \text{Demo. plot yield} - \text{Farmer's plot yield}$$

$$\text{Technology index} = \frac{Pi - Di}{Pi} \times 100$$

Where

Pi= Potential yield.

Di= Demonstration yield.

Data on yield metrics was gathered from farmers' fields during crop harvesting in both demonstration and control plots by the scientists, who visited the fields on a regular basis and conducted periodic monitoring. Based on data from farmers in the study area, the production cost and net return details have been computed. Analysis of the yield qualities and the impact of the technological gap on lentil yield was done and the findings were also presented.

RESULTS AND DISCUSSION

The results of the present findings as well as relevant discussions have been presented under following sub heads.

Differences between farmer's practices and Technology demonstrated

Regarding recommended varieties, seed treatment, application of fertilizer based on soil tests, weed control techniques and plant protection measures, the main discrepancies between the technology showcased and farmers' actions were noted. According to the information in Table 1 findings, the farmers in the demonstrated plot exclusively utilized the high-yielding variety, seed treatment and need-based plant protection chemicals and herbicides

Table 1: Details of improved package and farmers' practice.

Particulars	Improved package	Farmers practices (Local check)
Variety	HUL-57	Hawai masori
Seed rate	40 kg/ha	50 kg/ha
Sowing method	Line sowing	Broadcasting
Time of sowing	Mid Oct. to 1st week Nov.	Nov. to Dec.
Irrigation	Rainfed	Rainfed
Fertilizer dose	20:40:20 (N:P:K kg/ha)	No balance application, only urea applied
Plant protection measures	Need based insecticides and fungicides spray	No insecticides and fungicides spray

that were advised. All other scientific packages and practices were promptly carried out by the farmers. Additionally, it was noted that farmers lacked knowledge of scientific growing methods, seed treatment and balanced fertilizer management.

Grain yield

The performance of the lentil variety HUL-57 under cluster front line demonstration showed that the mean grain yield of 952 kg/ha was recorded in all three years under demonstrated plots, which was higher than the local check of 675 kg/ha. The maximum grain yield of 985 kg/ha was recorded during 2024-25 and the minimum grain yield was 920 kg/ha during 2022-23. The yield increased by 22.38% on average compared to the local check (Table 2). This demonstrates unquestionably the benefits of frontline demonstration using enhanced technologies. The results closely match those of Chongloi *et al*. (2025) Amuthaselvi *et al*. (2023) and Sunil *et al*. (2023).

Technological gaps

The prospective yield and demonstration yield of the lentil variety were compared in order to analyse the technology index. It enables farmers to implement high-yielding cultivars and other yield-maximizing technology on their farms. When the technology index number is lower, the feasibility is higher. To estimate the yield gap during the demonstration years (2022-23 to 2024-25), the yield of different demonstrations and farmers' practices were compared. Over the course of the years of research, the technology gap was shown to range from 415 to 480 kg/ha. The 2022-2023 period had the largest technological difference (480 kg/ha), while the 2024-2025 period had the smallest gap (415 kg/ha). Inappropriate rainfall distribution, variations in soil fertility, unfavourable weather and local crop management issues that arise in order to maximize the yield potential of certain crop cultivars could all be attributed on these factors (Chongloi and Singh, 2022). Popularizing a set of methods that emphasize improved varieties, using the right seed rate, applying nutrients in a balanced manner and using plant protection measures appropriately can help bridge the gap between technology and extension.

Extension gaps

The 2022-2023 period had the largest extension gap (287 kg/ha), followed by the 2023-2024 period (277 kg/ha) and the 2024-2025 period (265 kg/ha). In order to reverse this trend of a large extension gap, it was highlighted that farmers needed to be educated through a variety of techniques in order to adopt new agricultural production technologies. The concerning pattern of the increasing

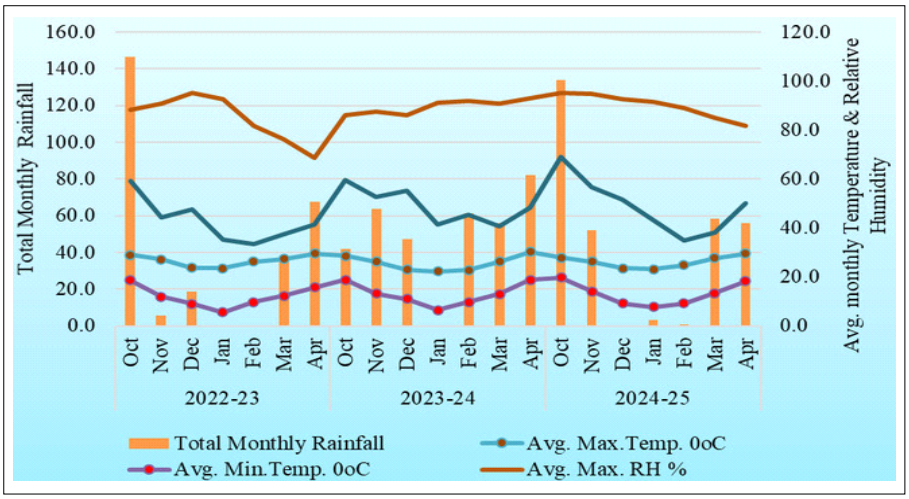


Fig 1: Monthly weather observations (rainfall, maximum and minimum temperatures and relative humidity) at study area during the experimental period of 2022-23 to 2024-25.

Table 2: Productivity and technology index of lentil under CFLD and farmer practise.

Year	Area (ha)	Demonstrations (No.)	Yield (kg/ha)			Increase in yield (%)	Tech gap (kg/ha)	Ext. gap (kg/ha)	Tech. index %
			Potential	Demonstration	Farmers practise				
2022-23	10	25	1800	920	643	43.08	480	277	34.29
2023-24	10	25	1800	950	685	38.68	450	265	32.14
2024-25	10	25	1800	985	698	41.12	415	287	29.64
Total	30	75							
Average				952	675	22.38	448	276	32.02

Table 3: Economics of lentil under CFLD and farmer practise.

Year	Cost of cultivation (₹/ha)		Gross return (₹/ha)		Net return (₹/ha)		B:C ratio	
	Demonstration	Farmers practise	Demonstration	Farmers practise	Demonstration	Farmers practise	Demonstration	Farmers practise
2022-23	29750	28450	73600	51440	43850	22990	2.47:1	1.81:1
2023-24	30850	29650	80750	58225	49900	28575	2.62:1	1.96:1
2024-25	32000	30960	88650	62820	56650	31860	2.77:1	2.02:1
Mean	30867	29686	81000	57495	50133	27728	2.62:1	1.93:1

extension gap will be reversed by the use of the latest production technology with high yielding varieties. Farmers will eventually abandon the outdated technology and embrace the new ones as a result of advances in technology.

In order to overcome the extension gap, this approach is crucial for promoting the adoption of improved lentil varieties and protective technologies. This alarming tendency can be addressed by encouraging the adoption of high-yield varieties and innovative production methods (Meena and Singh, 2016; Choudhary, 2013).

Technology index

A comparison of the lentil cultivar's potential yield and demonstration yield was used to analyse the technology index. It enables farmers to employ high-yielding cultivars and other yield-maximizing technology on their farms. A lower technology index number indicates greater feasibility. The technology index data (Table 2) demonstrated the viability of the advanced technology in farmers' fields. In 2024-2025, the technology index was at its lowest, 29.64%, while in 2022-2023 it was at its highest, 34.29%. Lower technology index values were mainly brought about by KVK scientists' ongoing monitoring through FLD implementation, farmers' encouragement to adopt yield-maximizing technologies through field visits, extension programs and trainings, as well as the provision of critical inputs and technical advice and a favourable climate. Therefore, the introduction of HYVs and the demonstration of improved technology, followed by a vigorous awareness campaign, will ultimately result in the district's farmers adopting the generated technology to speed up crop intensification, crop diversification and productivity enhancement in the lentil crop. Similar results were also seen in green gram, according to Bharti *et al*. (2024) and Shaktawat and Chundawat (2021) in blackgram.

Economic analysis

The prices of the products that persisted during the research of demonstrations were taken for calculating the economics. In cluster frontline demonstrations, where farmers followed recommended practices, the gross return, net returns and benefit:cost ratios were higher than farmers' practices, indicating higher profitability, according to the economic analysis of the data (Table 3) for lentils during the study period. Compared to the local check (1.93:1), the average benefit cost ratio under demonstration plots was 2.62:1. This might be due to the comparison to farmers' practices, improved technologies produced larger yields. The results validated the findings of Chongloi *et al*. (2025) and Paramita *et al*. (2022).

CONCLUSION

The technology demonstration at the cluster frontlines increased yield by an average of 22.38% compared to farmer practices. Based on the aforementioned results, it can also be said that combining enhanced production technology with HYV lentil seeds outperformed local checks and can significantly lower the technology index, which will boost district productivity. Under challenging rice fallow circumstances, pulse productivity could be increased with the use of improved variety seeds and scientific cultivation techniques. The demonstration's economic viability was explained by the favourable benefit-cost ratio, which also persuaded the farmers to accept the intervention.

ACKNOWLEDGEMENT

The Director of ICAR-ATARI, Zone VII, ICAR-Umiam, Meghalaya, is acknowledged by the authors for providing the financial support necessary to carry out this cluster front line demonstration. The authors also would like to acknowledge the Director of ICAR-RC for NEH Region in Umiam, Meghalaya, India, for continuing support and provision of the facilities they need.

Conflict of interest

The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication.

REFERENCES

Afzal, A., Kumar, R. and Guru, P. (2012). Impact of frontline demonstration on lentil in Ambala district of Haryana. *Agriculture Update.* **7(1 and 2):** 96-98.

Amuthaselvi, G., Anand, G.R., Vijayalakshmi, Noorjahan, A.K. Kanif, Dhanushkodi, V., Gayathri, M. and Ravi, M. (2023). Yield gap analysis through cluster front line demonstration in blackgram at Tiruchirapalli District. *Legume Research-An International Journal.* **46(7):** 898-901. doi: 10.18805/LR-5119.

Bharti, O.P., Jatav, R.C., Tiwari, S.K., Baraiya, B.R., Chouhan, P. and Singh, S.R.K. (2024). Impacts of cluster frontline demonstrations on yield and economics of green gram in Madhya Pradesh, India. *Legume Research*. **47(11):** 1944-1950. doi: 10.18805/LR-5250.

Chongloi, K.L., Devi, A.A., Devi, Y.P., Anal, B.H., Laha, R. and Singha, A.K. (2025). The impact analysis on productivity enhancement of blackgram through front line demonstration in Chandel District of Manipur State. *Legume Research-An International Journal*. **48(5):** 872-875. doi: 10.18805/LR-5322.

Chongloi, K.L. and Singh, D. (2022). Yield gap and economics analysis of lentil production under rainfed condition of Chandel District of NEH Region, Manipur. *Journal of Agri. Search.* **9(4):** 350-352.

Choudhary, A.K. (2013). Technological and extension yield gaps in oilseeds in Mandi district of Himachal Pradesh. *Indian J. Soil Cons*. **41(1):** 88-97.

Ghosh, P.K., Kumar, N., Hazra, K.K. and Venkatesh, M.S. (2012). Carrying Capacity of Untrapped Rice Fallows for Pulse Production. In: Proceedings of 3rd International Agronomy Congress, November 26-30, New Delhi. Indian Society of Agronomy, New Delhi, India. **1:** 61-62.

Meena, M.L. and Aishwarya, D. (2018). Increasing greengram production through frontline demonstrations under rainfed conditions of Rajasthan. *J. Krishi Vigyan.* **7(1):** 144-148.

Meena, M.L. and Singh, D. (2016). Technological and extension yield gaps in greengram in Pali district of Rajasthan, India. *Legume Research*. **40(1):** 187-190. doi: 10.18805/lr.v0iOF.3549.

Paramita, B., Paramita, B. and Suddhasuchi, D. (2022). Impact of cluster front line demonstrations on productivity and economics of lentil (*Lens culinaris* L.), chickpea (*Cicer aeritinum* L.) and field pea (*Pisum sativum* L.) in old alluvial zone of Malda, West Bengal, India. *Legume Research-An International Journal.* **45(12):** 1553-1558. doi: 10.18805/LR-4705.

Rozan, P., Kuo, Y.H. and Lambein, F. (2001). Amino acids in seeds and seedlings of the genus lens. *Phytochemistry.* **58:** 281-289.

Samui, S.K., Maitra, S., Roy, D.K., Mandal, A.K. and Saha, D. (2000). Evaluation of front line demonstration on groundnut. *Journal of Indian Society of Coastal Agricultural Research.* **18(2):** 180-183.

Shaktawat and Chundawat. (2021). Analysis of yield gaps and profitability in blackgram (*Vigno mungo* L.) in Mandsaur District of Madhya Pradesh. *J Krishi Vigyan.* **10(1):** 321-324.

Sunil, C.M., Chandrakala H., Manjunath, B., Gayathri, B. and Ananthakumar, M.A. (2023). Impact of large-scale demonstration on productivity and profitability of blackgram under rainfed conditions of Chamarajanagara District, Karnataka (Zone-6). *Legume Research*. **48(7):** 1196-1201. doi: 10.18805/LR-5074.

Yadav, G.S., Datta, M., Saha, P. and Debbarma, C. (2015). Evaluation of lentil varieties/lines for utilization of rice fallow in Tripura. *Indian Journal of Hill Farming*. **28(2):** 90-95.