P-ISSN: 2618-0723
E-ISSN: 2618-0731

NAAS Rating: 5.04
www.extensionjournal.com

International Journal of Agriculture Extension and Social Development

Volume 8; Issue 6; June 2025; Page No. 655-658

Received: 02-03-2025
Accepted: 05-04-2025

Indexed Journal
Peer Reviewed Journal

Impact of Technological Interventions of CFLD on Niger productivity and profitability in Jharkhand

[1]Sujeet Kumar, [2]Anjani Kumar and [3]Amrit Kumar Jha

[1]SRF, ICAR-ATARI, Zone -IV, Patna, Bihar, India

[2]Director, ICAR-ATARI, Zone -IV, Patna, Bihar, India

[3]Senior Scientist and Head, Krishi Vigyan Kendra, Sahibganj, Birsa Agricultural University, Ranchi, Jharkhand, India

DOI: https://www.doi.org/10.33545/26180723.2025.v8.i6i.2088

Corresponding Author: Amrit Kumar Jha

Abstract

Impact of scientific production techniques on productivity and profitability of niger was evaluated through cluster frontline demonstrations (CFLDs) by KVKs of Jharkhand under ICAR-ATARI, Zone IV, Patna during 2019-20 to 2022-23 covering 3261 farmers and 1247 ha area to evaluate the. The technological interventions were improved cultivars like Birsa Niger-1, Birsa Niger-3 and Pooja-1 with improved cultivation practices *viz.* line sowing, treatment of seed with fungicide, balanced nutrition, insect-pest management and weed management. The niger seed yield under CFLD and Farmer's Practice (FP) was recorded as 5.28 q ha-1 and 3.74 q ha-1, respectively. The per cent increase in yield with Improved Practices (IP) over FP was found to be 43.64. The extension gap and technological index were 1.55 q ha-1 and 15.40 per cent, respectively. The observed technology gap (0.99 q ha-1) reflected the farmer's cooperation in carrying out demonstrations. The higher net-return and benefit-cost ratio was recorded under CFLDs (Rs. 15,168/- to Rs. 20,077/- ha-1 and 1.71 to 2.05, respectively) as compared to FP (Rs. 8,443/- to Rs. 11,142/- ha-1 and. 1.39 to 1.70, respectively). Therefore, the results clearly indicate that the use of improved practices with scientific intervention contributed to increase the productivity and profitability of niger.

Keywords: Extension gap, technology transfer, Niger yield, cluster frontline demonstrations, technology index, economics.

Introduction

India holds a significant share in world oilseed production. The area under important oilseeds *viz.*, rapeseed and mustard, groundnut, sesamum, linseed, castor, soyabean, cottonseed, sunflower, safflower and niger seed occupied 20% of net sown area. However, the production of oilseeds has always fallen short of our demand and there always been a need to import oilseeds and its products. The total oilseeds production was estimated at 41.35 million tons (MT) during 2022-23. There is limited scope of bringing additional area under oilseeds cultivation, hence to increase oilseed production in order to meet our demand improved cultivation practices have to be promoted and adopted by the cultivators.

Niger (*Guizotia abyssinica* L.) is a minor oilseed crop primarily grown under rainfed conditions. The crop is believed to have originated in Ethiopia, Eritrea, and Malawi, where it has long served as an important oilseed in traditional farming systems. Globally, the two major *niger* seed producing countries are Ethiopia and India, contributing approximately 50% and 3%, respectively, to their total oilseed production (Bhatnagar and Krishna, 2013) [1]. In India, *niger* is cultivated mainly during the kharif season, covering an area of about 2.61 lakh hectares, with an average productivity of 3.21 quintals per hectare. The principal *niger*-growing states include, Andhra Pradesh, Assam, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Maharashtra, Odisha, and West Bengal. Despite its status as a minor oilseed, *niger* plays a crucial role in tribal and rainfed agricultural systems, offering both nutritional value and livelihood support in marginal farming regions.

Niger (*Guizotia abyssinica* L.), a member of the *Asteraceae* family, is an herbaceous green plant characterized by bright yellow flowers. The seeds of niger contain 37-47% oil, which is pale yellow in color, with a nutty taste and pleasant aroma. Niger seed oil serves multiple purposes like, culinary use (as cooking oil), body anointment in traditional practices, paint and soft soap manufacturing, lighting and lubrication purposes. The oil is rich in linoleic acid, which is the principal fatty acid. Linoleic acid has been scientifically linked to the prevention of cardiovascular diseases such as coronary heart disease, atherosclerosis, and high blood pressure (Bhavsar *et al.*, 2017) [2]. The cold pressed niger seed oil is increasingly used as a natural substitute for sunflower or olive oil, particularly in regions where these oils are scarce or expensive. Niger cake, a protein rich by product of oil extraction, is widely used as, cattle feed, organic manure and fuel source in rural areas. Traditional knowledge also recognizes niger oil as a nutritionally valuable and health-promoting oil, especially suited for hot and dry climatic conditions (Bhoge and Bobade, 2019) [3].

Niger has been an integral part of the tribal lifestyle for generations, particularly valued for its multipurpose utility. Tribal communities commonly use Niger seed oil for cooking, oil cake as nutritious animal feed and seeds as condiments in traditional dishes. Niger is well suited to tribal and rain fed farming systems due to its low water and fertilizer requirements, which makes it a low risk crop under unpredictable climatic conditions. Jharkhand, a tribal dominated state, cultivates niger on approximately 2.449 thousand hectares, with an average productivity of 3.98 quintals per hectare. However, the potential yield of recommended varieties for the region are Pooja-1, Birsa Niger-3 and JNS-29, ranges between 5.5 to 7.0 q ha^{-1}, indicating a significant yield gap. The observed gap between potential and actual yields is largely attributed to limited availability and adoption of improved varieties and lack of awareness and implementation of scientific cultivation practices. To address these constraints, demonstrations were conducted in several niger growing districts of Jharkhand, involving recommended high yielding varieties and Improved package of practices (PoP) including seed treatment, line sowing, balanced fertilization, pest and weed management. These interventions aimed to enhance the productivity and profitability of niger cultivation and bridge the technology adoption gap among tribal farmers.

Methodology

Cluster frontline demonstrations (CFLDs) on niger were conducted by KVKs of Jharkhand under ICAR-ATARI, Zone IV, Patna during 2019-20 to 2022-23. Number of locations (beneficiaries) during 2019-20, 2020-21, 2021-22 and 2022-23 were 354, 1406, 900 and 601, respectively with total of 3261, the area covered were 130 ha, 510 ha, 367 ha and 240 ha, respectively with total of 1247 ha and the number of districts participated were 12, 19, 20 and 15, respectively. Farmers and farmwomen were identified through their participation and feedback received during the preliminary survey, awareness programmes and interactive meetings. Trainings on improved package and practices of niger cultivation as recommended by the Birsa Agricultural University were organized and critical inputs for the technologies *viz*. seeds, fungicides, insecticide were distributed to the participating farmers however balanced plant nutrients were applied by the farmers from their own resources. Technological interventions of the CFLDs are presented in table 1. Field visit during entire period of crop growth, monitoring and need based advisories were provided by the scientists of concerned KVKs. All 3261 demonstrations in 1247 ha area were conducted by the active participation of the farmers with an objective to demonstrate the improved technologies of niger production potential in different villages. In case of local check, the traditional practices were followed by using existing variety. In demonstration plots, three improved varieties *viz*. Birsa Niger-1, Birsa Niger-3 and Pooja-1 with line sowing, timely application of weedicide and need based pesticide as well as balanced fertilizer were emphasized. The farmers under the programme were facilitated by KVK scientists in performing field operations like sowing, nutrient management, plant protection measures, harvesting etc. Finally, field days were organized involving demonstration holding as well as other farmers in the village, scientist from KVK, officials from Department of Agriculture, local extension functionaries to demonstrate the superiority of technology. The basic information was recorded from the demonstration and control plots and analyzed for comparative performance of the cluster frontline demonstrations (CFLDs) and farmer's practice. The yield data were collected both from the demonstration and farmers practice by random crop cutting method and analyzed by using simple statistical tools. The technology gap and technological index (Yadav *et al*., 2004) [15] along with the benefit cost ratio (Samui *et al*., 2000) [14] were calculated by using following formula as given below.

$$\text{Extension Gap} = \text{Demonstration Yield} - \text{Farmer's Practice Yield}$$

$$\text{Technology Gap} = \text{Potential Yield} - \text{Demonstration Yield}$$

$$\text{Additional Return} = \text{Demonstration Return} - \text{Farmer's Practice Return}$$

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

$$\text{Percent increase in yield} = \frac{\text{Demonstration Yield} - \text{Farmer's Practice Yield}}{\text{Farmer's Practice Yield}} \times 100$$

Results and Discussion

Technology adoption gap

The details of technological interventions under Cluster Frontline Demonstrations (CFLDs), Farmers' Practices (FP), and the gaps between them are presented in Table 1. The data clearly indicate a full gap in key aspects such as, use of improved varieties, seed treatment, plant protection measures and weed management. A partial gap was observed in, seed rate, sowing method and nutrient management. In general, farmers continue to grow un-descript local varieties rather than recommended improved cultivars, and often apply higher seed rates than suggested. They typically broadcast untreated seeds, which leads to uneven plant population and increased incidence of soil and seed borne diseases. The use of un-descript seed may stem from the unavailability of improved varieties at the appropriate time, while the persistence of unscientific cultivation practices is largely due to lack of awareness and access to technical guidance. These findings are in alignment with observations made by Jha *et al.* (2020) [4] and Kumar *et al.* (2023) [12], which also highlighted similar constraints in the adoption of recommended niger production technologies.

Table 1: Gap analysis between technological intervention and farmer's practices under CFLDs on Niger

Particulars	Technological intervention in CFLDs	Farmers practices	Gap
Farming situation	Rainfed upland	Rainfed upland	No gap
Land preparation	Ploughing with cultivator (2)	Ploughing with cultivator (2)	No gap
Variety	Birsa Niger-1, Birsa Niger-3 and Pooja-1	Local/own seed	Full gap
Seed rate	5 kg/ha	10 kg/ha	High seed rate
Sowing method	Line sowing	Broadcasting	Partial gap
Seed Treatment	Seed treatment was done with 2.5 gm of carbendazim per kg seed.	No seed treatment	Full gap
Fertilizer	Balanced fertilizer application 20 kg N, 80 kg P_2O_5, 40 kg K_2O, 40 kg Sulphur.	Improper dose	Partial gap
Weed management	One hand weeding at 25-30 DAS	No weeding	Full gap
Plant Protection	Need based plant protection measures.	No plant protection measures.	Full gap

Demonstration yield

Data presented in Table 2 reflects the positive impact of technological interventions under Cluster Frontline Demonstrations (CFLDs) on the grain yield of niger over a four year period (2019-20 to 2022-23). The average grain yield under CFLDs was recorded as 5.28 q ha^{-1}, significantly higher than 3.74 q ha^{-1} under Farmers' Practices (FP). This indicates a mean yield increase of 43.64% due to the adoption of improved technologies. Among the three improved varieties demonstrated Birsa Niger-1 recorded the highest yield at 5.55 q ha^{-1}, with a 51.16% increase over FP, Birsa Niger-3 yielded 5.44 q ha^{-1}, marking a 35.93% increase and Pooja-1 produced 4.86 q ha^{-1}, reflecting a 43.83% increase over FP. The observed yield enhancement can be attributed to several factors such as adoption of improved, high yielding varieties, scientific seed rate and sowing techniques, balanced nutrient application and timely weed and pest management. These findings align with previous studies reporting yield improvements from CFLDs in various crops like Kalita *et al.* (2019) [9] in mustard, Jha *et al.* (2020) [5] in black gram and chickpea, Jha *et al.* (2021) [6] and Kumar *et al.* (2022) [11] in mustard, Jha *et al.* (2022) [8] in green gram, Kumar *et al.* (2023) [12] in pigeon pea. Despite the notable increase in yield under CFLDs, the observed yields remained below the potential yield range (5.5-7.0 q ha^{-1}). This yield gap may be attributed to variability in climatic conditions across demonstration sites during the crop growth period. Similar constraints were also highlighted by Jha *et al.* (2022) [8] and Kumar *et al.* (2023) [12] in their studies on pulse crops.

Table 2: Impact of technological interventions of CFLDs on yield of niger

Variety	Year of release	Area (ha)	No. of Demo	Yield (q ha^{-1})			Increase over Control (%)
				Potential	Demo	Farmer's Field	
Birsa Niger 1	1995	530	1463	6.50	5.55	3.87	51.16
Birsa Niger 3	2009	527	1275	5.81	5.44	4.12	35.93
Pooja 1	2009	190	523	6.50	4.86	3.22	43.83
Total		1247	3261	-	-	-	-
Average				6.27	5.28	3.74	43.64

Extension gap, Technology gap and Technology index

The impact of technological interventions through Cluster Frontline Demonstrations (CFLDs) on extension gap, technology gap, and technology index over four years (2019-20 to 2022-23) is presented in Table 3. The findings indicate significant improvements and highlight key areas for further extension efforts. The extension gap, the difference between yields under CFLDs and farmers' practices ranged from 1.32 to 1.68 q ha^{-1} across the demonstration years. This consistent gap emphasizes the urgent need to educate and train farmers on improved agricultural practices to bridge this divide. The wide extension gap underscores the role of effective extension strategies in technology transfer and adoption. The technology gap, defined as the difference between potential yield and demonstrated yield, ranged from 0.37 to 1.64 q ha^{-1} across the different niger varieties and years. This gap reflects both, the cooperation of farmers in implementing improved practices and the effectiveness of demonstrations, especially as yields improved in subsequent years. These findings are in agreement with earlier reports by Katare *et al.* (2011) [10] in oilseeds, and Jha *et al.* (2021) [7] and Kumar *et al.* (2022) [11] in rice and mustard. The variability in technology gap among different varieties and locations may be attributed to differences in soil fertility, rainfall distribution, pest and weed pressure, geographic and climatic conditions across the demonstration sites. Despite these variables, the consistent yield advantage over farmers' practices suggests robust performance of the improved technologies under diverse field conditions. The technology index, which reflects the feasibility of the demonstrated technology under farmers' field conditions, ranged from 6.37% to 25.23%. The variation in index among varieties can be attributed to their differing potential yields, soil fertility variability and year to year climatic differences. Among the demonstrated varieties, Birsa Niger-3 recorded the lowest technology index (6.37%), indicating its high adaptability and feasibility for adoption under field conditions. The average technology index over the four years was 15.40%, which indicates the strong potential of the demonstrated interventions and their suitability for scaling up to improves niger productivity in tribal and rainfed regions.

Table 3: Gap Analysis of CFLDs on niger

Variety	Technology gap (q ha^{-1})	Extension gap (q ha^{-1})	Technology Index (%)
Birsa Niger 1	0.95	1.68	14.61
Birsa Niger 3	0.37	1.32	6.37
Pooja 1	1.64	1.64	25.23
Average	0.99	1.55	15.40

Economic analysis

Data presented in table 4 indicates the economic performance of different niger varieties under cluster frontline demonstrations. Results of economic analysis parameter revealed that the niger variety Birsa Niger-1, Birsa Niger-3 and Pooja-1 recorded gross return of Rs. 31,131/-, Rs. 35,033/- and Rs. 28,259/- per ha, respectively under CFLDs as compared to Rs. 20,672/-, Rs. 24,287/- and Rs. 19,588/- per ha, respectively under FP. Positive influence of technological interventions of CFLDs on net return and thereby benefit cost ratio (B:C ratio) over FP was noticed. The net return ranged from Rs. 15,168/- to Rs. 20,077/- per ha under recommended practice as compared to Rs. 8,443/- to Rs. 11,142/- per ha in FP among the varieties during four years of demonstration. The higher benefit cost ratio was also recorded under CFLDs and the observed B:C ratio was 2.26, 2.44 and 2.14 for the niger variety Birsa Niger-1, Birsa Niger-3 and Pooja-1, respectively as compared to 1.75, 1.89 and 1.77, respectively under FP. These results underscore the economic viability and profitability of adopting improved varieties and scientific management practices in *niger* cultivation. The findings are consistent with earlier studies by Jha *et al.* (2020) [4], Sangwan *et al.* (2021) [13], and Kumar *et al.* (2023) [12], which also reported enhanced returns and higher B:C ratios through the implementation of CFLDs in other crops.

Table 4: Economic analysis of CFLDs on niger

Variety	Demonstration Plot				Farmer's Field			
	Gross cost (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio	Gross cost (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
Birsa Niger 1	14233.69	31130.98	16897.29	2.26	12228.72	20672.09	8443.38	1.75
Birsa Niger 3	14955.43	35032.56	20077.13	2.44	13145.22	24287.36	11142.15	1.89
Pooja 1	13090.91	28258.82	15167.91	2.14	11009.09	19587.82	8578.73	1.77

Conclusion

The Cluster Frontline Demonstrations (CFLDs) on *niger* conducted by KVKs of Jharkhand under the supervision of ICAR-ATARI, Zone IV, Patna, significantly contributed to both vertical yield enhancement and horizontal dissemination of improved *niger* production technologies. Through a combination of on-farm demonstrations, training programmes, field days, and exposure visits, the CFLD initiatives served as effective tools for technology transfer at the grassroots level. The CFLDs led to an average yield improvement of 46.64% over traditional farmer practices, demonstrating the impact of scientific interventions on *niger* productivity. The realization of potential yields from high-yielding varieties like Birsa Niger-1, Birsa Niger-3, and Pooja-1 is achievable through timely access to quality inputs, adoption of recommended cultivation practices and continuous capacity building of farmers. Importantly, the CFLD programme also strengthened the rapport and trust between farmers and KVK scientists, fostering an environment of knowledge exchange and collaborative learning. The recipient farmers of CFLDs are now emerging as local ambassadors of change serving as sources of information, motivation, and quality seed material for fellow farmers in nearby villages. Hence, it can be strongly advocated that widespread adoption of improved package and practices in niger cultivation will play a pivotal role in enhancing productivity, profitability, and sustainability of niger farming in rainfed and tribal regions like Jharkhand.

References

1. Bhatnagar AS, Krishna GAG. Effect of extraction solvent on oil and bioactives composition of commercial Indian niger (*Guizotia abyssinica*) seed. J Am Oil Chem Soc. 2013;90:1203-12.
2. Bhavsar GJ, Sayed HM, Andhale RR. Characterization and quality assessment of mechanically and solvent extracted niger (*Guizotia abyssinica*) seed oil. J Pharmacogn Phytochem. 2017;6(2):17-21.
3. Bhoge YN, Bobade AF. GC-MS study of seed oil of *Guizotia abyssinica* Cass plant as a source of vegetable oil. Rev Res. 2019;8(7):1-5.
4. Jha AK, Chatterjee K, Mehta BK, Kumari M. Effect of technological interventions of cluster frontline demonstrations (CFLDs) on productivity and profitability of black gram (*Vigna mungo* L.) in Sahibganj district of Jharkhand. Int J Chem Stud. 2020;8(5):2124-7.
5. Jha AK, Chatterjee K, Mehta BK, Kumari M. Assessment of technological interventions on productivity and profitability of chickpea (*Cicer arietinum* L.) through cluster frontline demonstrations (CFLDs) in Sahibganj district of Jharkhand. Int J Adv Biol Res. 2020;8(2):186-91.
6. Jha AK, Mehta BK, Kumari M, Chatterjee K. Impact of frontline demonstration on mustard in Sahibganj district of Jharkhand. Indian J Ext Educ. 2021;57(3):28-31.
7. Jha AK, Kumar A, Mehta BK, Kumari M, Chatterjee K. On farm assessment of INM techniques on soil health and yield of rice in Sahibganj, Jharkhand. Indian J Ext Educ. 2021;57(4):89-92.
8. Jha AK, Chatterjee K, Mehta BK, Kumari M. Effect of technological interventions of cluster frontline demonstrations (CFLDs) on productivity and profitability of green gram (*Vigna radiata* L.) in Sahibganj, Jharkhand. Environ Ecol. 2022;40(2A):464-9.
9. Kalita SK, Chhonkar DS, Kanwat M. Assessment of cluster front line demonstrations on rapeseed (*Brassica campestris* L.) in Tirap district of Arunachal Pradesh. Indian J Ext Educ. 2019;55(3):17-22.
10. Katare S, Pandey SK, Mustafa M. Yield gap analysis of rapeseed-mustard through front line demonstrations. Agric Update. 2011;6:5-7.
11. Kumar A, Kumar A, Jha SK, Singh SK. Appraisal of cluster front line demonstration on rapeseed and mustard in Bihar and Jharkhand. Indian J Ext Educ. 2022;58(1):31-5.
12. Kumar A, Kumar A, Kumari P, Kumar S. Impact assessment of CFLD pulses on pigeonpea productivity and profitability in farmer's field. Indian J Ext Educ. 2023;59(2):36-40.
13. Sagwan M, Singh J, Pawar N, Siwach M, Solanki YP, Ramkaran. Evaluation of front-line demonstration on mustard crop in Rohtak district of Haryana. Indian J Ext Educ. 2021;57(2):6-10.
14. Samui SK, Maitra S, Roy DK, Mandal AK, Saha D. Evaluation of frontline demonstration on groundnut. J Indian Soc Coast Agric Res. 2000;18(2):180-3.
15. Yadav DB, Kamboj BK, Garg RB. Increasing the productivity and profitability of sunflower through frontline demonstrations in irrigated agro-ecosystem of eastern Haryana. J Agron. 2004;20:33-5.