International Journal of Statistics and Applied Mathematics 2023; SP-8(5): 558-561

International Journal of Statistics and Applied Mathematics

ISSN: 2456-1452
Maths 2023; SP-8(5): 558-561

https://www.mathsjournal.com
Received: 13-08-2023
Accepted: 15-09-2023

Rajesh Chandra Verma
Krishi Vigyan Kendra (ANDUAT), Ankushpur Ghazipur, Uttar Pradesh, India

Jai Prakash Singh
Krishi Vigyan Kendra (ANDUAT), Ankushpur Ghazipur, Uttar Pradesh, India

Shashank Shekhar
Krishi Vigyan Kendra (ANDUAT), Ankushpur Ghazipur, Uttar Pradesh, India

Narendra Pratap
Krishi Vigyan Kendra (ANDUAT), Ankushpur Ghazipur, Uttar Pradesh, India

Avinash Kumar Rai
Krishi Vigyan Kendra (ANDUAT), Ankushpur Ghazipur, Uttar Pradesh, India

Shashank Singh
Krishi Vigyan Kendra (ANDUAT), Ankushpur Ghazipur, Uttar Pradesh, India

Nimit Singh
Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, India

Corresponding Author:
Rajesh Chandra Verma
Krishi Vigyan Kendra (ANDUAT), Ankushpur Ghazipur, Uttar Pradesh, India

Enhancement of productivity through cluster frontline demonstrations and dissemination of production technology of pigeon pea (*Cajanus cajan*) in Ghazipur, Uttar Pradesh

Rajesh Chandra Verma, Jai Prakash Singh, Shashank Shekhar, Narendra Pratap, Avinash Kumar Rai, Shashank Singh and Nimit Singh

Abstract
The field study was carried out by Krishi Vigyan Kendra, Ghazipur-II to assess the yield gap of Pigeon Pea (*Cajanus cajan*) through Cluster Frontline Demonstrations (CFLD) on pulses on improved technologies were conducted in 40 ha at 15 villages of 114 farmers fields Ghazipur district, UP during Kharif seasons of 2020-21 and 2021-22. Improved Crop Management practices recorded the highest mean seed yield of 18.50 q/ha which was 40.14 percent higher than the yield with farmers practice (14.30 q/ha). The extension gap, technological gap and technological index were recorded 4.20 q/ha, 6.50 q/ha and 26.0 percent respectively. Due to adoption of improved package of practices, demonstration plot recorded higher average seed yield over the local check.

Keywords: CFLD on pigeon pea, extension gap, technology gap and technology index

Introduction
Pulses constitute a very important dietary constituents for human and animal because of their richness with proteins (Ranging from 20 to 24 per cent, depending upon the crop species) and essential minerals, vitamins and dietary fibres. The protein content of grain legumes is double that of wheat and three times that of rice. Therefore, pulses as a complement to cereals, make one of the best solutions to protein-calorie malnutrition. Beside proteins, these are also important source of the 15 essential minerals required by human beings. Pulses occupies unique place in India's nutritional food security for ever growing population and also weaker sections of the society who could not afford other sources of protein. These crops consume 2-3% less water compare to paddy (Shekhar *et al*. 2017, 2019, 2020, 2021a, b, c, 2022, Shekhar 2022) [16, 12, 17, 18, 10].

Pulses are one of the important segments of Indian agriculture. The important pulse crops are Chickpea (45.53%), Pigeon pea (17.06%), Urdbean (13.40%), Mungbean (7.76%), Lentil (5%) and Field pea (5%). The major pulse producing states are Madhya Pradesh (33%), Maharashtra (13%), Rajasthan (12%), Uttar Pradesh (9%), Karnataka (8%), Andhra Pradesh (5%), Gujarat (4%), Jharkhand (3%), Tamil Nadu, (2%), and Telangana (2%) which together for about 91 per cent of the total production [4]. Among the pulses, Pigeonpea [*Cajanus cajan* (L.) Millsp.] is an important pulse-cum-grain legume crop in semi-arid tropical and subtropical areas of the world. It is a second most important grain legume crop next to chickpea accounting for about 20 per cent of total pulse production [11], occupies a prominent place in Indian dry land agriculture by covering an area of around 3.9 m ha with productivity of 729 kg ha-1. India is the world's largest producer and consumer of pulses including pigeon pea. Pigeonpea is an important *kharif* pulse crop grown in India. Area under pigeonpea in India is about 4.42 million hectare with an annual production of 2.89 million tonnes and productivity of 655 kg/ha [3]. The average productivity of Pigeon pea in Uttar Pradesh was produced about 1040 kg/ha in 23.80 Lakh ha area.

In Ghazipur district pigeon pea was cultivated in an area of approximately 40000 ha with the productivity of 1014 kg /ha during 2020-21. The variation in the percent increase in the yield was found due to variation in agro climatic parameters under rainfed condition. The productivity and income gain under CFLDs over traditional practices of pigeon pea cultivation created greater awareness and motivated the other farmers to adopt appropriate production technology of pigeon pea in the district. The selection of critical input and participatory approach in planning and conducting the demonstrations definitely help in transfer of technology to the farmers. Ghazipur district has very low Productivity of Pigeon pea due to poor knowledge about newly released crop production and protection technologies and their management practices in the farmers' fields. Over a period, a number of improved pulses varieties and production technologies have been developed, but full potential of these varieties as well as technologies could not be exploited due to low rate of adoption and low yields. The proposed Centrally Sponsored Scheme 'National Food Security Mission (NFSM) is to operationalize the resolution of NDC and enhance the production of rice, wheat and pulses [1]. The aims of the cluster front line demonstration to target the select districts by making available the improved technologies like promotion of Integrated Nutrient Management (INM) Integrated Pest Management (IPM), promotion of micronutrients/gypsum/ bio- fertilizers, promotion of sprinkler irrigation, and Extension, training and mass media campaign. Keeping the above point in view, the CFLDs on Pigeon Pea using improved production technologies was conducted with the objective of showing the productive potentials of the new production technologies under actual farming situation. These demonstrations were conducted under the close supervision of scientists of Krishi Vigyan Kendra Ankushpur, Ghazipur. Hence, there is need for expansion of area and production in pulses in Uttar Pradesh. Cluster Front Line Demonstrations (CFLDs) under National Food Security Mission (NFSM) playing key role in introduction of improved varieties and production technologies in pulses.

Materials and Methods

The CFLDs of Pigeon Pea was conducted during kharif season 2020-21 and 2021-22 by the KVK Ghazipur-II. The demonstrations were conducted in farmer's field of 9 different villages (Hariharpur, Saitapatti, Tiwaritola, Enayatpatti, Chandani, Surtapur, Mahroonpur, Baki khurd, Katariya) in the year 2020-21 and 6 different villages (Tazpur manjha, Gaura, Ramnathpur, Gosandepur, Bhikhichaura, Salempur Lakhmi) in 2021-22, Ghazipur District. The area under each demonstration was 0.4 ha. Farmers were trained to follow the package and practices for pigeon pea cultivation. The treatment comprised of recommended practice (Improved variety NA-2 and IPA 203), integrated nutrient management- @ N:P:K:S (20:40:20:20) kg/ha + Zinc Sulphate @ 15 kg/ha + Rhizobium + PSB @ 5 g/kg seed, integrated pest management- deep ploughing + seed treatment with *Trichoderma viride* @ 5 g/kg seed + Carbandazim @ 2gm /kg seed + Fipronil 5% SC 10 ml/kg seed + Use of Emamectin Benzoate @250 ml /ha for pod-borer at 50% flowering and small pod stage and Neem oil @ 5ml/lit for sucking pest etc. vs. farmers practice. The need based inputs were provided to the beneficiaries. In case of local check, the traditional practices were followed by using existing varieties. An area of 20 hectare (2020-21) and 20 hectare (2021-22) was covered with plot size 0.4 ha, under cluster front line demonstration with active participation of 59 (2020-21) and 55 (2021-22) farmers respectively. In general, the soil of the experimental sites were Sandy and Sandy loam. Crop was sown between 15 June to 15 July with a spacing of 45 cm and seed rate was 15 kg/ha. The seeds were treated with *Trichoderma viride* @5 g/kg seeds then inoculated by Rhizobium and phosphate solubilizing bacteria biofertilizers each 5 g/kg of seeds. Application of Imazethapyr @100 g a.i. /ha at 25-30 DAS. Spray of Neem oil @2.5/ltr at flower initiation and install the pheromone trap for monitoring of pod borer. Before conducting the demonstration farmers group meeting and training were also organized. The farmers field and crop growth were frequently monitored and goshthi and field day were organized with extension functionaries and block level development officer at demonstration plots to visualize the technology difference and disseminate the technology at large scale. The production data on different parameters was collected from farmers practice and demonstration plots and calculated the Gross return, cost of cultivation, net returns and benefit cost ratio (B:C ratio) by using prevailing prices of inputs and outputs. We also collected data of both CFLD plots as well as Farmers Practice control plots for extension gap, technology gap, technology index along with the benefit cost ratio (Samui *et al*., 2000) [10] as given below:

Technology gap = Potential Yield – Demonstration Yield

Extension gap = Demonstration Yield – Farmer's Yield

$$\text{Technology index} = \frac{\text{Potential Yield} - \text{Demo. Yield}}{\text{Potential Yield}} \times 100$$

Additional Return = Demonstration return – Farmer's practice return

$$\text{Benefit} - \text{Cost Ratio} = \frac{\text{Gross Return}}{\text{Gross Cost}}$$

$$\text{Percent increase yield} = \frac{\text{Demonstration yield} - \text{Farmers yield} \times 100}{\text{Farmers yield}} \times 100$$

Table 1: Details of recommended package of practices for Red gram

S. No.	Technological practices	Recommended practice	Farmer's practice	Gap
1.	Variety	NA-2 & IPA-203	Own seed, Local varieties	75%
2.	Land preparation	3 ploughing	3 ploughing	Nil
3.	Seed rate	20 kg/ha	25 kg/ha	60%
4.	Seed treatment for wilt and Rhizoctonia	Carbendazim 2 gm or Thiram @ 2.5 gm/kg seed	Seed treatment by 25%	75%
5.	Seed treatment for Termite control	Fipronil 5% SC 10 ml/kg seed	Seed treatment by 20%	80%
6.	Method of sowing and Crop geometry	Line sowing 45×30 cm	Broadcasting and mixed cropping	75%
7.	Time of sowing	15 June to 30 June	15 June to 30 June	Nil
8.	Fertilizer	Recommended N:P:K:S (20:40:20:20) kg/ha as basal dose	N:P:K (00:40:00) kg/ha as basal dose	70%

9.	Weed Management	Use of Pendimethalin @ 1 kg a.i./ha as pre-emergence and Imazethapyr 10 S.L. @ 50 g a.i./ha post-emergence	No use of herbicide for weed management	70%
10.	PP measures for Pod borer	Use of Emamectin Benzoate @ 250 ml/ha for pod-borer at 50% flowering and small pod stage and Neem oil @ 5 ml/lit for sucking pest	No use	85%

Table 2: Productivity, Extension gap, Technology gap and Technology index of Pigeon Pea under CFLDs

Year	Name of Variety	No. of demo.	Area	Seed Yield (Q/ha)			% increase	Extension gap	Technology gap	Technology index
				Potential	CFLD	FP				
2020-21	NA-2	59	20.00	25.00	20.30	14.90	36.20	5.40	4.70	18.80
2021-22	NA-2	55	20.00	25.00	18.30	12.70	44.09	5.60	6.70	26.80
Average		57	20	25.00	18.50	14.30	40.14	4.20	6.50	26.00

Table 3: Economics of cluster frontline demonstrations on Pigeon Pea under CFLDs

Year	Gross Cost (Rs./ha)		Gross Return (Rs./ha)		Net return (Rs. ha-1)		Additional gain (Rs. ha-1) in CFLD	B:C ratio	
	CFLD	FP	CFLD	FP	CFLD	FP		CFLD	FP
2020-21	26550	23548	121800	89400	95150	65852	29298	4.58	3.79
2021-22	27675	23700	115290	80010	87615	56310	31305	4.16	3.37
Average	27113	23624	118545	84705	91383	61081	30302	4.37	3.50

Results and Discussion

Grain yield and Percent Increased

The grain yield and gap analysis of Red gram in demonstrated field's and farmer's practice is presented in (Table 2). Data revealed that average grain yield of demonstrated field's was higher from farmer's practice in both years. The results revealed that grain yield of Red gram under cluster frontline demonstrations were 20.30 and 18.30 Qt ha-1as compare to 14.90 and 12.70 Qt ha-1 recorded in farmer's practice. The average grain yield was recorded 18.50 q/ha under CFLD and 14.30 q/ha in farmers filed and yield increase of 36.20 and 44.09 per cent, respectively. The above finding was in accordance with Singh *et al., (*2018) [23], Jayalakshmi Mitnala *et al.*, (2018) [7], Singh *et al.*, (2020B) [21] and Singh and Singh (2020) [20].

Extensions gap

The difference between demonstrated yield and yield under existing farmers practice is extension gap. Extensions gap were observed as 5.40 and 5.60 q/ha for pigeon pea, respectively during demonstration period (Table 2). The average extension gap was recorded as 4.20 q/ha. This finding is in corroboration with the findings of Jayalakshmi Mitnala *et al.*, (2018) [7], Singh, *et al.*, (2019) [24], Singh *et al.*, (2020B) [21] and Singh and Singh (2020) [20].

Technology gap

The difference between the potential yield of the variety and yield of demonstration is technology gap. The difference between potential yield and demonstration plots yield was 4.70 and 6.70 q/ha in pigeon pea, respectively during demonstration period (Table 2). The average technology gap was observed 6.50 q/ha. The findings are in line with that reported by Vijaya Lakshmi *et al.* (2017) [25], Jayalakshmi Mitnala *et al.*, (2018) [7], Singh *et al.*, (2020B) [21] and Singh and Singh (2020) [20].

Technology index

The ratio between technology gap and potential yield expressed as percentage is technology index. The average technology index was observed 18.80 and 26.80 per cent in pigeon pea (Table 2). The average technology index was recorded as 26.00 per cent in pigeon pea crops. Similar findings were reported by Singh, *et al.*, 2019 [24], Singh *et al.*, (2020A) [22], Singh *et al.*, (2020B) [21] and Singh and Singh (2020) [20].

Economics analysis of red gram

Economic performance of red gram under cluster frontline demonstration was depicted in (Table 3). The economic analysis results revealed that the red gram recorded higher total return from recommended practice (CFLD's) were 121800 (NA-2) in 2020-2021 and 115290 (NA-2) in 2021-22 as compared to 89400 and 80010 in farmer's. Practice respectively. The net returns were 95150 (NA-2) in 2020-21 and 87615(NA-2) in 2021-22 as compared to 65652 and 56310 in farmer's. Practice respectively. It was economically observed that additional returns were 29298 (NA-2) and 31305 (NA-2) in recommended practice in both the years. The benefit cost ratio also recorded higher in recommended practice with 4.58 and 4.16 as compared to 3.79 and 3.37 in farmer's practice in both the years during 2020-21 and 2021-22, respectively. Similar findings were also reported in frontline demonstrations on pulse crops by Dwivedi *et al.*, (2011) [6], Dwivedi *et al.*, 2014 [5], Singh *et al.* (2018) [23], Singh, *et al.*, (2019) [24], Jayalakshmi Mitnala *et al.*, (2018) [7], Singh *et al.*, (2020B) [21] and Singh and Singh (2020) [20] also reported higher yield and net returns as well as benefit cost ratio as compared to local practices.

Conclusion

Cluster frontline demonstrations on pulses (pigeon pea) were conducted in 40 ha at 114 framers' fields of Ghazipur district during Kharif season of 2020-21 and 2021-22. Improved crop management practices recorded the highest mean seed yield of 18.50 q ha^{-1} which was 40.14 per cent higher than the yield obtained with farmers practice (14.30 q ha^{-1}). It was observed that potential yield can be achieved by imparting scientific knowledge to the farmers, providing the quality need based inputs and proper application of inputs. Horizontal spread of improved technologies may be achieved by the successful implementation of frontline demonstration and various extensions activities like training program, field day, exposure visit organized in CFLDs program in the farmer's fields.

Acknowledgement

Krishi Vigyan Kendra, Ghazipur-II is thankful to the Director, ICAR-ATARI, Zone-III, Kanpur, Uttar Pradesh for providing funds for conducting CFLDs and farmers who always show faith in Krishi Vigyan Kendra, Ghazipur-II. KVK, Ghazipur-II is also thankful to the host organization Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, Uttar Pradesh.

References

1. Annonymous. Agricultural statistics at a glance. DAC Department of Agriculture India; c2011. p. 118.
2. Annonymous. Fourth advance estimate Rabi and Kharif. Agricultural statistics. Department of Agriculture. Government of Rajasthan; c2019-20.
3. Anonymous. Area and production of pulse crop. Directorate of Economics and Statistics, Department of Agriculture and Cooperation; c2013. www.agril. coop.com.
4. DES. Directorate of Economics and Statistics, Department of Agriculture Cooperation and Welfare, Ministry of Agriculture, Government of India, New Delhi; c2018.
5. Dwivedi AP, Singh AM, Singh SRK, Singh M. Yield gap analysis of chickpea through front line demonstration in different agro-climatic zones of M. P. and Chhattisgarh. Journal of food legumes. 2014;27(1):50-63.
6. Dwivedi AP, Singh RP, Singh M. Effect of Technological Interventions on Yield and Economics of Pigeon pea in Eastern U.P. Indian Journal of Extension Education. 2011;47(3, 4):65-68.
7. Jayalakshmi M, Prasad Babu G, Chowdary KR, Vijayabhinandana B, Subba Rao M. Impact of cluster frontline demonstrations (CFLDs) on pulse production productivity, profitability and transfer of Technologies in Kurnool District of Andhra Pradesh, India. International Journal of Current Microbiology and Applied Sciences. 2018;7(12):937-947.
8. Samui SK, Maitra S, Roy DK, Mandal AK. Saha D. Evaluation of frontline demonstration on groundnut. Journal of the Indian Society of Coastal Agricultural Research. 2000;18(2):180-183.
9. Sharma OP, Gopali JB, Yelshetty Suhas Bambawale OM, Garg DK, Bhosle BB. Pests of pigeonpea and their management, NCIPM, LBS Building, IARI Campus, New Delhi-110012, India; c2010. p. 4.
10. Shekhar S. Water and Nutrient Management in Rice under Alternate Wetting and Drying Irrigation Practice: Field and Modeling Studies. Doctoral dissertation, IIT Kharagpur; c2022. http://www.idr.iitkgp.ac.in/jspui/bitstream/123456789/12050/1/NB17320_Abstract.pdf. Accessed 10 August 2023
11. Shekhar S, Dubey A, Pohshna C. Estimation of irrigation scheduling for different cropping pattern at different growth stage of crop by using the CROPWAT model. International Journal of Current Microbiology and Applied S1ciences. 2018;7(8):3855-3862.
12. Shekhar S, Mailapalli DR, Raghuwanshi NS. Potassium transport through paddy soils under alternate wetting and drying irrigation practice. AGUFM, San Francisco, USA, GC51N–1161; c2019.
13. Shekhar S, Mailapalli DR, Raghuwanshi NS. Simulating nitrogen transport in paddy crop irrigated with alternate wetting and drying practice. Paddy and Water Environment. 2021b;19:499-513.
14. Shekhar S, Mailapalli DR, Raghuwanshi NS. Effect of alternate wetting and drying irrigation practice on rice crop growth and yield: A Lysimeter Study. ACS Agricultural Science & Technology. 2022;2(5):919-931.
15. Shekhar S, Mailapalli DR, Das BS, Mishra A, Raghuwanshi NS. Hydrus-1D for Simulating potassium transport in flooded paddy soils. Communications in Soil Science and Plant Analysis. 2021;52(22):1-18.
16. Shekhar S, Mailapalli DR, Das BS, Raghuwanshi NS. Modelling water flow through paddy soils under alternate wetting and drying irrigation practice. AGUFM, New Orleans, Louisiana, USA; c2017. p. H43Q-07.
17. Shekhar S, Mailapalli DR, Raghuwanshi NS, Das BS. Hydrus-1D model for simulating water flow through paddy soils under alternate wetting and drying irrigation practice. Paddy and Water Environment. 2020;18:73-85.
18. Shekhar S, Tamilarasan R, Mailapalli DR, Raghuwanshi NS. Estimation of evapotranspiration for paddy under alternate wetting and drying irrigation practice. Irrigation and Drainage. 2021a;70(2):195-206.
19. Shekhar S, Mailapalli DR, Raghuwanshi NS, Pohshna C. Hydrus-1D model for simulating phosphorus transport in paddy crop irrigated with alternate wetting and drying practice. Communications in Soil Science and Plant Analysis; c2023.
20. Singh N, Singh AK. Yield gap and economics of Cluster Frontline Demonstrations (CFLDs) on pulses under rain-fed condition of Bundelkhand in Uttar Pradesh. International Journal of Advanced Research in Biological Sciences. 2020;7(8):1-7.
21. Singh RP, Singh AK, Singh RP, Singh RK, Singh M. Impact of Cluster Frontline Demonstrations on Pulses Productivity and Profitability in Farmer's Field. Indian Journal of Extension Education. 2020B;56(1):134-141.
22. Singh A, Singh RP, Singh RK, Singh V, Singh AK. Technological options on yield gap analysis, economics, adoption and horizontal spread of pulses crops. International Journal of Current Microbiology and Applied Sciences 2020A;9(6):3165-3179.
23. Singh BB, Ramawatar Soni RL, Bugalia HL. Impact of front-line demonstration on yield and profitability of chickpea (*Cicer arietinum* Linn) in Banswara district of Rajasthan. Indian Journal of Extension Education. 2018;54(3):150-153.
24. Singh Mamta, Dwivedi AP, Yadav KS. Gaps in pulses production in Vindhya Pleatue Agroclimatic zone of Madhya Pradesh: An assessment through frontier technology. Indian Journal of Extension Education. 2019;55(1):39-42.
25. Vijaya Lakshmi D, Vijay Kumar P, Padma Veni C. Impact of cluster frontline demonstrations to transfer of technologies in pulse production under NFSM. Bulletin of Envir. Pharm. and Life Sci. 2017;6(1):418-421.