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Impact of front line demonstration of chickpea under rice fallow in Manipur

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Abstract
One hundred and twelve front line demonstrations of chickpea were conducted during 2013-14 to 2018-19 under rainfed rice fallow land conditions in six different districts viz. Imphal East, Imphal West, Thoubal, Churandpur, Chandel and Bishnupur of Manipur. The productivity and economic returns of chickpea in improved full package practices were calculated and compared with the corresponding farmer's practices (local check). Improved full package practices recorded higher yield as compared to farmer's practices. On an average the improved technology (12.5 q/ha) had higher yield to the tune of 3.6 q/ha than the farmer's practices (8.9 q/ha). In spite of yield advantages, the technology gap, and extension gap existed. The improved technology gave higher gross return (Rs 66,787 /ha**),** net return (Rs 42,393 /ha) with higher cost benefit ratio (2.7) as compared to farmer's practices. By adopting improved full package production technologies, productivity of chickpea can be increased which will further uplift in the socio-economic level of the rice based farming communities.

Keywords: Chickpea, front line demonstration, technology gap, extension gap, technology index

Introduction
Rice (*Oryza sativa* L.) is grown in about 40 million ha in India. About 11.65 million ha remains fallow during the *rabi* (post-rainy season) after harvest of *kharif* (rainy season) rice. Nearly 82% of the rainfed rice fallow lands are located in the states of Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, and West Bengal.

However, large areas in North Eastern Region (NER) of India remain fallow (approx. 2.50 million hectare) after the rainy season (June-October) rice (*Oryza sativa* L.) due to various reasons such as cultivation of long duration rice varieties, water logging and excessive moisture in *Tal* areas, lack of moisture at planting time of winter crops, lack of irrigation, non-availability of seeds of short duration varieties of *rabi* crops and other social economic problems like cattle and blue bulls etc. Available moisture holding capacity (1 m soil profile) for most of these rice fallow areas ranges from 150-200 mm. The soils in these areas are fully saturated during most of the rice growing season, thus the residual moisture left in the soil at the time of rice harvest offers a huge potential niche for chickpea (*Cicer arietinum* L.) cultivation profitably during *rabi* season using available improved pulse production and protection technologies.

Chickpea is an ideal pulse for rice fallow land intensification as it meets 80% of its N requirement from symbiotic nitrogen fixation and can fix up to 140 kg N from the air. It leaves substantial amount of N behind for subsequent rice crop, and adds organic matter to maintain and improve soil health, long term fertility and sustainability of the ecosystem. Chickpea is a hardy crop well adapted to stress environments. It is much more water efficient than wheat and mustard, thus it is a boon to the resource poor marginal farmers in the rainfed rice fallow land.

In 2009, Central Agricultural University, Imphal has under taken an All India Coordinated Research Project on Chickpea sponsored by Indian Institute of Pulses Research, Kanpur and has been started working on chickpea since 2011. Since the implementation of this project, chickpea varieties Gujarat Gram Chana 5 (GJG 0809) and BDNGK 798 were recommended for general cultivation. Under rainfed rice fallow condition chickpea varieties Subra, Rajas, JG 16 and JG 14 were also recommended. The Indian Council of Agricultural Research, has implemented a new fully funded programme in mid eighties i.e. Front Line Demonstrations for transfer of technology to farmers. Under this unique programme, AICRP on Chickpea, CAU, Imphal sub centre has conducted the front line demonstrations (FLD's) on chickpea in six districts of Manipur state.

Materials and Methods

Demonstration on full package technology of chickpea cultivation in rice fallow was conducted to assess its performance during *rabi* seasons, 2013-14 to 2018-19. One hundred and twelve (112) demonstrations covering fifty (50) ha area were conducted in Imphal East, Imphal West, Thoubal, Churachanpur, Chandel and Bishnupur districts of Manipur. Full package technology in rice fallow includes use of improved variety JG-14 at optimum seed rate of 80 kg/ha, seed sowing during 2nd fortnight of November to 1st week of December at 30 cm x 10 cm spacing (line sowing), seed priming (soaking of seed for 4-5 hours in water), seed treatment with Trichoderma (6 g/kg) or Thiram @ 2-3 g/kg seeds or carbendazim @ 1-2 g /kg seed and Rhizobium culture one packet (200 g)/10 kg seed , proper tillage, balance dose of fertilizer application (20 kg/ha N + 40-50 kg/ha P_2O_5) as basal, spray of 2% urea at flowering stage (70 DAS) and 10 days thereafter and IPM (including Indoxacarb 500 ml/ha with sex pheromone trap for *Helicoverpa armigera*). Sex pheromone traps were applied at 10-12 numbers/ha after 25-30 days after sowing. In each demonstration, control plot (farmers' practice) was kept. Under farmer's practice (control plots), farmers used old varieties with high seed rate and without *Rhizobium* inoculation, imbalanced use of fertilizer, improper weed and pod borer (*Helicoverpa armigera*) control. Progressive farmers were selected with the help of local village leaders/representatives of farmers' unions. The physical inputs, i.e. seed, bio-fertilizers, insecticides, pesticides and technical advice were provided to farmers from sowing to harvesting, including other location specific technologies. Farmers were keen in learning and farm families were involved in various farm operations; wherever, hired labour was required, farmers arranged at their own. Several trainings were organized to provide time to time technical guidance to farmers. The yield data were collected from both the demonstration and farmers' practice by random crop cutting method and analyzed by using simple statistical tools. For the study, technology gap, extension gap and the technology index were worked out (Samui *et al.* 2000) [9] and Dayanand *et al.* (2012) [12] as given below.

Technology gap = Potential yield - Demonstration yield

Extension gap = Demonstration yield - Farmers yield

$$\text{Technology index} = \frac{(\text{Potentail Yield} - \text{Demonstration yield})}{\text{Potential Yield}} \times 100$$

Results and Discussion

Improved and recommended full package and practices were compared with the on-going farmer's practices. A comparative picture between the existing practice and recommended practices were recorded and explained below.

Table 1: Comparison of improved full package of practices and farmers' practices

Particulars	Improved full package of practices	Farmers' practices	Gap
Variety	BG 372 (1993), KPG 59 (1992), Pant G 186 (1996), JG 16 (2000), GCP 105 (2000), HK 2 (2005), JG 14 (2008) and HK 4 (2012)	Local	Full Gap
Soil testing	Have been done in all locations	Not in practice	Full Gap
Seed rate	80 kg/ha desi chickpea	100-120 kg/ha	Partial Gap
Seed priming	Seed priming is done for better germination. Seeds to be soaked during night for 4-5 hr with natural water, drain out excess water and dry in shade before sowing	Nil	Full Gap
Seed treatment	Seed treatment with Trichoderma (6 g/kg) or Thiram @ 2-3 g/kg seeds or carbendazim @ 1-2 g /kg seed and Rhizobium culture one packet (200 g)/10 kg seed	Nil	Full Gap
Sowing method	Line sowing at 30 cm x 10 cm spacing	Broadcasting	Full Gap
Sowing time	2nd fortnight of November to 1st week of December	Mostly after 1st week of December	Partial Gap
Fertilizer dose	15-20 kg N, 40 kg P2O5, 20 kg S/ha		Partial Gap
Weed management	Pre-emergence spray of Pendimethalin @ 1.0-1.25 ai kg/ha. One hand weeding, if required	Hand weeding	Partial Gap
Urea spray	Spray of 2% urea at flowering stage (70 DAS) and 10 days thereafte	Nil	Full Gap
Plant protection	Pest monitoring: Installation of Pheromone traps 5-6 traps/ha (6 male moth catches/night). Trap crop of marigold Installation of bird perches – 30 – 40 /ha (Remove bird perches at the time of maturity) Spray of NSKE 5%/NPV 250 LE, Indoxacarb 500 ml/ha	No application of chemicals	Partial Gap

Yield gap analysis

The average yield of improved full package technologies (demonstrated plots) of chickpea was much higher than average yield of farmers' practices (control plots). Maximum seed yield of 12.14 q/ha was produced under demonstration plot during the year, 2015-16. The average productivity of the demonstration plot was 12.5 q/ha which was 3.6 q/ha higher than the average farmers' practices (40.2.2% yield gap over farmers' practices). It might be due to line sowing with optimum spacing, improved variety with optimum seed rate, *Rhizobium* inoculation, optimum fertilizer application, proper weed control and *Helicoverpa armigera* control by pheromone trap. The results indicated that the front line demonstrations had given a good impact over the farming community of Manipur as they were motivated by the new agricultural technologies applied in the FLD plots. Similar study was done by Dubey *et al.* (2010) [2], Meena (2010) [5], Poonia and Pithia (2011) [6] and Tiwari and Tripathi (2014) [11] on chickpea.

Table 2: Productivity, technology gap, extension gap and technology index of chickpea (2013-14 to 2018-19)

Year	Average yield (q/ha)		Potential yield (q/ha)	Percent increase (%)	Technology gap (kg/ha)	Extension gap (kg/ha)	Technology index (%)
	Demonstration	Farmers' practice					
2013-14	11.92	8.88	15	34.2	308.0	304.0	20.5
2014-15	12.345	9.19	15	34.3	265.5	315.5	17.7
2015-16	14.12	9.5	15	48.6	88.0	462.0	5.9
2016-17	12.05	8.12	15	48.4	295.0	393.0	19.7
2017-18	11.64	7.96	15	46.2	336.0	368.0	22.4
2018-19	12.8	9.88	15	29.6	220.0	292.0	14.7
Mean	12.5	8.9	15.0	29.6	220.0	292.0	14.7

Technology gap analysis

An average technology gap over six years was estimated at 252 kg/ha. This gap may be attributed to the dissimilarity in the soil fertility status, agricultural practices and local climate conditions. Similar finding was also reported by Singh *et al.* (2014) [10], Lalit *et al.* (2015) [4].

Table 3: Impact of improved full package practices under FLD on economics of chickpea (2013-14 to 2018-19)

Year	Total cost of cultivation (E/ha)		Gross return (E/ha)		Net return (E/ha)		B: C Ratio	
	Demonstration	Farmers' practice	Demonstration	Farmers' practice	Demonstration	Farmers' practice	Demonstration	Farmers' practice
2013-14	22850	20100	47680	35520	24830	15420	2.1	1.8
2014-15	23394	21500	49380	36760	25986	15260	2.1	1.7
2015-16	25030	23478	84720	57000	59690	33522	3.4	2.4
2016-17	25030	23478	72300	48720	47270	25242	2.9	2.1
2017-18	25030	23478	69840	47760	44810	24282	2.8	2.0
2018-19	25030	23478	76800	59280	51770	35802	3.1	2.5
Mean	24394	22585	66787	47507	42393	24921	2.7	2.1

Extension gap analysis

Additionally, the extension gap is defined as the difference between demonstration yield and farmers yield. Extension gap was estimated at 358.8 /ha. The differences on the observed technology gaps may be attributed to dissimilarity in the soil fertility status, agriculture practices and local climatic conditions. This finding is in corroboration with the findings of Singh *et al.* (2014) [10]. These productivity gaps can be reduced by enhancing farmers knowledge through more effective extension methods.

Technology index

Technology index is defined as the difference between potential yields and demonstration yields over potential yield in percent terms. It shows feasibility of the technology at farmer's field. The lower the value of technology index more is the feasibility (Hiremath and Nagaraju 2009) [3]. Higher technology index reflects the inadequacy of the technology for transferring to farmers and insufficient extension services to transfer of technology (Dayanand *et al*. 2012) [12]. On an average technology index was 16.6%. Similar findings were reported by Rajiv and Singh (2014) [8] and Singh *et al.* (2014) [10].

Economic analysis

The inputs and outputs prices of commodities prevailed during the study of demonstrations were taken for calculating cost of cultivation, gross return, net return and benefit: cost ratio. In Front Line Demonstrations higher expenditure of Rs 24, 394 /ha was incurred due to improved full package technologies over farmers' practices (Rs 22, 585/ ha). Use of improved full package technologies in FLD also increased net economic return. On an average maximum net return (Rs 42, 393 /ha) was recorded in FLD, which was Rs 17, 471 /ha higher than farmers' practice. The benefit cost ratio of FLD under improved full package technologies was recorded as 2.7 (2.1 under farmers' practice). This might be due to higher yields obtained in FLD under improved full package technologies compared to farmers practice. This finding is in corroboration with the findings of Raj *et al.* (2013) [7].

Conclusion

Based on the study, it can be concluded that huge gap exists in terms of technological knowledge at farmer's level, which could be one of the major reasons for low adoption and productivity of chickpea in the non-traditional chickpea growing rainfed rice fallow areas of North East India. Low price of produces, poor market facility, non-availability of quality seed and lack of effective extension agencies are the major constraints. Use of improved production technologies like use of heat and drought tolerant high yielding variety chickpea JG-14 with full package practices showed significant increase in grain yield and monetary benefits. Therefore, improved production technologies need to be popularized among the farmers for obtaining high yield and monetary benefit for sustaining livelihood of the resource poor rice farmers in Manipur.

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