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Impact of front line demonstration on performance of wheat (*Triticum aestivum* L.) in Muzaffarpur, Bihar

Mohammad Hashim[1], K. K. Singh[2] and Shiva Dhar[3]

ICAR- Indian Agricultural Research Institute, Regional Station Pusa Samastipur (848125)-Bihar
e-mail: hashim.agronomy@gmail.com

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Abstract

To bridge the yield gap between lab-to-land and to demonstrate production potential of improved technologies Front line demonstrations (FLDs) on wheat crop was conducted by ICAR- Indian Agricultural Research Institute, Regional Station Pusa, Samastipur Bihar during 2017-18 and 2018-19 in, different villages of Muzaffarpur, Bihar to know the yield gap, economic return, extent of farmer's satisfaction and constraints faced by the farmers. Front line demonstrations (FLDs) were conducted on 16 farmers fields each year to demonstrate the impact of improved agro-techniques on production and economic benefits. HD 2967 variety was demonstrated with the use of bio-fertilizers- *Azatobactor* and PSB and zero-tillage technology. It was revealed that the demonstrated technologies under FLDs resulted in an augmented mean yield of 4.73 t/ha having an edge of 18.22% higher yield over Local Check (farmer's practice) of 4.01 q/ha. Induction of demonstration technology recorded a mean technology gap (TG) of 1.79 t/ha, extension gap (EG) of 0.72 t/ha and technology index (TI) of 27.41 t/ha. The FLDs recorded an additional return of 18350.72 ₹/ha and 15221.25 ₹/ha with B: C ratio of 1.44 and 1.58 for demonstration and 0.78 and 1.06 for Local Check during 2017-18 and 2018-19, respectively. Unavailability of improved high yielding varieties of wheat in relation to climate change was found to be most confronting constraint. Therefore, the wheat productivity could be increased with the adoption of new wheat varieties and recommended improved package of practices and technologies.

Key words*:* Economics, Extension gap, FLDs, Technology gap, Technology index, Wheat[1]

Wheat (*Triticum aestivum*) is an important and the most widely cultivated crop of the world. Wheat is and strategic cereal crop for the majority of world's population. It is a staple food for majority of population of India. It provides more than 50% of the calories to the peoples and contributing substantially to the national food security. In India, wheat is being cultivated on an area of 31.4 M ha with 107.86 mt of production and 3.4 t/ha of average productivity (U.S. Department of Agriculture, 2020-21). Poor extension of improved agronomic practices is the major constraints of low productivity of wheat in India. Due to water logging and water stagnation resulting into late harvesting of preceding rice in most part of the Bihar wheat sowing gets delayed and goes up to last December to early January causing substantial yield losses. Moreover, poor agronomic practices such as higher seed rate, unsuitable varieties for the specific area, faulty nutrient management practices as well as weed control measures etc. are responsible for low productivity of wheat in

Corresponding author's email: hashimagronomy@gmail.com
[1]Scientist, SS &[2]Head, ICAR- Indian Agricultural Research Institute, Regional Station Pusa, Samastipur, Bihar-848125
[3]Principal Scientist, Division of Agronomy, ICAR-IARI New Delhi - 110012

India (Tiwari *et al*., 2014).

Declining factor productivity, nutrient deficiencies (macro and micro), soil salinity and alkalinity and wild animals are the major wheat production constraints in Bihar. Water logging in *Kharif* season is major problem in most part of the Bihar. Due to that sowing of the wheat was delayed as fields are not ready for timely sowing resulting into substantial yield loss. Due to late sowing crop suffers from low temperature at sowing which causes delayed germination resulting into slow growth and development and ultimately low yield obtained. Further, delayed sowing causes high thermal stress at reproductive stage of the crop resulted into enforced maturity. To overcome this problem zero-tillage sowing is the best option. Adoption of local and low yielding wheat varieties, higher seed rate, imbalance use of fertilizer, traditional methods of weed control, poor plant protection measures of crop from insect-pest and wild animals and unavailability of irrigation facilities are also important factors affecting negatively on wheat productivity in the district.

Due to above limiting factors farmers of Muzaffarpur district often fail to achieve the desired yield of new wheat varieties. There is no scope for area expansion in near future; additional production could be harvested by increasing the productivity per unit area (Nagarajan, 1997). The wheat productivity and net monetary returns could be increased by adopting recommended scientific and sustainable production practices along with using suitable high yielding varieties.

Keeping these in view, Frontline demonstrations (FLDs) of improved production technology on wheat were carried out in a systematic manner on farmer's field to identify the constraints related to wheat production, to enhance the productivity and economic returns, convincing the farmers for adoption of improved wheat production technologies and improving livelihood of farmers.

Materials and Methods

To demonstrate production potential and economic feasibility of improved technologies on farmer's field 16 Front line demonstrations (FLDs) on wheat crop were conducted by ICAR- Indian Agricultural Research Institute, Regional Station Pusa, Samastipur Bihar during 2017-18 and 2018-19 in, different villages (Lukinandlalpur, Mahmadpur, Rajapur Dihuli, Patsara, Vaidya Gaighat, Loma, Bakhri and Sakri Kothi Man) of Muzaffarpur districts of Bihar India. The climate of the demonstrated site is sub-tropical humid with hot summer and cold winter and received an average annual rainfall of 1250 mm of which 75–80% is received during June-September. The soil of the demonstration area was sandy loam with low to medium fertility status. The demonstrations conducted were HD2967 wheat varieties on the use of bio-fertilizers-*Azatobactor* and PSB and zero-tillage technology. A total of 16 farmers were selected by Cluster approach method for conducting FLDs. The seed and other inputs were distributed to the selected farmers to verify the viability and successful conduct of FLDs. The sowing was done by seed drill and zero tillage machines as per requirement of the demonstration during second week of November and harvested during first week of April. The bio-fertilizers such as *Azatobactor* and PSB were purchased from Agriculture College, Dholi Muzaffarpur, Bihar. The FLD aimed to figure out the yield gap between demonstration yield and control yield i.e. farmer's practice, technology gap between potential yield and demonstrated yield, extension gap between demonstrated yield and yield under existing practice and technology index. Relevant data was collected from each selected farmer as well as from non-practicing farmer for the comparison. From the collected data, mean values for yield, cost of cultivation, gross returns, net returns and B: C ratio was worked out. To know the overall impact over two years of assessment (2017-18 and 2018-19), data were analysed for cumulative mean and variance using F-test. By analysis of technology gap, extension gap and technology index (Samui *et al*., 2000) final conclusions were drawn.

$$\text{Yield gap (\%)} = \frac{\text{Demontration yield} - \text{Control yield}}{\text{Control yield}} \times 100$$

Technology gap (t/ha) = Potential yield-Demonstration yield

Extension gap (t/ha) = Demonstration yield-Farmers yield

$$\text{Technology index (\%)} = \frac{\text{Potential yield – Domonstartion yield}}{\text{Potential yield}} \times 100$$

Additional cost (₹) = Demonstration cost (₹/ha) - Farmers' practice cost (₹/ha)

Additional returns (₹) = Demonstration returns (₹/ha) - Farmers practice returns (/ha)

Effective gain (₹) =Additional returns (/ha) - Additional cost (₹/ha)

Incremental B: C ratio = Additional returns (₹/ha) ÷ Additional cost (₹/ha)

Results and Discussion

The technology gap between frontline demonstrations (FLDs) and existing farmer's practice (FP) of wheat crop in Muzaffarpur district of Bihar is presented in Table 1. Full gap was observed in the case of use of HYV's, sowing methods, seed treatment, spacing, fertilizer dose and weed management and partial gap was observed in the sowing time and water management. These technology gaps were the reason for low potential yield of the wheat crop in the region. Unavailability of seed of high yielding varieties in time and lack of awareness about improved production technologies were the main reasons for low yield. Farmers followed the broadcast method of sowing against the recommended line sowing and they applied higher seed rate than recommended.

Yield analysis

The yield data of wheat obtained during two year (2017-18 and 2018-19) of FLD presented in Table 2. There was a quantum leap in demonstration yield of wheat (4.65 t/ha and 4.81 t/ha) against the local check control (3.85 t/ha and 4.16 t/ha) by a margin of 0.80 t/ha and 0.65 t/ha with a percentage increment of 20.71% and 15.72% over the local check (farmer's practice) during 2017-18 and 2018-19, respectively. The result indicates mean yield (mean of 2 years) of 4.73 t/ha and 4.01 t/ha for demonstration and local check, respectively. It was also found that the demonstrated technologies under FLD resulted in an increase in yield by 18.22% over Local Check. The results found to be in close conformity with the findings of Kumar, *et al.* (2020) and Singh, S.B. (2017).

Technology gap

Results of the technology gap between the improved technologies demonstrated (FLDs) and farmer's practice (FP) exhibited a full gap in variety used in the FLDs wherein the demonstrated

Table 1. Comparison of technology gap between frontline demonstrations (FLDs) and existing farmer's practice (FP).

Sr. No.	Particulars	FLDs	Farmers practice (FP)	Technology Gap
1	Variety	HD 2967	Local	Full
2	Sowing time	15-25 November	Whole December	Partial
3	Seed rate	100 kg/ha	120-150 kg/ha	High seed rate
4	Sowing method	Line sowing by seed drill	Broadcasting	Full
5	Seed treatment	Seed treatment with Mancozeb and Carbendazin @ 2.0 g/kg seed	Shade drying for 7 hours without seed treatment	Full
6	Spacing	Line sowing maintaining row to row spacing of 20 cm.	No practice	Full
7	Fertilizer application	Fertilizer application @ 120 kg N, 60 kg P_2O_5 and 40 kg K_2O per hectare.	Imbalance fertilizer application without considering the recommended rate of application	Full
8	Use of bio-fertilizers	Use of *Azotobactor* and PSB	No use of *Azotobacor* and PSB	Full
9	Weed management	Pre-emergence application of Pendimethaline and post emergence application of metsulfuron methyl	No weed control measures	Full
10	Water management	4 irrigations	1 irrigation	Partial

technology resorted to the use of improved variety of wheat HD 2967 while farmer's practice adopted local variety or old variety. The farmers had sown the wheat seed till whole December as against 15-25 November in FLDs. Moreover, partial gap in seed rate used and the farmer's practice used higher seed rate of 120-150 kg/ha as against 100 kg/ha in FLDs. Full gap were observed in between demonstration fields and farmer's practice in sowing method, seed treatment, spacing, fertilizer management and weed management. In respect of water management partial gap between the demonstration fields and farmer's practice were noticed. The factual data on technology gap exhibited that the highest technological gap was registered during 2017-18 (1.87 t/ha) and lowest technology gap was recorded during 2018-19 (1.71 t/ha) while the overall mean technological gap was 1.79 t/ha. Overall from the study the lower technological gap was evident in 2018-19 where the highest yield was obtained and this indicate that the lower technological gap has an inverse relationship with crop yield as narrower gap resulted in more adoption of the demonstrated technology. During both the years of FLDs, it can be emphasized that there is a need to convince and educate the farmers to adoption of improved agricultural technologies to minimize this trend of wide extension gap. More adoption of recent production technologies with high yielding varieties will subsequently change this alarming trend and will help to improve the farmer's income. The variation in technology gap may be attributed to dissimilarity in the soil fertility status, agricultural practices and local climatic situation (Thakur *et al*., 2019).

Extension gap

Results of two years showed that the highest extension gap (0.80 t/ha) was recorded during 2017-18 whereas, during 2018-19 an extension gap of 0.65 t/ha was reported while the mean of extension gap during both the year was 0.72 t/ha. From the data it was observed that there were wide extension gap between the demonstrated technology and farmers practice. There is need to impart training and awareness programmes to the farmers for an early adoption of improved agricultural production technologies of wheat and varieties to narrow down the wide extension gap between the demonstrated technology and farmers practice. This new technology will eventually realize the farmers to discard the existing practice and adopt new technology. This finding is in corroboration with the findings of Bhupenchandra *et al.* (2021) and Kumar *et al.* (2020) which showcased the efficacy of good performance of technical interventions.

Technology Index

As far as the technology index is concerned, the highest technology index (28.64%) was recorded during 2017-18 whereas, during 2018-19 a technology index of 26.18% was reported while the mean of technology index during both the year was 27.41%. Technology index indicates the feasibility of the evolved technology at the farmer's field. Lower the value of technology index more is the feasibility of the technology. Our results were in conformity with the result of Dhaka *et al*. (2010) and Singh, S.B. (2017).

Economic analysis

The economic performance of demonstrated technologies over farmer's practices was computed based on prevailing prices of inputs and outputs costs (Table 3). It is revealed that higher mean cost of cultivation of 35500 ₹/ha of demonstrated technology was recorded in 2018-19 while it was 33100 ₹/ha in 2017-18 as against cost involved in local check of 38300 ₹/ha and 37600 ₹/ha during 2018-19 and 2017-18, respectively. The

Table 2. Yield performance of wheat under Front Line Demonstration.

Year	Yield (t/ha)		% increase over local check	Technology Gap (t/ha)	Extension Gap (t/ha)	Technology Index (%)
	Demonstration	Local Check				
2017-18	4.65	3.85	20.71	1.87	0.80	28.64
2018-19	4.81	4.16	15.72	1.71	0.65	26.18
Mean	4.73	4.01	18.22	1.79	0.72	27.41

Table 3. **Detailed comparative analysis of the demonstrated technology and farmers practice on economic performance of wheat under Front Line Demonstration**

Year of demonstration	Cost of cultivation (₹/ha)		Gross returns (₹/ha)		Net returns (₹/ha)		B: C ratio		Additional cost (₹/ha)	Additional return (₹/ha)	Effective gain (₹/ha)	Incremental B : C ratio
	Demonstration	Local check	Demonstration	Local check	Demonstration	Local check	Demonstration	Local check				
2017-18	33100.00	37600.00	80718.71	66867.98	47618.71	29267.98	1.44	0.78	4500.00	18350.72	13850.72	4.08
2018-19	35500.00	38300.00	91449.38	79028.13	55949.38	40728.13	1.58	1.06	2800.00	15221.25	12421.25	5.44

cost of cultivation was higher in local check and minimum in demonstrated technologies during both the years. The demonstration plots fetched higher mean gross returns of 91449.38 ₹/ha and 80718.71 ₹/ha and mean net returns 55949.38 ₹/ha and 47618.7 ₹/ha with higher benefit: cost ratio of 1.58 and 1.44 as compared to mean gross returns of 79028.13 ₹/ha and 66867.98 ₹/ha, mean net returns of 40728.13 ₹/ha and 29267.98 ₹/ha and benefit: cost ratio of 1.06 and 0.78 during 2018-19 and 2017-18, respectively of local check. This finding is in concordance with the findings of Kumar *et al*. (2020) and Singh, (2017).

In respect of the highest additional cost generated from demonstrated field was reported during 2017-18 (4500.00 ₹/ha) and lowest was observed in 2018-19 (2800.00 ₹/ha). Same trends were also found in respect to additional return and effective gains. The highest additional returns of 18350.72 ₹/ha and most effective monetary gain of 13850.72 ₹/ha during 2017-18 and lowest additional returns of 15221.25 ₹/ha and the effective monetary gain of 12421.25 ₹/ha was recorded in 2018-19. Finally, the highest incremental B: C ratio was observed in 2018-19 (5.44) and the lowest was recorded in 2017-18 (4.08).

Conclusion

Overall from the present study, it may be concluded that improved intervened technologies are more productive and remunerative compared with farmers' practices. The yield and economic returns in wheat crop increased substantially with the improved production technologies over farmers' practice. The yield under FLDs was better than the farmer practice and could be further improved by adopting recommended production technologies. The FLDs reduced the extension and technology gap to a great extent which will improve the farmers' financial problems as well as the living standard. So, there is need to disseminate the improved production technologies among the farmers with effective extension methods.

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