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Adoption & yield gap analysis of improved durum wheat technology of HI-8713 (Pusa Mangal)

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Abstract
Wheat is very important cereal crop in India. The Kathia goon which is also called as durum wheat, was the predominant wheat species grown in central India. Major constraint for lower productivity in the district is low adoption of improved technologies. On Farm Trials are the better means for increasing productivity of wheat crop in the district over the existing one. The present study was undertaken to find out the yield gap through On Farm Trial (OFT) on wheat crop. Krishi Vigyan Kendra, Lalitpur conducted 20 trials to assess the durum Wheat variety Pusa Mangal (HI 8713) in Bundelkhand region in 2018-19 to 2019-20 in adopted villages. Prevailing farmers' practices were treated as control for comparison with recommended practices. The per cent increase in yield over control was 66.6 and 20.0 during 2018-19 and 2019-20, respectively. The average technology gap and index were found to be 17.2 and 25.22 per cent.

Keywords: Wheat, production technology, economics, gap analysis, grain yields

Introduction
Wheat is very important cereal crop in India. The cultivation of wheat dates back to more than 5000 years back during the era of Indus valley civilization where the original species was T. durum popularly known as Indian wheat has now disappeared and replaced by present day species- *Triticum aestivum* or the common Bread Wheat, Triticum durum or the Macaroni wheat and the Triticum durum or the Emmer Wheat. Wheat is a staple crop in more than 40 countries and provides more than 60 % of calories in human diet, together with rice and maize. Globally, India is the second largest wheat producing country. Although India has very large wheat biodiversity where all three major wheat species namely, Triticum aestivum (bread wheat), T. durum (Macaroni or Kathia wheat) and T. durum (Khapli or emmer wheat) are grown commercially, more than 95 % wheat area falls under bread wheat. The durum wheat is supposed to be originated in Abyssinia centre of origin and was possibly introduced in India by the Arabian traders in the Western Ghat region. At present, it is reported to be grown on a very restricted scale in Gujarat, Maharashtra and there is no outbreak of disease and pest in it, so farmers should cultivate it more and more. Kathia wheat plants are thick, and its leaves are broad. This quality wheat is grown in Malwanchal, Saurashtra and Kathiawar of Gujarat, Kota of Rajasthan, Mewar and Udaipur, Bundelkhand region of U.P. & M.P. The farmers which have better irrigation facility, farmers are growing Kathia wheat *viz*., HI-8713, PDW 34, PDW 215, PDW 233, Raj 1555, WH 896, HI 8498, HI8381, GW 190, and GW 273 respectively. Whereas scarcity of water is farmers sowing Raj 9-30-1, Meghdoot, Vijya Yellow JU12, HD 4672, Sujata and HI 8627 varieties of Kathia wheat. Due to its high disease-resistant capacity, it has more potential for export.
Pusa Mangal (HI 8713), a high yielding durum wheat variety was released in 2013 by CVRC for high fertility, irrigated, timely sown conditions of Central Zone, which is the largest durum wheat producing zone in India. HI 8713 recorded a mean yield of 52.3 q/ha and showed good levels of field resistance to stem and leaf rusts over 3 years of testing in national trials Ambati, *et al.*, (2022) [3]. Farmers cultivating HI 8713 in Madhya Pradesh and Uttar Pradesh got bumper yields, i.e. 80-90 % increase compared to the check varieties. Pusa Mangal showed consistent higher yield in national wheat trials as check variety and had higher breeder seed indent in the recent past. Kathia wheat is a better option for the farmers. Karnal bunt disease, the most dangerous disease in wheat, is also not found in Kathia wheat. It is resistant to this disease. The biggest feature of this wheat is that it has a better protein content than normal

wheat, which is 12 to 13 percent, a substance called beta-carotene is found in it, which makes vitamin A, whereas in ordinary wheat it is not Get. In such a situation, it is beneficial for eye diseases. It indicates the potential of Indian durum wheat for export, and providing economic and nutritional security to the wheat farmers of central zone. High yield potential and quality make HI 8713 (Pusa Mangal) the best choice for inclusion in the nutrifarm scheme and an excellent raw material for the upcoming semolina-based pasta industries, generating additional employment opportunities, boosting farm economy and nutritional security in the country. Cultivation of Kathia wheat was often done under irrigated condition, due to which the yield was also uncertain and the species was long, disease prone, low fertilizer taking capacity and grown in limited area. Nature has provided immense potential for production of Kathia wheat to Central India. Therefore, present studies were carried out at farmer field as on farm trial (OFT). The on-farm trial conducted under the close supervision of scientists of the KVK. The basic objectives of OFT were to identify existing practices that may help to solve major problems of many farmers in defined areas and also create awareness/establishment of new management technologies available.

Methodology

Krishi Vigyan Kendra, Lalitpur conducted On Farm Trial (OFT) on varietal Assessment of Kathia Wheat (var HI 8713) in consecutive Rabi seasons i.e., 2018-19 to 2019-20. Soils of the demonstration sites were Light to Heavy Black soils, low in organic carbon (0.2-0.3%) low to medium in phosphorus (20-45 kg/ha.) and medium to high in potash (320-350 kg/ha.) The demonstrations were laid out on irrigated fields with Black gram - Wheat, Maize - Wheat and Green Gram - Wheat crop rotations which are most prevalent in the district. Each demonstration was of one-acre area and recommended package was provided to the farmers along with on and off campus trainings. The sowing was done during mid-November to last week of November and harvesting of crop was done during first fortnight of April. The demonstrations on farmer's fields were regularly monitored from sowing till harvesting by scientists of Krishi Vigyan Kendra, Lalitpur. In demonstration plots, critical input in the form of quality seed of high yielding variety was provided by KVK. The grain yield of demonstration crop was recorded & analysed. The economic parameters (Cost of cultivation, Gross Return, Net Return and B: C ratio) were worked out on the basis of prevailing market prices of inputs and minimum support prices of outputs. Farmers' feedback was observed with the help of personal interview and data on quantitative parameters were recorded and per cent increase yield were calculated by using following formula. The technology gap, extension gap, technology index during the study was calculated as suggested by Samui, *et al.*, (2000) [7].

1. Percent increase yield = Demonstrated yield - Farmers yield (q/ha) / Farmers yield (q/ha) x 100.
2. Extension Gap (q/ha) = Demonstrated yield (q/ha) - Farmers yield (q/ha).
3. Technology Gap (q/ha) = Potential Yield - Demonstrated yield (q/ha).
4. Technology Index (%) = Potential Yield - Demonstrated yield/ Potential Yield x 100.

Table 1: Comparison between improved practices and farmer's practices under varietal assessment of Kathia Wheat during 2018-19

Sr. No.	Particulars	Improved practices	Farmers practices
1	Variety	HI-8713	Local
2	Seed rate	100 kg	120 kg
3	Sowing method	Line sowing with seed drill	Broadcasting
4	Situation	irrigated	irrigated
5	Fertilizer dose	NPK 120:60:40	120 kg DAP
6	Seed treatment	Carbendazim @1.5-2 gm/kg seed	NA
7	Weed Management	Sulfosulfuran @ 25gram AI/ha	NA
8	Plant protection measures	Use of IPM Practices	No use of IPM

Result and Discussion

During the period of study, a total no. of 20 OFT was conducted at farmer's field. The data given in table 2 revealed that the average yield was 50.0 & 52.0 q/ha in demo plot as well as control plot was 30.0 & 40.0 q/ha during 2018-19 and 2019-20, respectively. The per cent increase in yield over control was 66.60 and 20.0 during 2018-19 and 2019-20, respectively. The similar findings were reported by Joshi *et al.*, 2014; Mishra *et al.*, 2018 [2]. The extension gap was highest (20.0 q/ha) in year 2018-19 and lowest was (12.0 q/ha) in year 2019-20. This gap may be due to the adoption of improved cultural practices in demonstrations which resulted into higher grain yield than the farmer's practices. Similar finding were noted by Jeengar *et al.*, 2006 [4], Singh *et al.*, 2007 [5] and Shukla *et al.*, 2021 [8]. Wide technology gap was observed highest (18.2 q/ha) in year 2018-19 and lowest was (16.2 q/ha) in year 2019-20. This gap may be due to the adoption of improved cultural practices in demonstrations which resulted into higher grain yield than the farmer's practices. The variation in the technology index i.e. lowest 23.75 percent during 2019-20 and highest 26.69 percent during 2018-19. The average technology index was 25.22 percent. More extension gap reveals that there is need to motivate the farmers through various means for adoption of improved production technologies to lowering down this wide extension gap. Use of latest technologies in terms of new released varieties will lead to minimize the extension gap. The technology gap during different years could be minimized by adopting new high yielding varieties and practices by the farmers and replacement of old practices. Similarly, the technology index for different years was in accordance with technology gap. Thus lower the values of technology index indicates more feasibility of the technology similar finding were noted by Jeengar *et al.*, 2006 [4]; Singh *et al.*, 2007 [5] and Mishra *et al.*, 2018 [2]. The results depicted from table 3: The Vegetative growth characters shows that plant height, No.tillers/plant and Spike length was found higher in demonstrated wheat variety compare to local check. It may be concluded that the reason of increase in height, No. tillers and spike length due to leading to increase photosynthetic activity (Ali *et al.*, 2011) [1]. Table-4 shows the economics performance of study, the gross income is Rs. 150000 and 90000; Net return was Rs. 122000, Rs. 64000 in during 2018-19 and 2019-20, respectively. The average benefit cost ratio of demonstration plot was 5.3 as compare to farmer practices 3.4 during 2018-19. Benefit cost ratio was of demonstration plot was 4.6 as compare to farmer practices 3.8 during 2019-20.

Table 2: Yield performance of durum wheat between demonstrations and farmer's practices

Year	Yield (q/ha)		Yield (QT/ha)		Per cent increase in yield over check	Technology Gap (q/ha)	Extension Gap (q/ha)	Technology Demo Index (%)
	No of trials	Area (Ha)	Demo	Check				
2018-19	10	4.0	50	30	66.6	18.2	20	26.69
2019-20	10	8.0	52	40	20.0	16.2	12	23.75
Average	20	12.0	51	35	43.3	17.2	16	25.22

Table 3: Vegetative growth characters of Durum wheat between Demonstrations and Farmer's practices

Plant height (cm)					
Sl. No.	**Particulars**	**30 DAS**	**60 DAS**	**90 DAS**	**120 DAS**
1	V1 (HI 8713)	26	55.3	94.6	110.3
	V2 (Local Kathia)	28.5	67.2	98.3	115.4
No. of Tillers/Plant					
2.	V1 (HI 8713)		11	28	30
	V2 (Local Kathia)		5	17	18
Spike length(Cm)					
3.	V1 (HI 8713)			20.8	
	V2 (Local Kathia)			17.2	

Table 4: Economics of Durum wheat crop between Demonstrations and Farmer's practices

Year	Cost (Rs./ha)		Gross Income (Rs./ha)		Net Income (Rs./ha)		BCR	
	Demo	Check	Demo	Check	Demo	Check	Demo	Check
2018-19	28000	26000	150000	90000	122000	64000	5.3	3.4
2019-20	28000	26000	130000	100000	102000	74000	4.6	3.8
Average	28000	26000	140000	145000	173000	101000	7.6	5.3

Conclusion

On the basis of the result obtained in present study it can be concluded that use of improved method of wheat cultivation can reduced the technology gap to a considerable extent thus leading to increase productivity of wheat in the district. Extension gap ranged between 20 to 12 q/ha which emphasise the need to educate the farmers through various training programmes, Skill development programmes etc. Technology index which shows the feasibility of the technology demonstrated has depicted good performance of the intervention. Thus, it may be revealed that the yield and profit in wheat crop considerably increased with the adoption of improved and nitric variety of wheat HI 8713 with scientific package of practices. On the basis of its average yield, it was found better as compared to the local checks. Shows superiority over checks by giving 43.3 % higher yield over durum wheat checks during 2018-19 and 2019-20, respectively. It indicates the potential of Indian durum wheat for export, and providing economic and nutritional security in Lalitpur district of Bundelkhand region.

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