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Assessment of productivity and profitability of vegetable pea (*Pisum sativum* L var, *hortense*) under front line demonstrations in eastern Uttar Pradesh

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Abstract
To determine the increase in productivity and profitability of the pea variety Kashi Mukti in farmers' fields, 58 front-line demonstrations on vegetable pea (*Pisum sativum* L var, *hortense*.) were done throughout the rabi seasons of 2019–20, 2020–21, and 2021–22. According to the data, the average yield of the mid-duration pea variety Kashi Mukti under FLDs was reported at 117.38, 80.4, and 98.0 q/ha in the years 2019–20, 20–21, and 20–22, respectively. This was 16.98, 25.62, and 18.07% greater than the old variety Arkel utilized by the farmers in those years. Additionally, during the study period, the average yield of the pea variety Kashi Mukti grown under FLDs was recorded at 98.59 q/ha, 20.22% greater than the yield of the Arkel an old planted by the farmers. Economic data showed that, in comparison to farmer's practice, where gross return (Rs. 1,41253/ha), net returns (Rs. 92027/ha), and benefit cost ratio (2.99) were calculated, demonstrations recorded an average of three years gross return (Rs. 172790/ha), net returns (Rs. 122497 /ha), and benefit cost ratio (3.60). As a result, pea production using enhanced technology is more productive and pod yield may rise by as much as 31.5%. The demonstrations also improved the relationship and confidence between farmers and scientists.

Keywords: Front-line demonstrations, average yield, improved variety, vegetable pea, economics

Introduction
The most significant and nutrient-dense vegetable farmed as a winter crop worldwide is the vegetable pea (*Pisum sativum* L., var. *hortense*). It is typically cultivated for its green pods, which are used in soup, canned goods, frozen food, and dehydrated food in addition to being consumed as a vegetable. It is a leguminous vegetable, which means that a large percentage of its digestible proteins include important amino acids, particularly lysine (Nawab *et al*., 2008) [4]. It is rich in vitamins A and C as well as minerals like calcium and phosphorus. Symbiotic bacteria called rhizobia are present in the root nodules of several legumes, including peas. These bacteria have the unusual ability to fix the nitrogen (N_2) from the air molecules to create ammonia (NH_3). Recently, there has been a lot of discussion on how vegetables may strengthen the national economy. With an anticipated 10859 thousand ha and production of 200445 thousand MT, India comes in second place to China in terms of both area and vegetable production (Anonymous, 2022) [1]. Vegetable productivity was calculated at 18 t/ha, and the average production of vegetables from 2016–17 to 2020–21 was 186893 thousand MT. (Table: 1) Pea output and area in India ranged from 551.4 thousand hectares (ha) to 5604.6 thousand metric tons (MT), with an average productivity of 11.12 MT/ha (Table 1 and Fig. I). Uttar Pradesh, Madhya Pradesh, Jharkhand, Punjab, Himachal Pradesh, West Bengal, Haryana, Bihar, Uttarakhand, Orissa, and Karnataka are the major pea-growing states (Anonymous, 2022) [1]. The Frontline demonstration is a useful method for spreading new technology more widely. This raised awareness and encouraged the adoption of better pea producing technology by farmers. The FLD recipient farmers also serve as a valuable informational resource and produce vegetable seeds for the wider distribution of high-yielding pea types for adjacent farms.

Table 1: Area (Thousand, MH), Production (Thousand MT) and Productivity (MT/ha) of vegetables and vegetable pea

Year	Area and production of vegetable in India			Area and production of vegetable pea in India			Area and production of vegetable pea in Uttar Pradesh		
	Area	Production	Productivity	Area	Production	Productivity	Area	Production	Productivity
2016-17	10238	178172	17.40	530	5345	10.08	220.73	2508.36	11.36
2017-18	10259	184394	17.97	540	5422	10.04	221.00	2511.38	11.36
2018-19	*10073*	*183170*	18.18	552	5562	10.08	223.04	2534.85	11.37
2019-20	10310	188284	18.26	*567*	*5846*	10.31	*229.73*	*2321.03*	10.10
2020-21	10859	200445	18.46	568	5848	10.30	233.24	2661.28	11.41
Average	10347.8	186893	18.054	551.4	5604.6	10.162	225.548	2507.38	11.12

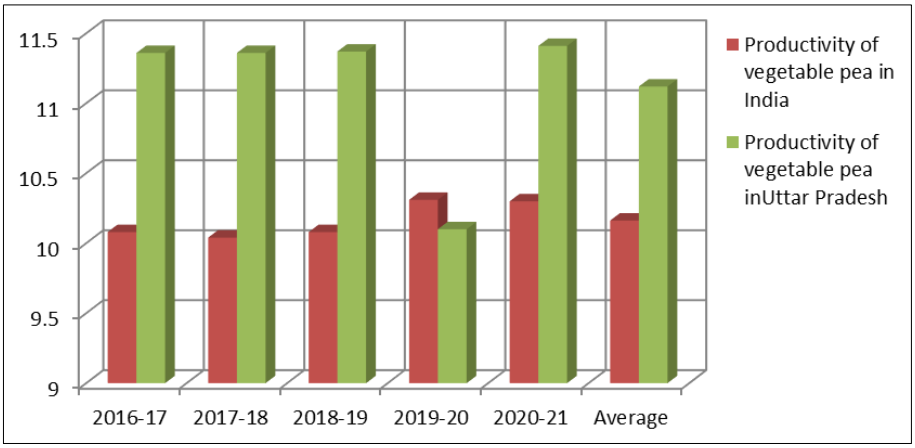

Fig 1: Productivity of vegetable pea in India and Uttar Pradesh

Materials and Methods

The ICAR-IIVR, Krishi Vigyan Kendra, Deoria, conducted front- line demonstrations on high yielding varieties and enhanced production techniques of vegetable pea throughout the Rabi seasons of 2019–20, 2020–21, and 2021–22. The Indian Institute of Vegetable Research in Varanasi provided the seeds of the vegetable pea variety Kashi Mukti, which were used to carry out 58 demonstrations on a total of 8.92 acres of farmer's land in the district. Prior to the start of the program each year, all chosen farmers received training in integrated crop management of peas on the farmer's field. The KVK also gave these chosen beneficiaries all the technical support they needed, including seed treatment, sowing of seeds, nutrient management, weed management, plant protection, harvesting, and post-harvest practices as outlined in Table 2. by the scientist of KVK. The farmer's field had sandy loam soil with a pH ranging from 7.5 to 8.5. These soils have low levels of organic matter, medium levels of accessible nitrogen and phosphorus, and high levels of available potassium. The outcomes in both cases were documented and compared in relation to several associated criteria. Data on green pod yield cost of production, gross and net returns, and benefit and cost ratio from both demonstrated plots and farmer's plot were collated and calculated to determine the economic feasibility of the exhibited technology in comparison to the framer's practice. The Net returns, Benefit: Cost ratio, and extension yield gap were determined using the formula proposed by (Samui *et al*, 2000) [7], which is as follows:

Benefit: Cost ratio = Gross Return/ Cost of Cultivation x 100
Net Return = Gross Return - Cost of Cultivation

Extension gap = Yield of Demonstrated Technology - Yield of Farmers Practice

Table 2: Agronomical practices used for mustard growing under FLDs and farmer practice

Practice	Demonstrated Technology	Farmers Practices
Farming situation	Irrigated and sandy loam	Irrigated and Sandy loam
Varieties	Kashi Mukti	Arkel
Seed treatment	Carbendazim 2.5 g/kg seed	No seed treatment
Date of sowing	25 October to 05 November	05 Nov. to 12 Nov.
Method of sowing	Line sowing with spacing of 22.5 X 10 Cm	Broadcasting
Seed Rate	100 kg/ha	80 kg/ha
Number of Irrigation	01	01
Fertilizers dose (kg/ha)	40 N, 60 P and 40 K	40 N, 60 P and 40 K
Use of Herbicide	Pendimethaline (30% EC) 1kg a.i./ha	Pendimethaline (30% EC) 1kg a.i./ha
Harvesting duration	Last December –Last January	Last December –Mid January

3. Results and Discussion

3.1 Crop yield

Kashi Mukti, a high yielding and powdery mildew resistant variety of vegetable pea with better packaging and procedures, was studied against farmer practices throughout the Rabi seasons 2019-20, 2020-21, and 2021-22 on selected farmer's fields in the Deoria district. The results of demonstrated technologies compared with farmers practices

are depicted in Fig. 2. In the years 2019-20, 20-21, and 2021-22, the average yield of HYV Kashi Mukti under FLDs was 117.38, 80.4, and 98.0 q/ha, respectively, which was 16.98, 25.62, and 18.07% greater than the old variety Arkel (Figure 3) utilized by farmers in the relevant years. Furthermore, during the six years of the study period, the average yield of the pea variety Kashi Mukti under FLDs was 98.59 q/ha, which was 20.22% greater than the old variety sown by the farmers. The findings are consistent with those of Mitnala *et al*. (2018) [3].

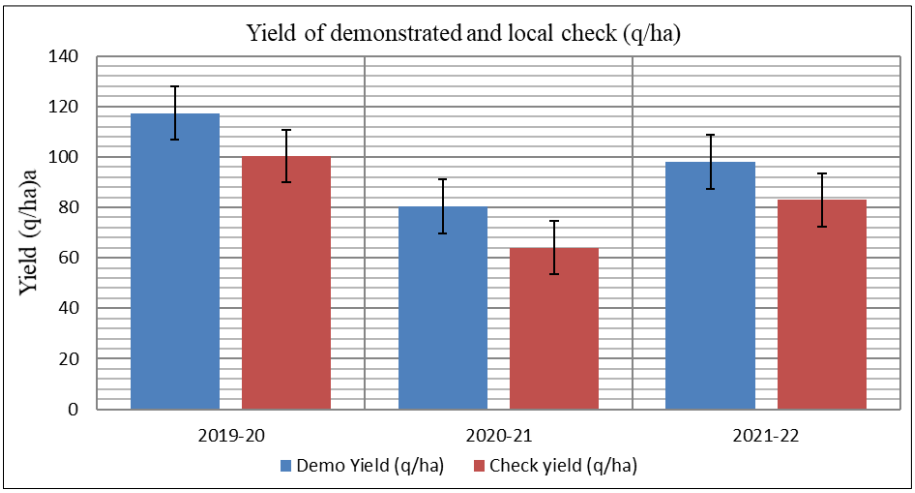

Fig 2: Yield performance of demonstrated and Farmer's practices (q/ha) during Rabi 2019-20, 2020-21 and 2021-22

The data in Fig 2&3 show that the yield of demonstration plots rose steadily. This definitely illustrates FLD's beneficial effect on conventional practices in this region. The results reveal that FLD has had a favorable impact on the farming community in the Deoria district with the introduction of recently released high-yielding varieties into the farmers' fields. These findings agreed with Mitnala *et al*., (2018) [3].

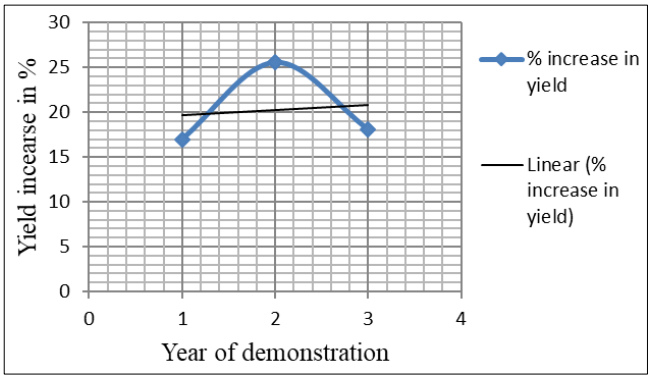

Fig 3: Yield increased over farmer's practice (q/ha) under front line demonstration during Rabi 2019-20, 2020-21 and 2021-22

production methods and high-yielding cultivars, the alarming trend of hurdle extension gap will be reversed. The aforementioned findings are comparable to those of Samui *et al*. (2000) [7] in groundnut.

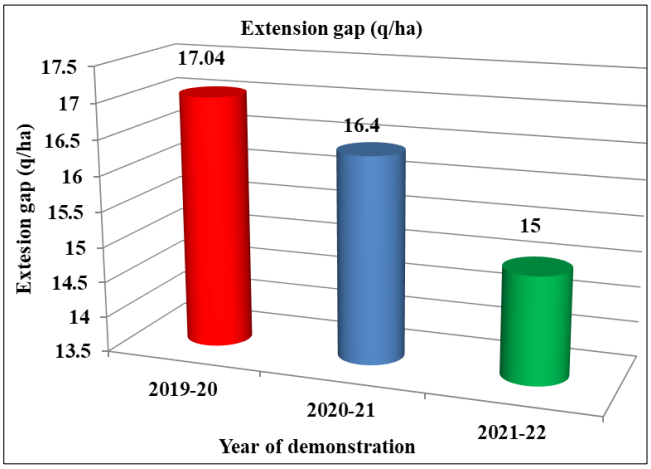

Fig 4: Extension gap (kg/ha) of vegetable pea under front line demonstration during Rabi 2019-20, 2020 21 and 2021-22

3.2 Extension gap

The extension gap ranged from 15 to 17.04 q/ha during the study period, highlighting the necessity to educate farmers through various means for the adoption of new technology in order to reverse this trend of broad extension gap. Mitnala *et al*. (2018) [3] discovered a garden pea expansion gap in the Vidarbh region. With increased utilization of cutting-edge

3.3 Economic analysis

According to the statistics in Table 3, the gross return of demonstrated varieties was higher than that of farmer's practice over the three-year study period from 2019-20 to 2021-22. The highest average gross return (Rs 1,86,070) was found in 2019-20, followed by Rs 17150, Rs. 1,60,800 in 2021-22 and 2020-21, respectively).

Table 3: Economics (Rs/ha) of demonstrated and farmer's practice during Rabi 2019-20 to 2021-22

Year	Economics of demonstration (Rs/ha)				Economics of farmer's practice (Rs/ha)			
	Gross cost	Gross Return	Net return	BCR	Gross cost	Gross Return	Net return	BCR
2019-20	38880.	186070	147190	4.79	38880.00	150510	111630	3.87
2020-21	48000	160800	112800	3.35	44800	128000	83200	2.85
2021-22	64000	171500	107500	2.67	64000	145250	81250	2.26
Average	50293	172790	122497	3.60	49227	141253	92027	2.99

Dwedi *et al*. (2014) [2] reported similar findings in chickpea, Singh *et al*. (2017) [6] and Singh *et al*. (2020) [5] in pulse crops. The largest net profit (186070) was obtained in the year 2019-20 under front line demonstration of vegetable pea, followed by Rs 107500 and Rs. 107500 in the years 2021-22 and 2020-21, respectively. In the year 2020-21, the front line demonstration of vegetable pea variety Kashi Mukti increased net profit by 35.57% above the old mustard variety. Figure 6 further shows that the shown technology boosted net profit by 31.85 to 35.57% over the old types over the three-year demonstration period. Undhad *et al*. (2019) [8] discovered a similar result in chick pea. The economics data indicated that an average of three years gross return (Rs 172790/ha), net returns (122497 Rs/ha), and benefit cost ratio (3.60) was recorded in demonstrations as compared to farmer's practice where, gross return (Rs 1,41253/ha), net returns (Rs 92027/ha) and benefit cost ratio (2.99) were calculated Figure:5. Thus, cultivation of pea with improved technology is more productive and pod yield might increase up to 31.5 per cent. The friendship and trust between farmers and scientists were also strengthened by these demonstrations.

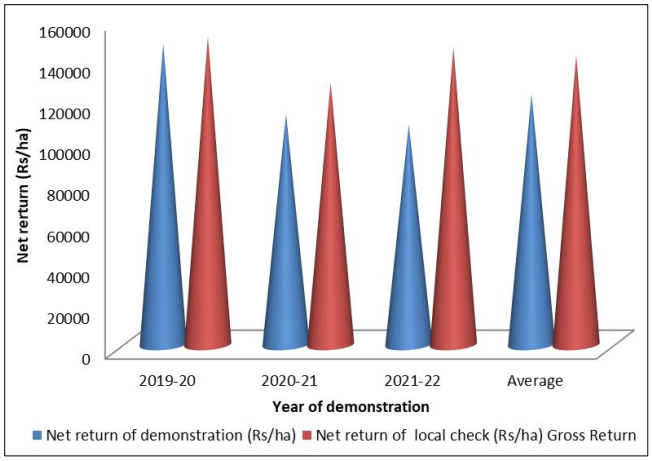

Fig 5: Net return (Rs/ha) of demonstration and farmer's practice practice under front line demonstration during Rabi 2019-20, 2020-21 and 2021-22

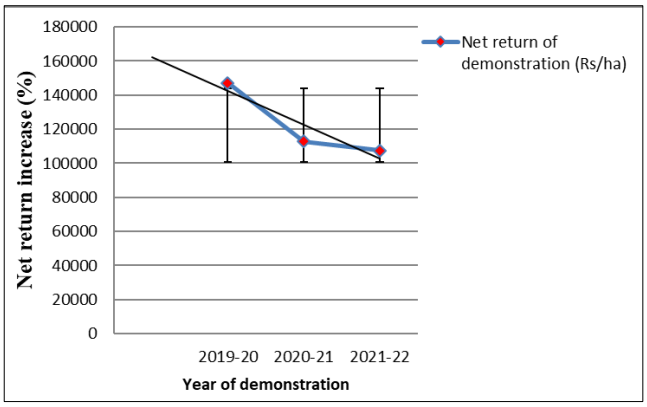

Fig 6: Percentage increased net return over farmer's practice practice under front line demonstration during Rabi 2019-20, 2020-21 and 2021-22

Conclusion

The findings of the study revealed that wide gap existed in demonstrated technology and local farmer's practices in vegetable pea due to the extension gap in Deoria district of Uttar Pradesh. By conducting front line demonstrations of proven technologies the yield of vegetable pea can be increased to a great extent. This will substantially increase the income as well as the livelihood of the farming community. There is need to adoptions multi pronged strategy that involves enhancing vegetable pea production through improved technologies in Deoria district. The study emphasized the needs to educate the farmers in adoption of improved technology to narrow the extension gaps through various technology transfer centers.

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