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Strengthening Seed System of Legumes: An Impact Assessment of Pulse Seed Hub Intervention on Seed Availability and Empowerment of Farmers

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ABSTRACT

Background: Legumes are an excellent source of high-quality plant protein, contributing significantly to the nutritional stability and overall health of the vast majority of Indians who follow a vegetarian diet based on cereals. Pulses are food legumes, grown primarily for their dry edible seeds, which are rich in protein, fibre and essential amino acids and minerals.

Methods: The study was conducted from 2017 to 2025 on the Pulse seed hub project entitled "Creation of seed hubs for increasing indigenous production of pulses in India", which was sanctioned to KVK, Banda in the year of 2016-17. A descriptive research design was employed in the present study. Data were collected and analysed from 49 selected farmers and from the seed hub to assess the impact of the pulse seed hub intervention on the socio-economic status of farmers and project viability.

Result: The results revealed that a total of 2553.41 quintals seed of major six legume crops was produced during 2017-18 to 2024-25 including 863.45 q, 954.66 q, 534.79 q, 174.26 q, 22.63 q and 3.62 q seed of chickpea, field pea, lentil, pigeon pea, green gram and black gram, respectively by KVK, Banda. These high-quality legume seeds covered around 4707.68 hectares, making up 2.62% of the Banda district's total cropped area used for pulse agriculture. Based on farmers' experience and desire in producing pulse seeds through buy-back agreements, seed production was undertaken on farmers' fields in various villages of Banda district. Over the years (2017-18 to 2024-25), KVK, Banda has made INR 2.01 crores in gross revenue from its pulses seed production program. KVK, Banda has made INR 0.80 crores in net profit. The 49 farmers received INR 1.21 crores through the seed hub repurchase program, including an additional INR 20.23 lakhs from seed production.

Key words: Cropping system, Legume, Protein, Quality seed, Seed hub, Seed production.

INTRODUCTION

The demand for legumes is growing at a rate of 2.8% annually due to the country's growing population, rising incomes and the fact that pulses are the main source of protein in the Indian diet (Chauhan *et al*., 2016). By 2026, 28 million tonnes of pulses are expected to be needed and by 2050, 39 million tonnes. The choice of pulses are secondary, mostly used in rainfed agriculture (Singh *et al*., 2021). Over 80.00 per cent of all pulses are grown in rainfed areas for 43.00 per cent of vegetarians (urban: 48%, rural: 41%), pulses, a historically important component of farming and eating patterns are the only rich source of protein (20-25%). With more than 12 major and minor pulses grown over 29-30 million, India is the world's largest producer (25% of global production), consumer (27% of global consumption) and importer (14%) of pulses (FAOSTAT, 2022). Madhya Pradesh (24%), Uttar Pradesh (16%), Maharashtra (14%), Rajasthan (6%), Andhra Pradesh (10%) and Karnataka (7%) are the country's top producers of pulses, accounting for roughly 77% of total production. Due to their high protein content (20-25%), capacity to fix atmospheric nitrogen (around 30-150 kg/ha) and reliability as a source of income and employment for small and marginal farmers, pulses have a leading place in global agriculture (Ali and Gupta, 2012). From 19.09 million hectares (1950-51) to 27.51 million hectares (2023-24) and 8.41 million tonnes (1950-51) to 24.25 million tonnes

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(2023-24), the area and production have grown significantly. The productivity increased from 377 kg/ha in 1966-1967 to 903 kg/ha in 2024-2025. Chickpeas account for 40% of total pulse output, followed by redgram (18-20%), greengram (11%), blackgram (10-12%), lentil (8-9%) and other pulses (20%). By 2030, 32 million tonnes of pulses would be required to feed the world's population, which is predicted to reach almost 1.68 billion by 2030 at a growth rate of 4.2% (NITI Aayog, 2025). The Bundelkhand region of Uttar Pradesh accounts for approximately 53% (1.21 M hectares) of the total state pulse area and contributed about 57% (1.35MT) of Uttar Pradesh's total pulse production. Additionally the region accounts 5.84% of the nation's total pulse production in 2019-20 (Sah *et al*., 2021). Only 45% of the 348259 hectares of gross cultivated land in Banda district, which is in the Bundelkhand region of Uttar Pradesh, are irrigated. The largest area covered by chickpeas (100.698 thousand ha), followed by lentils (43.49 thousand ha), pigeonpeas (24.79 thousand ha), fieldpeas (4.24 thousand ha) and blackgram (3.97 thousand ha). Despite having a sizable area devoted to these legumes crops, the district's productivity levels are still low due to a large number of factors. Approximately 25 to 30 lakh quintals of quality seed are needed annually to achieve a 30% seed replacement rate for improving the production and productivity of pulse crops, (IIPR Vision, 2030). However, a significant barrier to the region becoming self-sufficient in pulse production is the lack of high-quality seed, particularly for pulses (Chauhan, *et al.,* 2024).

The access to quality seed at the village level through seed companies, government institutions and farmers can significantly enhance seed availability in the region (Kumar *et al.,*2020). The Department of Agriculture and Farmers Welfare (DAC and FW) of the Government of India (GOI) approved a project called "Creation of Seed Hubs for Increasing Indigenous Production of Pulses in India" in 2016-17 with the dual goals of increasing rainfed farmers' income and achieving food and nutritional security. With a budget of INR 225.31 crores, it collaborates with 98 Krishi Vigyan Kendras (KVKs), 47 centres of All India Coordinated Research Projects (AICRPs) and eight Indian Council of Agricultural Research (ICAR) institutes. The aim of this project was to achieve the self-sufficiency in respect of quality seed of improved, high yielding and climate resilient at village level. Given this context, this study attempts to assess the impact of seed hub intervention on quality seed availability, nitrogen fixation, protein availability, water saving, technological and socio-economic impact on farming community of Banda district.

MATERIALS AND METHODS

The study was conducted at Krishi Vigyan Kendra, Banda under Banda University of Agriculture and Technology, Banda Uttar Pradesh during 2017-18 to 2024-25. After sanctioning of Pulse seed hub project by Government of India in the year of 2016-17 a one-time grant of INR 50 lakhs was given to the BUAT, Banda for project to build storage facilities and a plant for processing seeds. A revolving fund of INR 1.0 crore was also set aside to cover the costs of legume seed production, procurement and processing. Major six legume crops *i.e*. Pigeon peas, black and green gram in *Kharif*, chickpeas, field peas and lentils in *Rabi* season were the main subjects of the project. Two methods were used to produce seeds: The farmer's participatory seed production program and seed production at KVK farm. Farmers with well-equipped fields and sufficient irrigation infrastructure were chosen for the farmer's participatory seed production initiative. A descriptive research design was used in the present study. A total of 49 farmers were selected and their responses were analyzed. Data on seed production were also collected and analyzed from seed hub project. The legume yield data and per cent increase over the farmer's practice were calculated in the respective scheme. The economics of seed sale was calculated based on prevailing rates in Mandi, Minimum Support Price (MSP) and rate decided by university. The extension gap and technology gap were calculated by following the formulae as given below;

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

Extension gap (q/ha) =

Demonstration yield - Farmers yield (Check yield)

RESULTS AND DISCUSSION

Since the inception of seed hub project the quality seed of improved and high-yielding varieties of major six legume was produced. In chickpea varieties like JG-14, JG-12, JG-36, IPC-2006-77 and RVG-204 were produced. For Fieldpea, varieties such as IPFD-12-2, IPFD-10-12, IPFD-6-3 and 4-9 have been selected. Likewise, for Lentil (IPL-316, IPL-315, IPL-321 and KL-320), Green gram (IPM 2-3), Black gram (IPU 2-4 3) and Pigeon pea (IPA-203) varieties were introduced in the region. The main features, duration, potential yield, releasing year and developing Institute of various varieties are mentioned below in Table 1.

KVK Banda produced a total of 2553.41 q seed during the years 2017-18 to 2024-25 which includes 986.60 q Foundation Seed Category-I, 1369.60 q Foundation Seed Category-II and 197.20 q certified Seed. The yearly seed produced was 256.32 q, 344.13 q, 436 q, 276.2 q, 312.07 q, 479.22 q, 227.69 q and 221.78q seed during the years 2017-18, 2018-19, 2019-20, 2021-22, 2022-23, 2023-24 and 2024-25, respectively (Table 2). The seed produced under seed hub programme was demonstrated at farmer's field under different scheme/project and performance yield data were reported and analyzed by comparing with the yield of variety grown by the selected farmers (Table 3). The JG-14 and JG-36 varieties of chickpea were demonstrated under CFLD programme and performed well, gave higher yield as compared to local prevailing varieties. The wide acceptance of these varieties by farmers resulted in large horizontal expansion in the district.

All produced seed was sold to the farmers. KVK promoted the high-yielding, short-duration varieties of field pea, *viz*, IPFD 10-12, IPFD12-2 and IPFD 4-9 through its seed hub seed production programme. Among these varieties, IPFD12-2 was favored by farmers due to its short duration and higher yield and its widespread adoption has led to significant horizontal expansion in the district. Additionally, due to high market demand, farmers have shown a strong preference for IPFD10-12, a bold green-colored pea variety that can be used both as green pods for vegetables and as dry seeds for *namkeen* and vegetables as well. With an increase in irrigation facilities, fewer incidences of disease and pest in field pea gave the opportunity of assured production, which resulted in high demand as well as an increase in area and production of field pea in the study area.

Lentil is an important legume crop of the district as it is considered as best dry land pulse. The IPL-315 and IPL-321 varieties of lentil were identified for seed production

Table 1: Varieties of major six legume crops undertaken for quality seed production under the seed hub during 2017-18 to 2024-25 by KVK, Banda.

Crop	Variety	Release year	Institute	Yield (q/ha)	Duration (days)	Features
Chickpea	JG-14	2009	JNKVV, Jabalpur	19-20	113	Moderately resistant to pod borer, dry root and wilt,Heat-tolerant, Superior milling quality, Suitable for late sowing.
	JG-12	2014	JNKVV, Jabalpur	18-20	120	Moderately resistant to wilt, dry root rot.
	JG-36	2016	JNKVV, Jabalpur	18-20	110-120	Semi-spreading plant with dark brown seed. Tolerant to wilt.
	IPC-2006-77	2019	IIPR, Kanpur	20-21	112-115	Moderately resistant to wilt, dry root rot and stunt.
	RVG-204	2021	RVSKVV, Gwalior	20-21	112-115	Tolerant to wilt, amenable to machine harvesting, (Desi type variety).
Field pea	IPFD 10-12	2014	IIPR, Kanpur	21-22	110-115	Resistant for powdery mildew, dwarf type, green seeds.
	IPFD 4-9	2011	IIPR, Kanpur	20-25	120-129	PM-resistant and somewhat rust-resi stant, somewhat resilient to stem flies and pod borers.
	IPFD 6-3	2016	IIPR, Kanpur	22-25	110-120	Moderately resistant to powdery mildew and RUST
	IPFD 12-2	2017	IIPR, Kanpur	22-25	110	Round-seeded, White coloured, resistant to pod borer and powdery mildew, moderately resistant to aphids and leaf miner.
	IPFD-13-2	2020	IIPR, Kanpur	13-15	106-138	Resistant to powdery mildew and rust disease. Moderately resistant to pod borer.
Lentil	KL- 320	2009	CSAUAT, Kanpur	15-16	128	Bold-seeded, moderately resistant to wilt and rust.
	IPL -316	2013	IIPR, Kanpur	18-20	102-112	Wilt and rust resistance. Seeds are brown with red cotyledons and large (3.1 g/100 seed wt.).
	IPL- 321	2019	IIPR, Kanpur	9-10	130-135	Large seeded and Resistant to wilt.
	IPL-315	2019	IIPR, Kanpur	12-13	135-140	Resistant to rust and tolerant to wilt and large seeded.
Pigeon pea	IPA -203	2014	IIPR, Kanpur	18-20	249-255	Resistant to sterility mosaic disease, tolerant to Phytohthora blight and Fusarium wilt.
Green gram	IPM 2-3	2009	IIPR, Kanpur	12-15	65-70	Photo and thermo-insensitive with high resistance to Yellow Mosaic.
Black gram	IPU 2-4 3	2009	IIPR, Kanpur	10-11	70-72	Resistant to yellow mosaic virus and powdery mildew.

because of it short duration and bold size. However, in the case of Pigeon pea (IPA-203), Green gram (IPM 2-3) and Urdbean (IPU 2-43) varieties were preferred one. This strategic approach was aimed to ensure a reliable supply of high-quality seeds to meet out the regional demand. There is strong convergence between the seed hub programme and the CFLD and FLD programme of KVK. Seed produced through the seed hub was made available to farmers for conducting demonstrations by the KVK under different programmes like CFLDs, FLDs under NICRA, SCSP and Model Pulse village programme and sold to other KVK for the same purpose. The variety-wise yield data were collected and per cent increase over the check in different schemes was analyzed (Table 3). The yield increment was reported from 13.04% (IPF-4-9) to 37.00% (IPM 2-3), however, the average per cent yield increase over farmer's practice was reported to be 26.45% 17.43 %, 22.8%, 25.80%, 37.00% and 29.96% in chickpea, field pea, lentil, pigeon pea, green gram and black gram respectively. The maximum technology gap was reported for blackgram (9.88 q/ha) and green gram (10.25 q/ha); this wide gap was mainly due to intense/erratic rainfall during the year. In general, the *Kharif* pulses like green gram and blackgram are affected badly in the region; as a result, the yield as well as the area of these crops is variable/decreasing year after year. The results are in line with Abraham *et al*. (2024), where he found high technology and extension gap in Blackgram production in Gariyaband district.

The KVK farm is small and mostly unsuitable for legumes; therefore, the farmers' participatory approach became the main model of seed production. Out of 2,553.41 q, 2,096.46 q (82.10%) of seed is produced under the farmers' participatory seed production programme and the remaining 456.95 q. (17.90%) is produced at KVK, farm during the study period.

The details of monetary benefits to farmers as well as to KVK by the farmers participatory seed production programme are presented in Table 4. Over the course of eight years, the pulse seed production program generated a total gross income of INR 2,10,36,574, including INR 1,81,23,978 by farmers participatory seed production programme. The net profit realized by KVK amounted to INR 1,01,58,539 including Rs. 72,45,943 from farmer's participatory seed production. Furthermore, the farmers received INR 1,01,19,423 for their produced seed and an additional sum of INR 20,23,885 was allocated to farmers as remuneration for their participation in the seed production initiative. Farmers have expressed satisfaction with KVK's buy-back policy, as they received additional 20% remuneration for participation. This supplementary income from seed production enabled farmers to start alternative entrepreneurial ventures. Moreover, the profits generated from seed sales have been invested by Seed-Hub to improve the facilities needed for enhancing the quality of seed production processes.

It is evident from Table 5 that in the seed hub a total of 2553.41 qt seed of major six legume crops was produced during study period. This seed was sold to govt. agencies, direct selling to the farmers and also made available to farmers for demonstration under various schemes run by KVK like CFLD-pulses, NICRA, SCSP and Model Pulse village programme. However, 4707.68 ha area of 5369 farmers was estimated to be covered by quality seed produced under seed hub and replaces the old varieties used by farmers ultimately increase the yield of pulse crop

Table 2: Year-wise, crop-wise and variety-wise details of major legume seed production under seed hub of KVK, Banda (2017-18 to 2024-25)

Crop	Variety	Seed production (Qt.)								
		2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	Total
Chickpea	JG-14	77.99	178.31	232.90						863.45
	JG-12				11.60					
	JG-36				60.80	14.90	54.18	40.00		
	IPC-2006-77						80.55			
	RVG-204							43.49	68.73	
Field pea	IPFD 10-12	87.72								954.66
	IPF 4-9		92.10							
	IPF 6-3			46.00						
	IPFD 12-2			27.20	183.20	249.43	159.88			
	IPFD 13-2								109.13	
Lentil	KL-320	24.86								534.79
	IPL-316		26.66	42.20	20.60	47.74	175.17	136.60		
	IPL-321						9.44	7.60		
	IPL-315								43.92	
Pigeon pea	IPA-203	51.80	36.76	85.70						174.26
Green gram	IPM 2-3	10.33	10.30	02.00						22.63
Black gram	IPU 2-4 3	03.62								3.62
Total		256.32	344.13	436	276.2	312.07	479.22	227.69	221.78	2553.41

Table 3: Performance of major legume crop varieties (seed produced under the seed hub) demonstrated under various schemes/projects of KVK, Banda.

Crop	Variety	Year	Name of programme	Area (ha)	No. of demo	Check variety	Yield performance			Potential yield (q/ha)	Technology gap (q/ha)	Extension gap (q/ha)
							Check (q/ha)	Demo (q/ha)	Yield increase (%)			
Black gram	IPU-2-43	2017-18	CFLD-pulse	20	52	Local	3.17	4.12	29.96	14.0	9.88	0.96
Green gram	IPM 2-3	2019-20		25	63	HUM-6	3.45	4.75	37.00	15.0	10.25	1.3
Pigeon pea	IPA-203	2022-23		20	50	Bahar	12.4	15.6	25.80	20.0	4.4	3.2
Chickpea	JG-14	2018-19		20	50	Uday	15.78	20.0	26.74	25.0	5	7
	JG-36	202-23		30	75	Uday	16.5	19.82	20.12	23.0	3.18	3.32
	JG-12	2021-22		10	25	Uday	15.65	18.54	18.47	20.0	1.46	2.89
	JG-36	2024-25	SCSP	20	50	Uday	12.36	15.54	25.72	23.0	7.46	3.18
	JG-36	2024-25	NICRA	4	10	Uday	12.92	14.85	14.93	23.0	8.15	1.93
Average							14.64	17.75	21.2	22.8	5.05	3.664
Field pea	IPFD-10-12	2022-23	CFLD-pulse	20	50	Adarsh	16.10	19.30	19.87	22.0	2.7	3.2
	IPF-4 9	2020-21		10	25	Adarsh	16.10	18.20	13.04	19.0	0.8	2.1
	IPFD-12-2	2023-24	NICRA	6	15	Adarsh	14.42	17.22	19.39	25.0	7.78	2.8
Average							15.54	18.24	17.43	22.00	3.76	2.7
Lentil	KL-320	2017-18	CFLD-pulse	06	15	K-75	6.25	8.35	33.6	16	7.65	2.1
	IPL-316	2022-23		20	50	K-75	9.36	11.42	22.0	17	5.58	2.06
	IPL-316	2024-25	NICRA	4.8	12	K-75	8.85	10.68	18.00	17	6.32	1.83
	IPL-316	2024-25	Model pulse village	185	411	K-75	8.21	10.05	22.41	17	6.95	1.84
	IPL-316	2024-25	SCSP	32	80	K-75	7.35	9.87	34.28	17	7.13	2.52
Average							8.00	10.07	26.06	16.8	6.72	2.07

Table 4: Monetary benefits to farmers and KVK by farmers' participatory seed production programme during 2017-18 to 2024-25.

Year	Crop	Quantity produced by farmers	Monitory benefit to farmer						Economic benefit to KVK		
			Market rate (Rs.)	MSP/ KVK Procurement Rate (Rs.)	Seed cost @ MSP/ market Rate	20% additional amount (Rs.)	Total amount received by farmers	No. of farmers benefited	KVK selling price (Rs.)	Gross amount earned (Rs.)	Net profit to KVK
	1	2	3	4	5 (2*4)	6 (5*20/100)	7	8	9	10	11 (10-7)
2017-18	Chick pea	77.99	3450	4400	343156	68631	411787	8	8450	659016	247228
	Field pea	87.72	2900	2900	254388	50878	305266		8660	759655	454390
	Lentil	24.86	3275	4250	105655	21131	126786		10160	252578	125792
2018-19	Chickpea	178.31	4000	4620	823792	164758	988550	5	10260	1829461	840910
	Field pea	92.1	4216	4216	388294	77659	465953		7920	729432	263480
	Lentil	26.66	3550	4475	119304	23861	143165		10160	270866	127701
2019-20	Chickpea	232.9	4200	4875	1135388	227078	1362466	8	9594	2234443	871978
	Field pea	46	4453	4453	204838	40968	245806		9690	445740	199934
	Field pea	27.2	4453	4453	121122	24224	145346		9690	263568	118222
2020-21	Chickpea	11.6	4800	5100	59160	11832	70992	5	10422	120895	49903
	Chickpea	60.8	4800	5100	310080	62016	372096		10422	633658	261562
	Field pea	183.2	4867	4867	891634	178327	1069961		9390	1720248	650287
2021-22	Chickpea	14.9	5230	5230	77927	15585	93512	10	9305	138645	45132
	Field pea	249.43	5000	5000	1247150	249430	1496580		10315	2572870	1076290
	Lentil	47.74	5500	6325	301956	60391	362347		10195	486709	124363
2022-23	Chickpea	54.18	4870	5335	289050	57810	346860	8	8460	458363	111502
	Chickpea	80.55	4870	5335	429734	85947	515681		8880	715284	199603
	Field pea	159.88	4154	4154	664142	132828	796970		8670	1386160	589190
	Lentil	175.17	5752	6000	1051020	210204	1261224		11565	2025841	764617
2023-24	Chickpea	43.49	5650	5685	247241	49448	296689	2	9670	420548	123860
2024-25	Chickpea	68.73	5401	5650	388325	77665	465990	7	10703	735617	269627
	Field pea	109.13	3407	3407	371806	74361	446167		7318	798613	352446
	Lentil	43.92	5665	6700	294264	58853	353117		11487	504509	151392
Total		2096.46	-	-	10119426	2023885	12143311	49		20162720	8019410

Table 5: Area coverage and number of farmers benefited from seed production during 2017-18 to 2024-25.

Crops	Seed production (qt)	Horizontal expansion		Vertical expansion		Nitrogen Economy		Nutritional security as protein supplementation		Water saving (%)
		Area covered (ha)	No. of farmers	Average yield obtained (q/ha)	Average yield increase (%)	N fixation kg /ha	Total N fixation (kg)	Protein in grain g/100g	Total protein availability (q)	
Chickpea	863.45	1079.31	1155	17.75	26.45	40	43172.50	21	4023.13	56.00
Field pea	954.66	954.66	864	18.24	17.43	65	62052.90	25.1	4370.66	70.67
Lentil	534.79	1336.98	1675	10.07	26.06	40	53479.00	27.2	3662.04	65.33
Pigeon pea	174.26	1161.73	1386	15.6	25.80	100	116173.33	22	3987.06	87.81
Green gram	22.63	150.87	234	4.75	37	60	9052.00	25	179.16	91.56
Black gram	3.62	24.13	55	4.12	29.95	30	724.00	24	23.86	94.38
Total	2553.41	4707.68	5369				284653.73		16245.91	77.63

(17.43% to 37.00%). In addition to seed production and extensive coverage under the seed hub program, pulse production in the region has contributed to nitrogen supplementation and protein availability. The incorporation of legumes into agricultural systems offers economically viable and environmentally friendly methods to decrease external inputs and improve soil nutrient content (Kebede, 2020). As per the pulses nitrogen fixation capacity references, pulses grown on 4707.68 hectares of land could have fixed a total of 284.65 tonne of nitrogen. This fixed atmospheric nitrogen was made available for subsequent crops, assisting farmers in reducing their chemical fertilizer application. The burden of Chemical fertilizer (urea) has been reduced by 618.81 tons. Pulses contain approximately 21-25% protein (Tiwari and Singh, 2012) and serve as an affordable protein source for a significant portion of the rural population globally. With a total production of 2553.41 quintals of seed in the region, it is estimated that 16245.91 qt of protein has been made available for the population from the produce of seed sown. It is well established fact that the cereals need more irrigation water as compared to pulses and Global water consumption by cereals is reported to be about 60% as against 4% in grain legumes. The estimation of water saving was calculated w.r.t. Wheat which require 30-45 cm water as compared with *Rabi* pulsed which required only 10-21 cm water in Rabi season. Whereas in *Kharif* the estimation of water saving was calculated w.r.t. Paddy which required 100-220 cm water as compared with *Kharif* pulses which required only 6-23 cm of water (Kumar *et al.,* 2018). The easy availability of quality seed encouraged farmers to adopt pulse cultivation, resulting in average water saving of 77.63% compared to the conventional paddy-wheat cropping system.

Considering the challenges faced in a rainfed region, including the prevalence/use of long-duration varieties that are more subjected to exposed dry spell and susceptible to diseases and insect infestations, KVK has concentrated its efforts on promoting high-yielding, short-duration and disease-resistant legume crop varieties which has empowered farmers to achieve enhanced yields while simultaneously reducing their cultivation costs (Nain *et al.,* 2015).

CONCLUSION

KVK Banda has successfully produced high-quality legume seeds, yielding 2553.41quintals over eight years (2018-2025). Popular crop varieties like IPFD10-12, IPFD12-2 of field peas, IPL315 and IPL-321 of lentils and JG-14 and JG-36 of chickpeas were widely adopted by farmers with scientific cultivation techniques. The buy-back policy has been found quite satisfactory in the study area. Seed hub projects demonstrated a positive impact on enhancing quality seed production and increasing the availability of high-yielding, location-specific seeds. The increased quality seed availability through Seed Hub and the scientific support of KVK contributed to improved input use efficiency, leading to higher yields and sustainable agricultural

practices. The seed hub not only ensures the quality legume seed production but also increases the protein availability to the population, nitrogen fixation and water use efficiency of the cropping system. Additionally, it can also create employment opportunities and improve the socio-economic status of farmers through seed production.

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Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

Informed consent was obtained from BUAT, Banda and farmers before collection of data and conducting the interviews.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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