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Impact of DBT Biotech *Kisan* Hub Project on Production, Productivity and Socio Economic Variables of Pulse and Oilseeds Growing Farmers of *Rayalaseema* Region of Andhra Pradesh

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ABSTRACT: The present study was conducted in *Krishi Vigyan Kendra* (KVK), Banavasi in Kurnool district and KVK, Kalyandurg in Ananthapuramu district cluster adopted villages of *Rayalaseema* region in Andhra Pradesh state under Biotech KISAN project. Groundnut, pigeonpea and chickpea are important rainfed oilseed and pulse crops in these districts but the yields are not up to expectations due to adoption of old varieties, raifned farming, pests and disease incidence. Major challenges are to enhance the production, productivity, acreage of pulses and oilseeds by introducing latest Integrated Crop Management practices to achieve self sufficiency. This was tested on small scale for 2 years with the help of On-farm technology demonstrations with 130 locations in Ananthapuramu district and in 160 locations in Kurnool district. The on farm technology demonstrations on oils eed crop like groundnut and pulse like pigeonpea and chickpea crops were conducted by both KVKs in their cluster adopted villages from 2018-19 to 2019-20. The data from the study like cost of cultivation, production, productivity, gross returns and net returns, socio economic impact were collected as per schedule and analyzed. The results from the study revealed that average yield recorded was 784.3 kg/ha, 740.9 kg/ha and 875.9 kg/ha in rainfed groundnut, pigeonpea and chickpea crops respectively in demonstration plot in Ananthapuramu district compared to control plot yields 572.1 kg/ha, 566.3 kg/ha and 666.5 kg/ha, with plugged extension gap of 212.2 kg/ha, 174.6 kg/ha and 209.3 kg/ha in these crops respectively with 37.09, 30.83 and 31.41 percent of average yield improvement over control plot respectively. In case of Kurnool district the average yield recorded was 2900 kg/ha, 1239 kg/ha and 1640 kg/ha in rainfed groundnut, pigeonpea and chickpea crops respectively in demonstration plot compared to control plot yields 2505 kg/ha, 1003 kg/ha and 1352 kg/ha, with plugged extension gap of 395 kg/ha, 236 kg/ha and 287 kg/ha in these crops respectively with 15.35, 23.52 and 21.29 percent of average yield improvement over control plot respectively. Significance of yield difference was found at $p < 0.01$ in all the above crops except *rabi* chickpea which was found to be significant at $p<0.05$ in Ananthapuramu district. Technology gap enumerated from the study ranged from 253.2 kh/ha, 134.1 kg/ha and 424.09 kg/ha in ranfed groundnut, pigeonpea and chickpea respectively in Ananthapuramu district, with the technology index of 24.40, 15.33 and 32.62 percent. In case of Kurnool district technology gap was found to be -200.81 kg/ha, -289.64 kg/ha and 59.51 kg/ha in rainfed groundnut, pigeonpea and chickpea crops respectively with technology index -7.4, -30.49 and 3.50 percent respectively. Besides this, the demonstrated plots gave higher gross return, net return with higher benefit cost ratio when compared to farmer's practice.

Keywords: On farm demonstrations, production, productivity, extension gap, technology gap, technology index, socio economic impact, correlation, frequency, percentage.

INTRODUCTION

Pulses occupy a unique place in India and are considered as "the poor man's meat" because of their protein profile and are consumed equally by India's rich and poor as it is one of the less expensive sources of protein (Mohanty and Satyasai 2015). India has the largest demand and market for the pulses and reported that the pulse crops are grown only on 25.26 million hectare area and produces only 16.47 million tonnes with an average productivity of 652 kg/ha. In Andhra Pradesh (13 districts) the area under pulses is 12,53,000 hectares in 2020-21 which accounted for 29 per cent in total food crops area. The major pulses grown in the state are pigeonpea, chickpea, blackgram and greengram. India is one of the major oilseeds grower and importer of edible oils. Even though self-sufficiency in oilseeds attained through "Yellow Revolution" during early 1990's bout could not be

sustained leading to one of the largest importers of vegetable oils today. In Andhra Pradesh, 9 oilseed crops are grown over an area of about 24.70 lakh ha with an annual production of 30.64 lakh tones (2017-18). However, the state average yield of oilseeds is less than the national average.

Andhra Pradesh is one of the major contributors for pulses in India. Pulses occupied 14.68 per cent of the total cropped area in the state during 2010-11. The major pulses grown in the state are pigeonpea, chickpea, greengram and blackgram. Out of 21.31 lakh hectares of total area of pulses in the state during 2010-2011,

Pulses and oilseeds are generally grown under rainfed, highly unstable and complex production environments, substantial variability in soil and environmental factors, high year to year output variability, and variation in soil moisture. It is generally agreed by the researchers that very little biodiversity exists in case of pulses to develop new varieties with desirable characteristics like high yield and resistance to biotic and abiotic stresses. But even with available varieties and technologies pulses and oilseeds production can be doubled but the available technology is not reaching to the farmers. One is required to emphasize the need for identifying and quantifying level of adoption and its determinants across agro-climatic regions. In addition climate change will surely have an adverse effect on productivity of pulses and oilseeds on account of reduction in total crop cycle duration. Among so many, the most important way to increase production in the short-run is to reduce yield gaps between research station, on-farm demonstration and farmer's fields.

The Biotech- Krishi Innovation Scientific Application network (KISAN) Project sanctioned for Acharya N G Ranga Agricultural University is mainly aimed to bridge the yield gaps for pulse and oilseed producers through technological interventions especially location specific. The project objectives are expected to fulfill the technology requirement to improve productivity, reduce the cost of cultivation, create job opportunities, development of entrepreneurs for better livelihood to small and marginal farmers.

METHODOLOGY

As a part of the project, conducted baseline survey in the project areas i.e., in the districts of Anantapuramu and Kurnool to know the present yield status of the identified crops and also to identify technological, socio economic constraints of the farmers in those districts. Survey was conducted through structured interview schedule from the 120 selected farmers in both the districts (60 from each district) in the months of June and July, 2018. As per the project objective, the villages having low yields and poor and marginal farmers with poor technology implementers were selected. Accordingly, villages were selected from mandals having low productivity.

i. Ananthapuramu District: Selected 13 villages in 4 different mandals based on low yields recorded in the district.

ii. Kurnool District: Selected 25 villages from 13 mandals having low productivity.

In Kurnool and Antanpuramu districts on farm technology demonstrations were conducted to bridge the yield gaps at farmer level, village level and mandal level in groundnut, chickpea and pigeonpea crops. The demonstrations were conducted in 100 locations each in Kurnool and Ananthapuramu districts on groundnut, pigeonpea and chickpea crops with latest technologies like supply of improved seed, seed treatment chemicals, critical inputs like gypsum in groundnut, sticky traps, pheromone traps, lures, neem oil, bio fertilizers, bio fungicides, dryspell management through foliar spraying of fertilizers like 13-0-45, DAP, hydrogel, micro nutrients and need based chemicals. Post evaluation with structured interview schedule was administered and obtained the data from the farmers. Later analysis was carried out using statistical tools like averages, frequencies, percentages, correlation & 't' test to assess the impact in terms of increase in production, productivity, cost economics, significance of yields, technology spread, factors affecting knowledge & adoption and in terms of socio economic development with respect to perceived attributes of innovation, mass media usage, innovativeness, knowledge, adoption, contact with extension agencies, social contacts, social organization, social work and risk orientation.

Operationalization of various parameters:

Technology gap = Potential yield - Demonstration yield

Extension gap = Demonstration yield - Yield under existing practice

Technology index = Potential yield - Demonstration yield × 100 /Potential yield

Impact of yield = Yield of demonstration plot Yield of control plot/Yield of control plot X 100

Impact on adoption (% change) = No. of adopters after demonstration - No. of adopters before demonstration /No. of adopters before demonstration × 100

Impact on horizontal Spread (% change) = After area (ha) - Before area (ha)/ Before area × 100

RESULTS AND DISCUSSION

The data were pooled on different parameters and the results obtained were discussed accordingly. The empirical results were discussed under the sub-sections including on-farm technology demonstrations conducted in *Rayalaseema* region, perceived attributes of innovation, impact of demonstrations on production and productivity, cost economics of demonstrations, significant yield difference analysis, impact of the project on various socio economic variables like mass media usage, social organization, social participation, contact with extension agencies, risk orientation, innovativeness, knowledge and adoption, correlation

between socio economic variables and knowledge and adoption and technology spread.

During the years 2018-19 and 2019-20 a total of 130 demonstrations on groundnut, pigeonpea and chickpea were conducted in Ananthapuramu district in 20 mandals. Similarly 160 demonstrations on same crops were conducted in Kurnool district covering 30 mandals both in rainfed and irrigated conditions. Mandal wise results obtained were subjected to statistical analysis and results were presented.

A critical analysis of perceived attributes of innovation by farmers revealed that 86.67 & 93.33 percent of the farmers expressed that the technologies transferred through the project has got more relative advantage over farmers practice in Ananthapuramu and Kurnool districts respectively. Similarly 90.0 & 93.33 percent farmers expressed compatibility, 80.0 & 85.0 percent farmers expressed trialability and 76.67 & 81.67 percent farmers expressed observability in technologies transferred by KISAN hub in Ananthapuramu and Kurnool districts respectively. Similarly merely 13.3 & 16.67 percent farmers expressed that there was complexity in adoption of innovative technologies transferred through the project in Ananhrapuramu and Kurnool districts respectively.

The results from the above table clearly indicates that average yield recorded was 784.3 kg/ha, 740.9 kg/ha and 875.9 kg/ha in rainfed groundnut, pigeonpea and chickpea crops respectively in demonstration plots in Ananthapuramu district compared to control plot yields 572.1 kg/ha, 566.3 kg/ha and 666.5 kg/ha, with plugged extension gap of 212.2 kg/ha, 174.6 kg/ha and 209.3 kg/ha in these crops respectively with 37.09, 30.83 and 31.41 percent of average yield improvement over control plot respectively. In case of Kurnool district the average yield recorded was 2900 kg/ha, 1239 kg/ha and 1640 kg/ha in rainfed groundnut, pigeonpea and chickpea crops respectively in demonstration plot compared to control plot yields 2505 kg/ha, 1003 kg/ha and 1352 kg/ha, with plugged extension gap of 395 kg/ha, 236 kg/ha and 287 kg/ha in these crops respectively with 15.35, 23.52 and 21.29 percent of average yield improvement over control plot respectively.

Table 1: On farm technology demonstrations conducted.

Sr. No.	Crop	Demonstrations conducted (ha)				Total (ha.)
		Ananthapuramu dt.		Kurnool dt.		
		2018-19	2019-20	2018-19	2019-20	
Rainfed situation						
1	Groundnut	20	20	20	30	90
2	Pigeonpea	10	10	10	20	50
3	Chickpea	20	20	20	30	90
Irrigated situation						
1	Groundnut	10	20	-	-	30
2	Pigeonpea	-	-	10	20	30
	Total	**60**	**70**	**60**	**100**	**290**

Table 2: Perceived attributes of innovation (n=60).

Sr. No.	Perceive attributes	Anantapuramu Dt.		Kurnool Dt.	
		Frequency	%	Frequency	%
1.	Relative advantage	52	86.67	56	93.33
2.	Complexity	8	13.33	10	16.67
3.	Compatibility	54	90.00	56	93.33
4.	Trialability	48	80.00	51	85.00
5.	Observability	46	76.67	49	81.67

Table 3: Impact on production and productivity of oilseeds and pulses.

Crop	Yields 2018-19 (kg/ha.)		Yields 2019-20 (kg/ha)		Avg. Yield (kg/ha)		Potential yield	% increase in yield over control	Extension gap (kg/ha)	Technology gap (kg/ha)	Technology index (%)
	D	C	D	C	D	C					
Ananthapuramu dt. – Rianfed -situation											
Groundnut	642.6	434.5	926.0	709.8	784.30	572.10	1037.5	37.09	212.2	253.2	24.40
Pigeonpea	738.4	530.4	743.5	601.7	740.90	566.30	875.0	30.83	174.6	134.1	15.33
Chickpea	811.2	548.7	940.8	784.6	875.91	666.57	1300.0	31.41	209.34	424.09	32.62
Ananthapuramu dt. – Irrigated situation											
Groundnut	1662.6	1486.5	1923.8	1624.2	1793.69	1555.03	1940.0	15.35	238.66	146.31	7.54
Kurnool dt. – Rainfed situations											
Groundnut	2800.71	2605.7	3001.05	2404.9	2900.81	2505.75	2700.0	15.77	395.06	-200.81	-7.44
Pigeonpea	1138.27	898.53	1341.28	1108.4	1239.64	1003.62	950.0	23.52	236.02	-289.64	-30.49
Chickpea	1561.3	1255.0	1720.4	1450.0	1640.49	1352.57	1700.0	21.29	287.92	59.51	3.50
Kurnool dt. – Irrigated situations											
Pegeonpea	1822	1295	1945	1472	1883.33	1379.38	1366.0	36.53	503.95	-517.33	-37.87

D=Demonstration C=Control

Enhancement of pulses yields in demonstration plot was also reported by Raj *et al.,* (2013) in his study on Impact of Front Line Demonstrations (FLD) on the Yield of Pulses conducted in Gujarath state. These results were also in line with the results of Singh Dharminder *et al.,* (2017) who conducted their study on Impact analysis of frontline demonstrations on pulses in Punjab. Reduction in extension gap, improvement in production, productivity and net returns in pulses was also reported by Singh *et al.* (2019) in their study on frontline demonstration: an effective tool for increasing productivity of pulses in Gorakhpur district of Uttar Pradesh. Improvement in yield due to adoption of latest varieties of pulses and oilseeds was also reported by Dwivedi *et al.,* (2013) in their study on varietal performance of oilseeds and pulses at farmers field in Vindhyan zone under rainfed condition. Similar results were also reported by Singh *et al.,* (2014), Singh *et al.,* (2019), Jagmohan Singh *et al.,* (2017) and Subbaiah and Jyothi, (2019) on their studies conducted in various states.

Table 4: Cost economics.

Crop	Gross Expenditure (Rs/ha.)		Gross Returns (Rs/ha.)		Net Returns (Rs/ha)		BC Ratio	
	D	C	D	C	D	C	D	C
Ananthapuramu dt. – Rianfed situations								
Groundnut	12230	14153	39920	29122	27690	14969	3.2	2.0
Pigeonpea	13760	15200	42925	32778	29165	17578	3.1	2.2
Chickpea	18542	21403	40467	30795	21925	9392	2.2	1.4
Ananthapuramu dt.– Irrigated situations								
Groundnut	24450	26675	91298	79151	67478	52476	3.7	3.0
Kurnool dt. – Rainfed situations								
Groundnut	32243	34014	152414	126400	120171	92386	4.7	3.7
Pigeonpea	18200	19850	69925	56933	51725	37083	3.8	2.9
Chickpea	20409	23463	75309	62909	54900	39446	3.7	2.7
Kurnool dt.– Irrigated situations								
Pigeonpea	21433	25366	110465	80702	89032	55336	5.2	3.2

D=Demonstration C=Control

Results from the above table clearly indicate that there was reduction in cost of cultivation (ranging from Rs.1440 per hectare to Rs. 3933 per hectare) across all the crops in demonstration plots compared to control in both the districts. Similarly net returns (ranging from Rs. 11547 per hectare to Rs. 33696 per hectare) and benefit cost ratio (ranging from 2.2 to 5.2) were also high in all crops under demonstration plots compared to control plots in both the districts. Enhancement of net returns in pulses demonstration plot was also reported by Raj *et al.,* (2013); Kumar *et al.,* (2015); Anil *et al.,* (2019) and Mohapatra *et al.,* (2017) in their studies conducted on FLDs on pulses & oilseeds in Gujratha, Telangana and Orissa states respectively.

Table 5: Significant difference on yields.

Sr. No.	Components	No. of Mandals	Average Yield (kg/ha)		Mean difference	't'-cal. Value
			Demo	Control		
Rainfed crops in Ananthapuramu district						
1.	Groundnut	n=17	784.8	572.4	212.4	6.08**
2.	Pigeonpea	n=10	740.1	565.1	174.9	4.54**
3.	Chickpea	n=9	875.9	666.5	209.4	2.35*
Irrigated crop in Ananthapuramu district						
1.	Groundnut	n=20	1793.6	1555.1	238.5	4.40**
Rainfed crops in Kurnool district						
1.	Groundnut	n=30	2900.8	2505.7	395.1	4.38**
2.	Pigeonpea	n=21	1239.6	1003.6	236.0	3.56**
3.	Chickpea	n=30	1640.4	1352.5	287.9	9.94**
Irrigated situations in Kurnool district						
1	Pigeonpea	n=13	1883.3	1379.4	503.9	6.95**

**significant at 0.01 level of probability *significant at 0.05 level of probability

**0.01 't' - critical value – 2.73 (n=17) *0.05 't' -critical value - 2.03 (n=17)
**0.01 't' - critical value – 2.87 (n=10) *0.05 't' -critical value – 2.10 (n=10)
**0.01 't' - critical value – 2.92 (n=9) *0.05 't' -critical value – 2.11 (n=9)
**0.01 't' - critical value – 2.71 (n=20) *0.05 't' -critical value – 2.02 (n=20)
**0.01 't' - critical value – 2.66 (n=30) *0.05 't' -critical value – 2.00 (n=30)
**0.01 't' - critical value – 2.70 (n=21) *0.05 't' -critical value – 2.02 (n=21)
**0.01 't' - critical value – 2.66 (n=30) *0.05 't' -critical value – 2.00 (n=30)
**0.01 't' - critical value – 2.80 (n=13) *0.05 't' -critical value – 2.06 (n=13)

By using the statistical tools like 't' test, significant difference on yields was tested in different corps like groundnut, pigeon pea and chickpea under rainfed and irrigated situations. Results revealed that under rainfed situations both in Ananthapuramu and Kurnool districts the yields were found to be significant at 0.01 level of probability between demonstration and control plots in groundnut, pigeonpea and chickpea except in chickpea in Ananthapuramu district where in it was shown significance at 0.05 level of probability. Under irrigated situation also significant yield differences were notices between demonstrated plots and control plots in groundnut and pigeonpea crops in Ananthapuramu and

Kurnool districts respectively at 0.01 level of probability. Significant yield improvement in yields of groundnut due to FLDs was also reported by Sandeep *et al.,* (2018) in their study conducted in Maharashtra.

Impact of Biotech KISAN project on various socio economic variables: Impact of Biotech KISAN project was assessed during pre and post project implementation periods in terms of mass media usage, social organization, social participation, contact with extension agencies, risk orientation, innovativeness, knowledge and adoption. The results are shown below.

i. Mass media usage

The usage of mass media by the farmers for their knowledge enhancement during pre and post project implementation was compared in Table 6. In Kurnool district 53.33% of the farmers are in the category of high in using mass media after project completion while it is only 41.67% during pre project period. The farmers under medium usage category have reduced from 45.0% to 43.33% and from 13.33% to 3.33% under low category. In Ananthapuramu district during pre project period the farmers under category of high usage is only 25.0% and after completion of project it is 65.0% and under medium usage category reduced from 51.67% to 28.33% and under low category reduced from 23.33% to 6.67%.

ii. Social organization and social work

The farmers were assessed for their knowledge levels pertaining to social organizations and social work after two years of the project. The knowledge level of the beneficiaries has improved in the aspect of social organization and social work.

Table 6: District wise distribution of respondents in mass media usage during pre and post project period.

Sr. No.	District	Adoption Index	Post project period		Pre project period	
			Frequency	% age	Frequency	% age
1.	Kurnool	Low (up to 33.33)	2	3.33	8	13.33
		Medium (33.34 to 66.66)	26	43.33	27	45.00
		High (Above 66.66)	32	53.33	25	41.67
2.	Ananthapuramu	Low (up to 33.33)	4	6.67	14	23.33
		Medium (33.34 to 66.66)	17	28.33	31	51.67
		High (Above 66.66)	39	65.00	15	25.00

The Kurnool farmers has knowledge level of medium (45%) to high (43.33%) after the project period where as 85% responded medium before. In Ananthapuramu district much change has not observed with regard to social organizations.

iii. Contact with extension agencies

The data pertaining to the knowledge improvement of farmers with regard to the contact with private extension agencies has showed in Table 8. Significant improvement was not recorded in Ananthapuramu district. In Kurnool district, the response of the farmers under low category has reduced from 66.67% to 35% and significant increase in high and medium categories was observed. This clearly shows that the perception of the farmers has changed significantly with regard to their awareness. Improvement of farmers contact with KVK due to conduct of FLDs were also reported by Dar *et al.*, 2017 in their study on evaluation of extension activities organized under FLD on oilseeds and pulses in KVKs of Punjab and J&K States.

Table 7: District wise distribution of respondents in social organization and social work during pre and post project period.

Sr. No.	District	Adoption Index	Post project period		Pre project period	
			Frequency	% age	Frequency	% age
1.	Kurnool	Low (up to 33.33)	7	11.67	9	15.00
		Medium (33.34 to 66.66)	27	45.00	51	85.00
		High (Above 66.66)	26	43.33	0	0
2.	Ananthapuramu	Low (up to 33.33)	23	38.33	23	38.33
		Medium (33.34 to 66.66)	31	51.67	26	43.33
		High (Above 66.66)	6	10.00	11	18.33

Table 8: District wise distribution of respondents in maintaining contact with extension agencies during pre and post project period.

Sr. No.	District	Adoption Index	Post project period		Pre project period	
			Frequency	% age	Frequency	% age
1.	Kurnool	Low (up to 33.33)	21	35.00	40	66.67
		Medium (33.34 to 66.66)	26	43.33	15	25.00
		High (Above 66.66)	13	21.67	5	8.33
2.	Ananthapuramu	Low (up to 33.33)	20	33.33	29	48.33
		Medium (33.34 to 66.66)	6	10.00	4	6.67
		High (Above 66.66)	34	56.67	27	45.00

iv. Risk orientation

The risk orientation by the farmers before and after completion of the project was presented in Table 9. As per the data, in all districts the farmers fall under high category for their agreement on risk orientation in adoption of technology. In Kurnool district the farmers have responded for high category by 76.67% while it is only 13.33% before the project initiation. In Ananthapuramu district much difference was not observed before and after project period since 88.33% of the farmers responded for positive response. The reduction in medium and low category and improvement in high category was observed in risk orientation by the farmers.

Table 9: District wise distribution of respondents in risk orientation during pre and post project period.

Sr. No.	District	Adoption Index	Post project period		Pre project period	
			Frequency	% age	Frequency	% age
1.	Kurnool	Low (up to 33.33)	7	11.67	30	50.00
		Medium (33.34 to 66.66)	7	11.67	22	36.67
		High (Above 66.66)	46	76.67	8	13.33
2.	Ananthapuramu	Low (up to 33.33)	0	0.00	0	0
		Medium (33.34 to 66.66)	3	5.00	7	11.67
		High (Above 66.66)	57	95.00	53	88.33

v. Innovativeness

The innovativeness of the farmers in all the four districts after the project period was presented in Table 10. Improvement in innovativeness was observed in all the districts after two years of the project. In Kurnool district the farmers under high category was increased from 83.3% to 96.67% and in medium category the response was reduced from 16.67% to 3.33%. In Ananthapuramu district, the response of the farmers in the medium category has reduced from 11.67% to 3.33% and in high category the response was increased from 88.33% to 96.67%. In Srikakulum and Visakhpatanam districts, the response of the farmers on innovativeness under the high frequency category has increased from 78.33% to 90.0% and 83.33% to 93.33% respectively.

Table 10: District wise distribution of respondents in innovativeness during pre and post project period.

Sr. No.	District	Adoption Index	Post project period		Pre project period	
			Frequency	% age	Frequency	% age
1.	Kurnool	Low (up to 33.33)	0	0.00	0	0
		Medium (33.34 to 66.66)	2	3.33	10	16.67
		High (Above 66.66)	58	96.67	50	83.33
2.	Ananthapuramu	Low (up to 33.33)	0	0.00	0	0
		Medium (33.34 to 66.66)	2	3.33	7	11.67
		High (Above 66.66)	58	96.67	53	88.33

vi. Knowledge & adoption levels of the farmers on sustainable agricultural practices

The knowledge and adoption levels of the farmers on sustainable agricultural practices were presented in Table 11. The knowledge and adoption level of the Kurnool farmers remains same during post project period and 91.67% of the farmers has showed adoption rate to high while it is only 45.0% in knowledge level and nil in adoption in high category during the pre project period. In Ananthapuramu district the category of farmers showing high in knowledge level is 91.67% and adoption is 73.33% while it is only 30.0% in knowledge and 6.7% in adoption during pre project period. In Srikakulum and Visakhapatnam districts, the knowledge level for the farmers falling under category of high has increased drastically during post project period i.e., from 8.33% and 41.67% to 5.0% and 90.0% respectively. However the adoption of the sustainable cultivation practices by the farmers falling under high category is only 48.33% and 41.67% respectively in both the districts. The reduction in the farmers falling under low category has reduced drastically in all the districts which clearly spells the impact of the project. Improvement in adoption levels due to technical intervention was also reported by Beena Singh *et al.,* (2014) in their study on extent of adoption of recommended practices of pulses through FLD conducted in Madhya Pradesh.

Post demonstration improvement in adoption of various latest production practices were also reported by Kumar Pankaj *et al.,* (2015) in their study on economic impact of front line demonstration on pulses in Punjab- a step towards diversification in Punjab. Similar results were expressed by Meena *et al.,* (2019) on their study Impact of FLDs on the knowledge level of mustard production technology and yield between beneficiary and non-beneficiary farmers.

Correlation was administered to see the socio personal variables which are having positive and significant relationship with knowledge and adoption levels of farmers and it revealed that education, extension contact, social participation, innovativeness, risk orientation and mass media usage have found to have significant relationship with knowledge and adoption levels while age has got negatively significant correlation with knowledge and adoption.

Table 11: District wise distribution of respondents in knowledge and adoption of sustainable agricultural practices during pre and post project period.

Sr. No.	District	Adoption Index	Knowledge		Adoption		Knowledge		Adoption	
			Post project period				Pre project period			
			Frequency	%	Frequency	%	Frequency	%	Frequency	%
1.	Kurnool	Low (up to 33.33)	2	3.33	2	3.33	06	10.00	22	36.7
		Medium (33.34 to 66.66)	3	5.00	3	5.00	27	45.00	38	63.3
		High (Above 66.66)	55	91.67	55	91.67	27	45.00	0	0
2.	Ananthapuramu	Low (up to 33.33)	1	1.67	6	10.00	09	15.00	18	30.0
		Medium (33.34 to 66.66)	4	6.67	10	16.67	33	55.00	38	63.3
		High (Above 66.66)	55	91.67	44	73.33	18	30.00	4	6.7

Hence, in order to improve the knowledge and adoption levels we need to focus on the above factors which were found to be significantly correlated. These results are in line with the results obtained by Pordhiya *et al.*, (2017) in his study on Impact Analysis of Vocational Training on Scientific Dairy Farming in Haryana where in variables like education, land holding were significantly correlated with knowledge levels of participants. These results are in line with the results of Mandavkar *et al.,* (2013) in their study on farmer's knowledge and correlates of oilseed production technology. These results are in contradictory with the results of Kalra *et al.,* (2009) who reported no significant difference between FLD and non-FLD farmers with regard to adoption of recommended practices.

The result of improved technology intervention brought out that adoption of recommended technologies in oilseeds and pulses by farmers before demonstration was very low, which increased by 161 % to 666% in various practices after demonstration.

Use of improved seed was increased by 285.71%, adoption of seed treatment was improved by 512.50%, adoption of Recommended Dose of Fertilizers (RDF) was enhanced by 161.76%, use of bio-fertilizers was improved by 464.29%, use of IPM practices was enhanced by 214.81%, adoption level of micro nutrient deficiency corrections was enhanced by 666.67%, dry spell management was enhanced by 161.11% and use of improved storage methods was enhanced by 292.31%. There was significant area increase horizontally from 24 ha to 576 ha under latest varieties of pulses and oilseeds. Due to FLDs improvement in area was also reported by Kalra *et al.,* (2009) in their study in J&K state. These results are also in line with the results of Mahale *et al.,* (2019).

Table 12: Correlation between socio economic variables and knowledge and adoption.

Sr. No.	Socio economic variables	'r' value	
		Knowledge	Adoption
1.	Age	-0.42**	-0.51**
2.	Education	0.54**	0.58**
3.	Extension contact	0.61**	0.52**
4.	Annual Income	0.26	0.38
5.	Social participation	0.57**	0.54**
6.	Land holding	0.23	0.40
7.	Innovativeness	0.68**	0.62**
8.	Risk orientation	0.45**	0.56**
9.	Mass media usage	0.53**	0.57**

Table 13: Technology spread (n=120).

Technology	No. of adopters		Change in no.of adopters	Impact (%change)
	Before	After		
Improved seed	28	108	80	285.71
Seed treatment	16	98	82	512.50
RDF	34	89	55	161.76
Use of biofertilizers	14	79	65	464.29
IPM practices	27	85	58	214.81
Micro nutrients deficiency correction	9	69	60	666.67
Dryspell management	36	94	58	161.11
Improved storage methods	26	102	76	292.31
Area spread (ha)	24	576	552	2300.00

CONCLUSION

The results clearly indicated that the higher average yield and net returns were obtained in demonstration plots over the years compared to farmer's practice due to high knowledge and adoption of full package of practices i.e. use of improved seed, application of bio-fertilizers, recommended dose of fertilizers, use of IPM kits like pheromone traps, sticky traps, trap crops, bird perches etc. and timely application of plant protection chemicals whereas due to lack of knowledge on use of bio fertilizers, balanced dose of fertilizer, IPM practices yields were low in farmer's practice. The FLDs produced a significant positive result and provided an opportunity to demonstrate the productivity potential and profitability of the latest technology (intervention) under real farming situation. Therefore the study concludes that technology demonstrations conducted by KVKs under Biotech KISAN Project in *Rayalaseema* region in pulses and oilseeds made significant impact on horizontal spread of the technology and on socio economic variables of pulse and oilseeds growing farmers.

Therefore, target oriented training programmes on improved oilseeds & pulses production technology along with multiple demonstrations is required to enhance the level of knowledge and skills of growers which help in adoption of technology. This could circumvent some of the constraints in the existing transfer of technology system in the *Rayalaseema* region of Andhra Pradesh. The productivity gain under technology demonstrations over existing practices of oilseeds and pulse production has created greater awareness and motivated other farmers to adopt the demonstrated technologies in the district which helped to enhance the oilseeds and pulses production, consumption, nutritional security and overall livelihood security of the farmers in *Rayalaseema* region of Andhra Pradesh.

FUTURE SCOPE

As this study has got positive results to move towards self sufficiency of pulses and oilseeds, we can reduce the huge imports of pulses & edible oils if this intervention is extended across the nation and also can save valuable foreign exchange reserves to our nation.

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