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CORRELATES OF ADOPTION OF *KHARIF* GREENGRAM A HIGH VALUE PULSE CROP CULTIVATION TECHNOLOGY TO DOUBLE THE FARMER'S INCOME

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ABSTRACT

The Greengram (*Vigna radiata*) is a very important Indian native short duration high value pulse crop grown in all India for staple protein food supplier as well. This crop was found very suitable for growing in kharif season where irrigation facilities were not available and even in undulated areas with fewer resources to add ample mount of the income into the farming community in short period of time. This crop is found very much suitable for doubling farmer's income in central Narmada valley of MP state. The highest productivity of kharif Greengram in Harda district of Madhya Pardesh was found 1200 kg/ha in the year 2021-22 where the national productivity of kharif Greengram in India was expected about 570 kg/ha during 2022-23. Farmers adopted the kharif Greengram production technology spread through conducting front line demonstration and other important extension interventions in adopted villages in whole district to improve the vertical and horizontal spread by JNKVV, Krishi Vigyan Kendra-Harda (MP) during the year 2018-2022, resulting from these interventions the resource poor farmers received good income by adopting kharif Greengram production technology for their livelihood security in Madhya Pradesh.

Key words : *Kharif* Greengram, High value crop, Protein supplier, Poor resources, Income generation, Short duration crop, Soil health.

Introduction

The Greengram (*Vigna radiate*) family legume and commonly called as Mungbean, Moong or Mung in all parts of India. Greengram is an Indian native and short duration economic crop. Greengram production in India was expected to total 5.5 million hectares by 2022-23, it is yielding about 3.17 million tonnes with 570 kg/ha productivity. The Greengram pulse crop alone accounts about 10% of production and 16% of area for all pulses in India. The leading contributors to Greengram pulse cultivation in terms of area and production are state Rajasthan 46 per cent and 45 per cent respectively followed by Madhya Pradesh state, which covers 9 percent area and 14 per cent production, this data was reported in the Annual Report of AICRPR on *Kharif* pulses of year 2022-23. The annual global market revenue was contributed by Greengram was around USD 3,787.83 million reported in the year 2021. The compound growth rate of Greengram may be reached by 3.31 per cent from year 2021 to 2028 and revenue may be exhausted about USD 4,757.59 million by the year 2028. This Greengram pulse crop holds diverse applications across different regions of India and globally as well, as per whether condition of different regions the different varieties will be required to grow this crop. The most

Abbreviations used: MP (Madhya Pradesh), UP (Uttar Pradesh), DAS (Days after Sowing), USD (United States Dollar), CAGR (Compound Annual Growth Rate), AICRPR (All India Coordinated Research Project Report), MoA (Ministry of agriculture), GoI (Government of India), FLDs (Front Line Demonstrations), HYV (High Yielding Varieties), MYMV (Mung Yellow Mosaic Virus), e-NAM (e-National Agriculture Market).

Table 1 : Crop-wise Pulses Area Production Yield and Season wise Production Share in India.

Name of Pulse Crops	Major seasons	Normal area sown [Lakh ha]	Area sown (Season wise) [Lakh ha]	Normal pulse Production [Lakh Tones]	Pulse production (Season wise) [Lakh Tones]	Pulse Yield [kg/ha]
Pigeon Pea	*Kharif*	47.17	34	41.37	48	877
Chickpea	*Rabi*	98.86	66	107.37	71	1086
Greengram	*Kharif*	35.61	25	17.37	20	488
	Rabi	10.46	7	7.11	5	680
	Total	**46.07**	**16**	**24.48**	**10**	**531**
Urdbean	*Kharif*	38.94	28	20.25	23	520
	Rabi	9.13	6	7.14	5	782
	Total	**48.07**	**17**	**27.39**	**11**	**570**
Lentil	***Rabi***	14.29	10	13.34	9	934
Field Pea	***Rabi***	7.45	5	9.10	6	1222
Other pulses grown	*Kharif*	**18.47**	**13**	**8.05**	**9**	**436**
	Rabi	**10.00**	**7**	**7.12**	**5**	**712**
	Total	**28.47**	**10**	**15.17**	**6**	**533**
Total Pulses	*Kharif*	140.18	48	87.04	37	621
	Rabi	150.19	52	151.18	63	1007
	Total	**290.37**		**238.22**		**820**

Source: Directorate of Economics and Statistics, MoA, GoI (Avg. of 2016-17 to 2020-21).

Table 2 : Statistics of total Greengram area and production (*Kharif* + *Rabi*) state wise in India.

Name of States	Normal area of Greengram sown [Lakh ha]	Greengram area Contribution (Per cent)	Normal Greengram Production [Lakh Tonnes]	Greengram Production Contribution (Per cent)	Productivity of Greengram [kg/ha]
Rajasthan	21.40	46	10.97	45	513
Maharashtra	4.29	9	1.96	8	457
Madhya Pradesh	4.18	9	3.46	14	828
Karnataka	4.15	9	1.43	6	346
Odisha	2.51	5	0.87	4	346
Bihar	1.70	4	1.13	5	666
Tamil Nadu	1.70	4	0.69	3	408
Gujrat	1.41	3	0.86	4	611
Andhra Pradesh	1.21	3	0.82	3	677
Telangana	0.92	2	0.59	2	644
Others	2.59	6	1.68	7	647
All India	**46.07**		**24.48**		**531**

Source: Directorate of Economics and Statistics, MoA, GoI (Avg. of 2016-17 to 2020-21)

widespread consumption of Greengram pulse is being seen in the form of direct use of dry grains in cooking or grilling or roasting them for a snack purposes also.

The seeds of greengram pulse crop are very rich in high protein content around 28 per cent, which is very easily digestible also, the grains of Greengram are quite trouble-free to cook and not have flatulence factors in caparison to the other pulse crops (Sahoo *et al.*, 2003). This greengram crop is also establish as a very rich source of edible protein content about 14.6 to 33.0 g/100

Table 3 : Statistics of total Greengram area and production (Kharif + Rabi) of Madhya Pradesh.

Name of State and Season	Normal area sown of Greengram [Lakh ha]	Area contribution of Greengram [per cent]	Normal production of Greengram [Lakh Tonnes]	Production contribution of Greengram [per cent]	Productivity of Greengram [kg/ha]
Madhya Pradesh Total Greemgram (*Kharif*)	1.32	4	0.69	4	521
Total Greemgram (*Rabi*)	2.86	27	2.77	39	970
Total	**4.18**		**7.11**		**745.5**

Source: Directorate of Economics and Statistics, MoA, GoI (Avg. of 2016-17 to 2020-21)

g weight and it also holds the iron content ranging from 5.9 to7.6 mg/100 g (Dahiya *et al*., 2015). The Greengram pulse again contains around 50.4 per cent carbohydrates, 1- 3 per cent fat, 3.5-4.5 per cent fibers and 4.5-5.5 per cent ash in addition to the calcium and phosphorus are 132 and 367 mg per 100 grams of Greengram seeds, respectively (Frauque *et al*., 2000). The Greengram pulse is generally consumed as whole dry grains and it's sprouted mungoda form at morning breakfast as well as dhal in several ways of recipes in Indian homes from rural to urban societies. This is wonderful crop suitable for short duration green manuring to incorporate directly in the soil in India, and it is very preferably utilized by the dairy farmers in the form of wet husks as animal feed for natural protein supplements. In Indian scenario this pulse crops is being cultivated in three different seasons covering to *Kharif* season, *Rabi* season and summer season. Summer Greengram pulse is generally grown just after harvesting of major rabi crops like chickpea, lentil crop, pea, potato crop, mustard, wheat and cotton crop in different regions. The cultivation of Summer/ Zaid Greengram was found very important to increase Greengram production and farmers income in India (Kumar and Pandey, 2018).

The Greengram is being grown as third important pulse crop of India and MP and it covers pulse area of our country nearly 16 per cent. In many parts of the country this pulse crop is directly ploughed into the field to enrich the soil nitrogen content. Greengram or Mungbean is being treated as the most important protein suppliers in the food chain. This crop is very dynamic short duration and high value pulse crop suitable for grown in all type of cropping pattern in most of the plain regions of India. Greengram also known as the suitable diet suppliers for the patients form very old time. This crop is found very much suitable for doubling farmers income in many states especially in Madhya Pradesh state more specifically including Narmadapurum, Harda, Narshinghpur, Dewas districts.

Table 1 reflects the statistics of the total pulses in India as normal area was sown about 290.37 lakh ha may be bifurcated as in the kharif season about 140.18 Lakh ha and in *Rabi* season about 150.19 lakh ha. The seasonal percent share of all pulse crops in India was seen as 52 per cent area goes to *Rabi* pulses followed by the remaining 48 per cent as *kharif* area. The national yield was recorded as 820 kg/ha during the year 2021.

Table 2 reveals that in India normal area sown Greengram pulse total is about 46.07 lakh ha, from which 24.48 Lakh tonnes Greengram production was received with and the productivity Greengram was achieved about 531 kg/ha during the summarized data of year 2021.

Table 3 reveals that the normal area of *kharif* Greengram in state Madhya Pradesh is about 1.32 lakh ha by which the 4.0 Lakh tonnes production was received and the productivity of *kharif* Greengram was achieved @ 521 kg/ha. In total kharif pulses, Greengram is contributing around 4 % in respect to area and 4% in production in total pulse production of India. Simultaneously the normal area of rabi Greengram in state Madhya Pradesh was sown in 2.86 Lakh ha, which producing about 39 Lakh tonnes Greengram and productivity was seen @ 970 kg/ha during the year 2021. In case of rabi season the total Greengram pulses is contributing area about 27% and production about 39% in total pulse production during rabi season in India by the year 2021.

Table 4 reveals the production status of *kharif* Greengram of district Harda of last ten years since year 2012-13 to 2021-22. It can be evident from the above data table that the productivity of *Kharif* Greengram was received by farmers in the year 2012-13 was 600 kg/ha and in the year 2021-22 was 1200 kg/ha, which is doubled then to the base year. It means the technological and other extension interventions and efforts were very

Table 4 : Statistics of year wise area production productivity of kharif Greengram of district Harda, MP.

S. no.	Year	Area (ha)	Production (q)	Productivity (Kg/ha)
1	2012-13	250	1500	600
2	2013-14	00	00	00
3	2014-15	9800	41748	426
4	2015-16	4900	14455	295
5	2016-17	12850	91235	710
6	2017-18	2500	4975	199
7	2018-19	2700	21600	800
8	2019-20	350	560	160
9	2020-21	2250	1350	60
10	2021-22	1150	13800	1200

Source: Deputy Director Agriculture-District- Harda, Govt. of MP, Year 2022-23

effective and due these efforts the vertical and horizontal spread of *kharif* Greengram was increased in the district. Hence, it can be summarized that the adoption of *kharif* Greengram was fruitful to enhance the income of the farmers by growing the high value crops in the district Harda, Madhya Pradesh. By keeping the importance of this high value pulse crop cultivation in mind to enhance the income of farmers in short period with less input and irrigation facilities this study was planned to get the Correlates of Adoption of *kharif* Greengram a high value pulse crop cultivation to enhance the farmer's income in Madhya Pradesh.

Materials and Methods

The present field research was held in districts Harda of Madhya Pradesh was selected purposively because, Jawaharlal Nehru Krishi Vishwa Vidyalay, Krishi Vigyan Kendra-Harda had organized many demonstration (FLDs) and other extension activities to improve the vertical and horizontal spread of *kharif* Greengram production as high value pulse crop during 2018- 2022. Out of 3 *kharif* Greengram growing locations, 12 adopted villages and 15 farmers form per village selected to receive their responses randomly in this manner a sample of total 180 farmers was constituted. The proper planned and pre-tested interview schedule was appropriately finalized with associated professionals was placed to gather the needful observation and farmers perceptions for the study. The needed responses of the Greengram growing farmers of all three locales were noted down in the schedule. The farmers as per the adoption level of scientific technology were classified in three categories. The 3 points were allotted to regular adoptees, 2 points to less common adoptees and 01 point score to very less adopter's and 0 points to not at all adopters as per their collected responses. The score was varied from 20 points maximum to 0 point minimum. The summarized score of different farmers were converted to the adoption index and calculated by applying formula Adoption (*kharif* Greengram technology) = actual obtained adoption score X 100/maximum obtainable score. To assess the interrelationship among different variables of the study, the main needed statistical analysis like correlation coefficient for interrelationship and multiple regression analysis for finding the average relationship between the different variables were analyzed along with other tools as percentage and rank etc. to make research more rationale.

Results and Discussion

This may be indicated from the calculated values of correlation coefficient observed in the Table 5 that the education received by farmers (r = 0.347*) and caste of respondents (r = 0.246*) were also found positive towards high value pulse crop with superior technologies at 5 % of probability level was observed. The two factors were seems important for increasing the adoption rate of Greengram during kharif season. It may again infer that education level of farmers increased the comprehension and thoughtfulness, which trait helps farmers positively to perceive decision making for new technologies in short time. Continuously, the main occupation (r = 0.410**), possessed size of land asset by farmers (r = 0.481**), farmer's annual regular income (r = 0.628**), available marketing amenities (r = 0.527**) and available farm equipments/farm machinery (r = 0.257**) were again found positively and significantly interrelated to the acceptance of superior technologies of *kharif* Greengram at the 1 % level of possibility. It may indicate that the size of available land asset of farmers also may be a critical feature which may also affect the taking up of *kharif* Greengram technology. The other important independent variable of study as available marketing facilities in the locality was also realized the decisive cause for implementation of *kharif* Greengram technology because the assured marketing facility nearby. The age of respondents (r = -0.145*) was calculated as non-significantly connected to the taking up of kharif Greengram technologies. The above processed data discloses age factor of the interviewed people was not found related to the adoption of these technologies of *kharif* Greengram in Harda district. The observed finding of this segment may be justified with conclusions as earlier perceived by Choudhary and Mishra (2001), Joseph and Padaria (2007), Ram (2010) and Kumar *et al.* (2019.

Table 5 : Analyzing the possible correlation among socio-economic and personal variables with *kharif* Greengram growing technology adopted as high value pulse crop in Harda district of Madhya Pradesh.

S. no.	The Independent important Variables	Correlation Co-efficient ('r ' value)
1	Age of respondents	-0.145*
2	Education received	0.347*
3	Main Occupation	0.410**
4	Caste of respondents	0.246*
5	Size of land asseet possessed	0.481**
6	Farmer's annual regular income	0.628**
7	Available marketing amenities	0.527**
8	Available farm equipments/machinery	0.257**

* Values significant at 5 % level of probability ** Values significant at 1 %

Hales and Anderson (1994), Ram (2010) and Kumar *et al*. (2019).

Prior to start this study the adoption categories were rationalize by the expert on the basis of the scientific recommendations used by farmers in their *kharif* Greengram production practices. When the values of scientific recommended technological adoption was below 30 percent then these farmers were laid down under partial adoption for each scientific technology or intervention, whereas the adoption value with 31-60 percent accuracy was considered as medium level and the adoption value above 61 percent precision was put under the fully adoption category of the respondents. The details adoption scores of results are being given as under

- Value given in Table 7 shows 65 per cent farmers had used of high yielding varieties of *kharif* Greengram hence *i.e.* about 65 per cent majority, and other 27.22 percent had medium level of adoption, the last majority of farmers 7.78 per cent was found in partial use category of high yielding varieties of *kharif* Greengram. These findings were not same as earlier studied by Sahu (2010). The peasants from demo category showed higher extent of adoption of HYVs of *kharif* Greengram production compared to the farmers from other category.
- The demonstration intervention attended farmers of adopted villages were using appropriate seed rate as 20 kg/ha. As such, 51.11 per cent of demo farmers were found as fully adoptor
- The majority 46.11 per cent of the farmers used fully recommended application of fertilizers dose and the rest 32.22 percent had the medium use of recommended fertilizers dose followed by 21.67 per cent partial use of fertilizers.

Table 6 : Analysis of multiple regressions of main socio-economic and personal variables with the adoption of kharif Greengram.

S. no.	The Independent Important Variables	b- value	S.E. of 'variables ' b'	't' value
1	Age of respondents	-0.0301	0.0401	-0.9714
2	Education received	-0.3912	0.7771	0.6470
3	Main Occupation	0.4434	0.2771	1.7437*
4	Caste of respondents	-0.4863	0.1031	-1.2831
5	Size of land holding possessed	1.6112	0.8452	3.2991*
6	Farmer's annual regular income	-0.3943	1.5954	-0.4321
7	Available marketing amenities	0.1817	0.8171	0.3851
8	Available farm equipments/machinery	0.8932	0.2993	5.1517**

* Value significant at 5 % level of probability ** Value significant at 1 %
Multiple R=1.0005 Standard Error= 13.07737 R2 = 0.60735 Intercept
Constant = 84.920 Degree of Freedom= 13.775 Calculated 'F' Value= 4.9521**

The values given in Table 6 are the expression of difference between independent and dependent variable regarding the adoption of high value pulse crop *kharif* Greengram among the respondent's farmers. The 'F' value was calculated which was (4.9521**) get significant at 5 and 1 % level of possibility. Thus, the given 8 selected socio-economic and personal variables were with significant variations in the implementation of prescribed *kharif* Greengram cultivation in Harda. It was also seen that the calculated t-values get noteworthy for the size of land asset possessed by the farmers *i.e.* t value = 3.2991* and for main occupation of farmers t value = 1.7437* in case of available farm equipment/farm machinery t value = 5.1517** was received on the basis of these t value, it may be conclude that the adoption of kharif Greengram cultivation technologies by adoptee farmers are very important and needful. These research findings were also contributed by Kher and Halyal (1991),

Table 7 : Adoption of scientific *kharif* Greengram crop by farmers under KVK demonstrations.

S. no.	*Kharif* Greengram Production Technologies	Major Scientific recommendations in the Harda district	Major Categories of Adoption	Farmer's frequency distribution (N=180)	
				Demo farmers	Rank
1	Use of High Yielding Varieties of Greengram	PDM 139, Meha, TJM-3, IPM 410-3(Shikha), PM 205-7(Virat) and MH 421	Partial Adoption Medium Adoption Fully Adoption	14 (7.78) 49 (27.22) 117 (65)	III II I
2	Recommended dose of Seed	20 kg Seed/ha	Partial Adoption Medium Adoption Fully Adoption	23 (12.78) 65 (36.11) 92 (51.11)	III II I
3	Use of Recommended dose of Fertilizers per hectare	Nitrogen 15-20 kg, Phosphorus 30-40 kg, Potash 20 kg use at sowing time (Kumar and Pandey, 2018)	Partial Adoption Medium Adoption Fully Adoption	39 (21.67) 58 (32.22) 83 (46.11)	III II I
4	Seed treatment method before Sowing	With 2 gm Thirum.+ 1gm Carbendazim or Kepton & Carbendazim (1gm + 2 gm) to control the soil and seed borne diseases. To control sucking pests the seed treatment with Imidacloprid 70WS @ 7g/ kg or Thiamethoxam 4 g/kg seed. At last seed treatment with Rhizobium culture and PSB culture (5-7 gm/kg seed)	Partial Adoption Medium Adoption Fully Adoption	62 (34.45) 76 (42.22) 42 (23.33)	II I III
5	Use of Weedicide to control the rainy season weeds	Use of pre-emergence herbicide @ 0.75 kg pendimetheline 30 EC + Imazethapyr 2 EC with 600 liter water/ha and post emergence the Imazethapyr @ 0.075kg/ ha applied at 20-25 days after sowing (Kumar and Pandey, 2018)	Partial Adoption Medium Adoption Fully Adoption	121(67.22) 42 (23.33) 17 (9.45)	I II III
6	Use of major Insecticides/pesticides	Seed treatment, resistant varieties followed by two time Imidacloprid spray at 0.5 ml/l alone at 25 and 40 DAS for MYMV control etc (Jayappa *et al.*, 2017)	Partial Adoption Medium Adoption Fully Adoption	37 (20.56) 94 (52.22) 49 (27.22)	III I II
7	Water Management in standing crop	Good drainage facility required, If monsoon get delayed life saving irrigation may be given.	Partial Adoption Medium Adoption Fully Adoption	38 (21.11) 88 (48.89) 54 (30.00)	III I II
8	Marketing and Storage facilities	Government Mandies, e-NAM platform	Partial Adoption Medium Adoption Fully Adoption	34 (18.89) 36 (20.00) 110 (61.11)	III II I

Depicted values in small parentheses are in percentage.

- The results also seen as 42.22 per cent farmers under trials used practices of seed treatment before sowing and remaining 34.45 per cent partially adopted, whereas, 23.33 per cent farmers under study had fully adoption means good seed treatment process before sowing the *kharif* Greengram was done.
- Farmer's majority 67.22 per cent from demo category adopted recommended weed killer or herbicides and 23.33 per cent farmers received the medium level of weedicide use, this means the farmers were much aware of using the weed killer or herbicides in *kharif* Greengram crop. The Bekle and Pillai, 2011 and Kumar *et al.* 2019

also reported the same during said years.

- Again as per values of item no.7 a majority 48.89 per cent farmers managed irrigation water in *kharif* Greengram field as per recommendation in medium category.
- The farmer from demo category 61.11per cent (fully adoption) sold their produce at govt. mandies seems good sign to grow *kharif* Greengram for fetching the better income. The yield gain by the farmers was very much changeable year to year because of the weather vagaries like heavy rains, moisture stress, regular effective rainy days and weak water drainage systems in the field conditions.

The overall values received out of eight scientific recommendations for *kharif* Greengram production made for farmers and disseminated among demo groups for enhancing their income through growing high value pulse crops was found suitable and fruitful strategy be KVK and IISR, Indore scientists to double farmers income in soybean producing district of MP.

Conclusion

This may be concluded that the socio-economic and personal factors as the caste of the respondents, education received by farmers, size of land holding possessed by farmers, farmer's annual average income and available farm equipments or availability of marketing amenities nearby were absolutely related to the adoption of scientific *kharif* Greengram technologies in adopted villages. The respondent's age was non-significantly connected with the implementation of scientific *kharif* Greengram technologies. The significant and positive regression of coefficients calculated for the size of land asset possessed by farmers with the acceptance of *kharif* Greengram cultivation practices of the respondent farmers. The adoption of scientific *kharif* Greengram growing technology by the peasants under demonstration or trials and other important extension interventions was found able to reap *kharif* Greengram pulse crop yield around 50 per cent more during year 2021-22 (1200 kg/ha) against the base year 2018-19 (800 kg/ha) in Harda district of Madhya Pradesh. Hence, the technological demonstrations and other extension efforts made by Krishi Vigyan Kendra-Harda for transfer of technology in adopted village to assure the income enhancement of the resource poor farmers were found very fruitful through taking up of high value pulse crop as kharif Greengram.

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