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Research Paper

Impact assessment of improved variety of green gram: A case study of central Gujarat

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ABSTRACT

The present study compared the impact of two greengram varieties viz. GAM-5 and a locally grown variety, on the income of farmers. The study was conducted among 120 farmers of Central Gujarat of India. The economics of green gram production was calculated anddecomposition analysis was employed for impact assessment.The analysis revealed that the cultivation of GAM-5 variety was more profitable. The value of B:C ratio was found more for GAM-5 variety than the other variety. It was also found that the seed of locally grown varieties was expensive. The difference between the yields of the two varieties was negligible. Therefore the impact of both the varieties on income of farmers was almost the same.

Key words**:** B:C ratio, CACP cost concept, Decomposition analysis, Green gram, Impact assessment

INTRODUCTION

Pulses are the major and cheapest source of protein in India. This group of crops is not only an integral part of the -Indian diet but is also very important to maintain the fertility of the soil since these are leguminous plants. India produces a variety of pulses. India is the largest producer, consumer, and importer in the world. The production of pulses has increased from 192.49 lakh tonnes in 2013-14 to a record level of 254.63 lakh tones in 2021-22, an increase of about 32 percent (DES, GoI, Min. of Agriculture and Farmers Welfare). Inspite of being the largest producer of pulses in the world, India is still relying on imports to meet its domestic requirements. The volume of imports from 3.64 million MT in 2013-14 has declined to 2.69 million MT in 2021-22. Chickpea, pigeonpea, moong, urad, masur, peas etc. are major pulse crops grown in India. The major producers of pulses are Madhya Pradesh (52.95 lakh tones), Maharashtra (43.21 lakh tones), Rajasthan (42.52 lakh tones), Uttar Pradesh (24.76 lakh tones), Gujarat (18.09 lakh tones) and Andhra Pradesh (10.95 lakh tones) in 2020-21 based on production. In terms of area under pulse cultivation Rajasthan (61.45 lakh/ha), Madhya Pradesh (48.67 lakh/ha), Maharashtra (45.29 lakh/ha), Karnataka (31.26 lakh/ha), Uttar Pradesh (23.80 lakh/ha), Gujarat (13.07 lakh/ha) and Andhra Pradesh (12.44 lakh/ha) are major producers.

Green gram, a short-duration legume crop, has a share of 8-10% of the total production of pulses in India (Mohanty and Stayasai 2015). It is cultivated in India, Burma, Sri Lanka, Pakistan, China, Fiji, Quens land, and Africa. In India, 30.85 lakh tones of green gram is produced from an area of 51.30 lakh/ha with an average productivity of 601 kg/ha. Gujarat is a minor state in the production of pulses. The area under greengramin Gujarat has declined from 1.83 lakh hectares in 2013-14 to 1.55 lakh hectares in 2020-21 where as production has increased from 1.06 lakh tones to 1.10 lakh tones in the respective years (DES, GoI, Min. of Agriculture and Farmers Welfare). This indicates that the productivity of greengram has improved over the years. It is a kharif crop and is grown in areas having rainfall between 60-75 cm. It is called moong/mung in India and mug in Gujarat. It is majorly grown in Kachch, Junagadh, Banaskantha, and GirSomnath covering 63 percent of the total area and 59 percent of the total production of pulses in Gujarat. Kachch alone contributes 48 percent of the total area and 40 percent to the total production of pulses.

The state has the potential to contribute to pulse production at the national level. The government of India has a special focus on improving the production and productivity of pulses. Recognizing the need to enhance pulse production, the government has taken various initiatives. Apart from other technological interventions, several varieties have

been released in the last few years. Between 2007 and 2016, 170 new varieties were released (Chauhan *et al*. 2016). It is necessary to find out the contribution and importance of various technologies, since like any other proposition of investment, the allocation of resources to agricultural research needs to be justified (Murthy and Madhuri 2017). It helps in allocating the resources efficiently and directing the investment to a profitable and needed research strategy.

Impact assessment of agricultural technologies is not a new concept. It is donein three ways namely ex-ante assessment of research products, impact evaluation of projects promoting the up take of research outputs, and ex-post assessment of research (Maredia *et al.* 2014). Impact assessment after the fact (i.e. ex post) is done for various reasons like to determine the effectiveness of investments, to provide accountability, or to justify future research (Norton and Alwang 2016). Assessment of effect can be done at social and environmental levels or at economic level. The economic impact of any technology can be estimated in terms of changes in production cost, output price, gross income, net income, farm profit, return on investment etc. (Khan *et al*. 2022, Ward 2014, Ma and Abdulai 2017).

Therefore, the present study aimed to compare the impact of two greengram varieties on the basis of farmers income. The findings of the study will be helpful to farmers in making informed decisions.

MATERIALS AND METHODS

Plant material

The investigation was conducted in Central Gujarat. The first variety selected for the study was GAM-5 (Gujarat Anand Mungbean-5). This variety was developed by Anand Agricultural University and released for cultivation in 2018. Its yield ranges from 1500-1800 kg/ha with an average of 1811 kg/ha and a potential yield of 2000 kg/ ha. This variety is bold in seed size with attractive grain shine. It is highly resistant to Yellow Mosaic Virus disease. Chhota Udepur district was selected in consultation with Pulse Research Station, Vadodara. A list of farmers growing GAM-5 variety was obtained from Krishi Vigyan Kendra (KVK), Mangal bharti. The other variety, a locally grown popular + variety (LGP), was selected on the basis of farmers present in proximity to the growing areas of GAM- 5 variety listed farmers so that there will not be much difference in terms of area, soil quality, climatic conditions, and other parameters. Sixty farmers of each variety were selected for the study, thus making the total sample size equal to 120. For GAM-5, a list of farmers was provided by KVK, and for LGP variety snowball sampling was done. The study was conducted in the year 2020-21 and was based on primary data, collected through schedule.

Economic analysis

Economic analysis measuring the productivity, input-use pattern, costing analysis, gross and net returns, and benefit-cost ratios per unit of land for both varieties in sample regions was conducted. CACP cost concepts were used which have been using different cost concepts for measuring the economics of various crop cultivation. These are the following:

Cost A1	All actual expenses in cash and kind incurred in production by the owner
Cost A2	Cost A1 + rent paid for leased-in-land
Cost A2+FL	Cost A2 + imputed value of family labor
Cost B1	Cost A1 + interest on the value of owned capital assets (excluding land)
Cost B2	Cost B1 + rental value of owned land (net of land revenue) and rent paid for leased-in-land
Cost C1	Cost B1 + imputed value of family labour
Cost C2	Cost B2 + imputed value of family labour

Impact Assessment

There are various ways for economic impact assessment. One such method is Decomposition analysis (Bisaliah 1977). It was used to measure the contribution of variety (new technology) and resource use differentials to the total productivity differences between both varieties.

$$Y = AX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}X_7^{b7}e^u$$

where, Y= output in kg/ha

X_1= Planting material Rs./ha

X_2 = Manures Rs./ha

X_3= Fertilizers Rs./ha

X_4= Plant Protection Chemicals Rs./ha

X_5= Irrigation Rs./ha

X_6= Human labourRs./ha

X_7= Machine labourRs./ha

e = Error term

RESULTS AND DISCUSSION

Table 1 represents the socio-economic profile of the sampled respondents. The results show that the majority (71.6 %) of the sampled farmers belonged to the marginal and small farmers category. Similar

results were found by Kumari *et al*. (2018) in their study where 72.5 % of the farmers belonged to marginal and small category.

Table 1. Socio-economic profile of the sampled respondents

S.No.	Particulars	GAM-5	LGP
1	**Land Holding**		
	Marginal (Upto 1 ha)	20(33.3)	20(33.3)
	Small (1-2 ha)	23(38.3)	19(31.6)
	Medium (2-4 ha)	15(25)	17(28.3)
	Large (>4 ha)	2(3.3)	4(6.7)
2	**Age**		
	Upto 35 years	6(10)	8(13.3)
	36-55 years	31(51.7)	30(50)
	>55 years	23(38.3)	22(36.7)
3	**Education**		
	Illiterate	1(1.7)	2(3.3)
	Primary	24(40)	21(35)
	Secondary	29(48.3)	31(51.7)
	Diploma	2(3.3)	3(5)
	Graduate	4(6.7)	3(5)
4	**Occupation**		
	Farming	27(45)	33(55)
	Farming + A. H.	32(53.3)	27(45)
	Farming + A. H.+ Business	1(1.7)	0(0)
5	**Total no. of respondents**	60(100)	60(100)

Note: Figures in the parenthesis represent values in percentage.

The age of the respondent determines the ability to make decisions. It can also be used as a proxy for the experience of the farmer in farming which ultimately reflects his decision-making ability. It is evident from the table that the majority of the farmers were between 36 to 55 years of age. The study of Kumari *et al*. (2018) on pulse farmers of Telangana state also confirms that 52.5 percent of greengram farmers fall in the age group of 36 to 55 years.

Education is an important socio-economic factor that determines the level of exposure of respondents to different technologies and one's ability to adopt innovations. It is inferred from the table that a fair share of sampled farmers had educational qualifications up to the 12th class. Less number of farmers had diplomas or graduate degrees. Similar results were found by Prusty and Mohapatra (2021), where the highest proportion of pulse farmers i.e 33.2% were having middle and high school education.

Table 2 represents the cost and return estimates of GAM-5 and LGP varieties of green gram. The results represented in the table revealed that the total cost incurred by farmers of the GAM-5 variety was Rs. 25,379 per ha and for the LGP variety was Rs. 26,919 per ha. Almost similar total cost was estimated by CCPC, CARDS, TNAU, 2015 i.e. Rs. 25,166/-. The total cost of cultivation calculated by Angadi and Patil (2018) came out to be Rs. 22,603/-. The difference in the total cost of the two varieties is just Rs. 1,539 per ha. The cost of labour, irrigation, and fertilizers were major contributors tothe variable cost of GAM-5 where as in the case of LGP, labour, seeds, and irrigation were major contributors to the total variable cost. Overall the percentage share of the cost of machine labour was highest in both

Table 2. Cost and Returns

S.No	Particulars	GAM-5	% to total Cost	LGP	% to total Cost
1	Seed	2040.00	8.04	3230.00	12.00
2	FYM	1258.03	4.96	1194.22	4.44
3	Fertilizers	2110.83	8.32	2125.00	7.89
4	PPC	654.22	2.58	646.28	2.40
5	Irrigation	2890.00	11.39	3060.00	11.37
6 (a)	Hired Labour	3821.87	15.06	3880.69	14.42
6 (b)	Family Labour	640.00	2.52	640.00	2.38
7	Machine labour	6477.00	25.52	6382.79	23.71
8	Interest on working capital	596.76	2.35	634.77	2.36
	Total Variable Cost	**20488.71**	80.73	**21793.75**	80.96
9	Land revenue	42.50	0.17	42.50	0.16
10	Rental Value of land	4113.33	16.21	4113.33	15.28
11	Interest on fixed capital	415.58	1.64	415.58	1.54
12	Depreciation	318.96	1.26	553.75	2.06
	Total Fixed cost	4890.37	19.27	5125.17	19.04
	Total cost (TV+TF)	25379.09	100.00	26918.92	100.00
	Gross return	53178.13		53996.25	
	Net return	27799.04		27077.33	
	B:C ratio	2.10		2.01	

cases. The cost of seed was higher in the case of the LGP variety. One unit of LGP seed was available at Rs. 190/- where as in the case of GAM-5 it is Rs. 120/-. This shows that the university's variety is more affordable than the local variety. The impact of seed cost can also be seen in total cost.

For the GAM-5 category of respondents, the per hectare cost of cultivation was Rs. 25,379/- which comprised 81% of variable cost and approximately 20% of fixed cost. For the category of farmers belonging to the other group, the total cost of cultivation was Rs. 26,919/- with a similar ratio of variable to fixed cost i.e. 80:20. Similar observation was reported by Angadi and Patil (2018).

With respect to returns analysis, the gross return obtained per ha by GAM-5 farmers was Rs. 53,178/- and LGP farmers was Rs. 53,996/- . Net return per ha obtained by farmers growing LGP Rs.27,077 variety was slightly lower than the farmers growing GAM-5 variety Rs. 27,799/-. The benefit-cost ratio calculated for the GAM-5 variety was 2.10 and for the LGP variety 2.01. Therefore, for every rupee spent there will be a return of Rs. 2.10/- in the GAM-5 variety and 2.01 in the LGP variety which indicates that in comparison to the LGP variety, growing of GAM-5 variety is slightly more profitable for farmers.

Table 3. Cost concepts

Particulars	GAM-5	LGP
Cost A	20210.17	21750.00
Cost B	25011.42	26427.09
Cost C1	25651.42	27067.09
Cost C2	28216.56	29773.80

Table 4. Return over different cost and Input-Output Ratio GAM-5

S. No.	Particulars	Cost of Production (Rs/q)	Return per hectare over	Input : Output Ratio over
1	Cost A	2438.63	32967.95	1 : 2.63
2	Cost B	3017.97	28166.70	1 : 2.13
3	Cost C_1	3095.19	27526.70	1 : 2.07
4	Cost C_2	3404.71	24961.56	1 : 1.88

Table 5. Return over different cost and Input-Output Ratio LGP

S. No.	Particulars	Cost of Production (Rs/q)	Return per hectare over	Input : Output Ratio over
1	Cost A	2584.67	32246.25	1 : 2.48
2	Cost B	3140.47	27569.16	1 : 2.04
3	Cost C_1	3216.53	26929.16	1 : 1.99
4	Cost C_2	3538.18	24222.45	1 : 1.81

Tables 4 and 5 present returns over different cost and input-output ratios. It is evident from the table that the input-output ratios for all the costs namely A, B, C1, and C2 are better for GAM-5 than the LGP variety.

Decomposition analysis

Using the decomposition model, the productivity difference between GAM-5 and LGP variety was decomposed into its constituent resources, and perusal of the results of decomposition analysis in Table 6 revealed that there was a discrepancy between the observed differences (0.3978 %) and estimated difference (0.5634%) in the productivities of GAM-5 and LGP variety.

Table 6. Resources contributing to the yield differences between GAM-5 and LGP cultivation (per ha)

Sr. No.	Particulars	% Contribution
1.	Total observed difference in output (lnYg- lnYv)	0.3978
2.	Sources of contribution	
(i)	Technology	-2.7034
(ii)-1	a) Neutral ($lnA_{gi} - lnA_{vi}$)	0.7266
	b) Non-neutral ($\sum(b_{gi}-b_{vi})lnX_{vi}$	-3.43
	Seed	4.62
	FYM	2.78
	Fertilizers	-16.93
	PPC	38.36
	Irrigation	-54.52
	Human Labour	-6.22
	Machine labour	28.48
(ii)-2	Due to difference in input use $\sum b_{vi}(lnX_{gi}-ln\ X_{vi})$	2.14
	Seed	-0.01
	FYM	0.01
	Fertilizers	0.06
	PPC	-0.02
	Irrigation	0.48
	Human Labour	1.51
	Machine labour	0.11
	Expected difference	0.5634

The present study showed that there was a negligible difference in the yields of GAM-5 and LGP varieties. This implied that greengram output was not influenced by the introduction of the new variety. Since no significant difference was found between the yields of the two varieties further assessment of impact is of no relevance.

CONCLUSION

The study was conducted to estimate the impact of GAM-5 variety against any locally grown Green

gram variety. The investigation was conducted in Central Gujarat. The analysis revealed that the total cost incurred by farmers of the GAM-5 variety was lower than the LGP variety. The benefit-cost ratio calculated for the GAM-5 variety was 2.10 and for the LGP variety 2.01. So, for every rupee spent, there will be a return of Rs. 2.10/- in the GAM-5 variety and 2.01 in the LGP variety which indicates that in comparison to the LGP variety, growing of the GAM-5 variety is slightly more profitable for farmers. The cost of seed was higher in the case of the LGP variety. This shows that the university's variety is more affordable than the local variety. The present study further showed that there was a negligible difference in the yields between GAM-5 and LGP variety. This implied that green gram output was not influenced by the GAM-5 variety. Therefore, the impact of both varieties on farm income was almost the same. Farmers purchase the GAM-5 variety as it is more affordable than the LGP variety. However farmers were facing the problem of non-availability of GAM-5 seeds. Thus, there is a need to make GAM-5 seeds timely available to the farmers.

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