E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; SP-7(8): 185-189
Received: 27-06-2024
Accepted: 02-08-2024

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Study on cost of cultivation and economic returns from red gram BDN 711 crop in Marathwada central region of Maharashtra

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DOI: https://doi.org/10.33545/2618060X.2024.v7.i8Sc.1252

Abstract
An investigation was done to work out the cost of production, cost of cultivation, returns and profitability from BDN 711 Red gram crop in order to identify the variety is more profitable and economic for the farmers of Marathwada region from Maharashtra. On an average, the cost of production was 6027.61per quintal and the net return per hectare after subtracting the total cost (Cost C3) from the gross return was ` 193945.17 per hectare. Whereas, due to cultivation of BDN 711 the farmers got more production upto 7.82 percent which comprises that increased the benefit in Rs. 726.57 per quintal approximately for every year. The observations indicated that per quintal cost of production for pigeon pea BDN 711 crop was less than cotton, soybean and maize crops, on the other hand per hectare net return was the highest for pigeon pea BDN 711 when compared to other pigeon pea variety crop for draught resistant areas. All the major crops *viz*., Cotton, Soybean, Maize, Wheat and Pigeon pea were profitable for the farmers, but Pigeon pea BDN 711 was the most profitable crop when compared to the rest, because the per quintal cost of production as well as the per hectare return were more economic than Soybean and cotton crops.

Highlights

- Wheat emerged as the main food grain crop with its percentage share of 12.50% in the gross cropped area.
- The main produce quintal production was before 12.41 qtl / ha. and increased after cultivation of BDN 711 upto 20.24 qtl / ha., i.e. 7.82 percent increased. Also the by produce before cultivation of BDN 711, i.e Rs.14675.09 i.e. 17.51 Percent change after cultivation upto and Rs. 24958.01 per/qtl i.e. 20.46 i.e 2.95 percent has been increased in rupees per quintal.
- Pigeon pea was found to be the most profitable crop after cultivation of BDN 711 with the net return of ` 71959.98/ha, which was lesser before cultivation of this variety was earned ‘23934.38/- and increased 30.44% more of profit earned from BDN 711 crop.
- Per hectare cost of cultivation was found to be the highest for the large farms and the per hectare net return also seemed to be the highest for the large farms.

Keywords: Production, productivity, return, profitability, cropping pattern, cost concepts

Introduction

Red gram (*Cajanus cajan* (L.)) is a perennial legume from the family *Fabaceaesince* its domestication in the Indian subcontinent at least 3,500 years ago, its seeds have become a common food in Asia, Africa and Latin America. It is consumed on a large scale mainly in south Asia and is a major source of protein for the population of the Indian subcontinent. Red gram is the most important pulse crop widely cultivated in all tropical and subtropical regions.

The total world acreage under pulses is about 93.18 (Mha) with production of 89.82 (Mt) at 964 kg/ha yields level. India, with >28 Mha pulses cultivation area, is the largest pulse producing country in the world. It ranks first in area and production with 31 Percent and 28 Percent respectively. During 2020-21 tur productivity at 885 kg/ha, has also increased significantly over last 05 year. In Maharashtra in 2022-23 area under Red gram was 12.7 lakh/ha., 13.3 lakh tonnes production and productivity was 1042 kg/ha. area under irrigation (1.59%) having.

India occupies only 2.2% of the world’s land area, it supports approx 18% of the world’s population. The census projection report has further revealed that the proportion of the working

age population between 15 and 59 years is likely to increase from 58% in 2001 to > 64 Percent by 2021. Such a trend would make the country one of the youngest nations in the world. Thus, one of the India's competitive advantages is its demographic dividend. The future agricultural operations are likely to be highly skilled and competitive. The serious challenges to the workforce / youth of these resource poor and rainfed regions *viz*. lack of skill in scientific crop cultivation, repair and maintenance of farm machineries and implements, production of quality seeds, primary processing, value addition, modern animal husbandry, poor infrastructure (irrigation, godowns /warehouses ,trading centres) and organized pulses markets etc. have been considered by the government while formulating the strategy and roadmap to increase the production of pulses. The country's total area coverage and production of tur has been about 45 Lha and 42 Lt respectively. As known traditionally, Maharashtra has contributed >27 Percent of area and 25 Percent of total production during this period. With aggressive Transfer of Technology (ToT) in various thematic areas, highest ever productivity level of 937 kg/ha was achieved during 2017-18 (Table 1.2). More than 80 Percent of arhar production of the country during the period under report has been realized from 10 states of MS, MP, Karnataka, Gujrat, UP, Telangana, Jharkhand, Odisha, AP and TN.

Materials and Methods

The present study was undertaken in Marathwada region of Maharashtra state during the year 2021-22. In purposively selected two districts on *viz.*, Chhatrapati Sambhajinagar (Aurangabad), Jalna districts of Marathwada region of Maharashtra state on the basis of maximum number of farmers cultivating red gram BDN 711 were found in these two districts. The talukas also selected purposively on the basis of maximum number of farmers cultivating red gram BDN 711. So from Chhatrapati Sambhajinagar (Aurangabad), district two talukas were selected namely Paithan and Gangapur, from Jalna district two talukas namely Ambad and Badnapur were selected. Thus, total four talukas were selected. From each selected taluk 4 villages were selected purposively on the basis of maximum number of farmers cultivating red gram BDN 711for that purpose list obtained from NARP and KVK Aurangabad and Jalna, VNMKV, Parbhani hence sixteen villages were selected for conducting the study. So from each village fifteen farmers were selected purposefully from that list and we considered them as respondents, thus making a sample of 240 respondents. To study the impact some respondents was analysed before and after cultivation of BDN 711 i.e recall memory of farmers.

Ex-post facto research design was adopted in this study. The findings with regard to the selected profile characteristics of the respondents indicate that of the respondents i.e personal , psychological, socio-economic characteristics were belonged to education, family size, occupation, land holding , farming experience, marginal area under pulses crop in 2022 -23 , cropping pattern , sources of irrigation, annual income , social participation, information seeking behaviour, scientific orientation , economic motivation ,innovativeness , knowledge. The present study was undertaken in Marathwada region of Maharashtra state during the year 2018 and 2022 which was consider for recalling the cost of production of pigeon pea before using BDN 711 variety. For socio-economic impact of red gram BDN 711 selected as dependent variable for study.

Cost of Production

Cost of production was calculated by estimating all the costs which are incurred in producing one quintal of produce or output. On the cost structure, a fertilizer constitutes just 5% in the total cost of the production.

Cost of cultivation

It includes operational costs, material costs and other costs in crop production. In operational costs, the cost of hiring human labour, machine power, bullock charges have been estimated by prevailing the rate at that particular period of time in the study area. Hired labour charge at the actual wage paid in cash and other kind of payments were also converted into monetary terms at the prevailing price. Imputed value of the family labour was also calculated using the prevailing wage rate in the study area. In case of bullock, tractor and other machinery and hiring charges were applied to these as the cost for those who don't own them, whereas the cost of fuel, repairing and maintenance cost were calculated for those who own them. In case of material costs; cost of seeds, manure, chemicals, fertilizers irrigation charges were calculated at prevailing price at the time of application per hectare basis for different categories of farmers. Owned seed was priced as the prevailing seed price in the study area. Other costs includes land revenue, interests on fixed assets, interest on working capital, depreciation and rental value of the land. Simple interest was calculated on the working capital at a flat rate of 7% per annum as it prevailed at the time of investigation. Rental value of the land prevailed in the study area during study period was taken. Depreciation on the fixed asset per hectare was calculated on the basis of hours used for the crop.

Cost of production of red gram BDN 711

Cost of cultivation

Table 1 revealed that the cost concepts approach to farm costing is widely used in India. To work out the cost of cultivation standard method of cost of cultivation employed by Commission on Agricultural Costs and Price (CACP), Directorate of Economics and Statistics, Government of India was adopted which include Cost A1, Cost A2, Cost B1, Cost B2, Cost C1, Cost C2 and Cost C3.

The cost of cultivation of pigeon pea is shown in table 4.35 it can be seen that on an average per hectare cost of cultivation of pigeon pea was estimated as before the cultivation of BDN 711 Rs. 6754.13 which varied from Rs. 6027.615per hectare at marginal farms. The share of major cost on the cultivation of pigeon pea was observed human labour, and fertilizer. The average per hectare human labour cost was estimated as Rs. 2146.022 per hectare which varied from Rs. 2932.75 per hectare after cultivation of BDN 711 at marginal farms due to labour charges increased. The cost of production average per hectare before Rs.13415.34 after Rs.19517.63 cultivation of BDN 711 at marginal farms. The contribution of family human labour and hired human labour was observed before BDN 711 red gram cultivation 19.424 Percent and 19.70 Percent after cultivation which increased 0.27 Percent.

The next major cost was observed as bullock and machinery which was estimated before cultivation Rs. 2471.57 and after BDN 711 cultivation Rs.1977.25, decreased respectively of the total cost of cultivation. For machinery labour Rs. 9886.27 before and after cultivation to increase respectively. The contribution of bullock and machinery was observed 11.79 Percent to 8.10 Percent use reduced due to cost of cultivation has increasing respective of the total cost of cultivation respectively. Due to this BDN 711 pigeon pea variety crop was ready to harvest at one time hence all are ready use combine

harvester for harvesting but small and marginal land growers cannot use harvesters. The main produce quintal production was before 12.41 qtl / ha. and increased after cultivation of BDN 711 upto 20.24 qtl / ha., i.e. 7.82 percent increased. Also the by produce before cultivation of BDN 711, i.e Rs.14675.09 i.e. 17.51 Percent change after cultivation upto and Rs. 24958.01 per/qtl i.e. 20.46 i.e 2.95 percent has been increased in rupees per quintal.

Cost of cultivation of red gram (BDN 711)

Table 1: Cost of cultivation of pigeon pea at red gram (BDN 711) growers of before and after cultivation of BDN 711 variety (Rs./ha)

Sr. No.	Particulars per ha. Area (0.16)	BEFORE		After	
		Amount/Rs.ha	Percent	Amount/Rs.ha	Percent
1	Hired human labour	13412.64	12.44	18329.75	15.03
2	Bullock pair labour	2471.57	2.29	1977.25	1.62
3	Machine labours	9886.27	9.17	9886.27	8.10
4	Seed	200.13	0.18	375.21	0.31
5	Manures	2471.57	2.29	10380.58	8.51
6	N(Rs)	167.35	0.15	167.35	0.14
7	P(Rs)	708.14	0.65	708.14	0.58
8	K(Rs)	0	0	0	0
9	weedicide	481.95	12.59	481.95	0.39
10	Plant Protection (Rs.)	839.13	21.91	1631.23	1.33
11	Micronutrient	0	0.000	1311.61	1.07
12	Irrigation charges (Rs.)	66088.15	1725.76	76.41	0.063
13	Land revenue	41.68035	1.09	154.11	0.126
14	Incidental expenditure	925.2449	24.16	494.31	0.405
15	Interest on working capital @ 10%	1307.331	34.14	2165.27	1.8
16	Depreciation on capital assets @ 10%	10042.33	262.24	10042.33	8.23
17	Cost-A (∑ items 1 to 10)	43024.78	1123.51	59057.26	48.41
18	Rental value of land	17921.7	21.37	32170.09	26.37
19	Interest on fixed capital @ 12%	6612.98	7.89	6725.29	5.51
20	Cost-B (∑ item 11 to 14)	67559.5	80.58	97952.64	80.30
21	Family human labour	16286.5	19.42	24032.55	19.70
22	Cost-C (∑ item 15 to 16)	83845.9	100.00	121985.19	100.00
Returns					
23	Main produce (qtl)	12.41	0.015	20.24	0.017
24	By produce	7.34	0.009	13.86	0.011
25	Rate/quintal	46875	55.91	52179.69	42.77
26	Main produce	93105.2	111.043	168987.17	138.53
27	By produce	14675.1	17.502	24958.01	20.46
28	Gross return	107780	128.546	193945.17	1589
29	Net return	23934.38	28.546	71959.98	58.99
30	Output input ratio (GR/Cost-C)	7.55098	0.009	9.33	0.008
31	Per quintal cost of production	47830.3	57.045	42357.76	34.72
	B:C ratio	1.28		1.59	
	Cost C/Produce		6754.13		6027.61

Table 2: Distribution of Percent change in total cost of production / productivity quintal per hectare of red gram (BDN 711)

Sr. No.	Before		After		Increase total production (qtl)/Rs.	Percent change
	Total sown area	Total (qtl) /Rs.	Total sown area	Total (qtl)/Rs.		
1.	37.9633	12.41	37.9633	20.24	7.82	38.64%
2.		Rs. 6754.13		Rs. 6027.61	Rs.726.52	12.05%

From Table 2 concluded that the total sown area 37.9633 ha. before cultivation of BDN 711 production was 12.41 (qtl) increased up to 20.24 (qtl) whereas 38.64% change occurred before and after cultivation of BDN 711.Total cost of production per quintal Rs. 6754.13 before the cultivation of red gram (BDN 711) reduced up to Rs. 6027.61 which saves Rs.726.52 per quintal i.e. 12.05% cost savings was increased.

This result shows that due to cultivation of BDN 711 the farmers got more production upto 7.82 percent which comprises that increased the benefit in Rs. 726.57 per quintal approximately for every year.

The normal area under tur in Maharashtra is about 12.7 lakh hectare, then the production from BDN 711 acquired 20 qtl/ha. which receives 25400000 kg/ha. production and as per MSP given by government upto Rs.726.57/- farmers can saving per quintal hence it comprises Rs. 18400000/- earns more than another variety (Approximately Rs. 184 crores) after cultivation of BDN 711 in Maharashtra.

From this study result the inputs and outputs prices of commodities prevailed during the base year 2018 to 2022 were taken for calculating net return and benefit: cost ratio [Table-2]. The cultivation of pigeon pea under improved technologies gave higher net return after cultivation of BDN 711 Rs. 71959.98 per ha. over to before cultivation of BDN 711 Rs. 23934.38 which contribute increased with 58.99 percent than 28.54 percent. The benefit: cost ratio of pigeon pea cultivation under improved cultivation practices were increased 1.58 compared to 1.28 after cultivation of BDN 711. This may be due to higher yield obtained under BDN 711 variety compared to local other pigeon pea varieties.

The similar finding were with Pawar (2020) [33].

Change in total cost of production / productivity quintal per hectare of red gram (BDN 711)

From table 3 revealed that after cultivation of BDN 711 red gram variety the farmers has increased their annual income in Rs. 20316.67, followed by yield increased upto 7.82 qtl/ha., and saved cost of production upto 726.52 Rs./ha. Which shows changes in B:C ratio upto 0.31. The increased Net profit after cultivation of red gram BDN 711 Rs. 48025.60 per ha., also the cropping pattern got changed after harvesting of BDN 711 farmers could sow next crop like groundnut, which encompasses 33.33% area under selected area. BDN 711 variety has performed well in drought condition and if provided one or two irrigation if sources irrigation is available for major crops on irrigated farm that was hypothesis. This hypothesis has been proved because at some where irrigation facilities are available for major crops like cotton, wheat and Pigeon pea on irrigated farm.

Table 3: Distribution of change in total cost of production / productivity, B:C ratio, quintal per hectare of red gram (BDN 711)

Sr. No.	Particulars	Before cultivation BDN711	After cultivation BDN711	Change in Rs./(qtl/ha.)/ percent
1	Annual income	250226.4 (Rs.)	270543.07 (Rs.)	20316.67 (Rs.)
2	Yield	12.41 (qtl/ha.)	20.24 (qtl/ha.)	7.82 (qtl/ha.)
3	Cost of production	6754.13 (Rs./ha.)	6027.61 (Rs./ha.)	726.52 (Rs./ha.)
4	B:C ratio	1.28	1.59	0.31
5	Net profit	23934.38 (Rs./ha.)	71959.98 (Rs./ha.)	48025.60 (Rs./ha.)
6	Possibility of second crop	Pigeon Pea	Groundnut	33.33%

The similar findings revealed with Kauthekar (2015)

Conclusion

The cost concepts approach to farm costing is widely used in India. To work out the cost of cultivation standard method of cost of cultivation employed by Commission on Agricultural Costs and Price (CACP), Directorate of Economics and Statistics, Government of India was adopted which include Cost A1, Cost A2, Cost B1, Cost B2, Cost C1, Cost C2 and Cost C3. It conclude that the total sown area 37.9633 ha. Before cultivation of BDN 711 production was 12.41 (qtl) increased up to 20.24 (qtl) whereas 38.64% change occurred before and after cultivation of BDN 711 respectively. Total cost of production per quintal Rs.6754.13/- before the cultivation of red gram (BDN 711) reduced up to Rs.6027.61/- which saves Rs.726.52 per quintal i.e. 12.05% cost savings was increased.

The result shows that after cultivation of BDN 711 red gram variety the farmers has increased their annual income in Rs. 20316.67/- per ha.followed by yield increased upto 7.82 qtl/ha., and saved cost of production upto Rs.726.52/- per ha. which shows changes in B: C ratio upto 0.31. Increased Net profit after cultivation of red gram BDN 711 Rs.48025.60/- per ha., also the cropping pattern got changed after harvesting of BDN 711 farmers could be sowing next crop like groundnut, which encompasses 33.33% area under selected area. The normal area under tur in Maharashtra is about 12.7 lakh hectare, then the production from BDN 711 acquired 20 qtl/ha. which receives 25400000 kg/ha. production and as per MSP given by government upto 726.57/- farmers can saving per quintal hence it comprises Rs. 18400000 earns more than another variety (Approximately Rs. 184 crores) after cultivation of BDN 711 in Maharashtra.

These results clearly indicated that the higher average grain yield in farmer's field over the years compare to local check due to drought resistant of BDN-711 variety. The average yield of pigeon pea increased 32.64 Percent. The yield of pigeon pea could be increased over the yield obtained under farmer's practices of pigeon pea cultivation.

1) Funding

Dr. Babasaheb Ambedkar Research and Training Institute, Pune. Award no. BANRF2021/2135-579-21042023 recipient: Sangita Suresh Holmukhe Ph.D. Scholar.

2) Ethical approval

If applicable include the following details:

a. Full name of the committee that approved the research;

(R. P. KADAM) Research Guide & Chairman Advisory Committee
(P. S. KAPSE) Member
(A. S. LAD) Member
(D. K. PATIL) Member
(R. V. CHAVAN) Member

b. Confirmation that all research was performed in accordance with relevant guidelines/regulations applicable when human participants are involved (e.g. Declaration of Helsinki, or similar);- Not Applicable

c. If a study was granted exemption from requiring ethics approval, the reason for this should be explained in sufficient detail.-Not applicable.

3) Informed consent

This article does not contain any studies with human participants performed by any of the authors'.

4) Author's contribution

1) Holmukhe S.S is the researcher of the study & correspondence author, 2) Dr. Kadam R.P is the Research guide 3) Dr. Chavan R.V, committee member and guided to cost of production.

5) Conflict of interest

Dr. Babasaheb Ambedkar Research and Training Institute, Pune. Award no. BANRF2021/2135-579-21042023 recipient: Sangita Suresh Holmukhe PhD. Scholar has been provided partial instalment for research study.

6) Data availability statement

All original research has been included a data availability statement. Data availability statements included information on where data supporting the results reported in the article presented. Additional data can't provide the data in the case of copyright.

7) Acknowledgement
I am very fortunate that I got chance to research on ground level and with the farmers. T am thankful to my research guide and committee members to enlighten the path research will revitalize research studies in the extension. I am very much glad to inform you that this study based on the variety developed under VNMKV University.

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