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## Impact analysis of university released chickpea varieties on farm economy

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**Abstract**

In this study, impact analysis of university released chickpea varieties was analyzed and quantified using Partial budgeting approach. For this purpose varieties released by the AICRP, Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth Rahuri has been considered as they were appreciably performing with increasing adoption over time. The total additional cost (direct + indirect) of university released varieties over other competing varieties was observed to be Rs. 8231.00 per hectare. However, the reduced costs (or saving) and added returns due to university released varieties over other competing varieties was Rs. 25916.11. Thus, the total economic worthiness of university released chickpea production technology over other competing varieties of chickpea in the region was Rs. 17685.11 per hectare for the year 2017-18. The gross and net economic impact of chickpea variety to the farming community in Maharashtra state for the year (1990-91 to 2017-18) was Rs. 29120.37 crores and Rs. 6189.27 crores, respectively. Therefore, it is advocated that government may allocate substantial funds for research and extension in chickpea crop.

**Keywords:** Chickpea, economic impact, partial budgeting

**Introduction**

India ranks first in area and production of Chickpea in World contributing nearly 2/3<sup>rd</sup> area and production of chickpea in the World. India ranks 8<sup>th</sup> in chickpea productivity. It was revealed that Maharashtra state ranks second in area and production of chickpea in India. Madhya Pradesh ranks first in area and production of chickpea. However, in case of productivity Telangana ranks first and Maharashtra ranks seventh in productivity of chickpea. This was true in chickpea production of Maharashtra, as a result this crop continue to be the focus of attention for politician, policy makers, academicians and others. Maharashtra has made significant progress in the production of chickpea during the past three decades. In Maharashtra MPKV, Rahuri has released remarkable varieties of chickpea *viz.*, Vijay, Vishal, Digvijay, Phule G-5, etc., to increase the productivity which are tolerant to drought. These varieties are responsible for the socio-economic and political changes in the farming communities in Maharashtra. In this context, it was imperative to examine the impact of university released chickpea varieties on income generation. It was revealed from the study that, the university released Chickpea varieties were dominant in farmers filed and contributing nearly 75 per cent area to the total area under Chickpea in western Maharashtra. Among the different university released chickpea varieties Vijay was mostly (34%) preferred by the farmers followed by Digvijay (22.10%) and Vishal (16.15%).

**Selection of Study Area**

In Maharashtra area under chickpea was dominantly covered by the varieties released by All India Co-ordinated Research Project (AICRP) on Pulses, leading research station since 1973 under Mahatma Phule Krishi Vidyapeeth, Rahuri. So, AICRP on Pulses Improvement Project was purposively selected for the study. Both primary and secondary data were used for the study. The data regarding research and extension expenditure and out-come on agriculture research on chickpea crop was collected from the financial records of research station.

**Sources of Data**

The primary data regarding research investment, outcome of chickpea and seed cell was taken from Pulses Improvement Project, MPKV, Rahuri research unit. The year wise data regarding i) expenditure on research (ii) expenditure on pay and contingency (iii) expenditure on agriculture district wise development and extension etc. was collected and used in the analysis of the present study. The cost of cultivation of chickpea was collected from official record of state cost of cultivation scheme.

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## Analytical Tools

### Partial budgeting

The partial budgeting technique was used to find the economic viability of partial change in the farm such as use of new variety or new technology or new innovation or new practice or new equipment or new service. Partial budget approach was used for estimating the impact of research outcome on income generation. The partial budgeting is a method of organizing experimental data and information about the cost and benefits from some change in the technologies being used on the farm. Partial budgeting technique was used to capture the economic impact of the university released chickpea varieties. There are four components in partial budgeting. First, the added costs due to the new variety are considered. This includes list of all increased expenses due to new variety over the counterfactual (or control). In this study the control or check variety of chickpea was local variety. The second component was the reduced returns or reduced income due to new variety in relation to the counterfactual. The third component was the reduced costs due to new variety over the counterfactual which include reductions of certain expenses such as seed, bullock labour cost. The fourth component was the added income due to the new variety over the counterfactual, due to

increase in yield. The third and fourth component added to the 'returns side' or the credit side of the partial budget. The final step in partial budget was the summary indicated by the difference between the credit and the debit. The chickpea varieties were released from the year 1982 onwards. However, the majority and prominent varieties of chickpea were released after the 1989.

## Results and Discussion

### Area, Production, and Productivity of Chickpea

India was the largest producer of chickpea in the World. The area under chickpea in India was 1055.33 lakh hectares and production was 111.58 lakh tones with productivity of 1078 kg/ha during the year 2017-18. In India, Maharashtra ranks second with respect to area and production of Chickpea. In Maharashtra, the area under Chickpea was 20.00 lakh ha and production was 17.61 lakh tones with productivity of 880.50 kg/ha, during the year 2017-18 (Anonymous, 2017-18). In India three major states viz ; Madhya Pradesh, Maharashtra and Rajasthan together contributes more than 65 per cent area and 70 per cent production of the chickpea. The information on area, production, and productivity of chickpea during the year 2017-18 in major producing states and India is presented in Table 1.

**Table 1:** Area, production and productivity of chickpea in India (2017-18) (Area –Lakh ha, Production – Lakh tons and Productivity- q/ha)

Sr. No.	State	Area (Lakh ha)	Production (Lakh tons)	Productivity (qtls/ha)
1	Madhya Pradesh	35.90 (33.95)	45.95 (41.18)	12.70
2	<b>Maharashtra</b>	<b>20.00 (18.92)</b>	<b>17.61 (15.78)</b>	<b>8.80</b>
3	Rajasthan	13.75 (13.01)	14.71 (13.19)	10.60
4	Karnataka	13.75 (13.00)	8.25 (7.39)	6.00
5	Uttar Pradesh	6.11 (5.78)	6.84 (6.13)	11.20
6	Andhra Pradesh	5.21 (4.93)	6.76 (6.06)	12.90
7	Gujarat	2.95 (2.79)	3.62 (3.24)	12.20
8	Chhattisgarh	2.93 (2.77)	2.60 (2.33)	8.80
9	Jharkhand	2.33 (2.20)	2.03 (1.82)	8.70
10	Telangana	1.03 (0.97)	1.50 (1.34)	<b>14.50</b>
11	Others	1.77 (1.67)	1.50 (1.52)	8.40
	All India	105.73 (100.00)	111.58 (100.00)	10.50

(Fig in the parenthesis indicates percentage to the total India)

Source: Ministry of Agriculture and Farmers welfare, Govt. of India, 2017-18.

The region-wise compound growth rates of area, production and productivity of chickpea at different point of time in Maharashtra are presented in Table 2. The growth rates of area, production and productivity of chickpea for entire state was observed to be positive and highly significant at 1 per cent level of significance for the entire period of 37 year. The area, production and productivity of chickpea increased at the

rate of 4.01 per cent, 6.59 per cent and 2.48 per cent per annum, respectively during the entire period. Among the different periods, the performance of area, production and productivity of chickpea was satisfactory in period I, II, III and entire period. The period IV (2010-11 to 2017-18) was unsatisfactory due to consistent drought years from 2011-12 to 2014-15 for overall Maharashtra.

**Table 2:** Region wise CAGR of Chickpea in Maharashtra

Sr. No.	Particulars		Period				Overall (1980-2018)
			I (1980-90)	II (1991-00)	III (2001-10)	IV (2011-18)	
1.	Western Maharashtra	A	8.52***	4.59***	4.63***	6.2	2.82***
		P	13.47***	6.78***	9.38***	6.51	5.07**
		Y	4.57	2.09	4.54***	0.3***	2.19***
2.	Marathwada	A	0.8	5.67**	6.64***	7.55*	3.5***
		P	3.78	5.97	12.43***	3.89	6.04***
		Y	2.96	0.29	5.43***	-3.4	2.46***
3.	Vidarbha	A	10.21***	8.48***	14***	5.3**	6.12***
		P	14.49***	9.3*	20.61***	2.17	9.01***
		Y	3.88	0.76	5.8**	-2.97	2.72***
4.	Konkan	A	11.94***	2.65**	1.89*	-4.85	2.23***
		P	12.95***	5.02*	5.45***	-4.46	4.77***
		Y	0.9	2.3	3.36**	0.15***	2.46***

5.	Maharashtra	A	6.28***	5.88***	8.24***	6.25*	4.01***
		P	10.78***	7.22*	13.93***	4.49	6.59***
		Y	-4.24	1.26	5.25***	-1.65	2.48***

\*\* and\*\*\* indicate significance at 10, 5 and 1% level  
Varietal status of Chickpea varieties

The All India Co-ordinated Research Project on Chickpea (AICRP-Chickpea), MPKV Rahuri has released remarkable varieties of chickpea since its establishment. The important chickpea varieties released by MPKV, Rahuri since its establishment was presented in Table 3.

The varieties viz., Vikas and Vishwas were very old varieties released in the year 1982. These varieties were very popular amongst the farmers in earlier period. In between 1989 to 1995 university released another promising variety of Chickpea viz., Phule G-12, Vijay and Vishal which also occupied major area of chickpea. Among the three, Vijay variety was famous in farmers due its characters viz., high yield potential, wilt resistant, drought tolerant, suitable for rainfed, irrigated and late sown conditions. In the year 2001, university released a promising variety of chickpea viz., Virat, which was very famous in farming community due to its extra bold seed (Kabuli variety), wilt resistant, fetches higher market price etc. Hence, the seeds of all improved varieties of chickpea especially Vijay, Vishal, Virat, Digvijay, Phule G-12 were tremendously demanded by the farmers in Maharashtra and other states also.

In the year 2006 and 2009, MPKV, Rahuri has released another new variety Digvijay and Kripa. Recently university released two important varieties of chickpea viz., Phule Vikram and Phule Vikrant especially for mechanical harvesting. At present the area under Chickpea varieties

released by MPKV, Rahuri is 45-50 per cent to the total area under Chickpea of Maharashtra (Source: AICRP, MPKV, Rahuri).

**Table 3:** Year wise chickpea varieties released by AICRP-Chickpea, MPKV, and Rahuri

Sr. No.	Variety	Year of release
1	Vikas	1982
2	Vishwas	1982
3	Phule G-12	1989
4	Vijay	1993
5	Vishal	1995
6	Virat	2001
7	Vihar	2002
8	Rajas	2005
9	Digvijay	2006
10	Kripa	2009
11	Himali	2012
12	Phule Vikram	2016
13	Phule Vikrant	2017

The information on varietal spread of Chickpea on sample farms in western Maharashtra for the year 2018-19 is presented in Table 4. The data on area under different Chickpea varieties from 10 districts of western Maharashtra was collected. The total numbers of samples were 242.

**Table 4:** Variety wise area under chickpea varieties on sample farms (2018-19)

Sr. No.	Variety	Area (ha)	% to total area	Total area (%)
1	Vijay	32.15	34.36	75.15 (University released)
2	Vishal	15.11	16.15	
3	Digvijay	20.68	22.10	
4	Phule G-5	2.00	2.14	
5	Kripa	0.40	0.43	
6	Local	5.24	5.60	24.85 (Other varieties)
7	Annigiri	6.05	6.47	
8	Chafa	2.26	2.42	
9	Jocky	0.80	0.86	
10	Janki	0.50	0.53	
11	JG-11	8.37	8.95	
	Total	93.56	100.00	

It was revealed from the Table 4, that, the university released Chickpea varieties were dominant in farmers filed and contributing nearly 75 per cent area to the total area under Chickpea in western Maharashtra. Among the different university released varieties Vijay was mostly (34%) preferred by the farmers followed by Digvijay (22.10%) and Vishal (16.15%).

#### Economic Impact of the University Released Chickpea Varieties

Partial budgeting technique was used to capture the economic impact of the university released chickpea varieties. There are four components in partial budgeting. First, the added costs due to the new variety are considered. This includes list of all increased expenses due to new variety over the counterfactual (or control). In this study the control or check variety of chickpea was local variety. The second component was the reduced returns or reduced income due to new variety in

relation to the counterfactual. The third component was the reduced costs due to new variety over the counterfactual which include reductions of certain expenses such as seed, bullock labour cost. The fourth component was the added income due to the new variety over the counterfactual, due to increase in yield. The third and fourth component added to the 'returns side' or the credit side of the partial budget. The final step in partial budget was the summary indicated by the difference between the credit and the debit. The chickpea varieties were released from the year 1982 onwards. However, the majority and prominent varieties of chickpea were released after the 1989.

In Maharashtra farmers were grown university released different chickpea varieties across the different regions over a period of time. However, the area under university released chickpea varieties tremendously increased from their release year. At present, Vijay, Vishal, Digvijay, Phule G-5 and Kripa contribute 50-60 per cent share of chickpea cultivation in the

state. Hence, it was decided to estimate the economic impact of the university released chickpea varieties. The most of chickpea varieties were released from the year 1989 onwards. Hence, it was decided to estimate the economic impact of chickpea varieties on farmer economy from the 1990

onwards. Debit and credit side of partial budgeting is presented in Table 5. The list of all increased expenses due to new variety over the counterfactual were presented in the Table.

**Table 5:** Economic Impact of the University Released Chickpea Varieties

Debit side	Cost (Rs./ha)	Credit Side	Cost (Rs./ha)
Particulars		Particulars	
A. Item of added expenditure due to cultivation of chickpea varieties		B. Reduced cost (or saving) due to cultivation of university released varieties	0.00
i. Additional total human labour cost	3480.82		
ii. Additional machine cost	1619.28		
iii. Addition in bullock labour cost	496.41		
iv. Addition on seed cost	482.82		
v. Additional chemical fertilizer cost	871.74		
viii. Addition in irrigation	10.73		
ix. Addition on plant protection	238.52		
ix. Total additional cost	7200.32	Total saving due to cultivation of university released varieties	0.00
x. Opportunity cost of capital @ 6% per annum for 6 month	216.01		
xi. Management cost @ 5%	360.02		
xii. Risk premium @ 5%	360.02	D. Added returns from university released varieties	25916.11
xiii. Research cost per ha.	69.53	6.62 qtl. added main produce @ 3914.82/qts.	
xiv. Extension cost per ha.	25.11		
Total additional cost due to cultivation of university released chickpea variety.	8231		
B. Reduced returns due to cultivation of improved chickpea varieties	0		
Total debit side	8231	Total credit side	25916.11

Table 5 revealed that. economic impact of university released chickpea production technology over competing varieties of chickpea in the region was Rs. 17685.11. Table 5 reveals that, the total additional cost (direct + indirect) of university released varieties over other competing varieties was observed to be Rs. 8231.00 per hectare.

However, the reduced costs (or saving) and added returns due to university released varieties over other competing varieties was Rs. 25916.11. Thus, the total economic worthiness of university released chickpea production technology over other competing varieties of chickpea in the region was Rs. 17685.11 per hectare.

### Upscaling the Economic Impact

In order that the results of the partial budgeting was applicable for wider area under university released chickpea varieties, linear extrapolation of the benefits of Rs. 17685.11 per ha was not tenable due to operation of the law of

diminishing marginal returns at an early stage in agriculture. Accordingly, to reflect the operation of LD MR, three parameters such as i) Probability performance of the technology, ii) Rate of adoption of the technology and iii) Depreciation in the technology are applied in linear extrapolation.

These implicitly capture the operation of the LD MR since the field conditions are not akin to the lab conditions and the farmer was different from the researcher. The upscaling the economic impact of chickpea research was presented in Table 6.

Accordingly the ultimate economic impact of chickpea per hectare works out to  $17685.11 * 0.7 * 0.79 * 1 =$  Rs. 9779.87. The area under university released chickpea varieties for the year 2017-18 was 518282.70 ha. So, the total economic impact to the farming community in Maharashtra state was Rs. 506.87 crores for the year 2017-18.

**Table 6:** Upscaling the economic impact chickpea covering the area of adoption

Sr. No.	Economic Impact of University Released Chickpea Varieties	Value
1	Probability performance of Chickpea variety	0.7
2	Rate of adoption of Chickpea variety	0.79
3	Depreciation of technology (if 1, No depreciation)	1
4	Economic worthiness of university released variety per ha	Rs. 17685.11
5	Economic impact of university released variety per ha	Rs.9779.87
6	Area adopted under university released Chickpea in 2017-18	518282.70 ha
7	Economic impact for the year 2017- 18	Rs. 5068737429 i.e. 506.87Crores

The upscaling the economic impact of chickpea covering the area of adoption was presented in Table 6. It was revealed from the Table 6 that, the ultimate total economic impact per hectare of university released chickpea varieties works out to  $Rs. 17685.11 * 0.7 * 0.79 * 1 =$  Rs.9779.87 per ha subsuming the operation of LD MR. This benefit of Rs. 9779.87 per ha was

linearly extrapolated to cover the area 518282.70 ha under the university released variety of chickpea, to obtain Rs. 506.87 crores in the year 2017-18. Similar observations were reported by Suresh and Chandrakanth (2015), Pokharkar (2000)<sup>[4]</sup>, Kulkarni (2018)<sup>[3]</sup> and Adhale (2019)<sup>[1]</sup>.

### Total Economic Impact of Chickpea Varieties in Maharashtra

The total economic impact of chickpea varieties for 28 years (from 1990-91 to 2017-18) has been estimated and presented in the Table 7. The gross and net gain from university released varieties for the year 2017-18 over check variety has been deflated on the basis of Consumer Price Index (CPI). It was noted from the Table that the net and gross economic impact of chickpea varieties to the farming community in Maharashtra state for the 28 years was Rs. 6189.27 crores and

Rs. 29120.37 crores.

The area under university released chickpea varieties was estimated on the basis of seed sell by University, Mahabeej, NSC, farmers to farmers etc. However, the data on actual seed sell of chickpea varieties from different agencies was not available. Hence, the area under university released chickpea varieties was estimated on the basis of breeder seed produced by the university. Breeder seed was converted into foundation and certified seed. The estimated area under university released chickpea varieties are given in Table 7.

**Table 7:** Economic Impact of Chickpea Varieties in Maharashtra

Sr. No.	Year	Gross Gain (Rs/ha)	Net Gain (Rs /ha)	Area (MS+OS) (ha)	Net Economic Impact (Rs. Crores)	Gross Economic Impact (Rs. Crores)
1	1990-91	5512.36	1171.60	166400	19.50	91.73
2	1991-92	6372.67	1354.46	108864	14.75	69.38
3	1992-93	7072.89	1503.28	137632	20.69	97.35
4	1993-94	7629.87	1621.66	32460	5.26	24.77
5	1994-95	8505.99	1807.87	188800	34.13	160.59
6	1995-96	9451.10	2008.75	111360	22.37	105.25
7	1996-97	10431.68	2217.16	290432	64.39	302.97
8	1997-98	11192.78	2378.93	273280	65.01	305.88
9	1998-99	12880.07	2737.55	398080	108.98	512.73
10	1999-2000	13658.62	2903.02	327136	94.97	446.82
11	2000-01	14198.15	3017.69	185433.6	55.96	263.28
12	2001-02	14836.10	3153.28	177408	55.94	263.20
13	2002-03	15454.27	3284.67	163776	53.79	253.10
14	2003-04	16081.44	3417.97	225216	76.98	362.18
15	2004-05	16716.68	3552.98	235904	83.82	394.35
16	2005-06	17486.07	3716.51	289120	107.45	505.56
17	2006-07	18741.76	3983.40	281920	112.30	528.37
18	2007-08	19980.56	4246.69	334720	142.15	668.79
19	2008-09	21980.81	4671.83	494494.4	231.01	1087.00
20	2009-10	25063.64	5327.06	332064	176.89	832.27
21	2010-11	28004.07	5952.02	527632	314.04	1477.58
22	2011-12	30943.72	6576.81	545609.6	358.83	1688.31
23	2012-13	34381.91	7307.57	727427.2	531.57	2501.03
24	2013-14	37949.13	8065.75	1067711.8	861.18	4051.87
25	2014-15	40285.7	8562.37	882118.4	755.30	3553.67
26	2015-16	42361.41	9003.54	902485.3	812.55	3823.05
27	2016-17	44357.5	9427.79	533056	502.55	2364.50
28	2017-18	46014	9779.87	518282.7	506.87	2384.82
f	Total				Rs 6189.27 crores	Rs 29120.37 crores

### Conclusions

The area under chickpea in Maharashtra state was found to be more stable and consistent rather than production and productivity. The gross and net economic impact of chickpea variety to the farming community in Maharashtra state for the 28 years was Rs 29120.37 crores and Rs.6189.27 crores, respectively. Therefore, it was recommended that the state government may provide substantial funds for research and extension in chickpea crop.

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