

**RESEARCH ARTICLE :**

# Comparative economic analysis of chickpea cultivation in mechanized and non-mechanized farms of India

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**SUMMARY :** The present study examines the extent of mechanization, cost and returns of manual and mechanical harvesting and threshing of chickpea. A multistage sampling procedure was adopted for the selection of study area, sample farmers and machine owners. The sample size for the study was 90 comprised of 60 chickpea growing farmers and 30 machine owners. Farm budgeting and tabular analysis was used to analyze the data. The data pertained to the agriculture year 2013-14. About 70 per cent of the sample farmers harvested chickpea engaging human labour and threshed it with machine and remaining 30 per cent of the sample farmers have used machine both for harvesting and threshing. On an average both states together, total human labour, bullock labour and machine hours utilized in the study areas was found to be 33.66 man days, 5.39 pair days and 4.69 hours, respectively. Although the quantities of inputs used were less per acre, the total expenditure incurred on these inputs was more in case of Maharashtra (Rs.13,443.88/ha) when compared to Madhya Pradesh (Rs.12,133.73/ha). The benefit-cost ratio indicated that chickpea cultivation was found to be economically viable for the farmers in the study states. The net profit of mechanical harvesting and threshing over manual harvesting and machine threshing was Rs. 2613 and Rs.3044 in Maharashtra and Madhya Pradesh, respectively.

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**BACKGROUND AND OBJECTIVES**

Chickpea or chana is an important pulse crop from the point of view of food basket for growing population in the country. Scientifically is named *Cicer arietinum* belonged to Leguminosae family. Chickpea is a highly nutritious pulse crop and placed third in the list of the food legumes that are cultivated throughout the world. It contains

25 per cent proteins and 60 per cent carbohydrates. There are mainly two types of chickpea produced *i.e.* Desi and Kabuli. The Desi type chickpea contribute to around 80 per cent and the Kabuli type around 20 per cent of the total chickpea production. India is the largest producer of chickpea of around 6 million tons followed by Pakistan, Turkey and Iran and contributes to around 70% of

the world's total chickpea production. The major producing countries of Desi chickpea are India, Pakistan, Myanmar, Australia and Bangladesh. Countries like Turkey, Iran, Ethiopia, Mexico, Syria, Spain, Canada, United States, Algeria, Ethiopia, Malawi, Sudan, Tanzania, Tunisia, Spain and Portugal are the major producers of Kabuli chickpea. Chickpea producing states in India are Madhya Pradesh, Uttar Pradesh, Rajasthan, Maharashtra and Andhra Pradesh. Madhya Pradesh has major share *i.e.* around 40 per cent in the India's chickpea production. India also exports chickpea to different countries namely USA, UK, Saudi Arabia, UAE and Sri Lanka. The major trading centers of Chickpea in India are Indore (Madhya Pradesh), Bhopal (Madhya Pradesh), Vidisha (Madhya Pradesh), Jalgaon (Maharashtra), Latur (Maharashtra), Mumbai (Maharashtra), Akola (Maharashtra), Jaipur (Rajasthan), Bikaner (Rajasthan), Kota (Rajasthan), Jodhpur (Rajasthan), Sriganaganagar (Rajasthan), Hanumangarh (Rajasthan), Delhi, Chennai, Kanpur, Hapur, Hyderabad, Vijayawada, Gulbarga, Sirsa, Jalandhar, Ludhiana and Sangrur.

The important issue in chickpea cultivation is mechanization. Since India is primarily an agricultural country. Over the ages, Indian farmers have mainly used human and animal power and traditional methods were passed onto them by their ancestors for cultivation of various agricultural crops. There was not much use of mechanical power in farming practices. These traditional farming practices are time consuming, require a large number of costly human labour and effort. Indian agriculture is undergoing a gradual shift from dependence on human power and draft animal power (DAP) to mechanical power in recent years in view of high maintenance cost of DAP and manual labour. Hence mechanical power has become more economical and indispensable to meet targets of timeliness and thereby ensure a substantial reduction in cost of cultivation. With increasing scarcity of labour farmers are shifting towards adoption of mechanization of agricultural operations during various stages of crop cultivation and their harvesting. Use of high capacity and energy efficient farm implements are more important in adjusting to changing climate conditions in the recent years. This includes limited sowing period available due to delayed monsoon or long dry spells between rainfall events to complete farm operations. It is also relevant for various intercultural practices such as weeding or harvesting.

Further, farm power availability from human and animal power sources has reduced considerably during past 20 years (0.24 Kw/ha in 1951 to 0.20 Kw/ha in 2009). Farm power from tractors and electrical sources put together has increased 20 fold in the same period (0.04 Kw/ha in 1950 to 0.93 Kw/ha in 2009). The present study has made an attempt to analyze the profitability of chickpea cultivation in mechanized and non-mechanized farms in two major chickpea growing states *viz.*, Maharashtra and Madhya Pradesh in India with the following specific objectives.

- To analyze and document current status on mechanical and manual harvesting of chickpea in two major chickpea production pockets of India.
- To study the labour and input utilization pattern in chickpea cultivation.
- To study the cost and returns of manual and mechanical harvesting and threshing of chickpea.

## RESOURCES AND METHODS

A multistage sampling procedure was adopted for the selection of study area and the sample farmers. In the first stage, Maharashtra and Madhya Pradesh states were selected purposively as the states were the chickpea bowls of India. From each state one major district with highest areas under chickpea was selected namely, Ahmednagar and Vidisha, respectively from Maharashtra and Madhya Pradesh. From each district, two taluks namely Rahuri and Sangamner from Ahmednagar and Basoda and Sironj from Vidisha districts were selected as they were having highest area under chickpea. From each taluk three villages were selected and from each village five farmers growing chickpea were selected for the purpose of evaluating objectives. Thus, for each taluk a sample size selected was 15 farmers constituting 30 for each district. From each selected district, 15 machine owners (persons carrying out custom hiring services) were selected. Thus, from each state 30 chickpea farmers and 15 machine owners were selected and thereby the final sample size for the study states was in all 90 (60 chickpea farmers and 30 machine owners). The primary data required for the study was collected from the sample farmers and machine owners adopting personal interview method using pre-tested schedule prepared for the purpose. The primary data related to general characteristics, land holding, cropping pattern, cost and return in chickpea cultivation, input utilization, herbicide

usage, labour utilization pattern for different farm operations, yield and income, different methods of harvesting and threshing of chickpea, advantages and constraints in each method of harvesting and threshing of chickpea in the study area. The machine owners were interviewed to know the cost and returns of owning combined harvesters and threshers.

### Analytical techniques employed :

#### *Budgeting technique :*

To assess the costs and returns in the production of chickpea and economics of owning different machines.

#### *Tabular analysis:*

The descriptive statistics like averages, percentages, etc were used and tabulated to compile the data on socio-economic characteristics of farmers and the machine owners, resource use pattern, cost and return structure to ensure the meaningful interpretation of information.

## OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

### Use of machine for harvesting and threshing of chickpea :

The use of machine for harvesting and threshing of chickpea crop in Maharashtra and Madhya Pradesh is presented in table 1. Manual harvesting and threshing by machine was found to be more predominant among the farmers in both states than undertaking both harvesting and threshing of chickpea crop by machines. The harvesting manually and threshing by machine was evident both in terms of adoption by a considerable proportion of farmers and also a large extent of area covered under this practice. Among the states, in Maharashtra, about 70 per cent of the farmers covering an area of 63.79 per cent harvested the chickpea crop manually and threshed

it using machines and the remaining 30 per cent of them undertook both harvesting and threshing using machines covering an area of 36.21 per cent. On the other hand, in case of Madhya Pradesh, about 56.67 per cent of the sample farmers harvested chickpea manually by using human labour and threshed it using machine covering an area of 50.80 per cent and about 43.33 per cent of them used machine labour both for harvesting and threshing and the extent of chickpea area covered was 49.20 per cent. Overall, out of 60 sample farmers from two states, 63.33 per cent of the farmers harvested chickpea by human labour and threshed it using machine on an area of 55.77 per cent while, about 36.67 per cent of them undertook both harvesting and threshing using machine covering an area of 44.23 per cent.

### Operation wise labour utilization pattern in chickpea cultivation :

Operation wise labour utilization pattern in chickpea cultivation is presented in Table 2. The total human labour, bullock pair days and machine hours utilized by sample farmers in Maharashtra were 31.79 man days, 4.43 pair days and 4.07 hours, respectively. While, the same utilized by sample farmers in Madhya Pradesh were 35.53 man days, 5.57 pair days and 3.39 hours, respectively. On an average both states together, total human labour, bullock labour and machine hours utilized in the study areas was found to be 33.66 man days, 5.39 pair days and 4.69 hours, respectively. The critical analysis on the intensity and amount of human labour, bullock and machine power used exhibited a similar trend across study states in the cultivation of chickpea crop. Hence, in both the states, weeding operation required more human labour per acre followed by sowing and harvesting operations. The extent of labour for weeding was 8.54 man days in Maharashtra and 10.11 man days in Madhya Pradesh. More bullock pair days were used for harrowing both in Maharashtra (2.58 pair days) and Madhya Pradesh (2.36 pair days). Similarly, the extent of machine labour used was more

Sr. No.	Harvesting method	Maharashtra n=30		Madhya Pradesh n=30		Overall	
		Number	Area	Number	Area	Number	Area
1.	Harvested by human labour and threshed using machine	21 (70.00)	5.46 (63.79)	17 (56.67)	7.01 (50.80)	38 (63.33)	6.24 (55.77)
2.	Both harvesting and threshing by machine	9 (30.00)	3.1 (36.21)	13 (43.33)	6.79 (49.20)	22 (36.67)	4.95 (44.23)
	Total	30 (100)	8.56 (100)	30 (100)	13.8 (100)	60 (100)	11.18 (100)

for ploughing operation in Maharashtra (2.55 hours) and Madhya Pradesh (3.32 hours).

### Input utilization pattern and cost of inputs :

Table 3 presents the input utilization pattern and cost of inputs per acre of chickpea cultivation in the study area. The quantity of seeds, FYM, urea, DAP, herbicides and PPC used by the sample farmers in Maharashtra were 63.83 kg, 4.30 tons, 29.28 kg, 104.83 kg, 1.15 lit and 108.78 ml, respectively. In Madhya Pradesh, the corresponding quantities of inputs like seeds, FYM, urea,

DAP, herbicides and PPC were 75.80 kg, 2.50 ton, 38.63 kg, 125.30 kg, 1.28 lit and 110.83 ml respectively. It could be seen from the results that quantities of inputs such as seeds, fertilizers, and herbicides were relatively more in case of farmers of Madhya Pradesh when compared to farmers of Maharashtra. Although the quantities of inputs used were less per acre, the total expenditure incurred on these inputs was more in case of Maharashtra (Rs.13,443.88/ha) when compared to Madhya Pradesh (Rs.12,133.73/ha) and this could be attributed to differences in the unit prices of inputs.

Sr. No.	Operations	Maharashtra	Madhya Pradesh	Overall
		(n=30)	(n=30)	
1.	<b>Human labour (man days)</b>			
	Harrowing	2.13	2.07	2.1
	FYM transport and application	1.69	1.33	1.51
	Application of chemical fertilizers	1.82	1.96	1.89
	Sowing	6.32	6.89	6.605
	Weeding	8.54	10.11	9.325
	Spraying of PPC	0.72	0.63	0.675
	Preparation of irrigation canals	0.88	0.96	0.92
	Irrigation	1.36	1.47	1.415
	Harvesting	5.1	6.23	5.66
	Threshing	3.23	3.88	3.55
	Sub total	31.79	35.53	33.66
2.	<b>Bullock pair (pair days)</b>			
	Harrowing	2.58	2.36	2.47
	Sowing	1.83	2	1.915
	Transportation of manure	1.16	1.03	1.095
	Sub total	4.43	5.57	5.39
3.	<b>Machine labour ( hours)</b>			
	Ploughing	2.55	3.32	2.935
	Sowing	0.52	0.91	0.715
	Transportation of manure	0.32	0.46	0.39
	Sub total	4.07	3.39	4.69

Sr. No.	Particulars	Unit	Maharashtra (n=30)		Madhya Pradesh (n=30)		Overall	
			Quantity	Amount	Quantity	Amount	Quantity	Amount
1.	Seeds	Kg	25.53	893.55	30.32	1273.44	27.93	1083.50
2.	FYM	Tonne	1.72	2924	1.00	1733	1.36	2328.5
3.	Chemical fertilizers							
	Urea	Kg	11.71	161.43	15.45	212.99	13.58	187.21
	DAP	Kg	41.93	470.36	50.12	562.23	46.03	516.29
4.	Herbicides	lit	0.46	564.81	0.51	678.6	0.485	621.71
5.	Plant protection chemicals(PPC)	ml	43.51	363.4	44.33	393.23	43.92	378.32
	Total cost			5377.55		4853.49		5115.52

### Cost of cultivation of chickpea :

The comparative cost of cultivation of chickpea crop in the study states (Table 4) indicated that the total variable cost incurred per hectare of chickpea cultivation in Madhya Pradesh was substantially (Rs.38,265.85) more than in Maharashtra (Rs. 36,267.78) while, the overall for both states together was Rs. 37,266.85. Thus, a higher cultivation cost in Madhya Pradesh was mainly attributed to a marginally higher costs associated with cost of seed, fertilizers, herbicides, human labour and due to higher rates for hiring machines. However, the cost on human labour was found to be highest in both the states and was found to be Rs. 8797.50 and Rs. 9532.50 respectively in Maharashtra and Madhya Pradesh. The major varieties cultivated in both the states were JG-315, Vishal, JG-9305 while, some farmers across states cultivated local varieties of spreading type. Cost on FYM was found to be 7310 and Rs.4332.50, respectively in Maharashtra and Madhya Pradesh. The other major inputs on which a substantial cost was incurred were fertilizers, bullock and machine labour.

### Cost and returns in cultivation of chickpea :

The cost and returns structure in the cultivation of

chickpea is depicted in Table 5 and the perusal of the results in table showed that the farmers harvested on an average 20.9 quintal of main product and 8.55 quintals of by-product per hectare. It could be observed that per hectare productivity was relatively higher in Madhya Pradesh as compared to Maharashtra. The higher productivity performance of chickpea crop in Madhya Pradesh over Maharashtra was evident in the study conducted for the period from 2000-01 to 2010-11 by Kadli (2013) in addition to Madhya Pradesh having highest area and production under chickpea during said period. The gross returns, net returns and B:C Ratio was found to be Rs. 76,285, Rs. 40,017.22 and 2.10 respectively for Maharashtra. Whereas, the corresponding gross and net returns and B.C ratio were higher at Rs. 91,179.58, Rs. 52,913.73 and 2.38 respectively for Madhya Pradesh. The benefit-cost ratios indicated that chickpea cultivation was found to be economically viable for the farmers in the study states. Interestingly, the price per unit of main and by products remained almost on par across states and hence it could be inferred from the results that the highest returns were mainly attributed to higher productivity per unit area in Madhya Pradesh.

Sr. No.	Particulars	(n=60)		
		Maharashtra (n=30)	Madhya Pradesh (n=30)	Overall
1.	Seed	893.55	1273.44	1083.50
2.	FYM	2924.00	1733.00	2328.50
3.	Fertilizers	631.79	775.22	703.50
4.	Plant protection chemicals	363.40	393.23	378.32
5.	Herbicides	564.81	678.60	621.71
6.	Human labour	3519.00	3813.00	3666.00
7.	Bullock pair	1949.50	1886.50	1918.00
8.	Machine labour	2712.00	3752.00	3232.00
9.	Interest on working capital (7%)	949.06	1001.35	975.21
Total variable cost (TVC)		8743.59	14507.11	15306.34

Particulars	(n=60)								
	Maharashtra (n=30)			Madhya Pradesh (n=30)			Overall		
	Qty	Price	TR	Qty	Price	TR	Qty	Price	TR
Main product	8.36	3200	26752	9.48	3291.67	31205	8.92	3245.83	28978.5
By product	3.42	1100	3762	4.56	1155	5266.8	3.99	1127.5	4514.4
Gross return			30514			36471.8			33492.9
Total cost			14507.11			15306.34			14906.72
Net return			16006.89			21165.46			18586.18
B : C ratio			2.10			2.38			2.25

### Cost and returns of manual and mechanical harvesting and threshing of chickpea :

The critical analysis of pattern of harvesting of chickpea crop by farmers across states was attempted to know the net gain to the farmers. Table 6 depicts comparative costs and returns realized by farmers through manual harvesting of crop and threshing by machine and both harvesting and threshing by mechanical means across states. The farmers in both states adopted both the methods for chickpea harvesting. The sample farmers of Maharashtra and Madhya Pradesh, respectively incurred Rs. 3549.08 and Rs. 4191.68 in manual harvesting of chickpea using labour and a cost of Rs.3064.38 and Rs.3352.1 towards threshing of chickpea in that order. Where in threshing included cost of machines for grain separation along with manual winnowing, cleaning, drying/bagging. Thus, put together, the farmers of Maharashtra and Madhya Pradesh incurred cost of Rs. 6613.46 and Rs. 7543.78 in manual harvesting and mechanical threshing of chickpea. On the other hand, the cost incurred by farmers in mechanical harvesting and threshing of chickpea was Rs. 1600 and Rs. 1800 respectively in Maharashtra and Madhya Pradesh. The net profit gained by farmers per acre by way of undertaking both harvesting and threshing using mechanical means over that of manual harvesting and

machine threshing was quite substantial and was Rs. 989.63 in Maharashtra and Rs.1168.67 in Madhya Pradesh. Thus, it could be very well be inferred that development of suitable erect and tall chickpea varieties which are convenient for both mechanical harvesting and threshing ensure not only economic gains to farmers but also save in time besides escaping labour scarcity coinciding harvesting period. In addition to the direct benefit realized by farmers, they have the advantage of preparing the produce for the market to gain from price advantage.

### Conclusion :

Chickpea is emerging as a major pulse crop in *Rabi* season and in such context mechanization is one such technology which will help to overcome the problem of labour scarcity and high wage rates during harvesting and threshing operations. It is evident from the study that, the mechanical method of harvesting and threshing of chickpea was found to be profitable over manual harvesting. No doubt small and marginal farmers can't afford machines like combined harvester for mechanization. Therefore, co-operative model of custom hiring facility should be popularized both by private and public agencies to increase the peace of mechanization in India and to facilitate easy availability of machines to

**Table 6: Cost and returns of manual and mechanical harvesting and threshing of chickpea (Rs./acre)**

Sr. No.	Particulars	Maharashtra (n=30)				Madhya Pradesh (n=30)					
		No of labors used		Machine labor		Total cost Rs.	No of labors used		Machine labor		Total cost Rs.
		Men	Women	Rs./ Bag	Avg. bag		Men	Women	Rs./ Bag	Avg. bag	
1.	Harvesting										
	Uprooting of matured chick pea plants	3	4	-	-	1419.63	2	6	-	-	1676.67
	Assembling, bundling, transportation, heaping										
2.	Threshing										
	Shelling (grain separation from pods and plants)	4	2	65	18	1225.75	3	3	68	19	1340.84
	Winnowing and cleaning										
	Drying/bagging										
	Transportation										
	Total cost					2589.63					2968.67
3.	Mechanical harvesting cum threshing										
	Harvesting and threshing by machine					1600					1800
4.	Net benefit of mechanical harvesting										
	Over Manual cum machine method					989.63					1168.67

the farmers.

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