

# Cost of cultivation and resource use efficiency of major rabi crops in vidisha district of Madhya Pradesh

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## ABSTRACT

The present study has been made to work out the cost of cultivation, resource use efficiency, profitability and constraints of wheat and chickpea production in Vidisha district of Madhya Pradesh. The study is based on primary data, collected from 40 wheat and 40 chickpea cultivators in Vidisha district through interview schedule. The cost of cultivation of wheat was found higher (Rs. 28037.18/ha) in comparison to chickpea (Rs. 23899.00/ha). The variable cost was 57.86% and 55.46% of the total cost of wheat and chickpea cultivation, respectively. The Cost  $A_1$  was 56.87% and 55.15% of the total cost of wheat and chickpea, respectively. The family labour and seed have a positive and significant impact on the productivity of wheat. The only fertilizer has a positive and significant impact on the productivity of chickpea. The 0.554 and 0.616 return to scale from the cultivation of wheat and chickpea respectively shows decreasing return to level. The gross income, net income, farm business income, farm investment income, contribution margin, margin safety, break even point and benefit cost ratio of wheat were higher in comparison to chickpea. The benefit-cost ratio was higher in wheat (1:2.18) compared to chickpea (1:1.97).

**Keywords:** Costs, resource use efficiency, profitability, break-even point, benefit-cost ratio

Wheat and chickpea are important crops of *Rabi* season in Vidisha district. Both are occupying more than 80% area of total *Rabi* season. Wheat plays important role in

fulfillment of food requirement of human and animals. The production is 16517 thousand tonnes from area of 5613.10 thousand hectare with productivity of 2948 kg/ha of wheat. The chickpea is cultivated for income generation and to improve physical, chemical and biological properties of soils. The area and production are 2722.36 thousand and 3321.09 thousand tonnes, respectively with productivity of 1221 kg per hectare of chickpea in the state in 2012-13(GOI).

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The Specific objectives of the study are given below:

1. To estimate the cost of cultivation and resource use efficiency of wheat as well as chickpea crops
2. To estimate profitability of wheat as well as chickpea cultivation
3. To work out the various production constraints of wheat as well as chickpea cultivation faced by cultivators.

### MATERIALS AND METHODS

On the basis of highest cultivated area under wheat and chickpea in *Rabi* season were selected for the study. The present study was confined to Vidisha districts which have seven blocks viz., Vidisha, Ganj Basoda, Kurbai, Sironj, Nateran, Gyaspur and Latery. Three stage random sampling design, i.e. block, village and cultivators. The Ganj Basoda block from Vidisha district was selected randomly and in which two villages were further selected for collection of primary data from wheat and chickpea cultivators. A list of all the wheat and chickpea cultivators of these selected villages was prepared. Thus, the sampling unit comprised of 80 cultivators in which 40 wheat cultivators and 40 chickpea cultivators were selected to taken information through interview schedule. The primary data were collected from sample respondents through pre-tested interview schedule for the agricultural year 2014-15. The cost of cultivation of wheat as well as chickpea was estimated under various cost concepts.

Cost  $A_1$  = Value of hired human labour, hired bullock labour, owned bullock labour, hired machine labour, owned machine labour, value of seed (both farm produced and purchase), value of insecticide and pesticides, value of manure (owned and purchased) , value of fertilizer, depreciation on implements and farm buildings, irrigation charges, land revenue and other taxes, interest of working capital and miscellaneous expenses (artisans etc.).

Cost  $A_2$  = Cost  $A_1$  + rent paid for leased in land

Cost  $B_1$  = Cost  $A_1$  + interest on value of owned fixed capital assets (excluding land).

Cost  $B_2$  = Cost  $B_1$  + rental value of owned land and rent paid for leased- in land.

Cost  $C_1$  = Cost  $B_1$  + imputed value of family labour.

Cost  $C_2$  = Cost  $B_2$  + imputed value of family labour.

Cost  $C_3$  = Cost  $C_2$  + value of management input at 10% of cost  $C_2$  (<http://eands.dacnet.nic.in>). The cost concepts were used for estimation of wheat and chickpea cultivation, which are adopted by the Commission for Agricultural Cost and Price, Ministry of Agriculture, GOI. The profitability may be calculated by using various economic formulas:

Gross Income	=	(Main Product X Price per unit) + (By Product X Price)
Net Income	=	Gross income - Cost C3
Farm Business Income	=	Gross Income – Cost A1
Family Labour Income	=	Gross Income – Cost B2
Farm Investment Income	=	Net Income + Rental value of owned land + Interest on fixed capital
Benefit Cost Ratio	=	Gross Income/ Cost C3
Break Even Point	=	Fixed cost / (Price (Rs. /q) - Variable cost per q.)
Contribution margin	=	Price per unit of output- variable cost per unit
Margin of safety	=	Total out put- Output at BEP
Cost of production	=	(Total cost – Value of straw material)/Yield

Input use efficiency of wheat as well as chickpea production can be calculated by using following Cobb-Douglas production function.

$$Y = ax_1^b x_2^b x_3^b x_4^b x_5^b x_6^b x_7^b$$

$$\text{Log } Y = \text{Log } a + b^1 \log x_1 + b^2 \log x_2 + b^3 \log x_3 + b^4 \log x_4 + b^5 \log x_5 + b^6 \log x_6 + b^7 \log x_7$$

Where:

Y = Productivity (₹/ha), Dependent variable

A = Constant / intercept value

$X_1$  = Hired human labours (₹/ha)

$X^2$  = Family labours (₹/ha)

$X^3$  = Machine labours (₹/ha)

$X^4$  = Seeds (₹/ha)

$X^5$  = Fertilizers (₹/ha)

$X^6$  = Plant protection materials (₹/ha)

$X^7$  = Irrigation charges (₹/ha)

The collected data were processed to work out the various costs, profitability with the help of various cost concept and profitability concept and identify the constraints in cultivation of wheat and chickpea faced by cultivators.

## RESULTS AND DISCUSSION

### *Cost of cultivation of wheat and chickpea*

The cost of cultivation of wheat (Table 1) was ₹ 28037.18 per hectare whereas chickpea ₹ 23899.00 per hectare. The rental value of owned land of wheat was higher (₹ 7500.00/ha) than chickpea (₹ 7100/ha). In case of variable cost, wheat cultivators spend highest expenses on machine power (₹ 3694.06/ha) followed by irrigation charges (₹ 3422.74/ha), fertilizers (₹ 2598.74/ha), hired human labours (₹ 2324.59/ha), seed (₹ 1764.65/ha), family labour (₹ 1289.62/ha), plant protection (₹ 578.50/ha) and interest on working capital (548.55/ha). The cultivators of wheat spend expenses of ₹ 16221.45, ₹ 9266.90, and ₹ 2548.83 per hectare on variable cost, fixed cost and managerial cost, respectively which contributes 57.86%, 33.05% and 9.09% to the total cost of cultivation, respectively. The variable cost of ₹ 13255.04 per hectare and fixed cost of ₹ 8471.33 per hectare were recorded for chickpea cultivation. In case of variable cost, chickpea cultivators spend more expenses on seed (₹ 3305.60/ha) followed by hired human labours (₹ 3295.20/ha), machine labour (₹ 1882.40/ha), plant protection materials (₹ 1267.20/ha), fertilizers (₹ 1210.40/ha), irrigation charges (₹ 960.00/ha), family labour (₹ 886.00/ha) and interest on working capital (₹ 448.24/ha).

**Table1:** Break up cost of cultivation of wheat and chickpea (₹/ha)

Particulars	Wheat	Chickpea
A. Variable cost		
Hired human labour	2324.59 (8.29)	3295.20 (13.79)
Family labour	1289.62 (4.60)	886.00 (3.71)
Machine labour	3694.06 (13.18)	1882.40 (7.88)
Seed	1764.65 (6.29)	3305.60 (13.83)
Fertilizers	2598.74 (9.27)	1210.40 (5.06)
Plant protection materials	578.50 (2.06)	1267.20 (5.30)
Irrigation charges	3422.74 (12.21)	960.00 (4.02)
Interest on working cost @7%	548.55 (1.96)	448.24 (1.88)
Total variable cost	16221.45 (57.86)	13255.04 (55.46)
B. Fixed cost		
Land revenue	18.35 (0.07)	15.80 (0.07)
Rental value of owned land	7500.00 (26.75)	7100.00 (29.71)
Interest on fixed capital	752.79 (2.68)	559.00 (2.34)
Depreciation	995.76 (3.55)	796.53 (3.33)
Total fixed cost	9266.90 (33.05)	8471.33 (35.45)
Managerial cost (10% of A+ B)	2548.83 (9.09)	2172.63 (9.09)
Total cost	28037.18 (100)	23899.00 (100)

Figures in parenthesis shows percentage of total cost

It concludes from the data that wheat cultivators spend more expenditure on family labour, machine labour fertilizers, irrigation charges interest on working capital as compared to chickpea cultivators, while chickpea cultivators spend more on hired human labours, seed

and plant protection materials as compared to wheat cultivators.

**Table 2:** Cost of cultivation with using cost concept of wheat and chickpea (₹/ha)

Cost concept	Wheat	B.C ratio	Chickpea	B.C. ratio
Cost A1	15945.94 (56.87)	3.83	13181.37 (55.15)	3.58
Cost A2	15945.94	3.83	13181.37	3.58
Cost B1	16698.73	3.66	13740.37	3.43
Cost B2	24198.73	2.52	20840.37	2.26
Cost C1	17988.35	3.39	14626.37	3.22
Cost C2	25488.35	2.40	21726.37	2.17
Cost C3	28037.18 (100)	2.18	23899.00 (100)	1.97

Parenthesis shows the percentage of total cost

The benefit cost ratio at different cost concept presented in table 2, revealed that the cost of cultivation wheat was found ₹ 15945.94, ₹ 15945.94, ₹ 16698.73, ₹ 24198.73, ₹ 17988.35, 25488.35 and ₹ 28037.18 as cost A<sub>1</sub>, cost A<sub>2</sub>, cost B<sub>1</sub>, cost B<sub>2</sub>, cost C<sub>1</sub>, cost C<sub>2</sub> and cost C<sub>3</sub>, respectively. The benefit cost ratio of wheat was observed 1:3.83, 1:3.83, 1:3.66, 1:2.52, 1:3.39, 1:2.40 and 1:2.18 at cost A<sub>1</sub>, cost A<sub>2</sub>, cost B<sub>1</sub>, cost B<sub>2</sub>, cost C<sub>1</sub>, cost C<sub>2</sub> and cost C<sub>3</sub>, respectively. The chickpea cultivators invested expenditure ₹ 13181.37, ₹ 13181.37, ₹ 13740.37, ₹ 20840.37, ₹ 14626.37, ₹ 21726.37, and ₹ 23899.00 per hectare in cultivation of chickpea at cost A1, cost A2, cost B1, cost B2, cost C1, cost C2 and cost C3 respectively. The benefit cost ratio was observed 1: 3.58, 1: 3.58, 1: 3.43, 1: 2.26, 1: 3.22, 1: 2.17, and 1: 1.97 at cost A<sub>1</sub>, cost A<sub>2</sub>, cost B<sub>1</sub>, cost B<sub>2</sub>, cost C<sub>1</sub>, cost C<sub>2</sub> and cost C<sub>3</sub> respectively. The wheat cultivators received 2.18 rupees in place of invested one rupee in the cultivation of wheat, while chickpea cultivators gained 1.97 rupees invested in place of one rupee in the cultivation of chickpea. It means that the wheat crop was more profitable as compared to chickpea cultivation for the cultivators.

### RESOURCE USE EFFICIENCY

The resource use efficiency of wheat and chickpea is presented in table 3, revealed that the resource use

efficiency in production of wheat was estimated by using Cobb-Douglas production function. The value of R<sup>2</sup> (coefficient of multiple determination) was observed 75% of wheat, which indicates that the Cobb- Douglas production function was best fitted to the dependent and independent variables. The coefficient of family labour and seed were found to be positive and significant in the cultivation of wheat. The expenditure on hired human labour and irrigation were found to be positive impact on productivity of wheat but non significant. The multiple coefficient of machine labours, fertilizers, plant protection materials were found to be negative impact on productivity of wheat it means that these resources were excess use in the cultivation of wheat. The sum of regression was found to be 0.554 which indicates that the decreasing return to scale from the cultivation of wheat. Similar study of wheat has been conducted by Raghuwanshi *et al.* (1999)

**Table 3:** Resources use efficiency of wheat and chickpea cultivation

Particulars	Wheat	Chickpea
Number of respondent	40	40
Constant value	2.960	2.778
Hired human labour (X <sub>1</sub> )	0.132 (0.099)	0.089 (0.056)
Family labour (X <sub>2</sub> )	0.174* (0.074)	-0.103 (0.085)
Machine labour (X <sub>3</sub> )	-0.268 (0.161)	-0.192 (0.147)
Seed (X <sub>4</sub> )	0.406* (0.169)	0.026 (0.465)
Fertilizers (X <sub>5</sub> )	-0.026 (0.106)	0.439* (0.253)
Plant protection materials (X <sub>6</sub> )	-0.051 (0.034)	0.372 (0.255)
Irrigation charges (X <sub>7</sub> )	0.187 (0.124)	-0.015 (0.012)
Return to scale (Sum of b)	0.554	0.616
Coefficient of multiple determinations (R <sup>2</sup> %)	75	83

\* Significant at 5 % probability level

As regards, the  $R^2$  83% was found in cultivation of chickpea which indicates that the almost variables considerable and best fitted to explain the different variables. The return to scale was 0.616 which indicates that the decreasing return to scale from cultivation of chickpea crop. The fertilizer has positive and significant impact on yield of chickpea. The hired human labour, seed and plant protection have positive and non- significant impact on yield, it much scope to increase these input to apply to cultivation of chickpea for increasing productivity level. The family labour, machine labour and irrigation show negative impact on yield it means that these inputs were applied to excess quantity in the cultivation of chickpea.

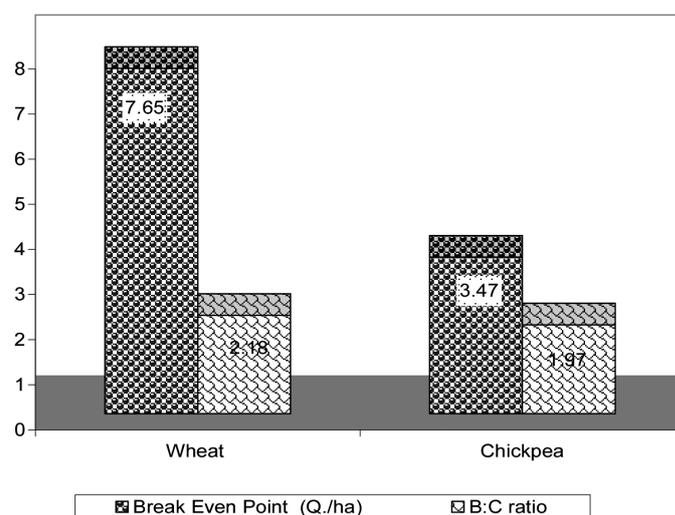
**Table 4:** Profitability of wheat and chickpea cultivation

Particulars	Wheat	Chickpea
Main Product (Kg/ha)	3700	1300
Price (₹/Kg)	16.50	34.90
Value of main product (₹/ha)	61050.00	45370.00
By Product (Q/ha)	00.00	15.00
Price (₹/q)	00.00	120.00
Value of by product (₹/ha)	00.00	1800.00
Gross Income (₹/ha)	61050.00	47170.00
Net Income (₹/ha)	33012.18	23271.00
Farm Business Income (₹/ha)	45104.06	33988.63
Family Labour Income (₹/ha)	36851.27	26329.63
Farm Investment Income (₹/ha)	41264.97	30930.00
Contribution margin (₹/ha)	1211.59	2474.38
Margin of safety (Q/ha)	29.35	9.53
Break Even Point (Q./ha)	7.65	3.47
B:C ratio	1:2.18	1: 1.97
Cost of production (₹/Q)	757.76	1699.92

Profitability of wheat and chickpea

The profitability of wheat as well as chickpea have been presented in the Table 4, revealed that 37 quintal production was found by wheat cultivators, while chickpea cultivators found only 13 quintal production from cultivation of chickpea. The wheat and chickpea cultivators sell out his production at the rate of Rs.

1650 per quintal and 3450 per quintal, respectively. It is observed from the data that the straw material from wheat cultivation was found zero it means majority of wheat cultivators harvested his crop by combine or harvester machine so that no income generated from straw material to the wheat cultivators, while chickpea cultivators harvested his crop with the help of human labours so that chickpea cultivators gained ₹ 1800 to sell out straw materials. The gross income was found to be ₹ 61050.00 per hectare from cultivation of wheat, while chickpea cultivators received ₹ 47170 per hectare from the cultivation of chickpea. The net income was found ₹ 33012.18 per hectare from the cultivation of wheat. The gross income was found ₹ 23771 per hectare by the cultivators from the chickpea cultivation. Similar study of wheat cultivation has also been conducted by Ahirwar *et al.* ((2015). The farm business income, farm investment income and contribution margin were found to be ₹ 45104.06, 36851.27, 41264.97 and 1211.59 by the cultivators from the cultivation of wheat, respectively. As regards, chickpea cultivators found ₹ 33988.63, ₹ 26329.69 ₹ 30930.00 and 2474.38 as a farm business income, family labour income, farm investment income and contribution margin from the cultivation of chickpea, respectively.



The break even point was found to be 7.65 quintals and benefit cost ratio was also found ₹ 1: 2.18 from wheat cultivation by the cultivators. The break even point and benefit cost ratio of chickpea was found ₹ 3.47 and 1:1.97, respectively.

**Constraints of wheat and chickpea cultivation**

The production constraints of wheat and chickpea are presented in table 5, revealed that the major constraints such as lack of knowledge to apply plant protection materials, lack of knowledge recommended doses of fertilizers, lack of seed replacement, high price of fertilizers, lack of knowledge of micro-nutrient applications and lack of knowledge about seed treatment were reported by wheat and chickpea cultivators.

**Table 5:** Production constraints in cultivation of wheat and chickpea faced by farmer

Production constraints	Wheat	Chickpea
Number of respondents	40	40
Lack of soil testing	30 (75)	34 (85)
Lack of knowledge for seed treatment	32 (79)	34 (86)
Lack of seed replacement	34 (84)	35 (88)
High price of certify seed/HYVs	30 (76)	32 (80)
Lack of knowledge for recommended dose of NPK	34 (86)	35 (87)
Lack of knowledge for plant protection measurement	35 (88)	36 (90)
Lack of knowledge for micro nutrients applications	32 (79)	33 (83)
Attack of insects to crop	08 (20)	14 (35)
High price of fertilizers	33 (83)	26 (65)
Non- availability of fertilizer at operation time	19 (48)	15 (38)
Weed problems	06 (15)	04 (11)
Non-availability of hired human labour at peak operational season	25 (62)	26 (65)
Irregularity of electricity supply	29 (72)	27 (67)
Non-availability of high yielding variety seeds	26 (66)	28 (70)
Lack of proper training for cultivators	22 (55)	21 (52)

Parenthesis shows the percentage

The 88% of wheat cultivators reported that the lack of knowledge to applied of plant protection materials as major constrains followed by lack of knowledge of recommended dose of fertilizers (86%), lack of seed replacement (84%), high price of fertilizers (83%), lack of seed treatment (79%), lack of micro-nutrients application (79%), high price of certified seed/high yielding varieties (76%), lack of soil testing of farmer field (75%), irregular supply of electricity supply (72%), non-availability of high yielding variety seed (66%), non- availability of hired human labour at peak operation season (62%), lack of proper training to wheat cultivators (55%), non-availability of fertilizer at operation time (48%), attached insect (20%) and weed problems (15%) in the study area. The 90% chickpea cultivators reported that the major constraints of lack of knowledge to apply plant protection materials followed by lack of seed replacement (88%), lack of recommended dose of fertilizers (87%), lack of knowledge of seed treatment (86%), lack of soil testing (85%), lack of knowledge of micro nutrients applications (83%), high price of certified seed (80%), non- availability of high yielding variety seed (70%), irregular electricity supply (67%), non-availability of hired human labour at peak operation season (65%), high price of fertilizers (65%), lack of proper training to chickpea cultivators (52%), non-availability of fertilizers at operation time (38%), attacked of insects (35%), and weed problems (11%) in the crop. Similar study has been conducted by Nirmal Chandra (2006) revealed that the major constraints such as marginal and scattered land holding, non availability of good quality seed of improved varieties, lack of irrigation water and non availability of farm inputs responsible for low wheat productivity. Malviya *et al.* (2005) studied that major constraints in chickpea production was recorded lack of knowledge about spray of DAP, Inadequate use of plant protection chemical on proper time and dose, inadequate seed treatment with fungicides and culture, inadequate use of recommended sowing methods, use of inadequate methods of insecticide application etc.

**CONCLUSION**

The total cost of cultivation was found ₹ 28037.18 per hectare in wheat cultivation while, the cost of cultivation of chickpea was ₹ 23899.00 per hectare. The cost of

cultivation of wheat was found maximum as compared to chickpea. The Cost  $A_1$  of wheat recorded ₹ 15945.94 per hectare which contributes 56.87% of the cost  $C_3$ . The cost  $A_1$  of chickpea cultivation was ₹ 13181.37 per hectare which contributes 55.15% of the cost  $C_3$ . The family labour and seed have positive and significant impact on yield of wheat whereas; only fertilizer has positive and significant impact on yield of chickpea. The return to scale of both crops was found less than one, it means that the decreasing return to scale. The gross income, net income, farm business income, farm investment income contribution margin, margin safety, break even point and benefit cost ratio of wheat were found to be more as compared to chickpea cultivation. The benefit cost ratio of wheat and chickpea were 1:2.18 and 1:1.97, respectively. The wheat and chickpea cultivators reported that lack of knowledge to apply plant protection materials, lack of knowledge for recommended dose of fertilizers, lack of seed replacement, high price of fertilizers, and lack of

knowledge for micro- nutrient applications and lack of knowledge about seed treatment in cultivation of wheat as well as chickpea.

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