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### Optimizing mustard cultivation in Hardoi district: Policy implications and strategic insights

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#### Abstract

The study surveyed 100 farmers in India, dividing them into marginal, small, and medium size groups. The average holding size was 0.67, 1.17, and 2.75 hectares, with medium farmers cultivating the most. Cropping patterns vary, with major crops in Kharif, Rabi, and Zaid seasons. Marginal farms have the lowest costs, with the highest due to irrigation and human effort. The average cost of a farm was Rs.49197.50, with medium farms having the highest gross revenue. Family income was highest on marginal farms.

**Keywords:** Cropping intensity, policy, input - output ratio

#### Introduction

Mustard (*Brassica juncea.*), an essential oilseed crop, holds significant economic and nutritional value globally. Mustard seeds are rich in oil (30-35%) and protein (25-30%), making them a valuable source of nutrition. India is the third-largest mustard-rapeseed producer globally, accounting for 12% of total production. This crop accounts for about one-third of India's oil production, making it a crucial source of income, livelihood, and employment for small and marginal farmers in rainfed zones. By increasing local production, substantial import exchange can be achieved. Mustard cultivation in Uttar Pradesh is the fourth largest, accounting for 12.08% of total mustard production in India. Haryana is the second largest, cultivating 0.61 mh (9.78%), while Madhya Pradesh is the third. Uttar Pradesh is the third largest producer, accounting for 11.96% of total production, followed by Rajasthan (43.69%) and Haryana (13.42%). The productivity of these states is 1483 Kg/Hectare, 1720 Kg/Hectare, and 2058 Kg/hectare. Agra takes lead as the major growing district, with a share of about 13% to the state's total production, followed by Mathura (10%), Badaun (5%), Aligarh (3.97%), Ramabai Nagar (3.83%), Kheri (3.62%), Etah (2.95%), Etawah (2.77%) and Auraiya (2.61%) (Percentage share calculation is for 10 years average).

#### Materials and Methods

The collection of primary data was done on different factors with the help of the survey method for the agricultural season of 2023–2024. A total of 100 mustard-rapeseed farmers from 10 villages were selected from two blocks,

namely Kothawan & Kachhauna, from Hardoi District. The farmers were classified into the following land size groups i.e.

- Marginal (below 1 ha),
- Small (1-2ha),
- Medium (2-4ha).

To work out the cost of cultivation, the standard method was adopted, which includes costs A/A<sub>2</sub>, cost B<sub>1</sub> cost B<sub>2</sub>, cost C<sub>1</sub>, C<sub>2</sub> and C<sub>3</sub>. Income measures including farm business income, family labor income, net income, farm investment income, and B-C ratio were calculated with the help of their respective formulas.

#### Results and Discussion

##### Average size of holding

The study covers a sample of 100 farmers, which divided in three size groups namely marginal (below 1 ha), small (1-2ha) and medium (2-4ha) with respect to cropped area. The average size of holding on various groups of sample farms presented in Table 1. It is evident from the table that the average size of holdings in study area were 0.67, 1.17 and 2.75 hectares in marginal, small and medium farm groups, respectively Whereas overall size of holding size was 1.07 hectares. It is clear from the data that net cultivated area of sample farms 36.09, 40.98 and 30.20 hectares falls under marginal, small and medium categories, respectively. It concluded that medium farmers were cultivating maximum area followed by small and marginal categories of farmers.

**Table 1:** Average size of holding on sample farms under different size group:

S. No.	Size groups of farm	No. of Farmers	Net Cultivated Area (ha.)	Average size of holding
1	Marginal	54	36.09 (33.64)	0.67
2	Small	35	40.98 (38.20)	1.17
3	Medium	11	30.20 (28.15)	2.75
Grand Total		100	107.27 (100.00)	1.07

(Figures in parentheses indicate percentage to total)

**Cropping pattern**

Cropping pattern shows the area devoted to the various crop during the given period, conventionally in single year. It indicates the yearly sequence and spatial arrangement of crops followed in a particular area. The cropping pattern followed by the sample farms on marginal, small and medium farms are presented in Table 2. The table provided shows the cropping pattern, average size of sample farms, and overall farm average size for different crops in India. The crops are categorized into three seasons: Kharif, Rabi, and Zaid.

In the Kharif season, paddy, maize, sugarcane, and groundnut are the major crops grown. The average size of sample farms for paddy is 0.12 hectares for marginal farms, 0.34 hectares for small farms, 0.96 hectares for medium farms, and 0.29 hectares for the overall farm average size. Similarly, the average size of sample farms for maize is 0.21, 0.18, 0.44, and 0.22 hectares, respectively, for marginal, small, medium, and overall farm average size. The average size of sample farms for sugarcane is 0.12, 0.26, 0.58, and 0.22 hectares, respectively, and for groundnut is 0.22 (15.07%), 0.34 (13.33%), 0.73 (12.76%), and 0.32 (13.77) hectares.

In the Rabi season, wheat, potato, mustard, gram, and braseem are the major crops grown. The average size of sample farms for wheat is 0.16 hectares for marginal farms, 0.26 hectares for small farms, 0.78 hectares for medium farms, and 0.26 hectares for the overall farm average size.

Similarly, the average size of sample farms for potato is 0.08, 0.14, 0.29, and 0.12 hectares, respectively, for marginal, small, medium, and overall farm average size. The average size of sample farms for mustard is 0.19 (13.01%), 0.28 (10.98%), 0.62 (10.84%), and 0.27(11.64) hectares, respectively, for marginal, small, medium, and overall farm average size.

In the Zaid season, vegetables, cucumber, chari, and mentha are the major crops grown. The average size of sample farms for vegetables is 0.12 hectares for marginal farms, 0.18 hectares for small farms, 0.34 hectares for medium farms, and 0.17 hectares for the overall farm average size. Similarly, the average size of sample farms for cucumber is 0.03, 0.08, 0.12, and 0.06 hectares, respectively, for marginal, small, medium, and overall farm average size. The average size of sample farms for chari is 0.03, 0.09, 0.14, and 0.06 hectares, respectively, and for mentha is 0.08, 0.16, 0.28, and 0.13 hectares.

The overall farm average size for Kharif, Rabi, and Zaid crops is 1.46, 2.55, and 0.88 hectares, respectively. Figures in parenthesis indicate the percentage to the total cropped area was covered by groundnut & mustard crop: medium (12.76 & 10.84 percent) of total cropped area followed by small (13.33 & 10.98 percent) and marginal (15.07 & 13.01 percent). It may be concluded that paddy & wheat were considered as main food crops having 1<sup>st</sup> and 11<sup>nd</sup> place in cropping pattern.

**Table 2:** Cropping pattern under different size group of farms (ha)

S. No.	Crop	Cropping pattern			Overall farm
		Average size of sample farms			
		Marginal	Small	Medium	
A	Kharif	0.67 (45.89)	1.12 (43.92)	2.71 (47.38)	1.05 (45.54)
1	paddy	0.12 (8.22)	0.34 (13.33)	0.96 (16.78)	0.29 (12.53)
2	Maize	0.21 (14.38)	0.18 (7.06)	0.44 (7.69)	0.22 (9.73)
3	Sugarcane	0.12 (8.22)	0.26 (10.20)	0.58 (10.14)	0.22 (9.51)
4	Ground nut	0.22 (15.07)	0.34 (13.33)	0.73 (12.76)	0.32 (13.77)
B.	Rabi	0.53 (36.30)	0.92 (36.08)	2.13 (37.24)	0.84 (36.47)
1	Wheat	0.16 (10.96)	0.26 (10.20)	0.78 (13.64)	0.26 (11.39)
2	Potato	0.08 (5.48)	0.14 (5.49)	0.29 (5.07)	0.12 (5.37)
3	Mustard	0.19 (13.01)	0.28 (10.98)	0.62 (10.84)	0.27 (11.64)
4	gram	0.04 (2.47)	0.12 (4.71)	0.22 (3.85)	0.09 (3.80)
5	Braseem	0.06 (4.11)	0.12 (4.71)	0.22 (3.85)	0.10 (4.27)

C.	Zaid	0.26 (17.81)	0.51 (20.00)	0.88 (15.38)	0.42 (18.00)
1	vegetable	0.12 (8.22)	0.18 (7.06)	0.34 (5.94)	0.17 (7.15)
2	Cucumber	0.03 (2.05)	0.08 (3.14)	0.12 (2.10)	0.06 (2.48)
3	Chari	0.03 (2.05)	0.09 (3.53)	0.14 (2.45)	0.06 (2.73)
4	Mentha	0.08 (5.48)	0.16 (6.27)	0.28 (4.90)	0.13 (5.63)
Gross total		1.46 (100)	2.55 (100)	5.72 (100)	2.31 (100)

**Cropping Intensity**

Cropping intensity is an index of intensity of land use strong-minded by the number of crops grown in a particular field, during a year. It has been worked out by using the following formula.

$$\text{Cropping Intensity} = \frac{\text{Total cropped area}}{\text{Net sown area}} \times 100$$

It has been computed for all size groups of farms and is presented in Table 3. The maximum cropping intensity was

observed to be 218.45 percent in case of marginal farm followed by small and medium farms to 217.79 and 208.34 percent, respectively with an average of 215.34 percent.

**Economics of Mustard**

Costs and returns of mustard per hectare on sample farms have been worked out and presented in this section. The different cost concepts were used for mustard production. Per hectare output was estimated and valued as gross income, net income, and family labour income. Thus, measures of farm profits were represented as farm business income.

**Table 3:** Cropping intensity of different size group of sample farms

S.N	Farm Group	No of farmers	Average size of holding	Gross cropped area (ha)	Cropping intensity (%)
1	Marginal	54	0.67	1.46	218.45
2	Small	35	1.17	2.55	217.79
3	Medium	11	2.75	5.72	208.34
Total		100	1.07	2.31	215.34*

\*Indicated overall average of cropping intensity

**Inputs**

For inputs estimates, the various factors which enters into cost have been considered such as human labour (both family and hired), machinery charges, seed, manures & fertilizer, irrigation, plant protection, interest on working capital, rental value of land, interest on fixed capital and 10% covered managerial cost against C2.

**Cost of cultivation of mustard**

Per hectare costs on various input factors in mustard production were worked out. The details of input costs are shown in Table 4

The per hectare cost on various input factors in mustard production was worked out and its details presented in the Table 4. This Table indicated that on an average per hectare cost of cultivation of mustard was found Rs.31813.08 The cost of cultivation was experiential on marginal farm (Rs.30913.73) followed by small farm (Rs.32488.56) and

medium farm (Rs.34078.84).

The total cost on marginal farm was maximum due to heavy outflow on irrigation and human labour. The study further open that in case of small farm, cost incurred on irrigation was (7.43 percent) followed by human labour (15.79 percent) and medium farm cost incurred on irrigation (07.60 percent) and tractor charge (12.43 percent).

The further distribution of the costs on overall farm average showed the maximum expenditure on irrigation i.e. (7.43 percent) followed by human labour charge (15.83 percent). The expenditure on overall, tractors charges, manures and fertilizers, seed, plant protection, to 11.59, 4.78, 5.96 and 3.37 percent, respectively. of the total costs of cultivation .it was observed that hired labour, machinery charge, seeds, manure & fertilizers, irrigation showed positive relationship with the increase in the farm size while family labour showed the negative relationship with increase the farm size.

**Table 4:** Per hectare costs of different inputs used in mustard production (Rs.)

S. No.	Particulars	Size Group of Farms			Overall Average
		Marginal	Small	Medium	
1	Human Labour	4914.36 (15.90)	5128.85 (15.79)	5335.25 (15.66)	5035.73 (15.83)
	a. Family Labour	3024.00 (9.78)	2458.35 (7.57)	2080.65 (6.11)	2722.25 (8.56)
	b. Hired Labour	1890.36 (6.11)	2670.50 (8.22)	3254.60 (9.55)	2313.48 (7.27)
2	Machinery Charges/ Tractor Charges	3460.70 (11.19)	3865.08 (11.90)	4236.74 (12.43)	3687.60 (11.59)
3	Seed Cost	1768.60 (5.72)	1978.85 (6.09)	2265.20 (6.65)	1896.81 (5.96)
4	Manures and Fertilizers	1450.74 (4.69)	1546.27 (4.76)	1768.96 (5.19)	1519.18 (4.78)
5	Irrigation	2254.65 (7.29)	2465.02 (7.59)	2590.88 (7.60)	2365.26 (7.43)
6	Plant Protection	980.42 (3.17)	1140.50 (3.51)	1290.86 (3.79)	1070.60 (3.37)
7	Total working capital	14829.47 (47.97)	16124.57 (49.63)	17487.89 (51.32)	15575.18 (48.96)
8	Interest on working capital @ 4%	593.18 (1.92)	664.98 (1.99)	699.52 (2.02)	623.01 (1.96)
9	Rental value of owned land	12000.00 (38.82)	12000.00 (36.94)	12000.00 (35.21)	12000.00 (37.72)
10	Interest on fixed capital	680.74 (2.20)	765.50 (2.36)	793.36 (2.33)	722.79 (2.27)
11	Sub-Total	28103.39 (90.91)	29535.05 (90.91)	30980.77 (90.91)	28920.98 (90.91)
12	Marginal Cost @ 10% of sub-total	2810.34 (9.09)	2953.51 (9.09)	3098.08 (9.09)	2892.10 (9.09)
	Grand Total	30913.73 (100)	32488.56 (100)	34078.84 (100)	31813.08 (100)

(Figure in parenthesis indicate percentage to the total cost)

#### Measures of costs and returns of mustard crop in study area

The Table 5 revealed that, on average cost A/A<sub>2</sub>, cost B<sub>1</sub> cost B<sub>2</sub>, cost C<sub>1</sub>, C<sub>2</sub> and C<sub>3</sub> came to Rs.13475.93, Rs.14198.73, Rs.26198.73, Rs.16920.73, Rs.28920.98 and 31813.08 respectively.

On an average, gross income was recorded Rs.49197.50 and net income came to Rs.17384.42 On medium farms, gross income was highest, which was recorded Rs.59730.00, followed by small farms Rs.51700.00, and marginal farms Rs.45430.00, respectively.

The net income was highest on small farms Rs.25651.16, followed by medium Rs.19211.44, and lowest marginal Rs.14516.27 On an average family labour income, farm investment income and farm business income were observed to Rs.35721.57, Rs.33408.09 and 22998.77, respectively. Family labour income was highest on marginal farms followed by small and medium farms & farm investment income was highest on medium farms followed by small and marginal farms and farm business income was highest on marginal farms followed by small farms and medium farms. On an average, cost of production per quintal and

yield per hectare were estimated to Rs.3575.86 and 8.95 quintal, respectively.

On an average input output ratio the basis costs A<sub>1</sub>/A<sub>2</sub>, B<sub>1</sub>, B<sub>2</sub>, C<sub>1</sub>, and C<sub>2</sub> were recorded 1:3.65, 1:3.46, 1:1.87, 1:2.90 and 1:1.70, respectively. On the basis of cost C<sub>2</sub> input output ratio was highest on marginal farms (1:1.62) followed by small (1:1.75) and medium (1:1.93), respectively.

#### Suggest suitable policy Implications

To improve mustard cultivation in Hardoi District, a comprehensive assessment of current agricultural practices is needed. This includes surveys, interviews, field observations, historical yield analysis, and prioritizing constraints like input availability, soil health, irrigation facilities, and market access. Socioeconomic factors and agricultural infrastructure conditions should also be considered. Policy implications include improving access to quality seeds and fertilizers, enhancing irrigation infrastructure, providing financial support, promoting farmer training programs, and ensuring stable market prices. These interventions aim to boost productivity and sustainability in the region.

**Table 5:** Measures of per- hectare cost and profits of mustard (Rs.)

Sl. No.	Particulars	Size group of farms			Over all Average
		Marginal	Small	Medium	
1	Cost A1/A2	12398.65	14311.20	16106.76	13475.93
2	Cost B1	13079.39	15076.70	16900.12	14198.73
3	Cost B2	25079.39	27076.70	28900.12	26198.73
4	Cost C1	16103.39	17535.05	18980.77	16920.98
5	Cost C2	28103.39	29535.05	30980.77	28920.98
6	Cost C3	30913.73	32488.56	34078.84	31813.08
7	Yield (qtl/ha.)	8.26	9.40	10.86	8.95
8	Gross Income	45430.00	51700.00	59730.00	49197.50
9	Net Income	14516.27	19211.44	25651.16	17384.42
10	Family Labour Income	20350.61	24623.30	30829.88	22998.77
12	Farm Business Income	33031.35	37388.80	43623.24	35721.57
12	Farm Investment Income	31140.99	34718.30	40368.64	33408.09
13	Cost of production (Rs./Qtl.)	3742.58	3456.23	3138.01	3575.86
<b>14</b>	<b>Input - Output Ratio</b>				
a.	On the basis of Cost A1	1:3.66	1:3.61	1:3.71	1:3.65
b.	On the basis of Cost B1	1:3.47	1:3.43	1:3.53	1:3.46
c.	On the basis of Cost B2	1:1.81	1:1.91	1:2.07	1:1.87
d.	On the basis of Cost C1	1:2.82	1:2.95	1:3.15	1:2.90
e.	On the basis of Cost C2	1:1.62	1:1.75	1:1.93	1:1.70
f.	On the basis of Cost C3	1:1.47	1:1.59	1:1.75	1:1.54

**Conclusion**

The study surveyed 100 farmers, dividing them into marginal, small, and medium size groups. The average holding size was 0.67, 1.17, and 2.75 hectares, with a total holding size of 1.07 hectares. The net cultivated area was 36.09, 40.98, and 30.20 hectares, with medium farmers cultivating the most. Table 5 shows maximum cropping intensity of 218.45% for marginal farms, followed by small and medium farms at 217.79 and 208.34%, respectively, with an average of 215.34%. Cropping pattern in India shows the area devoted to different crops during a given period. Major crops grown in Kharif season include paddy, maize, sugarcane, and groundnut. In Rabi season, wheat, potato, mustard, gram, and braseem are the major crops. In Zaid season, vegetables, cucumber, chari, and mentha are the major crops. The overall farm average size for Kharif, Rabi, and Zaid crops is 1.46, 2.55, and 0.88 hectares, respectively. The average cost per hectare for mustard cultivation in India is Rs. 31813.08. Marginal farms have the lowest costs, with the highest cost due to irrigation and human effort. Factors such as hired labour, machinery charges, seeds, and fertilizers influence farm size. The average cost of a farm was Rs. 49197.50, with the highest gross revenue reported on medium farms. Small farms had the highest net income, followed by medium farms. Family income from labor, investments, and businesses was highest on marginal farms. The average cost of production per quintal and output per hectare were Rs. 3575.86 and 8.95 quintals, respectively. The typical input-output ratios for basis costs were 1:3.65, 1:3.46, 1:1.87, 1:2.90, and 1:1.70.

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