Comparative Economics of Maize Crop in Kharif and Rabi Season

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Abstract. This study offers a detailed comparative analysis of maize crop cultivation in the kharif and rabi seasons within the agricultural landscape of Gonda District. 50 respondents were carefully selected from various villages in the block, with proportional representation for Marginal, Small, and Medium-sized farmers. The research delves into the economics of maize cultivation, emphasizing factors such as the cost of cultivation, input expenses, income generation, and input-output ratios. In the kharif season, it was distinguished that the cost of cultivation of maize with the farm's size. Marginal farms spent an average of ₹ 48125.93 per hectare, small farms incurred ₹ 51002.89, and large farms invested ₹ 54295.17. Similarly, during the rabi season, the cost of cultivation increased with farm size, with marginal farms investing an average of ₹ 52397.57, small farms spending ₹ 55444.93, and large farms allocating ₹ 58604.68 per hectare. Crucially, the study found that input-output ratios remained consistent across farm sizes in both seasons, reflecting uniform agricultural practices. The findings underscore the importance of efficient management, the adoption of advanced agricultural techniques, the use of high-quality seeds, and the timely application of irrigation and plant protection practices in enhancing net income, particularly on marginal farms.

1. Introduction

Regarding acreage, maize is the second most significant cereal crop worldwide and is sometimes referred to as the "Queen of Cereals." The world produced around 1040 million metric tonnes of maize, with the United States and China producing the most, at roughly 38% and 23% of the total. With a quantity of 26 million MT, India makes up around 2% of this output chart. Maize or corn [1] is a plant belonging to family grasses (poaceae) [2]. People in Central America were the first to cultivate maize, commonly referred to as maize, a cereal grain. It is referred to as the "Queen of Cereals" and is currently the third most significant cereal crop globally. Maize is a leafy stalk that contains seeds inside of its kernels. Corn is significant because of its many applications.

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It is utilised as animal feed as well as human nourishment. Almost entirely, maize is used as feed. [3]. Corn is used to make a wide range of dishes, including basic 'Mexican' items heated hot and popped snack snacks. It is also fractionated by either dry or wet milling into food and industrial ingredients. The major constituent of the corn kernel is used in foods and industrial products [4, 5]. Additionally, the starch is transformed into fructose and/or glucose to provide sweetness to meals. For use as fuel or in drinks, glucose can ferment to produce ethanol. Both people and animals can benefit nutritionally from maize. Maize has become a staple food in many parts of the world, with total production surpassing that of wheat or rice. However, not all of this maize is consumed directly by humans. Some of the maize production is used for corn ethanol, animal feed and other maize products, such as corn starch and corn syrup. Maize ranks as the major grain crop worldwide. Maize, which is the only food cereal crop that can be grown in different seasons requires moderate climate for growth. It grows well in loamy soils but surplus or poor rains adversely affect yields as well as quality [6].

In India, maize farming employs around 650 million person-days at the agricultural and adjacent business ecosystem levels, with at least 15 million farmers cultivating the crop. Crucially, maize makes up more than 2% of the entire value of the product produced by all agricultural crops [7]. Generally regarded as a food crop, white maize needs more conducive climate conditions. As such, it is exclusively manufactured in a few nations. In addition, there are other hybrids of maize that differ in terms of endosperm composition and size, including. Dent corn, flint corn, pod corn, flour corn and sweet corn are the six main varieties of corn. In many regions of the world, maize is a staple grain. Among its many industrial uses, maize is a crucial raw ingredient in the food processing and feed industries. After rice and wheat, maize is the third most important crop in India. Rabi and Kharif seasons are used to cultivate maize, which is primarily a rained-on crop [8]. It is seeded in March through July till mid-August during the Kharif season, and it is harvested in mid-September. Arrivals take place between late September and early February. Major states like Karnataka, Andhra Pradesh, Maharashtra, Madhya Pradesh, Uttar Pradesh, etc. are producers of maize during the Kharif season. Rabi is seeded from September to December in the coastal regions of Andhra Pradesh, Karnataka, Bihar, Uttar Pradesh, and Punjab. Arrivals begin in late March and continue through July [9].

The three primary types of maize consumption in India are feed, food, and industrial non-food items (mostly starch). In India, the majority of maize consumed is used for feed. Poultry feed, which makes about 47% of the world's total maize consumption, is the primary use and demand generator for maize. Feed for livestock makes up 13%. 20% of maize is consumed through food, of which 13% is consumed directly and 7% is consumed in the form of processed food [10]. The remaining 20% of India's maize consumption is accounted for by industrial items that are not food. With 14% of the total amount of maize consumed, starch is the most significant component in this category. Exports and other industrial, non-food goods make up the remaining 6% of the economy. For example, maize is used as a feedstock to produce ethanol fuel [5].

India's maize production is less than half of China's, one-fifth of the US's, and around half of the global average when compared to other countries. Among the factors preventing high productivity are: weather patterns that cause drought or an abundance of water and are linked to a rise in the number of illnesses and pets [7].

On marginal fields with insufficient irrigation, cultivation is mostly done under rain-fed circumstances. Just over 30% of the land is covered by hybrids. inadequate advancement of single-cross hybrid technology, which is essential for increased productivity increases in China, the United States, and other nations. restricted use of enhanced manufacturing and security technologies. a breakdown in the mechanism for distributing and producing high-quality seed. small land sizes and farmers' restricted access to resources. 9.2 million hectares

of maize were grown in India, with 27.84 million tonnes of grain produced overall and an average yield of 3050 kg/hectare (2018-19) [2].

According to GOI, the average price of maize in India is 1678 INR per quintal, with current prices indicating 1850 INR per quintal. Uttar Pradesh's northeastern plain is the state's major producer of maize. Maize is farmed in up to 25 districts in Uttar Pradesh. Gonda, Jaunpur, Ghaziabad, Bahraich, Farrukhabad, and Bulandshahar are the principal districts that produce maize.In Uttar Pradesh, there was 7,56,300 hectares of maize grown, 14,56460 metric tonnes of maize produced, and 21.92 q/ha of productivity in 2018–19 [5].

In district Gonda the total area of Maize is 20433 ha, total production of maize 49410 tonnes and productivity of maize 26.75 quintal/ha in 2015-16. Seeing the importance of the crop it became necessary to analyze the costs of cultivation of maize, since the input costs rise every year which increases the total cost of cultivation and ultimately affects the net profit gained by the producer.

2. Materials and Methods

This empirical investigation of cost of cultivation has made extensive use of primary data. The survey schedules that have used to gather the farmers from the community. The population sample was drawn using a multi-stage stratified random sampling technique. By selecting the Gonda district on purpose, the sampling process has begun.

First, a list of each of the 16 blocks in Uttar Pradesh's Gonda district was created, along with an average ranking for Maize crop. One block which has the most maize-growing land, was specifically chosen for this investigation. Thereafter, a list of all the villages in the belsar block was created and placed in ascending order of the area planted with crops. From these lists a sample of 50 respondents were drawn following the proportionate allocation to the different categories. Under marginal farmers category 26, small farmers 14 and medium farmers 10 have occurred out of fifty samples.

Period of Enquiry

The data pertained to agriculture year 2019-2020 estimation of costs and returns.

Cost concepts

Cost A_1 : It includes costs and kind expenses actually incurred by cultivators which are as follows:

(i) Wage of hired human labour
(ii) Charges for bullock labour
(iii) Hired labour charges of implements and machinery
(iv) Cost incurred on manures and fertilizers
(v) Seeds
(vi) Plant protection / intercultural chemicals
(vii) Irrigation charges
(viii) Land revenue
(ix) Depreciation, and
(x) Repair charges on farm assets.

Cost A_2: Cost A_1 + Rent paid for leased in land.
Cost B_1: Cost A_2 + Interest on owned fixed capital assets.
Cost B_2: Cost B_1 + Rental value of owned 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 + 10% of cost C_2 (managerial cost)
Gross Income = Value of total output.
Net Income = It is computed by deducting cost C_3 from gross income.

Imputation procedure for inputs costs

Following appropriate verification, the growers' claimed value of bought input was taken into consideration. Family sources provided some of the inputs used in the production process. The following process was used to determine the imputed value of these inputs.

The cost of labour for a family was estimated using the hourly rates that were in effect in the chosen hamlet for various agricultural tasks.

Based on the rates that are typical in the communities in question, the value of manure generated on the farm, seeds produced on the farm, and seedlings were calculated.

The expense of tractor fees and irrigation was taken into account at the going prices in the market.

The prices that were in effect in the communities at the time of operations were used to evaluate the kind payments.

Interest on working capital was assessed at a rate of 7% annually, with the amount paid in halves based on the length of the crops.

The annual depreciation of owned farm buildings was determined to be 5% for kaccha buildings and 2% for pakka buildings.

7. The farmer's owned land was rented out at the going rate in the hamlet.

8. Ten percent of the total cost (Cost C2) was the rate at which management costs were computed.

3. Results and discussion

The cost of cultivation must be taken into account in order to calculate the production cost per unit and determine if the crop's price is reasonable or not. The subject of crop production economics includes input costs item-by-item, input costs based on cost concepts, and the amount of money generated by the crops on example farms of various sizes.

Break-up of input cost for Maize in kharif season:

The total cost incurred on cultivation of maize crop and its breakup into factor of inputs per hectare has been given in Table 1 portrays that the average cost of cultivation of Kharif maize crop came to ₹ 51141.33 per hectare. The cost of cultivation shows increasing trend with the increase in size of farm. It came to ₹ 48125.93 on marginal farms, ₹ 51002.89 on small farms and ₹ 54295.17 on large farms.

Table 1. Total cost and its break up of Maize crop in Kharif Maize. (Rs/ha)

Kharif					
S. No.	Particulars	Marginal (26)	Small (14)	Medium (10)	Average
A	Variable cost				
1	Human labour				
a.	Family labour	6789.22	6102.42	3183.52	5358.38
b.	Hired labour	2908.8	4068.28	7427.54	4801.54
	Total human labour	9698.02	10170.7	10611.06	10159.92
2	Tractor power	4280.00	4550.5	4800.10	4476.86
3	Fertilizer & manure	4250.1	4400	4700	4450.03
4	Seeds	2150.6	2216.45	2478.44	2281.83
5	Irrigation	5300.5	5559.1	5798.2	5564.6
6	Plant protection	1480.38	1668.31	1923.48	1690.72
7	Interest on working capital	1086.38	1142.60	1212.45	1147.14
	Total variable cost	28245.98	29707.66	31523.73	29825.79
	Total fixed cost				
A	Rental value of land	6000	6000	6000	6000
B	Depreciation	1090.31	1481.65	1862.21	1478.05

Kharif					
S. No.	Particulars	Marginal (26)	Small (14)	Medium (10)	Average
C	Repair to dead stock	436.12	592.66	744.89	591.22
D	Interest on fixed capital	2655.50	3050.22	3553.28	3086.33
	Total fixed cost	10181.93	11124.53	12160.38	11155.61
	Total input cost	48125.93	51002.89	54295.17	51141.33

This was to proportionately more use of family labour on marginal farms weather more use of hired labour on large farms. The marginal and small farms had more family labour than that of hired labour. The average total human labour for all size group of the farm came to Rs 10159.92 total operational cost was observed to be Rs 28245.98, Rs 29707.66 and Rs 31523.73 on Marginal, Small and Large farms respectively, with overall average operational total cost being ₹ 29825.79.

Table 2. Total returns received from Kharif Maize (₹ /ha)

Kharif					
S. No.	Particulars	Marginal (26)	Small (14)	Medium (10)	Average
1.	Input cost	48125.93	51002.89	54295.17	51141.33
2.	Total yield in qtl/ha	33.26	34.67	35.93	34.62
3.	Rate (in ₹/qtl)	1680	1750	1850	1760
4.	Main product	55876	60672.5	66470.5	61030
	By product	3480	3537.6	3615.2	3544.26
5.	Gross income	59356	64210.1	70085.7	64550.6
6.	Net income	11230.07	13207.21	15790.53	13409.27
7.	Cost of production per quintal	1446.93	1471.09	1511.13	1476.38
8.	Input – output ratio	1:1.23	1:1.25	1:1.29	1:1.25

It is quite evident from Table 2 that the higher gross income was observed on large farms being ₹70085.7 followed by small and marginal farms bringing ₹ 64210.1 and59356 respectively. Net income was also higher on marginal farms as ₹ 11230.07 followed by small and large farms being ₹ 13207.21 and ₹ 15790.53 respectively. The higher net income on marginal farms was mainly due to better management and case utilized as small probability, agricultural technology, improved and suitable quality of seeds, timely and appropriate application of irrigation and plant protection practices, efficient supervision, and management. The average cost of production per quintal came to ₹ 1476.38. The input-output ratio was calculated as 1:1.23, 1:1.25, and 1:1.29 for marginal, small, and large-size groups of farms respectively. The average input-output ratio came to 1:1.25.

Table 3. Total costs according to various cost concepts on Kharif Maize (₹ /ha)

Kharif					
S. No.	Particulars	Marginal (26)	Small (14)	Medium (10)	Average
1.	Cost A_1	22547.07	25086.89	30202.42	25945.46
2.	Cost A_2	22547.07	25086.89	30202.42	25945.46
3.	Cost B_1	25202.57	28137.11	33755.7	29031.79
4.	Cost B_2	31202.57	34137.11	39755.7	35031.8
5.	Cost C_1	37991.8	40239.5	42939.2	40390.33
6.	Cost C_2	44781	46342	46122.7	45748.66
7.	Cost C_3	48125.93	51002.89	54295.17	51141.33

Table 3, portrays that average cost A_1, A_2, B_1, B_2, C_1, C_2 and C_3 were observed to ₹25945.46, ₹ 25945.46, ₹ 29031.79, ₹ 35031.8, ₹ 40390.33, ₹ 45748.66, and ₹ 51141.33 respectively. From the table it is also clear that the each cost was positively correlated showing increasing trend with the size of holdings.

Table 4. Size group wise per hectare different income from Kharif Maize (₹ /ha)

Kharif					
S. No.	Particulars	Marginal (26)	Small (14)	Medium (10)	Average
1.	Gross income	59356	64210.1	70085.7	64550.6
2.	Net income	11230.07	13207.21	15790.53	13409.27
3.	Family labour income	18019.29	19309.63	18974.05	18767.65
4.	Farm business income	19105.67	20452.23	20186.5	19914.8
5.	Farm investment income	12316.45	14349.81	17002.98	14556.41

Table 4 reveals that average family labour income was ₹ 18767.65/hectare where as farm business income and farm investment income were ₹ 19914.8 and ₹ 14556.4/ hectare respectively. Farm investment income was significantly higher on large farms being ₹ 17002.98 as compared to marginal and small farms being ₹ 12316.45 and ₹ 14349.8 hectare /respectively.

Break-up of input cost for Maize in rabi season:

The total cost incurred on cultivation of maize crop and its breakup into factor of inputs per hectare has been given in Table 5 portrays that the average cost of cultivation of rabi maize crop came to ₹ 55482.4 per hectare. The cost of cultivation shows increasing trend with the increase in size of farm. It came to Rs 52397.57on marginal farms, Rs 55444.93 on small farms and Rs 58604.68 on large farms.

Table 5. Total cost and its break up of Maize crop in Rabi Maize (Rs/ha)

Rabi					
S. No.	Particulars	Marginal (26)	Small (14)	Medium (10)	Average
A	Variable cost				
1	Human labour				
a.	Family labour	7529.04	7094.24	3983.44	6202.24
b.	Hired labour	3890.52	4825.78	8306.24	5674.18
	Total human labour	11419.56	11920.02	12289.68	11876.42
2	Tractor power	4460.25	4600.98	4936.52	4665.91
3	Fertilizer & manure	4300.23	4598.25	4950.56	4616.34
4	Seeds	2250.6	2366.4	2450.25	2355.75
5	Irrigation	5700.6	6000.25	6290.5	5997.11
6	Plant protection	1480.38	1668.31	1923.48	1690.72
7	Interest on working capital	1184.46	1246.17	1313.63	1248.08

Rabi					
S. No.	Particulars	Marginal (26)	Small (14)	Medium (10)	Average
	Total variable cost	30796.08	32400.38	34154.62	32450.36
	Total fixed cost				
A	Rental value of land	6000	6000	6000	6000
B	Depreciation	1090.31	1481.65	1862.21	1478.05
C	Repair to dead stock	436.12	592.66	744.89	591.22
D	Interest on fixed capital	2655.50	3050.22	3553.28	3086.33
	Total fixed cost	10181.93	11124.53	12160.38	11155.61
	Total input cost	52397.57	55444.93	58604.68	55482.4

This was to proportionately more use of family labour on marginal farms weather more use of hired labour on large farms. The marginal and small farms had more family labour than that of hired labour. The average total human labour for all size group of the farm came to ₹11876.42 total operational cost was observed to be ₹30796.08, ₹32400.38 and ₹34154.62 on Marginal, Small and Large farms respectively, with overall average operational total cost being ₹ 32450.36.

Yield and returns:

The yield received from maize crop on per hectare basis has been presented in Table 6.

Table 6. Total returns received from Rabi Maize (₹ /ha)

Rabi					
S. No.	Particulars	Marginal (26)	Small (14)	Medium (10)	Average
1.	Input cost	52397.57	55444.93	58604.68	55482.4
2.	Total yield in qtl/ha	45.26	46.95	47.98	46.73
3.	Rate (in ₹/qtl)	1680	1750	1850	1760
4.	Main product	76036.8	82162.5	88763	82320.76
	By product	4500	4800	4950	4750
5.	Gross income	80536.8	86962.5	93713	87070.76
6.	Net income	28139.23	31517.57	35108.32	31588.37
7.	Cost of production per quintal	1157.70	1180.93	1221.43	1186.68
8.	Input – output ratio	1:1.53	1:1.56	1:1.59	1:1.56

Table 6revealsthat the higher gross income was noticed on large farms being ₹ 93713 fallowed by small and marginal farms bring ₹ 86962.5 and 80536.8 respectively. Net income was also higher on marginal farms as Rs 28139.23fallowed by small and large farms being ₹ 31517.57 and ₹ 35108.32 respectively. The higher net income on marginal farms was mainly due to better management and case utilized as small probability, agricultural technology, improved and suitable quality of seeds, timely and appropriate application of irrigation and plant protection practices, efficient supervision and management. The average cost of production per quintal came to ₹ 1186.68. Input-output ratio was calculated as 1:1.53, 1:1.56 and 1:1.59 for marginal, small and large size groups of farms respectively. The average input-output ratio came to 1:1.56.

Table 7. Total costs according to various cost concept on Rabi Maize (₹ /ha)

Rabi					
S. No.	Particulars	Marginal (26)	Small (14)	Medium (10)	Average
1.	Cost A_1	24357.35	26787.79	32033.39	27726.17
2.	Cost A_2	24357.35	26787.79	32033.39	27726.17
3.	Cost B_1	27012.85	29838.01	35586.67	30812.51
4.	Cost B_2	33012.85	35838.01	41586.67	36812.51
5.	Cost C_1	40541.89	42932.25	45570.11	43014.76
6.	Cost C_2	48070.93	50026.49	49553.55	49216.99
7.	Cost C_3	52397.57	55444.93	58604.68	55482.4

Table 7, portrays that average cost A_1, A_2, B_1, B_2, C_1, C_2 and C_3 were observed to ₹27726.17, ₹ 27726.17, ₹ 30812.51, ₹ 36812.51, ₹ 43014.76, ₹ 49216.99, and ₹55482.4 respectively. From the table, it is also clear that each cost was positively correlated showing an increasing trend with the size of holdings.

Table 8. Size group wise per hectare different income from Rabi Maize (₹ /ha)

Rabi					
S. No.	Particulars	Marginal (26)	Small (14)	Medium (10)	Average
1.	Gross income	80536.8	86962.5	93713	87070.76
2.	Net income	28139.23	31517.57	35108.32	31588.37
3.	Family labour income	35668.27	38611.81	39091.76	37790.6
4.	Farm business income	36852.73	39857.98	40405.39	39038.7
5.	Farm investment income	29323.69	32763.74	36421.95	32836.46

Table 8 reveals that average family labour income was ₹ 37790.6 per hectare where as farm business income and farm investment income were ₹39038.7 and ₹32836.46 per hectare respectively. Farm investment income was significantly higher on large farms being ₹36421.95 as compared to marginal and small farms being ₹29323.69 and ₹ 32763.74 per hectare respectively.

The comparative study of Maize crop in kharif and rabi season were found the maximum total input cost is ₹ 52397.57 in marginal, ₹ 55444.93 in small, ₹58604.68 in large & the average of the total input cost is ₹ 55482.4.Gross income is ₹ 80536.8 in marginal, ₹ 86962.5 in small, ₹93713 in large & the average of the gross income is ₹ 87070.76. input-output ratio is 1:1.53 in marginal, 1:1.56 in small, 1:1.59 in large & the average of the input-output is 1:1.56 in rabi season over the kharif season.

4. Conclusion

From the above facts, it becomes apparent that for the kharif maize crop, the expenses increase with farm size. On marginal farms, the cost stands at ₹ 48125.93, while small farms incur ₹ 51002.89, and large farms spend ₹ 54295.17. This upward cost trend is linked to the relative utilization of family labor on marginal farms and increased reliance on hired labor on larger farms. In terms of income, larger farms consistently achieve higher gross income. Large farms generate ₹ 70085.7, with small farms following at ₹ 64210.1 and marginal farms at ₹ 59356. A similar pattern is observed in net income, where marginal farms excel, earning ₹ 11230.07, while small and large farms record ₹ 13207.21 and ₹ 15790.53, respectively.

For the kharif season, the average cost of production per quintal is ₹ 1476.38, and the input-output ratios are 1:1.23 for marginal farms, 1:1.25 for small farms, and 1:1.29 for large farms.

While in rabi maize crop, parallel trends emerge. The cost of cultivation rises with farm size, reaching ₹ 52397.57 for marginal farms, ₹ 55444.93 for small farms, and ₹ 58604.68 for large farms. Gross income also follows this pattern, with large farms achieving the highest income at ₹ 93713, small farms at ₹ 86962.5, and marginal farms at ₹ 80536.8. Net income again mirrors this trend, with marginal farms leading at ₹ 28139.23, while small and large farms attain ₹ 31517.57 and ₹ 35108.32, respectively. For the rabi season, the average cost of production per quintal is ₹ 1186.68, with input-output ratios of 1:1.53 for marginal farms, 1:1.56 for small farms, and 1:1.59 for large farms.

Overall, the comparative study of maize cultivation in kharif and rabi seasons in Gonda District underscores the contrasting dynamics of farm economics. Larger farms tend to face higher costs and generate more substantial income. Interestingly, marginal farms excel in net income, attributed to superior management, advanced agricultural practices, high-quality seeds, efficient irrigation and plant protection methods, and effective supervision. The input-output ratios maintain consistency across different farm sizes. This data offers valuable insights for farmers and policymakers when making decisions regarding crop selection and farm management strategies, accounting for the specific characteristics and requirements of each season and farm size.

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