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Original Research Article

Cost of Cultivation and Income Analysis of Hybrid Maize Cultivation in Nabarangpur District of Odisha

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A B S T R A C T

Maize is one of the most important and widely grown cereal crops in the tribal district of Odisha. The study was carried out to study the cost of cultivation and income measures received from the hybrid maize cultivation in Nabarangpur district of Odisha. A sample of 90 respondents was chosen through purposive cum proportionate random sampling and were categorised as marginal (30), small (30) and medium (30) size group of farm holdings. Personal interview with use of pre-structured interview schedule was used to collect data from farmers. Simple tabular analysis was performed to find out the result which revealed that cost of cultivation and gross income was associated positively with the size of farm. Large farmer experienced the highest variable cost of Rs 38407 followed by medium (Rs 34312.69) and small farmer (Rs30935.19). The component of variable cost like human labour accounted for the largest proportion of variable cost (53.73%) followed by fertiliser and manure (14.4%) and total machinery labour (12.47%). The utilisation of human labour was most prominent compared to machine and animal labour in the study area. The calculation of total fixed cost concluded that large farmer account for the highest expenditure of Rs 15734.87 compared to small (Rs15268.14) and medium farmer (Rs 15263.78). The rental value of owned land had a greater share towards contribution of total fixed cost, the value of which was highest in case of large farmer (Rs12054.62) compared to small (Rs11712.56) and medium (Rs11719.20) farmer. The present study inferred that per hectare total cost of cultivation was highest among large farmer (Rs 54142.71) compared to small (Rs 46203.33) and medium farmer (Rs 49576.47) while it was worked out to be Rs 49974.14 on an overall basis. The per hectare gross return received from the hybrid maize cultivation in the study area was Rs 78200.00, Rs 69700.00 and Rs 64600 in case of large, medium and small farmer respectively.

Keywords

Hybrid maize, Cost of cultivation, Income measures, Total cost

Introduction

Maize is the most important and widely distributed cereal in the world after Wheat and Rice. Globally, maize is known as queen of cereals because of its highest genetic yield potential among the cereals. It is one of the most important cereal crops in the tribal districts of Odisha. It is cultivated in an area of 247.6 thousand ha with an average production of 730 thousand MT and productivity of 2948 kg/ha. (Odisha Economic Survey, 2018-19).It is predominantly cultivated as Kharif crop in Ganjam, Gajapati, Keonjhar, Koraput, Nawarangpur, Mayurbhanj and Kalahandi districts of Odisha and considered as second most important crop next to paddy during kharif season in terms of both area and production. Among different districts, Nabarangpur covers the maximum area of 69,270 ha, contributing around 30 % of total production. The cultivation of maize has assumed critical importance due to its diversified use as food, feed and fodder. Small farm holdings and limited resource availability and vagaries of monsoon like drought associated with highest cost on labour increased pressure of diseases/pests are the major constraints faced by the farmers (Devi and Suhasini, 2016). Considering the above facts, the present study has highlighted the cost of cultivation of hybrid maize in Nabarangpur district of Odisha along with the various income measures received from the hybrid maize cultivation in the study area.

Materials and Methods

Nabarangpur district being the potential area under maize cultivation in Odisha was selected purposively for the present study. Umerkote block was selected purposively based upon the concentration of areas under maize. The list of maize growing villages of the selected block was prepared on the basis of information obtained from the respective block agricultural office. Accordingly, villages like Murtumma, Ambaguda and URV-6 were selected. For selection of the sample cultivators, a list of maize growers was prepared from the revenue records of each of the villages. They were grouped into three categories on the basis of their operational holding viz., small farmers (1-2 ha.), medium farmers (2-4 ha), large farmers (more than 4 ha). The total sample cultivators selected from study area were 90, comprising of 30 small farmers, 30 medium farmers and 30 large farmer, based on probability proportion to their size. Primary data were obtained from the sample cultivars by survey method through a well-developed questionnaire prepared beforehand. Tabular analysis was performed to estimate the cost and returns structure. Standard cost concepts used in Cost of Cultivation scheme under state and central government were applied. Weighted average and percentage method were used for the calculation. The formula used for weighted average was $\Sigma W_I X_I / \Sigma W_I$ where X_I is the variable and W_I is the weight of variables.

Inputs use like seed, fertiliser, manure, human labour, bullock labour, machine labour was estimated in quantitative and monetary terms. Owned machinery charges were calculated on the basis of the cost of maintenance of farm machinery which included diesel, power, lubricants and depreciation, repair and maintenance expenses. Hired machinery charges for the crop was the actual amount paid for the hired service of machinery.

Interest on working capital was calculated at the rate of 12 percent per annum for half of the crop period. Land revenue was charged @ Rs 12 for non-irrigated farmers and Rs 75 for irrigated farmers. Interest on fixed capital, excluding land, was charged at the rate of 10% per annum whereas rental value of land was Rs1000/acre.

Analytical tools

Following cost concepts were used for estimating the magnitude of returns and costs.

Cost A1: All actual expenses in cash and kind incurred in production by owner which includes: (i) Value of hired human labour (ii)Value of owned machine labour (iii) Hired machinery charges (iv) Value of seed (both farm produced and purchased) (v)Value of insecticides and pesticides (vi)Value of manure (owned and purchased) (vii)Value of fertilizers viii. Irrigation charges (ix) Depreciation on implements & farm buildings (x) Land Revenue and other tax (xi) Interest on working capital (xii) Miscellaneous expenses (artisans etc.).

They are all referred as paid out cost.

Cost A_2: Cost A_1 + Rent paid for leased- in land
Cost B_1: Cost A_1 + interest on fixed capital (excluding land)
Cost B_2: Cost B_1 +Rental value of owned land + 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 + 10 percent of Cost C_2 as management cost

Operational or Variable cost comprised of input costs for seed, fertiliser, plant protection chemicals, human labour (owned and hired), machine labour (owned and hired) and interest on working capital. However, fixed cost comprised of Irrigation / Electricity Charge, rental value of owned land, depreciation on farm implements, land revenue and interest on fixed capital. Total cost was computed as the sum of variable and fixed cost.

Estimation of income measures

(i) Gross farm income: It is the total value of main product i.e. GI = (Qm × Pm)

Where, GI = Gross farm income, Qm = Quantity of main product and Pm = Price of main product

(ii) Net farm income = Gross farm income - Total expenses

(iii) Returns over variable cost (RVC): RVC = Gross income – Cost A_1

(iv) Farm business income (FBI): FBI = Gross income – Cost A_2

(v) Family labour income (FLI) or returns to family labour: FLI = Gross income – Cost B2

(vi) Returns to management (RM): RM = Gross income – Cost C_3

Estimation of cost ratios

Gross ratio

The gross (cost) ratio of total expenses to gross income is a combined measure of the profit making ability of the farm

GR = TC/GI where TC = Total Cost and GI= Gross Income

Fixed cost ratio

The ratio of fixed cost per year and the gross income of the farm give fixed cost ratio.

FCR = TFC/GI where FCR = Fixed Cost Ratio, TFC=Total fixed cost and GI= Gross Income

Return over variable capital (RVC): This was calculated by deducting operational cost (TVC) from gross farm income.

RVC = GI–TVC. Where TVC=Total variable cost, GI=Gross Income

Results and Discussions

Item wise variable costs incurred by the sample farmers in cultivation of maize have been presented in table 1 which shows that average per hectare variable cost in the study area is Rs 34,551.92. Large farmers experienced the highest variable cost of Rs 38407.84 followed by medium farmers (Rs 34312.69) and small farmers (Rs 30,935.19). Calculation of each component of variable costs confirmed that human labour accounted for the largest proportion of variable costs (53.73%) followed by fertiliser and manure (14.4%) and total machinery labour (12.47%). The other components of variable costs were categorised as seed (11.31%), total animal labour (4.86%), interest on working capital (1.93%), irrigation charges (0.78%), insecticides (0.30%) and miscellaneous expenditure (0.15%).The utilisation of human labour was most prominent during the maize cultivation in the study area. Both small and medium farmers employed approximately 55%of total variable cost as human labour. The expenditure incurred on inputs like seeds were Rs 3232.50, Rs 3778.00 and Rs 4709.00 which accounted for 10.445, 11.01% and 12.26% of total variable cost for small, medium and large farmers respectively. The expenditure incurred for input like fertiliser and manure in case of small, medium and large farmers were Rs 4014.26, Rs4440.73 and Rs 6551 respectively. The farmers utilise the human labour mostly followed by machine and animal labour in the study area. The expenditure on total human labour in case of small, medium and large farmers was found to be Rs 1578.68, Rs 1661.01 and Rs 1801.83 respectively. The large farmers spent Rs 4800.00 on machine labour which was higher than that of medium farmer (Rs 4136.00) and small farmer (Rs 3997.95).The other components off variable costs were found to have negligible share in cultivation of hybrid maize in the study area. Total variable costs were observed to be Rs 4014.26, Rs 4440.73 and Rs 6551for small, medium and large farmers respectively.

The calculation of fixed costs revealed that rental value of owned land had a greater share towards the contribution of fixed cost, the value of which were Rs. 11,712.56 (76.61%), Rs. 11719.20 (76.78%) and Rs. 12054.62 (76.61%) for small, medium and large farmers respectively (Table 2). On an average, the rental value of owned land was calculated to be Rs11828.79 (76.69%).The rent paid for leased in land was highest (Rs 2567.68) in case of large farmer compared to small farmer (Rs 2500.58) and medium farmer (Rs 2490.61). On an average, the .rent paid for leased in land was calculated to be Rs2519.62.The components like land revenue and depreciation had a negligible share towards composition of fixed cost. Interest on fixed capital was found to be highest in case of large farmer (Rs 810.00) compared to small farmer (Rs 755.00) and medium farmer (Rs 754.00).Among different components of fixed costs, rental value of owned land accounted for the largest proportion (76.69%) followed by rent paid for leased in land (16.34%). Total fixed cost was highest in case of large farmer (Rs 15734.87) compared to small (Rs 15268.14) and medium farmer (Rs 15263.78).On an average, the total fixed cost incurred for hybrid maize cultivation in the study area was calculated to be Rs 15422.25. The total cost (summation of total fixed cost and total variable cost) incurred by small, medium and large farmer were calculated to be Rs 46203.33, Rs 49576.47 and Rs 54142.71 respectively. The figure

obtained in calculating the total cost showed a positive trend with increase in farm size. Similar conclusion was also reported by Choudhri *et al* (2018).

Table 3 summarizes the cost of cultivation on the basis of cost concepts. The table revealed that on an average, cost A_1, cost A_2, cost B_1, cost B_2, cost C_1, cost C_2 and cost C_3 were computed to be Rs 22379.72, Rs 24899.34, Rs 23152.71, Rs 37501.14, Rs 35625.76, Rs 49974.17 and Rs 54938.25 respectively. The cost A_1 was highest in case of large farmer (Rs 24344.87) compared to medium farmer (Rs 22576.89) and small farmer (Rs 20217.39).The cost A_2 was highest in case of large farmer (Rs 26912.55) compared to medium farmer (Rs 25067.50) and small farmer (Rs 22717.97). Among different categories of land holdings, cost C_1 was highest for large farmer (Rs 39520.41) and lowest for small farmer (Rs 31990.19).Cost C_2 which is also known as total cost were worked out to be Rs 46203.33, Rs49576.47 and Rs 54142.71 for small, medium and large farmer respectively. Cost C_3 which includes managerial cost was worked out to be Rs 54938.25 on an overall basis. The per hectare yield of main product was highest in case of large farmer (46 quintal) followed by medium farmer (41 quintal) and small farmer (38 quintal) respectively which indicated that large farmers were most efficient compared to small and medium farmers in the study area (Table 4). Income measures from hybrid maize cultivation among different categories of farm holdings (Rs/ha)

Table 4 revealed the income measures obtained from different categories of farm holdings. On an average, gross income per hectare was reported to be Rs 70833.34.It was highest in case of large farmer(Rs 78200) followed by medium farmer (Rs 69700) and small farmer (Rs 64600) respectively. The net income was highest for large farmer (Rs 24057.29) followed by medium farmer (Rs 20123.53) and small farmer (Rs 18396.67). On an average, the net income per hectare was worked out to be Rs 20859.16.The return over variable cost was highest in case of large farmer (Rs 53855.13)followed by medium farmer (Rs 47123.11) and small farmer (Rs 44382.61). The farm business income varied within the range of Rs 41882.03 per hectare to Rs 51287 per hectare on different size of land holdings. On an average, the family labour income was computed to be Rs 33332.20. The overall returns to management were found to be Rs 15895.08 per hectare. It varied within the range of Rs 13776.34 to Rs 18643.02. The returns per rupee investment are an effective method to measure the economic feasibility of any crop. It was found to be Rs1.41 on an overall basis. It was highest in case of large farmer (Rs1.45) followed by medium (Rs 1.40) and small farmer (Rs 1.39) respectively. The figure of returns per rupee investment confirmed that large farmers realised lowest cost per unit area indicating much efficiency compared to small and medium farmers in the study area.

Table 5 represents the ratio measures of different size of farm holdings. Gross ratio express the percentage of the gross income consumed by the expenses and is therefore indicative of absolute size of business. The gross ratio was found to be 0.71, 0.71 and 0.69 for small, medium and large farmer respectively. It was observed that fixed cost ratio were highest in case of large farmer (0.23) compared to medium farmer (0.22) and small farmer (0.20). Operating cost ratio was lowest in case of small farmer compared to medium and large farmer. The study confirmed that small farmer needs proper resource allocation and technical know-how of scientific cultivation of hybrid maize for enhancing productivity at micro level. Rational allocation of scarce farm resources could be a better option to reduce per unit

cost of cultivation. Similar results were found by Murthy *et al* (2015), he reported that Maize production was found to be profitable and also supported by B:C Ratio of 1.42 to 1.50 among different categories of farmers.

Table.1 Composition of variable cost of hybrid maize cultivation (Rs/ha) among different categories of farm holdings

Sl no	Particulars	Size Groups of Farmers			
		Small	Medium	Large	Overall average
1	Seed	3232.50 (10.44)	3778.00 (11.01)	4709 (12.26)	3906.50 (11.31)
2	Fertiliser and manure	4014.26 (13.00)	4440.73 (12.94)	6551.00 (17.05)	5001.99 (14.47)
3 a. b.	Human labour Family labour Hired labour	17051.37 (55.11) 11022.94 (35.63) 6028.43 (19.48)	19163.65 (55.85) 12035.80 (35.08) 7127.85 (20.77)	19485.81 (50.73) 14365.54 (37.40) 5120.27 (13.33)	18565.23 (53.73) 12473.05 (36.09) 6092.18 (17.64)
4 a. b.	Animal labour Owned Hired	1578.68 (5.10) 1020.57 (3.30) 558.11 (1.80)	1661.01 (4.84) 1100.56 (3.21) 560.45 (1.63)	1801.83 (4.69) 1320.57 (3.44) 481.26 (1.25)	1680.50 (4.86) 1147.23 (3.32) 533.27(1.54)
5 a. b.	Machine labour Owned Hired	3997.95(12.92) 388.78(1.25) 3609.17(11.67)	4136(12.05) 110.50(0.32) 4025.50(11.73)	4800 (12.49) 350.80 (0.91) 4449.20 (11.58)	4311.31(12.47) 283.36(0.82) 4027.95(11.65)
6	Insecticides/pesticide	110(0.36)	56.28(0.14)	145(0.42)	103.76(0.30)
7	Interest on working capital	650(2.10)	675.2(1.97)	672(1.74)	665.73(1.93)
8	Irrigation charges	255(0.82)	272.10(0.79)	275.67(0.71)	267.59(0.78)
9	Miscellaneous Expenditure	50.57(0.16)	41(0.12)	56.25(0.14)	49.27(0.15)
10	Grand Total	30935.19(100)	34312.69(100)	38407.84	34551.92(100)

(Figure in the parenthesis indicates percentage value)

Table.2 Composition of fixed cost of hybrid maize cultivation (Rs/ha) among different categories of farm holdings

Sl no	Particulars	Size Groups of Farmers			
		Small	Medium	Large	Overall average
1	Rental value of owned land	11712.56(76.71)	11719.20(76.78)	12054.62(76.61)	11828.79(76.69)
2	Rent paid for leased in land	2500.58(16.38)	2490.61(16.32)	2567.68(16.32)	2519.62(16.34)
3	Land revenue, taxes, ceses	30 (0.19)	30 (0.20)	30 (0.19)	30 (0.19)
4	Depreciation of implements and farm buildings	270(1.77)	269.97(1.76)	272.57(1.73)	270.84(1.76)
5	Interest on fixed capital	755(4.95)	754(4.94)	810(5.15)	773(5.02)
6	Grand total	15268.14(100)	15263.78(100)	15734.87(100)	15422.25(100)

(Figure in the parenthesis indicates percentage value)

Table.3 Cost of cultivation of hybrid maize (Rs/ha) on different cost concept basis among different categories of farm holdings

Sl no	Particulars	Size Groups of Farmers			
		Small	Medium	Large	Overall average
1	Cost A_1	20217.39	22576.89	24344.87	22379.72
2	Cost A_2	22717.97	25067.50	26912.55	24899.34
3	Cost B_1	20972.39	23330.89	25154.87	23152.71
4	Cost B_2	35185.53	37540.70	39777.17	37501.14
5	Cost C_1	31990.19	35366.69	39520.41	35625.76
6	Cost C_2	46203.33	49576.47	54142.71	49974.17
7	Cost C_3	50823.66	54434.12	59556.98	54938.25
8	Main product yield (q/ha)	38	41	46	41.67
9	bye product yield (q/ha)	57	61.5	69	62.5

Table.4 Income measures from hybrid maize cultivation among different categories of farm holdings (Rs/ha)

Sl no	Particulars	Size Groups of Farmers			
		Small	Medium	Large	Overall average
1	Gross income	64600.00	69700.00	78200.00	70833.34
2	Returns over variable cost	44382.61	47123.11	53855.13	48453.62
3	Farm business income	41882.03	44632.50	51287.45	45934.00
4	Family labour income	29414.47	32159.30	38422.83	33332.20
5	Returns to management	13776.34	13265.88	18643.02	15895.08
6	Net income	18396.67	20123.53	24057.29	20859.16
7	Returns per rupee investment	1.39	1.40	1.45	1.41

Table.5 Estimation of cost ratios

1	Gross ratio	0.71	0.71	0.69	0.70
2	Fixed cost ratio	0.23	0.22	0.20	0.22
3	Operating cost ratio	0.48	0.49	0.49	0.49

It can be concluded that large farmers experienced the highest variable cost of Rs 38407 followed by medium (Rs 34312.69) and small farmer (Rs 30935.19). The component of variable cost like human labour accounted for the largest proportion of variable cost (53.73%) followed by fertiliser and manure (14.4%) and total machinery labour (12.47%). The utilisation of human labour was most prominent compared to machine and animal labour in the study area. The calculation of total fixed cost concluded that large farmer account for the highest expenditure of Rs 15734.87 compared to small (Rs15268.14) and medium farmer (Rs 15263.78). The rental value of owned land had a greater share towards contribution of total fixed cost, the value of which was highest in case of large farmer (Rs12054.62) compared to small (Rs11712.56) and medium (Rs11719.20) farmer. The present study inferred that per hectare total cost of cultivation was highest among large farmer (Rs 54142.71) compared to small (Rs 46203.33) and medium farmer (Rs 49576.47) while it was worked out to be Rs 49974.14 on an overall basis. The per hectare gross return received from the hybrid maize cultivation in the

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