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Production efficiency of summer groundnut in Washim District of Maharashtra State

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Abstract
The present study entitled, "Production Efficiency of Summer Groundnut In Washim District of Maharashtra State". The study was undertaken to examine the cost and returns summer groundnut cultivation. For the present study 120 summer groundnut farmers were selected from Mangrulpir, Manora and Washim tehsils of Washim district. The primary data was collected from the summer grounndnut farmers by survey method and pretested schedule. To estimate the cost and returns of summer groundnut standard cost concepts i.e. cost A_1, cost A_2, cost B_1, cost B_2, cost C_1, cost C_2 and cost C_3 were used. To estimate technical, allocative and economic efficiency. stocastic frontier production function was used. It is revealed from the study that Cost 'C_3' of summer groundnut farmer was Rs 96259.40. Gross returns of summer groundnut was Rs 103774.61. The Benefit-cost ratio at cost 'C_3' of summer groundnut was 1.52. It shows that the summer groundnut crop appeared to be good for monitory benefits and profitable crop. The mean technical efficiency was 89.55. It is observed that the minimum technical efficiency was 43.79 and the maximum technical efficiency was 99.47. The mean economic efficiency was 56.74. The minimum economic efficiency was 2.32 percent and maximum economic efficiency was 79.90 percent. The mean allocative efficiency of the sample farms was 63.72 percent. The minimum allocative efficiency was 5.30 percent and maximum allocative efficiency was 103.19 percent.

Keywords: standard cost concepts, benefit-cost ratio, profitable, technical efficiency, allocative efficiency

Introduction
Groundnut (*Arachis hypogaea*) is a leguminous crop belonging to the family Fabaceae. It has a taproot system with nodules that fix atmospheric nitrogen, enabling the plant to thrive in nitrogen-deficient soils. The stem can be either spreading or erect, growing up to 30-60 cm in height. The leaves are pinnately compound with four oval-shaped leaflets. Groundnut produces small, yellow, self-pollinating flowers above ground which develop into pegs (stalks) that grow downwards into the soil. These pegs produce underground pods containing 1-4 seeds, commonly known as peanuts. The pods are typically 2-5 cm long and have a reticulated surface. The seeds are rich in oil, protein and nutrients, making groundnut a valuable crop for food, nutrition and economy. Its unique botanical features, such as geocarpy (fruiting underground), contribute to its adaptability and economic importance as a food and oilseed crop (Singh *et al* 2016) [10]. Groundnut cultivation requires specific climatic conditions to thrive. It grows best in tropical and subtropical regions with warm temperatures, ranging from 20-30°C (68-86°F). Adequate moisture is essential with annual rainfall or irrigation of 600-1,200 mm (24-47 in). The crop prefers well-drained soils such as sandy loam or sandy clay loam, with a pH range of 6.0-7.0. Groundnut is sensitive to extreme temperatures, waterlogging, and frost. High temperatures above 35°C (95°F) can lead to reduced yields, while frost can damage or kill the crop. Excessive rainfall or waterlogging can cause root rot and other diseases. Full sun exposure is also crucial for groundnut growth with at least 6-8 hours of direct sunlight per day. The crop's sensitivity to climatic conditions makes it essential to carefully select suitable regions and varieties for cultivation.

In Maharashtra State during 2024-25, area covered under Summer Groundnut is 98.49 thousand hectares with production of 162.45 thousand tonnes with an productivity of 1649.40 kg per hectare. The trend continued in 2022-23, with further reduction in area to 48.6 thousand hectares, and production decreased to 76.4 thousand tonnes, though the productivity remained high at 1571.50 kg/ha. A notable rise was observed in 2023-24, where the area increased sharply to 70.31 thousand hectares, and production rose to 109.05 thousand tonnes, with productivity at 1550.94 kg per hectare.(Commissionerate of Agriculture, GOM 2024-25) Summer groundnut is an important crop in Washim district the area under summer groundnut in 2023-24 was 5073.00 hectares with production 13696.00 tonnes and productivity 2700.00kg per hectare hectares and in 2024-25 area was 5143.00 with production 10852.00 tonnes and productivity 2110kg per hectare. (District wise third advance estimate for Maharashtra state). Area under Summer Groundnut is increasing in the district as summer groundnut is profitable oilseed crop.

Materials and Methods

The present study was undertaken in Washim district of Vidarbha region. The district was selected purposively, because of concentrated area under summer groundnut. The simple random sampling technique was used. Out of six tehsils in Washim district three tehsils i.e. Washim, Mangrulpir and Manora were selected on the basis of potential area under Summer Groundnut. From each village 10 farmers were selected. Total 120 farmers were selected for the present study. Primary data was collected by survey method by using pre tested schedule for the year 2024-25. The standard cost concepts i.e. cost A_1, cost A_2, cost B_1, cost B_2, cost C_1, cost C_2 and cost C_3 were used in present analysis. To estimate the technical, economic and allocative efficiency, stochastic frontier production function was used.

The analytical part of the research was mainly confined to: Per hectare cost A_1, cost A_2, cost B_1, cost B_2, cost C_1, cost C_2 and cost C_3 was estimated at different cost. Net returns at cost A_1, cost A_2, cost B_1, cost B_2, cost C_1, cost C_2 and cost C_3 was estimated.

$$\text{Benefit-cost ratio} = \frac{\text{Gross Income}}{\text{Respective cost}}$$

Specification of the model

$$L_nY_i = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + \beta_6 lnX_6 + \beta_7 lnX_7 + (V_iU_i)$$

Where,

Y_i = Output of summer groundnut (Quintals ha^{-1})
X_1 = Human labour (hrs ha^{-1})
X_2 = Bullock hours (hrs ha^{-1})
X_3 = Machine hours (hrs ha^{-1})
X_4= Quantity of seeds (kg ha^{-1})
X_5 = Quantity of Manures (kg. ha^{-1})
X_6 = No of days Irrigated (hrs. ha^{-1})
X_7 = Quantity of fertilizer (kg ha^{-1})
V_i = Random variable
U_i = Farm specific technical efficiency related variable
β_0=Intercept/Constant**.**

Stochastic frontier profit function was used to estimate economic efficiency of gram

Specification of the model

$$L_n\ \Pi_i = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + \beta_6 lnX_6 + \beta_7 lnX_7 + (V_iU_i)$$

Where,

Π_i = Normalized profit at cost-A of the i^{th} farmer
X_1 = Human labour wage rate per hr normalized by output price of i^{th} farm
X_2 = Bullock labour wage rate per hr normalized by output price of i^{th} farm
X_3 = Machine wage rate per hour normalized by output price of i^{th} farm
X_4 = Price of seed per kg normalized by the output price of i^{th} farm
X_5 = Price of mannures per kg normalized by the output price of i^{th} farm
X_6 = Price of irrigation normalized by the output price of i^{th} farm
X_7 = Price of fertilizer normalized by the output price of i^{th} farm
V_i = Random variable
U_i = Farm-specific economic efficiency related variable
β_0 = Intercept

The allocative efficiency can be calculated using following formula.

AEi=EEi/Tei

Results and Discussion

The per hectare cost of cultivation for summer groundnut crop is presented in Table 1. The study reveals that per hectare cost of cultivation i.e. cost 'C_3' was ₹96259.40. The major share in groundnut cultivation was found towards cost ''A1'' and cost 'A_2' (52.37 per cent). the share of cost of hired human labour has occupied first position with (16.03 per cent) followed by seed (12.77 per cent), machine charges (6.10 per cent), manures (6.37 per cent), plant protection (2.84). Thus, it could be inferred that seed, machine charges, hired human labour, bullock labour, fertilizers, plant protections and manures were the major cost components. Per hectare yield of summer groundnut crop was obtained 24.58 quintals with gross returns of ₹146931.20. The per quintal cost of production was ₹3512.15.

Table 2 revealed that per hectare average gross returns for summer groundnut was worked out to Rs. 146931.20. The net returns per hectare obtained at various costs were Rs. 96522.97 at cost 'A_2', Rs. 70513.28 at cost 'B_2' 50671.80 at cost 'C_3'. This means summer groundnut crop appeared to be good for monitory benefits and profitable crop. The benefit-cost ratio at cost 'C_3' was recorded 1.52. The benefit-cost ratio which is an indicator of economic efficiency in crop production for the crop and other discussion indicated that summer groundnut registered a good benefit-cost ratio 1:1.52 means this is profitable crop. Similar result reported by Ramoliya R and Prajapati M (2022) cost 'A' was 42819.05, cost 'B' was 50707.47 and cost 'C_2' was reported ₹82590.42 where benefit cost ratio at cost 'C' was 1.65.

Table 1: Per hectare cost of cultivation of summer groundnut farmers (Rs/ha)

Sr. No.	Item	Unit	Input/ Ha	Cost/Unit of input Rs.	Total Cost/ha Rs.	Per cent to total cost C_3
1	Hired human a)Male labour b)Female	Days	17.43	348.02	5669.28	5.89
		Days	38.68	252.33	9760.12	10.14
	Sub-total	Days	56.11	577.59	15429.41	16.03
2	Bullock a)Hired labour b) Owned	Days	2.42	305.41	739.09	0.77
		Days	4.87	305.41	1487.35	1.55
	Sub-total	Days	7.29		2226.44	2.31
3	Machine a)Hired Charges b)Owned	Hours	5.51	627.70	3458.62	3.59
		Hours	3.84	627.70	2410.36	2.50
	Sub-total	Hours	9.35		5869.00	6.10
4	Seed	Kg.	105.94	116.06	12295.40	12.77
5	Manures	Tons.	4.57	1340.80	6127.46	6.37
6	Fertilizers a) N	Kg.	38.38	8.70	333.91	0.35
	b) P	Kg.	60.26	30.14	1816.24	1.89
	Sub-total	Rs.	98.64		2150.14	2.23
7	Irrigation charges	Rs.			942.76	0.98
8	Plant protections	Rs.			2733.71	2.84
9	Incidental charges	Rs.			193.71	0.20
10	Repairing charges	Rs.			192.48	0.20
11	Working capital (1 to 10)	Rs.			48160.49	50.03
12	Int. on wor. Cap. @ 6 per cent /annum	Rs.			1444.81	1.50
13	Depreciation	Rs.			734.78	0.76
14	Land revenue	Rs.			68.14	0.07
15	Cost "'A1'" (11 to 14)	Rs.			50408.23	52.37
16	Rental value leased in land	Rs.			0.00	0.00
17	Cost "A_2" (15+16)	Rs.			50408.23	52.37
18	Int. on fix. cap. @ 10 per cent/annum	Rs.			1589.30	1.65
19	Cost "B_1" (17+18)	Rs.			51997.53	54.02
20	Rental value of land	Rs.			24420.39	25.37
21	Cost "B_2" (19+20)	Rs.			76417.92	79.39
22	Imputed value a) Male Family labour b) Female	Days	15.55	309.71	4815.99	5.00
		Days	26.20	239.49	6274.64	6.52
	Sub-total	Days	41.75		11090.63	11.52
23	Cost "C_1" (19+22)	Rs.			63088.15	65.54
24	Cost "C_2" (21+22)	Rs.			87508.55	90.91
25	Supervision charges @ 10 per cent of C_2	Rs.			8750.85	9.09
26	Cost "C_3" (24+25)	Rs.			96259.40	100
27	Yield per a) Main produce Hectare b) By-produce	Qtls	24.58	5573.66	137000.56	
			10.61	935.97	9930.64	
28	Gross returns	Rs.	35.19		146931.20	
29	Per qtl. cost of production	Rs.			3512.15	

Table 2: Per hectare cost and returns of summer groundnut farmers

Sr. No	Particulars	Value (summer Groundnut)
1.	Main Produce (quintal/ha)	5573.66
2.	Value of Main Produce	935.97
3.	By produce (quintal/ha)	137000.56
4.	Value of by produce	9930.64
5.	Gross Returns	146931.20
6.	**Cost of Cultivation at**	
	Cost 'A_1'	50408.23
	Cost 'A_2'	50408.23
	Cost 'B_1'	51997.53
	Cost B_2	76417.92
	Cost C_1	63088.15
	Cost C_2	87508.55
	Cost C_3	96259.40
7.	**Net Returns at**	
	Cost 'A_1'	96522.97
	Cost 'A_2'	96522.97
	Cost B_1	94933.67
	Cost B_2	70513.28
	Cost C_1	83843.05
	Cost C_2	59422.65
	Cost C_3	50671.80

8.	**Benefit-cost ratio**	
	Cost 'A_1'	2.91
	Cost 'A_2'	2.83
	Cost B_1	1.92
	Cost B_2	2.33
	Cost C_1	1.68
	Cost C_2	1.53
	Cost C_3	1.52

Technical, economic and allocative efficiency of summer groundnut

Maximum likelihood estimates (MLE) of stocastic frontier production function along with mean technical efficiency are presented in Table 3

From the Table 3 the results of the stochastic frontier production function has shown that the estimated value of the coefficient of human labour (1.451), bullock labour (1.952), and machine labour (0.986) were positive and statistically significant at the 1per cent level of significance. This indicates that these inputs have a strong influence on the productivity of summer groundnut and that increasing their usage could significantly enhance yield per hectare. The coefficient of manures (0.529) and irrigation (0.412) were also found to be positive and significant at the 1per cent level. Fertilizer had a coefficient of 0.375, which was significant at the 10per cent level, reflecting a moderately positive impact on production. On the other hand, the coefficient of seed (-0.452) was negative and not statistically significant, indicating that overuse of seed may not necessarily contribute to higher yields and could even reduce productivity The estimate of sigma square (0.097) and gamma (0.965) further confirmed the presence of technical inefficiency in production, while the high value of the log likelihood function (163.336) and mean technical efficiency (72.355) indicates the model's robustness and a reasonable level of technical efficiency among summer groundnut farmers.

Table 3: Coefficient of stochastic frontier production function of summer groundnut

Variables	**Coefficient**	**Standard Error**
Constant	-3.712***	(0.066)
Human labour	1.451***	(0.014)
Bullock labour	1.952***	(0.030)
Machine labour	0.986***	(0.019)
Seed	-0.452	(0.124)
Mannures	0.529***	(0.043)
Irrigation	0.412***	(0.002)
Fertilizer	0.375*	(0.100)
Sigma Square	0.097	
Gamma	0.965	
log likelihood	163.336	
Mean TE	72.355	

(**Note:** ***, ** and * indicates significance at 1per cent, 5per cent and 10per cent levels respectively)

From the Table 4. The frequency distribution of sample farmers by the level of technical efficiency in rising the summer groundnut crop. The mean level of technical efficiency has been estimated 72.35 per cent. This implies that on average farmers were able to achieve only 72.35 per cent of their potential output by using existing inputs and technology. Hence on an average 27.65 per cent of technical efficiency was not utilized. The minimum technical efficiency was 37.09 per cent and the maximum technical efficiency was 107.10 per cent. The mean technical efficiency was 72.35 per cent. Majority of the farmers (64.17 per cent) were operating close to the frontier with the technical efficiency lied between 70 to 80 per cent. 19.17 per cent of the summer groundnut farmers led between 60 to 70 per cent of the technical efficiency level. Further the analysis revealed that 6.67 per cent of the sample farmers lied between 80 to 90 per cent technical efficiency level.

Table 4: Technical efficiency of sample farmers of summer groundnut (N=120)

TE (per cent)	**No. of Farmers**	**Percentage to total**	**Average**	**Percentage to Increase production to Achieve maximum efficiency**
<10	0.00	0.00	0.00	0.00
10.01-20	0.00	0.00	0.00	0.00
20.01-30	0.00	0.00	0.00	0.00
30.01-40	2.00	1.67	37.25	0.00
40.01-50	2.00	1.67	48.40	0.00
50.01-60	5.00	4.17	55.84	47.87
60.01-70	23.00	19.17	67.86	36.84
70.01-80	77.00	64.17	74.18	30.74
80.01-90	8.00	6.67	82.70	22.79
>90	3.00	2.50	99.28	7.31
Mean TE (per cent)	72.35			
Min TE (per cent)	37.09			
Max TE (per cent)	107.10			

Maximum likelihood estimates (MLE) of stocastic frontier production function along with mean technical efficiency are presented in Table 5. The coefficient of human labour price (1.527) showed a significant positive effect on the profits at 1per cent level of significance. The coefficient of bullock labour price (0.824) and machine labour price (0.774) was positively significant at 1per cent level of significance. The coefficient of seed price (1.998) was positively significant at 1per cent level of significance and manure (0.399) was positive but not significant. The coefficient of irrigation (0.898) and fertilizer (0.698) showed a significant positive effect at 1per cent level of significance. The estimated value of gamma is 0.185. The results showed that one percent increase in the prices of human labour, bullock labour, machine labour, seed, irrigation and fertilizer will increase the profit significantly. The log likelihood function (183.39) was positive and significantly different from zero indicating a good fit and the correctness of the specific distribution assumption.

Table 5: Estimation of coefficient of Stochastic Frontier Profit Function of summer groundnut

Variable	Coefficient	Standard Error
Constants	-5.417***	(0.575)
Human labour price	1.527***	(0.030)
Bullock labour price	0.824***	(0.027)
Machine labour price	0.774***	(0.070)
Seed price	1.998***	(0.064)
Mannures	0.399	(0.012)
Irrigation	0.898***	(0.020)
Fertilizer	0.698***	
Sigma Square	0.166	
Gamma	0.185	
log likelihood	183.39	
Mean EE	57.739	

(Note: ***, ** and * indicates significance at 1per cent, 5per cent and 10per cent levels, respectively.)

The mean level of economic efficiency has been estimated as 57.73 per cent which means, in principle that the sample farmers can potentially reduce their overall cost of summer groundnut production and still achieve existing level of output. These results indicate the potential to further improve the economic efficiency of the summer groundnut. It is observed from Table 6 that majority 91.67 per cent of the farmers in sample operated at economic efficiency levels of 60-70 followed by 70.00 per cent of the farmers with economic efficiency of 50-60 per cent. Only 11.67 per cent of the farmers achieved higher efficiency levels of greater than 30-40 per cent.

Table 6: Economic efficiency of sample farmers of summer groundnut (N=120)

EE (per cent)	No. of Farmers	Percentage to total	Average	Percentage to increase production to achieve maximum efficiency
<10	0.00	0.00	0.00	0.00
10.01-20	1.00	1.67	17.61	79.57
20.01-30	3.00	5.00	26.52	71.54
30.01-40	7.00	11.67	33.92	60.64
40.01-50	6.00	10.00	42.99	50.11
50.01-60	42.00	70.00	57.32	33.49
60.01-70	55.00	91.67	63.11	26.77
70.01-80	4.00	6.67	73.58	14.62
80.01-90	2.00	3.33	84.65	1.78
>90	0.00	0.00	0.00	0.00
Mean EE (per cent)	57.739			
Mix EE (per cent)	17.610			
Max EE (per cent)	86.182			

Table 7 states that, The mean allocative efficiency of the sample farms was 68.81 per cent which means, the potential to further improve the allocative efficiency by 31.19 per cent. In the area the allocative efficiency ranges from 47.49 to 107.76 per cent with a mean efficiency of 68.81 per cent. The minimum allocative efficiency was 47.49 per cent and maximum allocative efficiency was 107.76 per cent. Similar result reported by Reddy *et. al.* (2017) [6] the mean technical efficiency was 79 per cent, mean allocative efficiency was 72 per cent and mean economic efficiency was 57 per cent.

Table 7: Allocative efficiency of sample farmers of summer groundnut (N=120)

AE (per cent)	No. of Farmers	Percentage to total	Average	Percentage to increase production to achieve maximum efficiency
<10	0.00	0.00	0.00	0.00
10.01-20	0.00	0.00	0.00	0.00
20.01-30	3.00	2.50	24.63	77.14
30.01-40	2.00	1.67	32.31	70.02
40.01-50	4.00	3.33	44.65	58.56
50.01-60	3.00	2.50	54.90	49.05
60.01-70	5.00	4.17	64.71	39.95
70.01-80	33.00	27.50	76.87	28.67
80.01-90	47.00	39.17	84.10	21.96
>90	23.00	19.17	97.53	9.49
Mean AE(per cent)	68.81			
Mix AE (per cent)	47.497			
Max AE (per cent)	107.76			

Conclusion

The study that Cost 'C_3' of summer groundnut farmer was Rs 96259.40. Gross returns of summer groundnut was Rs 103774.61. The Benefit-cost ratio at cost 'C_3' of summer groundnut was 1.52. The mean technical efficiency of sample farmer in summer groundnut cultivation was 72.35. It is observed that the maximum technical efficiency was 107.10 and the minimum technical efficiency was 37.09. Mean economic efficiency of sample farmer in summer groundnut cultivation was 57.73. The maximum economic efficiency was 86.18 per cent and The minimum economic efficiency was 17.16 per cent. The mean allocative efficiency of the sample farmers in summer groundnut cultivation was 68.81 per cent. The maximum allocative efficiency was 107.76 per cent and the minimum

allocative efficiency was 47.49 per cent. The analysis indicates that summer groundnut is a profitable crop, offering favourable returns over investment; therefore farmers should be encouraged to expand its cultivation area to enhance farm income and overall profitability.

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