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Economic analysis of production of ginger in Sangli district of Maharashtra

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Abstract
The present study entitled, 'Economics of production of Ginger in Sangli district of Maharashtra' is based on a sample of 90 Ginger growers drawn from Kadegaon and Khanapur tahsils of Sangli district in order to estimate existing production cost and study resource use of Ginger cultivation. The factors affecting yield of Ginger were estimated by using the Cobb- Douglas type production function. The data pertained to the agricultural year 2017-18. The production was 407 quintal per hectare. The estimated per hectare cost, at overall level was Rs.662829. The per hectare inputs utilized for Ginger at overall level were 458 human days, 31 tonnes manures, 146 kg N, 248 kg P, 228 kg K. Average per hectare gross income was Rs.16,63, 975. The gross income received in size group small, medium and large was Rs. 1824688, Rs. 1656162 and Rs.1511074, respectively. The benefit-cost ratio was 2.43 at the overall level and it was found higher in small size group (2.48). The results of Cobb-Douglas type production function analysis revealed that the factors *viz*., human labours, manures, N were found positive and significant thereby influencing the yield of Ginger. The magnitude of coefficient of multiple determinations (R2) was 0.91.

Keywords: Ginger, costs, returns, resource use, production

Introduction
The spice Ginger is the underground rhizome of the Ginger plant, known botanically as *Zingiber officinale*. The plant's botanical name is thought to be derived from its Sanskrit name "singabera" which means "horn shaped," a physical characteristic that Ginger reflects. The flesh of the Ginger rhizome can be yellow, white or red in colour, depending upon the variety. The Ginger rhizome has a firm, striated texture and it has pungency. It is one of the earliest oriental spices known to Europe and is still in large demand. India is the largest producer, China is the largest exporter and Japan is the largest importer of Ginger in world. Spices, the high value and export oriented crops play an important role in Indian economy. India occupies a preeminent position in production and global trade of spices. Spices are the traditional items in the export basket of India and accounts for half of the global trading in spices. Total spice export from India in 2017-2018 was 10.8 lakh tonnes valued US$ 3.11 billion**.** Major **s**pice growing states are Andhra Pradesh, Rajasthan and Gujarat etc. Global production of Ginger is about 21.40 lakh tonnes production, out of which India is in the unique position of being the largest producer. Other major producers are China,
Taiwan, Nigeria, Jamaica, Sierra, Leone, Thailand and Australia. The countries importing the highest amount are the United Kingdom, United States and Saudi Arabia.
India has made good progress in horticultural sector, among the different horticulture crops; spice group is one of the dominant groups. Total area under Ginger in India was 1.68 lakh hectare. India is the largest producer with an annual production of Ginger was 10.7 lakh MT with productivity of 6.37 MT/ha, in the year 2016-2017. Though Ginger can be grown in all the states in India, the major production of this important Ginger crop is confined to Assam (1.67 lakh MT), West Bengal (1.38 lakh MT), Maharashtra (1.26 lakh MT) which account about 39.75 per cent of total production in India. Total estimated import of Ginger was 34.3 lakh MT in quantity with a value of Rs.10060.32 lakh, while as estimated Export of Ginger 22.61 lakh MT in quantity with value of Rs.21607.49 lakh in 2017-18 year. In Maharashtra during 2016-2017, total production of Ginger was 125.50 thousand MT having 8.50 thousand hectare area with the productivity of 14.76 MT/ha.

Objectives

1. To study the resource use, costs and returns of Ginger.
2. To estimate resource use efficiency of inputs.

Methodology

Sangli district is the one of the districts growing Ginger in Maharashtra. The total area under Ginger during 2017-2018 was 181 ha. The Sangli district was selected purposively for the present study. Secondly, two tahsil *viz.* Kadegaon (79 ha) and Khanapur (37 ha) were selected purposively on the basis of highest area under Ginger. Three villages from Kadegaon Tahsil (Vangi, Hingangaon, Tondoli) and three villages from Khanapur Tahsil (Aalsand, Balawadi, Bhalawani) were selected purposively on the basis of more area under sole Ginger crop. 15 Ginger growers from each village were randomly selected to constitute total sample size of 90 Ginger growers. They were grouped into three categories on the basis of their area under sole Ginger viz; small growers (below 0.40 ha), medium growers (0.41 to 0.80 ha), large growers (0.81ha and above).Then sample of 30 growers were selected randomly. Thus total sample of 90 Ginger growers from six villages i.e.; three from each tahsil were selected comprising 30 small growers, 30 medium growers, 30 large growers. The data was collected by survey method by conducting personal interviews using specially designed questionnaire for the study purpose. The data of Ginger crop during the year 2017-18 was collected and analyzed with simple tabular method.

Analytical Tools

1) Estimation of Costs and Returns

The costs and returns of Ginger crop were estimated with the help of standard cost concept. The details of standard cost concept used in present study are as below,

Cost 'A'

Includes the costs on account of hired human labour, bullock labour, machinery charges, value of manures, value of fertilizers, value of seedling, irrigation charges, plant protection charges, land revenue, depreciation and repairs, interest on working capital etc.

Cost 'B'

Rental value of land and interest on fixed capital represent imputed cost which is added to the Cost 'A'.

Cost 'B' = Cost 'A' + rental value of land + interest on fixed capital.

Cost 'C'

It is the total cost of production, which included all the costs items, actual as well as imputed. The value of owned labours is imputed and added to cost 'B' to work out cost 'C'.

Cost 'C' = Cost 'B' + imputed value of family labour.

2) Functional Analysis

The empirical evidence from previous studies suggest that amongst the many mathematical functions, Cobb-Douglas production function is the appropriate one for the studies of resources productivities because it gives specific diminishing, increasing or constant returns. The data were therefore, subjected to functional analysis by using the following Cobb-Douglas type of production function,

$$Y = a X1^{b1} X2^{b2} X3^{b3} X4^{b4} X5^{b5} X6^{b6} X7^{b7} X8^{b8} X9^{b9} . e^{u}$$

When expressed in logarithmic terms this function transfer into linear function of the following types,

$$\text{Log } Y = \text{Log } a + b1 \text{ Log } X1 + b2 \text{ Log } X2 + \ldots\ldots\ldots + b9 \text{ Log } X9 + u \text{ Log } e$$

Where,

Y= Dependent variable (Output) in Quintals
a = Intercept
X1 = Seed (Rhizomes) (Kg)
X2= Male Labour (man days)
X3= Female Labour (man days)
X4= Manures (quintals)
X5= Nitrogen (kg)
X6= Phosphorus (kg)
X7= Potash (kg)
X8= Irrigation charges (Rs.)
X9= Plant protection charges (Rs.)
bi's = Elasticity of production of respective factors
e = Error term

Results and Discussion

A) Input Use Pattern in Ginger Cultivation

The information on per hectare utilization of different inputs for Ginger is presented in Table 1.

For human labour, it can be observed from the table that, at the overall level, the use of total human labour was 458.17 labour days per hectare, comprising 195.64 male labour and female 262.52 labour days. The use of human labour was found more in small size group of holding, it was 526.46 labour days followed by 439.83 labour days in medium size and 408.21 labour days in large size group.

At the overall level, the per hectare use of machine labour was 39.74 hours. The per hectare machine labour utilization was observed slightly more in case of large size group of holding (40.01 hours) than small and medium size group of holdings. The machine power i.e. use of tractors was mostly for the operation of carrying of FYM, ploughing and harrowing etc.

Table 1: Per Hectare Utilization of Physical Input for Ginger Crop

Sr. No.	Particulars	Size Groups			Overall
		Small	Medium	Large	
1	Human labour (Days)	526.46	439.83	408.21	458.17
	Male	236.42	184.02	166.49	195.64
	Female	290.04	255.81	241.72	262.52
2	Machine labour (hours)	39.48	39.73	40.01	39.74
3	Manures (Tonnes)	32.10	33.33	28.10	31.18
4	Fertilizers (kg)				
	N	168.94	109.46	160.03	146.14
	P	313.54	270.38	159.03	247.65
	K	249.70	227.97	206.38	228.02
5	Rhizome (kg)	2521.42	2477.31	2476.03	2491.59
6	Plant protection (Rs.)	15766.39	15041.40	14542.99	15116.93

The use of manure per hectare at overall level was 31.18 tonne/ha. The use of manure was found more on medium size of group (33.33 tonnes) holding than small (32.10 tonnes) and large size (28.10 tonnes) of group holdings. In manure, Ginger farmers applied Farm yard manure, Compost and Sugarcane Press mud. At the overall level, the per hectare use of chemical fertilizers i.e. Nitrogen, Phosphorous, Potash were 146.14, 247.65 and 228.02 kg/ha, respectively. The per hectare use of fertilizer found more in small size group than medium and large size group of holding.

At the overall level, on an average, utilization of seeds (i.e. rhizome) was 2491.59 kg per hectare which was higher than the recommendation (i.e. 20 quintals per hectare). Farmers belonging to small size group use more rhizome than medium and large size group.

The per hectare utilization of plant protection charges were Rs. 15116.93, at overall level. The per hectare use of plant protection charges were more in small size group of holding than medium and large size of group holding.

B) Economic Aspects of Ginger Cultivation

I) Cost of Cultivation

The profitability of any enterprise depends upon costs and returns. The per hectare cost of cultivation of Ginger was worked out by using standard cost concepts. The information on various items of cost of cultivation of Ginger for different size of groups of holdings is presented in Table 2.

Table 2: Per Hectare Cost of Cultivation of Ginger **(**Rupees**)**

Sr. No.	Particulars	Small	Medium	Large	Overall
A.	**Cost of Cultivation**				
i)	Hired Labour				
	Male	45321.29 (6.15)	42348.81 (6.20)	41232.19 (6.51)	42967.43 (6.28)
	Female	50082.22 (6.80)	46912.87 (6.87)	45382.19 (7.16)	47459.09 (6.93)
	Total labour	95403.51 (12.95)	89261.68 (13.07)	86614.38 (13.67)	90426.52 (13.21)
ii)	Seed	126070.79 (17.12)	123865.27 (18.13)	121325.49 (19.15)	123753.85 (18.08)
iii)	Machinary	23689.18 (3.22)	23835.91 (3.49)	24005.27 (3.79)	23843.45 (3.50)
iv)	Manure	64204.84 (8.72)	66665.53 (9.76)	56202.99 (8.87)	62357.79 (9.11)
v)	Fertilizer	37909.08 (5.15)	35782.74 (5.24)	29772.58 (4.70)	34488.13 (5.04)
vi)	Irrigation	5796.55 (0.79)	5736.08 (0.84)	6193.12 (0.98)	5908.58 (0.86)
vii)	PPC	15766.39 (2.14)	15041.4 (2.20)	14542.99 (2.30)	15116.93 (2.21)
viii)	Repairs	1132.09 (0.15)	1256.55 (0.18)	1189.63 (0.19)	1192.76 (0.17)
ix)	Incidental charges	1884.79 (0.26)	1792.08 (0.26)	1758.14 (0.28)	1811.67 (0.26)
	Working Capital	371857.22 (50.49)	363237.24 (53.18)	341604.59 (53.92)	358899.68 (52.44)
x)	Interest on working capital @6%	22311.43 (3.03)	21794.23 (3.19)	20496.28 (3.24)	21533.98 (3.15)
xi)	Depreciation	816.11 (0.11)	889.13 (0.13)	3472.22 (0.55)	1725.82 (0.25)
xii)	Land revenue	210 (0.03)	208.5 (0.03)	214 (0.03)	210.83 (0.03)
	Cost A	395194.76 (53.65)	386129.10 (56.53)	365787.09 (57.74)	382370.32 (55.87)
xiii)	Rental value of land	303904.73 (41.26)	275818.44 (40.38)	251631.65 (39.72)	277118.27 (40.49)
xiv)	Interest on F.C. @10%	3917.03 (0.53)	3996.64 (0.59)	4392.96 (0.69)	4102.21 (0.60)
	Cost B	703016.52 (95.45)	665944.18 (97.50)	621811.70 (98.16)	663590.80 (96.96)
xv)	Family labour				
i)	Male	25605.6 (3.48)	12856.77 (1.88)	8715.42 (1.38)	15725.93 (2.30)
ii)	Female	7925.79 (1.08)	4249.88 (0.62)	2962.45 (0.47)	5046.04 (0.72)
	Total	33531.39 (4.55)	17106.65 (2.50)	11677.87 (1.84)	20771.97 (3.04)
	Cost C	736547.91 (100.00)	683050.83 (100.00)	633489.57 (100.00)	684362.77 (100.00)
B.	Output (Qtl) Main produce	421.23	403.72	395.73	406.89
	Gross value	1824688.39	1656161.61	1511073.89	1663974.63
C.	Per Qtl. Cost of Production	1748.56	1691.89	1600.81	1680.42
D.	B: C ratio	2.48	2.42	2.39	2.43

(Figure in parenthesis indicates percentage to the total cost i. e. Cost C)

The data revealed that at overall level per hectare cost of cultivation for Ginger was worked out to Rs.684362.77. The contribution of Cost 'A' (Rs. 382370.32) accounted for 55.87 per cent to total cost. The contribution of Cost 'B' to total cost was 96.96 per cent. Out of total per hectare cost of cultivation of Ginger, the maximum 40.49 per cent cost was incurred on rental value of land followed by rhizomes (18.08 per cent) and hired labour cost (13.21 per cent). For Cost 'C', the F cal 23.35 was higher than F tab 3.10 at 5% level of significance and 4.86 at 1% level of significance. Cost 'C' for small size group (Rs.736547.91) is significantly high at 5% level and 1% level than medium (Rs.683050.83) and large (Rs.633489.57) size groups. There was significant difference between Cost C of large and medium group at 5% level.

Cost 'B' for small size group (Rs.703016.52) is significantly high than medium group (Rs.665944.18) and large group (Rs.621811.70). The F cal 25.49 was higher than F tab 3.10 at 5% level of significance and 4.86 at 1% level of significance. It indicates that the Cost B was significantly high both at 5 and 1 per cent level. For Cost 'A', the F cal 20.92 was higher than F tab 3.10 at 5% level of significance and 4.86 at 1% level of significance. There was significant difference between small group (Rs.395194.76) and large group (Rs.365787.09), also there was significant difference of Cost 'A' between medium and small group. There was no significant difference of Cost 'A' between small and medium group.

It was further noticed that among the different size groups per hectare cost of cultivation was maximum (Rs.736547.91) in small size group followed by medium (Rs.683050.83) and large (Rs.633489.57) size group. In small size group Cost 'A' was Rs.395194.76 which accounted for 53.65 per cent to the total cost and Cost 'B' Rs.703016.52 accounted for 95.45 per cent to the total cost. It can also be seen that in medium size group the contribution of Cost 'A' was 56.53 per cent to the total cost and contribution of Cost 'B' in the total cost of cultivation was 97.50 per cent to the total cost. In large size group Cost 'A' accounted for 57.74 per cent to total cost and Cost 'B' 98.16 per cent to the total cost. There was no significant difference between Cost 'A' and Cost 'B' of large size group and medium size groups. Per qtl cost of Ginger was calculated on net Cost 'C' by dividing it value of main

produce, at overall level per qtl cost of Ginger was Rs.1680.42. It was Rs.1748.56, Rs. 1691.89, and Rs.1600.81for small, medium and large group, respectively.

II) Costs, Returns and Profitability of Ginger Farm

At the overall level, the per hectare gross return was found to be Rs.1663974.63. The per hectare gross returns of Ginger in small, medium and large size group was Rs.1824688.39, Rs. 1656161.61 and Rs.1511073.89, respectively as depicted in Table 3.

The net returns obtained at overall level were Rs.979611.86. Net returns obtained from small, medium and large size groups were Rs.1088140.48, Rs.973110.78 and Rs.877584.32, respectively.

The benefit-cost ratio indicates the return from each rupee investment in Ginger cultivation. The results revealed that the B: C ratio is highest in small size group and it was 2.48. Similarly, B: C ratio was 2.42 and 2.39 for medium and large size groups, respectively. At overall level, B: C ratio at Cost 'C' was 2.43. It clearly indicated that, Ginger is a profitable cash crop.

Gross returns obtained at overall level were Rs.1663974.63. It was Rs. 1824688.39, Rs.1656161.61 and Rs.1511073.89 in small, medium and large size group, respectively. At overall level, Cost 'A' was Rs.382370.32, Cost 'B' was Rs.663590.80 and Cost 'C' was Rs.684362.77 and total production was 406.89 quintals. In small size group total production was 421.23 quintal followed by medium size group (403.72 quintal) and large size group (395.7 quintal). Per quintal cost of production were Rs.1748.56, Rs.1691.89 and Rs.1600.81 in small, medium and large size group, respectively. At overall level, output-input ratio at Cost 'A' was 4.35 followed by 2.50 at Cost 'B' and 2.43 at Cost 'C'.

Table 3: Per hectare Profitability of Ginger (Rupees)

Sr. No.	Particulars	Size Group			
		Small	Medium	Large	Overall
1	Gross returns	1824688.39	1656161.61	1511073.89	1663974.63
2	Costs (Rs.)				
	i) Cost A	395194.76	386129.10	365787.09	382370.32
	ii) Cost B	703016.52	665944.18	621811.70	663590.80
	iii) Cost C	736547.91	683050.83	633489.57	684362.77
3	Profit (Rs.)				
	i) Cost A	1429493.63	1270032.51	1145286.80	1281604.32
	ii) Cost B	1121671.87	990217.43	889262.19	1000383.83
	iii) Cost C	1088140.48	973110.78	877584.32	979611.86
4	Production	421.23	403.72	395.73	406.89
5	Per Qtl cost of production	1748.56	1691.89	1600.81	1680.42
6	Output-Input ratio				
	i) Cost A	4.62	4.29	4.13	4.35
	ii) Cost B	2.60	2.49	2.43	2.50
	iii) Cost C	2.48	2.42	2.39	2.43

C) Functional Analysis

I) Cobb-Douglas Production Function

The Cobb- Douglas type of production function was found to be "best fit" to present data. The regression coefficients for identified resources for Ginger are presented in Table 4. It was observed that at overall level the magnitude of coefficient of multiple determinations (R2) was 0.91, indicated that 91 per cent variation in Ginger production was explained by variables included in the function.

It is also revealed from the data presented in Table 4 that the elasticity coefficients for male labour (X2), female labour (X3) and N (X5) were positive and found statistically significant at 1 per cent level of probability. Manure (X4) was also found positive and statistically significant at 5 per cent level of probability. Seed (X1) and P (X6) was negatively significant at 1 per cent level, this may be because of their excess use than recommended level. Whereas, the elasticity coefficient for irrigation (X8) though positive but found negative and non-significant, indicating no significant effect of these variables on yield of Ginger. Plant protection found negatively significant, this may be because of farmers was using insecticide and fungicide before occurrence of pest and disease, in order to take precaution. The R2 was 0.91 indicating 91 per cent variation in the yield of Ginger caused by the input factors.

Table 4: Results of Estimated Cobb-Douglas Production Function

Sr. No.	Variables	Regression coefficients
1	Constant (Intercept)	3.593 (0.661)
2	Seed (X1)	-1.240*** (0.211)
3	Male (X2)	0.310*** (0.078)
4	Female (X3)	1.121*** (0.115)
5	Manure (X4)	0.060** (0.020)
6	N (X5)	0.015*** (0.004)
7	P (X6)	-0.045*** (0.008)
8	K (X7)	-0.014NS (0.010)
9	Irrigation Cost (X8)	0.012NS (0.034)
10	Plant Protection Cost (X9)	-0.031NS (0.025)
	R2	0.910

(Figures in parentheses indicates standard error)

*** - Significance at 1% level

** - Significance at 5% level NS - Non significant

II) Resource Use Efficiency in Ginger Production

The resource use efficiency was studied and the marginal value of product (MVP) of each explanatory variables were computed with factor cost (FC) to know the resource use efficiency of farmer and the results are presented in Table 5. The data revealed that, the ratio of MVP/Px was found greater than unity in case of male labour, female labour, manures, nitrogen, and irrigation indicated the underutilization of these resources. The ratio of MVP/Px is less than unity in case of seed, phosphorous, potassium and plant protection charges etc. which showed excess utilization of these resources. Use of these resources should be curtailed down for maximization of profit.

Table 5: Marginal Value Product in Ginger Cultivation

Sr. No.	Resources	M.V.P.	F.C.(Px)	MVP/FC	Remarks
1	Seed (X1)	-807.07	4900.00	-0.16	Excess utilized
2	Male (X2)	3523.40	300.00	11.74	Under utilized
3	Female (X3)	7672.89	200.00	38.36	Under utilized
4	Manure (X4)	3147.54	2000.00	1.57	Under utilized
5	N (X5)	194.20	11.91	16.31	Under utilized
6	P (X6)	-322.37	37.50	-8.60	Excess utilized
7	K (X7)	-101.12	28.00	-3.61	Excess utilized
8	Irrigation Charges	3.17	1.00	3.17	Under utilized
9	Plant Protection Charges	-3.32	1.00	-3.32	Excess utilized

Conclusions

1. At overall level, per hectare cost of cultivation of Ginger was Rs.6,62,829. The per hectare total cost of small size was significantly higher than medium and large size group. Cost 'A' contributed 54.44 per cent and Cost 'B' contributed 96.87 per cent of total cost. Among all costs incurred rental value of land had maximum share of 41.81 per cent.
2. At overall level, per hectare yield of Ginger was 407 qtl and per hectare gross returns were Rs.16,63,975. The benefit cost ratio at overall level was 2.43, indicating that Ginger production is profitable. Per quintal cost of production was Rs.1680.42.Same trend observed among size groups.
3. The R2 was 0.91 indicating 91 per cent variation in the yield of Ginger caused by the input factors. The regression coefficients for male labour (X2), female(X3), manure (X4) and N (X5) were positive and statistically significant.

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