

Research Paper

Determinants of Organic Large Cardamom Production in North Eastern States of India: Logit Regression Analysis

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ABSTRACT

The large cardamom among the spices is recognized as expensive spice for which India is second largest producer in the world. This paper demonstrates the comparative economic returns from organic large cardamom over non organic one. Significant positive differences were observed for organic orchards of large cardamom than the non-adopting orchards. The factor share and logistic analysis has provided in-depth policy implications for technological interventions such as small size machinery, sapling multiplication of high yielding variety of large cardamom and governmental assistance to cope up the risk in organic method for its adoption in larger area of NEHR as well as in country as a whole.

HIGHLIGHTS

- Paper has focused on determinates of organic large Cardamom production in North Eastern States of India.
- The analysis has shown in-depth economics of organic large Cardamom over non-organic one.

Keywords: Organic, large cardamom, determinants, NEHR and Logit

Spices are low volume and high export-oriented commodity that has great economic significance in India (Sugasini *et al.* 2018). Besides offering culinary value in exquisite aroma, texture and taste, spices also possess tremendous nutritive and therapeutic value (Dini, 2018; Bower *et al.* 2016; Srinivasan, 2014). India produces 75% of world's spices. The total area under spice was 3,671 thousand hectares (ha) with production of 8,122 thousand metric tonnes (MT) in 2016-17 (GoI, 2017). North eastern region of India is considered as a major hub of spices production with a share of 9.38% of total production and 6.51% of the country's land areas under spice cultivation as in 2016-17. Among the spices, large cardamom (*Elettaria cardamomum* Maton) is one of the oldest known spices in the world. It is known as 'queen of spices', also called 'grain of paradise', is a perennial herbaceous spice crop belonging to the family of *Zingiberaceae*. It is the third most expensive spice

in the world after saffron and vanilla. It is a shade loving plant. India is the second largest producer of large cardamom after Nepal. The major growing state of large cardamom in India are Sikkim, West Bengal (particularly Darjeeling), Nagaland and Arunachal Pradesh. A total of 8.67 thousand MT of large cardamom was produced in the country during 2018-19 and the state of Sikkim was leading in both area (54.42%) production (58.02%) of large cardamom and followed by Arunachal Pradesh (23.12%), Nagaland (6.31%) and West Bengal (3.31%). The North Eastern Hill Region (hereafter; NEHR) contributed about 87.66% of the total production of large cardamom in the country (Spice Board of India, 2020).

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Due to scanty application of inorganic fertilizers and chemicals for a long period of time, the NEHR is recognized as an organic by default (Wani *et al.* 2017). According to an estimated data available with the Agricultural and Processed Food Products Export Development Authority (APEDA, 2018) nearly 90,500 ha of land in NEHR is already under organic cultivation (GoI, 2017). Even though Sikkim accounts for more than three-fourths of this, other states such as Meghalaya and Assam have shown tremendous progress in embracing organic farming. As per the available statistics, another 77,600 ha are in the process of switching over to organic cultivation. Sikkim is the leading state among NEHR, constituting around 63.74% of the total organic area in the region. Assam is the second largest state in terms of area under organic farming in NE India (23.71%) followed by Nagaland (5.16%), Meghalaya (3.84%) and Arunachal Pradesh (3.49%) (NPOP, 2018). Sikkim is the only state in NEHR that has been conferred the title of “organic state” in the year 2016. So far there is no as such study of economic analysis of organic production of large cardamom in NEHR. There are many factors influencing the organic production (Chiphang and Singh, 2020). The rejection and acceptance of any intervention and technological method depends on its cost and returns. Hence, to assess the economic benefits of organic cultivation of large cardamom and different determinants of organic cultivation of it; a comparative analysis has demonstrated through present paper

MATERIALS AND METHODS

Study was conducted in Arunachal Pradesh (Non-adopter) and Sikkim (Adopter) states of NEHR. Lower Dibang district from Arunachal Pradesh and two districts *viz*; East Sikkim and West Sikkim were selected from the state of Sikkim. Two collection centres from each selected district of respective state were selected. Two villages from Arunachal Pradesh and four villages of Sikkim were selected purposively in the radius of 15-20 km of selected collection centres. Further, 50 growers from Arunachal Pradesh and 75 growers of large cardamom from Sikkim were selected. Primary and secondary data were collected for the study. A structured interview schedule was prepared to

collect primary data of orchard of large cardamom from its establishment to harvest of crop. The data were collected through personal interview method during the crop year of 2017-2020.

Analytical tools

The cost cultivation has been worked out by using the variable and fixed cost components.

Comparison of means

One-way analysis of variance (ANOVA)

ANOVA is used to determine whether there are any statistically significant differences between the means of two or more independent groups on the basis of one factor. To determine if there was any difference between the yield and returns from the selected spice in the organic state, Sikkim and the conventional states - Arunachal Pradesh, ANOVA was used.

Paired sample t-test

A paired t-test is used to compare two population means where two samples in which observations in one sample can be paired with observations in the other sample. The yield and returns for each selected spice was compared between the organic adopters in Sikkim state and non-organic adopters Arunachal Pradesh. Both the analysis was performed by using the software SPSS 21 version.

Factor share analysis

The determination of the major inputs in production process is very important, because the concept of factor share has a bearing on production and cost structures and choice of technology. It is the ratio of cost of factor input used in production process to the value of output. The physical quantity of each factor input when multiplied by its price and then divided by the value of the total product, will yield factor share input (Dhondyal, 1977).

$$\begin{aligned} \Pi(X_1) &= P_1X_1/P_y, \Pi(X_2) = P_2X_2/P_y, \Pi(X_3) = P_3X_3/P_y, \\ \Pi(X_4) &= P_4X_4/P_y, \Pi(X_5) = P_5X_5/P_y, \Pi(X_6) = P_6X_6/P_y, \\ \Pi(X_7) &= P_7X_7/P_y, \Pi(X_8) = P_8X_8/P_y, \Pi(X_9) = P_9X_9/P_y \end{aligned}$$

Where,

- $\Pi (X_1)$ = Share of seed P_1 = Cost of seed
- $\Pi (X_2)$ = Share of Hired labour P_2 = Cost of Hired labour
- $\Pi (X_3)$ = Share of Imputed value of family labour P_3 = Cost of Imputed value of family labour
- $\Pi (X_4)$ = Share of Total human labour P_4 = Cost of Total human labour
- $\Pi (X_5)$ = Share of Manure P_5 = Cost of Manure
- $\Pi (X_6)$ = Share of Depreciation P_6 = Cost of Depreciation
- $\Pi (X_7)$ = Share of Interest on working capital P_7 = Cost of Interest on working capital
- $\Pi (X_8)$ = Share of Rent paid for lease in land P_8 = Cost of Rent paid for lease in land
- $\Pi (X_9)$ = Share of Interest on owned fixed asset P_9 = Cost of Interest on owned fixed asset
- $\Pi (X_y)$ = Share of Interest on owned fixed asset P_y = Price of the output

Logit regression

To determine the factors that influence the producers to adopt organic farming system, the logit regression analysis was run. Logistic regression is used when the dependent variable is dichotomous (organic adopters = 1, non-organic adopters = 0). The regression analysis is used to describe data and to explain the relationship between one dependent binary variable and one or more nominal, ordinal, interval or ratio- level independent variables. The analysis was run by using SPSS 21 version software. Mathematically, the logit regression analysis is expressed as follows:

$$\log it(y) = \ln \frac{p}{1-p} = \beta_0 + \beta_1 * x$$

Where,

Y is the dependent variable, where 1 indicates “organic” and 0 indicates “inorganic”.

p = probability that farmer will adopt organic farming.

RESULTS AND DISCUSSION

The cost of large cardamom per kg for organic adopter was estimated and found to be less than the farm of non-adopter of organic method. It was accounted of 6.33 per cent to 11.04 per cent lesser on organic orchard (Sikkim). Contrary to it, selling price of organic large cardamom was observed to be higher (6.16%) than the price of large cardamom produced on non-adopter orchards. Similarly, the net returns were observed and estimated higher (11.51% to 14.82%) for the organic large cardamom than the non-organic. These findings were in conformity of earlier findings by Singh and Feroze, 2018 and Singh *et al.* (2020) where organic turmeric and ginger fetched higher prices.

Table 1: Comparative cost and returns of large cardamom production (₹/kg)

Particulars	Organic adopter farm			Non-adopter farm		
	3 rd Year	4 th Year	5 th Year	3 rd Year	4 th Year	5 th Year
	Cost of Production	159.66	124.95	133.95	175.59 (9.07)	140.46 (11.04)
Selling Price	456.93	456.93	456.93	428.80 (-6.16)	428.80 (-6.16)	428.80 (-6.16)
Net return	297.28	331.98	322.98	253.21 (-14.82)	288.34 (-13.15)	285.79 (-11.51)

Note: Figures in parentheses indicate difference in percentage between organic and non-organic adopters

Paired sample t-test

It has been proved the paired-t-test analysis that yield and economic returns both were found significantly higher at organic orchard of large cardamom of the Sikkim state in comparison to the orchard of Arunachal Pradesh (Table 2).

Table 2: Difference in yield and returns of large cardamom farm of organic adopter and non-adopter using paired t-test

States	Yield				Economic returns		
	Year	Mean Difference (kg/ha)	t-value	p-value	Mean Difference (₹/ha)	t-value	p-value
Sikkim vs	3 rd	30.95	2.25	0.029**	20295.35	2.95	0.000***
Arunachal Pradesh	4 th	66.67	4.19	0.000***	38042.46	4.559	0.000***
	5 th	38.64	3.25	0.000***	25112.06	3.67	0.000***

Note: * $p \leq 0.10$, *** $p \leq 0.01$

Factor share analysis

Factor share analysis is litmus test for different factors of production which have pivot role in yield of particular crop. The Table 3 shown that family labour has pivot role in production of large cardamom irrespective of year of orchard and irrespective of the state. In the first year orchard of Arunachal Pradesh the family labour has contributed of 78.46 per cent which has been observed to be increased in subsequent years of orchard upto 80.09 per cent in the fifth year. The other factors like; rental value of land, interest on fixed capital and depreciation were observed to be decreased in subsequent year of the large cardamom orchard in the state of Arunachal Pradesh. Hence, the human labour which contributed by family labour

(Singh *et al.* 2020) was found and identified a pivot factor in production of large cardamom. Therefore, small sized machinery for land preparation and intercultural activity in the orchard of large cardamom need to develop for enhancing efficiency of this factor to increase the productivity of large cardamom in the state. Similarly, in the state of Sikkim; apart from human labour manure has contributed its major share (Singh *et al.* 2019 and Singh *et al.* 2020) in productivity of large cardamom. Obviously, the Sikkim state is organic state and every crop has its utility. Hence, developing of small machines and production of bio-fertilizers through public-private partnership by involving youths for entrepreneurship development having ample scope in the state of Sikkim as well as in the region as a whole.

Table 3: Factor Share Analysis of Large Cardamom

Arunachal Pradesh									
	3 rd Year			4 th Year			5 th Year		
	Value (₹/ha)	Large cardamom ₹ 428.80/kg	Factor share (%)	Value (₹/ha)	Large cardamom ₹ 428.80/kg	Factor share (%)	Value (₹/ha)	Large cardamom ₹ 428.80/kg	Factor share (%)
Output	80301.38	187.27	100	108627.90	253.33	100	106685.44	284.80	100
Manure	—	—	—	—	—	—	—	—	—
Hired Labour	—	—	—	—	—	—	—	—	—
Family labour	63001.14	146.92	78.46	87000.37	202.89	80.09	85444.65	199.26	80.09
Total human labour	63001.14	146.92	78.46	87000.37	202.89	80.09	85444.65	199.26	80.09
Depreciation	1029.84	2.40	1.28	1287.44	3.00	1.19	1264.42	2.95	1.19
Interest on working capital	77.24	0.18	0.10	96.56	0.23	0.09	94.84	0.22	0.09
Interest on fixed capital	7645.92	17.83	9.52	9558.38	22.29	8.80	9387.46	21.89	8.80
Rental value of land	8547.24	19.94	10.64	10685.15	24.92	9.83	10494.07	24.48	9.83
Sikkim									
	Value (₹/ha)	Large cardamom ₹ 456.93/kg	Factor share (%)	Value (₹/ha)	Large cardamom ₹ 456.93/kg	Factor share (%)	Value (₹ /ha)	Large cardamom ₹ 456.93/kg	Factor share (%)
Output	90243.68	197.50	100	123183.76	269.59	100	114904.19	251.47	100
Manure	9276.55	20.30	10.28	11853.17	25.94	9.62	11056.48	24.20	9.62
Hired Labour	5692.48	12.46	6.31	9138.64	20.00	7.42	8524.40	18.66	7.42
Family labour	62394.09	136.55	69.14	85593.85	187.32	69.48	79840.82	174.73	69.48
Total human labour	68086.57	149.01	75.45	94732.49	207.32	76.90	88365.22	193.39	76.90
Depreciation	115.92	2.44	1.24	1425.87	3.12	1.16	1330.03	2.91	1.16
Interest on working capital	1206.38	2.64	1.34	1681.34	3.68	1.36	1568.33	3.43	1.36
Interest on fixed capital	5950.55	13.02	6.59	7603.36	16.64	6.17	7092.31	15.52	6.17
Rental value of land	4607.71	10.09	5.10	5887.53	12.89	4.79	5491.82	12.02	4.79

Determinants of organic cultivation of large cardamom

The factors of land holding size, yield, and returns from the crop, price of saplings, price of manure and assistance from the government to adopt the organic method for cultivation of large cardamom which has been estimated and found significant among the factors of production of large cardamom. Size of land holding is always deciding factor for adoption and rejection of new intervention, hence, larger land holding owner always coming forward to accept the new method (Chiphang and Singh, 2020). Ofcourse, the yield and returns from adopting organic method in large cardamom were found significant. The price of saplings and FYM has their pivot role as FYM is main factor for organic production of large cardamom. Hence, affordable prices of saplings and FYM surely would attract the adoption of organic method for large cardamom production. Similarly, to meet out the risk from the adoption of organic method the assistance from the government would encourage the farmers to cope up any of production as well as price risk in cultivating large cardamom organically.

Table 4: Factors influencing in cultivation of organic large cardamom

Variables	B	Sig.	Exp (B)
Land holding size	35.76	0.000***	1.703
Yield (3 rd Year)	4.77	0.029**	1.124
Yield (4 th Year)	13.68	0.030**	1.531
Yield (5 th Year)	6.38	0.012**	1.494
Returns (3 rd Year)	7.89	0.205	1.005
Returns (4 th Year)	16.54	0.040**	1.998
Returns (5 th Year)	9.27	0.002***	1.299
Number of sapling	0.259	0.611	1.008
Price of sapling	89.34	0.000***	0.799
Price of FYM	49.29	0.067*	0.200
Number of farm assets	43.62	0.990	0.610
Age	3.621	0.157	0.866
Education	0.130	0.719	0.007
Farm Experience	0.027	0.870	0.906
Assistance from Govt	0.000	0.057*	1.957
Annual Income	0.000	0.977	1.080

Note: * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$.

CONCLUSION

The organic method of large cardamom production has been found to be highly economically beneficial.

The factor share and logit analysis has provided apparent way forward for research and development on determinants price of saplings, assistance from the government to cover the risk in organic cultivation of large cardamom. Among the technical issues like small machinery for land preparation and intercultural activities in orchard of large cardamom were the need of hours. The yield and returns analysis has given way forward for research and development on variety and cultivar of the crop. Hence, the replication of organic model of Sikkim state in other states for production of large cardamom in the region was most pivot policy implication of the study for enhances the livelihood and income.

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