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ECONOMIC ANALYSIS OF ORGANIC GINGER FARMING IN LONGLENG DISTRICT: A CASE STUDY PONGO, YONGNYAH, YONGAM AND BHUMNYU VILLAGE

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Abstract

Ginger (Zingiber officinale Rosc.) is an herbaceous perennial crop usually grown as an annual for its rhizome. It is a valuable cash crop does not only serve as integral medium for food security, but also as a source of income generation, and employer of labour in the producing areas of Longleng. Lack of finance, inadequate farm inputs, storage facilities and high cost of labour are identified as the primary constraints to organic ginger production in the region. Research survey of farmers producing organic ginger was conducted in 2022 in Pongo, Yongnyah, Yonyam and Bhumnyu villages. Total of thirty (30) organic ginger producers were selected using random sampling methods from each of the four villages with a total sample size of one hundred twenty (120). The results revealed that the organic ginger production was profitable on cash cost basis (BCR 1.75). Seed have major cost share for ginger production (65.1%). The estimated coefficients of Cobb-Douglas production function showed that seed, labour and number of years for crop rotation were the significant factors for organic ginger production. The study concluded that ginger production can be made viable enterprise with increased focus on conducive environment and investment climate by subsidising farm inputs and providing affordable loans to the smallholder farmers for a sustainable production. The study pointed out that the organic ginger farming could be a highly beneficial and market-oriented activity in Longleng. It also points out the problems faced by the organic ginger farmers and finally suggests policy implication.

Keywords: Economic analysis, production factor, and profitability

1. Introduction

Longleng is characterised by a rich diversity of landscapes, natural vegetation, land use patterns, climate conditions and socio-economic settings (Jamir, 2021a; Jamir, 2021b; Jamir, 2019a; Singh & Dhillon, 2015). Over the past 50 years, Longleng has undergone considerable changes in land use system, area cover, including deforestation, arable land change, rapid urban expansion and agri-infra development (Jamir, 2020b; Jamir, 2022; Jamir & Ezung, 2020c; Jamir, 2021d; Jamir, 2021e; Ezung & Jamir 2018). As per 2011 Census report 84.90% of Longleng population lives in rural sector and with relatively high poverty rates, making one of the largest population living below the World Bank's $1.90-a-day poverty line in Nagaland (Jamir & Ezung 2017a; Jamir & Ezung, 2017b; Jamir, 2020a; Jamir, 2021c; Jamir, 2019b). The region has seen a major increase in agricultural productivity over the past few decades. However, there are still significant yield disparities of food and non-food crops in the region. The existence of the productivity gap can be highlighted by many confounding determinants, such as the dominance of subsistence agriculture, low access to chemical inputs, technological improvements, management techniques and lack of irrigation. As the United Nation (UN) agenda sets 2030 as the target year to make significant improvements in achieving the Sustainable Development Goals (SDGs). Although the state government plans and policies have made the agricultural sector a priority over the years, however the growth rate of the agricultural sector is still slowing down. The production and productivity is low compare to most other districts.

Organic ginger (Zingiber officinale Rosc.) is an important crop grown for its aromatic rhizome and used both as a spice and as medicine purpose (Egbuchua & Enujeke, 2013; Neerja & Korla 2010; Nmor, 2013; Parthasarathy et al. 2008). Organic ginger is grown in

almost every village (Rai & Anitha, 1999). Besides improved varieties like Nadia, Chinese, Varada, etc., some local varieties still exist in the region (Acharya et al. 2019; Smith, et al. 2011; Stirling et al. 2009). Freshly harvested organic ginger is mainly used for consumption as green ginger throughout the region, with only a small surplus being sold in the market, often at very low prices compare to other districts. Sometimes, due to marketing problems, farmers are unable to sell their produce because there is no local market large enough to absorb and process green organic ginger in large quantities Due to its abundance in the region, it is possible to prepare a variety of products that are in high demand overseas, such as ginger oil, ginger oleoresin, ginger powder, ginger candy, ginger liquor, wine beer and soft drinks for export in other states (Karthick et al. 2015; White, 2007; Timsina, 2010; Singletary, 2010; Rahman, et al. 2007; Poudel, et al. 2016).

The traditional organic ginger farming systems in Pongo, Yongnyah, Yongam and Bhumnyu are *jhum systems* or shifting cultivation. Before growing organic ginger, weeds and re-growing bushes are manually cut and left on the ground as mulch or burned in situ. The soil is then plowed using manpower (Borthakur, 1992; Babu, et al. 2015; Bhat, et al. 2012; Kumar et al. 2012). Organic ginger is grown on mountain slopes, at altitudes of 1,066 m, with or without terraces, as well as on plains, outdoors or in the shade of bamboo grass and other forest trees. The size of the land varies, from small plots of 200 m^2 to 0.3 hectare. Organic ginger growers consider that growing on the same land/plot every year can't yield much ginger. In the *jhum* region, organic ginger is grown without much tilling, i.e., just scraping the soil to make holes and planting rhizomes in it. Farm yard organic manure is used before ploughing the area. Before planting, the stored seed rhizomes should be sorted, choosing large, glossy rhizomes without spots or marks, buds or eye wounds for planting. Depending on elevation and precipitation, planting is starts from February to April. The rhizomes are planted in 2-3 rows in beds and filled with soil. The normal distance between the rhizomes is maintained at an average 15-20 cm. During planting seed rhizomes are broken into pieces to ensure each piece has 2-4 sprouts. The study areas often intercrop with yams, paddy, tapioca, pumpkin, cucumber, sweet potato, pigeon peas, kidney beans, green peppers and other vegetables with organic ginger (Jaswal et al. 1993; Rymba et al. 2021; Veeresh, 1999). When organic ginger is usually intercropped with other crops, the spacing between rows is usually kept wide (60-90 cm). Heavy rainfall from June to September promotes strong weed growth. After a month, the beds are weeded and disposed off. The beds are immediately covered with an 8-10 cm thick layer of mulch made up of rotten forest mulch, straw, grass, and other plant remnants. Mulching protects seedlings from rain, suppresses weed growth, keeps soil soft and moist, and speeds growth. Farmers thought that mulching would increase germination; reduce weed growth and soft rot (Rahman et al. 2009; Rajan, 1999).

At the end of May or June, i.e., when the organic ginger crop reaches 60 days, farmers cut off the parent rhizomes, leaving the germinated rhizomes in the soil. Organic ginger reaches maturity in 8 to 9 months, consequently peak harvest starts from November and lasts until January. Harvest is done according to market demand condition, but some farmers do not harvest the whole crop but leave a portion in situ purpose till February-March. The soft rhizome, known as green ginger, is harvested in a month that is before the rhizome reaches fibrous maturity and is used as a pickle or for household purposes (Rai & Hossain, 1998). In *jhum* system, the ratio of ginger to other crops is usually $1/10^{th}$ hectare and the reported yield

is 1 ton. The crop rotation cycle varies from 2 years but is strongly influenced by the size of the land area and the market price of organic ginger. Rice, yams, maize, tapioca, pumpkin, mustard, xanthoxylum, cucumber, pigeon peas, kidney beans and green peppers are grown in rotation. However, only few farmers grow ginger on continuous acreage due to scarcity of land.

Table 1. Area, production and productivity of ginger in Nagaland

Year	Area	Production	Productivity
2009-10	2800	32000	11.43
2010-11	2300	33000	14.35
2011-12	2800	32000	11.43
2012-13	2700	40000	14.81
2013-14	3520	52800	15.00
2014-15	3661	54423	14.87
2015-16	4819	48076	9.98
2016-17	4862	43605	8.97
2017-18	4811	36483	7.58
2018-19	4749	35630	7.50
Mean ($\bar{x}$)	3702.2	40801.7	11.59
Standard deviation (σ)	1030.15	8512.21	3.03
Growth Rate (%)	0.043	0.035	0.03

Source: Statistical Handbook of Nagaland, 2010-2019

Table 2. Area, production and productivity of ginger in Longleng

Year	Area	Production	Productivity
2009-10	200	2000	10.00
2010-11	100	1000	10.00
2011-12	200	2000	10.00
2012-13	200	3000	15.00
2013-14	269	4178	15.53
2014-15	271	4219	15.57
2015-16	284	4388	15.45
2016-17	295	4388	14.87
2017-18	275	3450	12.55
2018-19	275	3390	12.33
Mean ($\bar{x}$)	236.9	3201.3	13.13
Standard deviation (σ)	61.02	1186.78	2.44
Growth Rate (%)	0.10	0.13	0.04

Source: Statistical Handbook of Nagaland, 2010-2019

2. Methods

2.1 Study area

Research survey of farmers producing organic ginger was conducted in 2022 in four sample villages of Longleng. The study was conducted in Pongo, Yongnyah, Yonyam and Bhumnyu. The research sites were selected based on feasibility, degree of commercialization and accessibility. A well structured questionnaire was used for data collection.

2.2 Sample and sampling technique

Thirty (30) organic ginger producers were selected using random sampling methods from each of the four village with a total sample size of (one hundred twenty) 120. The data collected is related to area, production, productivity, input costs and product prices.

2.3 Research analysis

Economic analysis was performed using Benefit-Cost Ratio (BCR), Net Present Value (NVP), and Internal Rate of Return (IRR). Initially, setup costs are high, followed by annual profits that are non-linear throughout the life of the plant (Nkang et al., 2007).

a. Gross margin

The gross margin provides simple and quick method of farm business analysis. Gross margin was estimated by taking gross return and the total variable cost incurred.

Where:

$$GM = [(Py * Y) + (Pz * Z)] - \sum_{i=0}^{n}(pxi * Xi) \quad (1)$$

GM = gross margin,
Py = price of main product,
Y = quantity of main product or output,
Pz = price of byproduct,
Z = quantity of byproduct,
PX_i = price of i^{th} input
X_i = quantity of i^{th} input

b. Measurement of Cost-Benefit using Benefit-Cost Ratio Method

Mathematical expression for BCR:

$$BCR = \frac{\text{Discount Benefit}}{\text{Discounted Cost}} \quad (2)$$

Total cost of production and gross return from broom grass cultivation were used to analyze the benefit-cost ratio (Gitting, 1984). Therefore, the BCR ratio was calculated using the following formula:

BCR = Gross return/total cost where, gross return was calculated from the income of sold product. The total cost of production was calculated by summing the variable cost and fixed cost items incurred in the production process.

Cost = Expenses incurred for agronomic operation in terms of labour, tools and raw material costs.

c. Return to scale using Cobb-Douglas production function model

Cobb-Douglas production function :

$$\mathbf{Y=AL^{\beta}K^{\alpha}} \quad (3)$$

Y=Total production (the real value of all goods produced in a year)
L=Labour inputs,
K=Capital inputs,
A=Total factor productivity α and β are the output elasticity of capital and labour (Cobb & Douglas, 1928).

3. Results and Discussion

On an average, 0.082 hectare of land was devoted to organic ginger cultivation in the study areas. Most of the inputs such as labour cost, seeds and organic manure were provided by the farmers themselves. Self-labour, seed use and organic manure supply were 87.70%, 54.06% and 99.65%, respectively (see Table 3). Organic ginger from Pongo, Yongnyah, Yongam, and Bhumnyu was cultivated primarily with yams, xanthoxylum, tapioca, squash, cucumbers, bringials, pigeon pea, common beans, green peppers, and other vegetables i.e., 98.43% (Lyocks et al. 2013). Studies found that intercropping with maize and vegetables

provide good source of income generation, rise in productivity, food security and sustainable environment to the farmers in short periods. The results of the present studies are similar to those reported by (Sanwal et al. 2006) who recorded a intercropping of ginger and other vegetable. Crop rotation of organic ginger is very important and it is not recommended to grow organic ginger on the same land/area every year (Smith et al. 2011; Stirling, 1998). In the study area, the average number of crop rotations was 2 years. Sowing continued from March to May. Within the month of April 82.48% farmers completed sowing rhizomes indicated that main season for planting in mid hill was April (Basnet & Gurung (2018). Respondent farmers reported different species of tree leaves using as mulching material. The most common tree species were Ficus semicordata (Drooping fig), Castanopsis indica (Chestnut), Duabanga grandiflora (Duabanga), Engelhardtia spicata (Mauwa), Juglans regia (Walnut), Gmelina arborea (Garami), Quercus semiserrata (Oak).

Table 3. Organic ginger cultivation practices of the sample farmers

Particulars	Study Area				
	Pongo	Yongnyah	Yongam	Bhumnyu	All Area
Average organic ginger areas (ha)	0.09	0.12	0.05	0.07	0.082
Own land use (%)	94.31	96.56	98.40	98.00	96.82
Own labour use (%)	90.24	82.30	85.91	92.33	87.70
Own seed use (%)	55.97	48.63	60.22	51.44	54.06
Own manure use (%)	99.60	99.41	99.58	100	99.65
Organic manure used	100.00	100.00	100.00	100.00	100.00
Intercropped with yam, maize, pumpkin, cucumber, brinjal, pigeon pea, kidney bean, tapioca, green chillies and other vegetables	98.24	99.49	97.66	98.34	98.43
Crop rotation (years)	2.50	2.10	2.00	2.20	2.20
Month of sowing season (%)					
March	7.00	4.00	6.00	6.00	6.41
April	87.00	90.00	82.00	85.00	82.48
May	6.00	12.00	16.00	15.00	11.10

Source: Field Survey Report, 2022

Table 4. Level of input use per hectare for organic ginger cultivation

Type of Input	Study Area				
	Pongo	Yongnyah	Yongam	Bhumnyu	All Area
Labour (working days/ha)	275	293	262	260	272
Own labour used	257	273	246	238	253(93.01)
Hired of labour	18.00	20.00	16.00	22.00	19(6.99)
t-value	4.541***	5.381***	3.695***	5.918***	4.866***
Land preparation cost (₹/ha)	10739	15211	13678	8510	12034.5
Seed (kg/ha)	4483	6929	5327	3671	5102.5
Own	2893	3569	3894	3030	3346.5(65.58)
Purchased from government	1890	2460	1033	1641	1756
Organic manures (kg/ha)	7270	10567	8935	5428	8000
Own	7270	10567	8935	5428	8000
Purchased	--	--	--	--	--

Source: Field Survey Report, 2022
Figure in the Parentheses indicate the percentage
**** indicates the values at 0.01 level of significance*

Table 4 shows the input usage patterns. On average, organic ginger farmers spent 272 man-days of human labour per hectare, of which 93.01% was provided by their families. Yongnyah farmers used the most man-labour (293 man-days/ha) compared to average use (253 man-days /ha). The t-tests for self-employed and wage labour showed significant differences in all areas of the survey. On an average of 5102.5 kg of seeds were used per hectare, which is above the recommended value. At the time of harvest, farmers prefer to sell their mother rhizomes at a higher price for early harvest, as they get lower price of organic ginger in the market. Similar findings were made by Monnaf et al. (2010). The study found that the farmers used more than 65.58% of the seeds they needed from their sources. On average, farmers used 8000 kg of organic manure/ha, which was more in Yongnyah (10567 kg/ha). The least use of manure was (5428 kg/ha) in Bhumnyu. There was no use of chemical fertilizer in the study areas.

Table 5. Cost of organic ginger cultivation by the sample farmers

Cost items	Study Area				
	Pongo	Yongnyah	Yongam	Bhumnyu	All Area
Land preparation cost	10739	15211	13678	8510	48138 (8.86)
Own labour	7670	12899	10870	5722	37161
Hired labour	3069	2312	2808	2788	10977
Human labour cost:	18237	25675	21450	15326	80688 (14.85)
Own labour	14380	19072	17521	11827	64200
Hired labour	3857	6603	3929	3499	16488
Seed	70592	130783	101553	61424	364352 (67.06)
Own	59985	112000	88580	53100	313665
Distribution by government	31107	66983	48973	26624	173687
Organic manures:	5605	8130	6821	4210	24766 (4.56)
Own	5605	8130	6821	4210	24766
Purchased	---	---	---	---	---
Organic insecticides:	---	---	---	---	---
Interest on hired capital	3270	4821	4000	2860	14951 (2.75)
Land use cost	2665	3126	2418	2250	10459 (1.92)
Total cost					
Cash cost basis	13560	24568	5723	9367	53218
Full cost basis	181700	318529	251473	156004	907706

Source: Field Survey Report, 2022

3.1 Cost of production and profitability of organic ginger farming

Production costs include various variable cost factors such as land preparation, labour, seed, manure, interest on operating costs and land rental value. Cash expenditure and imputed value of household supplied inputs were included in the analysis and presented in (Table 5). The study shows that the highest cost of seed (rhizome) was found to be (67.06%). The cost for land preparation, labour, organic manure, interest on hired capital and land use cost was 8.86% 14.85%, 67.06%, 4.56%, 2.75% and 1.92% respectively. Mulching cost was included in the labour as it is collected from own land or from nearby forest free of cost. Cost for labour was higher in Yongnyah than the remaining areas. It was due to higher labour use for organic manure application. The use of organic manure in Yongnyah was almost double to other village. The average cost of production for cash cost basis in Yongnyah was higher (₹/ha 24568) among four sites.

Table 6. Profitability of organic ginger cultivation

Items	Study Area				
	Pongo	Yongnyah	Yongam	Bhumnyu	All Area
Main Yield (Kg/ha)	12056	16780	7421	9178	11358.75
Yield of Rhizome (Kg/ha)	1194	2491	670	825	1295.00
Total Yield	13250	19271	8091	10003	12653.75
Gross return (₹/ha)	421960	587300	259735	321230	1590225
Total Cost					
Cash cost basis	13560	24568	5723	9367	53218
Full cost basis	181700	318529	251473	156004	907706
Benefit-Cost ratio (BCR)	2.16	1.84	1.00	1.94	1.75

Author calculation using fieldwork data

Table 6 shows the organic ginger farmers received an average of 11358 kg/ha of total yield. Main productivity is found higher in Yongnyah. At the study sites, all villages have the practices of collecting mother rhizomes. The average total productivity of organic ginger production is 1590225 ₹/ha. The average cost-benefit ratio is 1.75. The benefit-cost ratio is lowest in Yongam due to high labour and other external input costs, and the highest was in Pongo village (Sharma, 2009; Pottangi Shah & Zala, 2006).

3.2 Factors affecting organic ginger production

The maximum likelihood estimates for parameter of the Cobb Douglas production function of organic ginger is presented in Table 7. Of the five parameters, four are statistically significant and positive. The empirical results show that the coefficients of seed cost, labour cost and intercropping are all positive and significant at 1% level. But crop rotation years were found to be positive and significant at the 5% level.

Table 7. Estimation of Cobb-Douglas production function of organic ginger cultivation

Observation	Coefficients	Standard Error	t-value	P-value
Constant	-1.107	5.29	-0.741	0.371
Seeds	0.502	0.081	9.84	0.000***
Organic manures	-0.039	0.084	-0.47	0.237
Labour cost	0.332	0.132	5.43	0.000***
Crop rotation	0.131	0.041	2.16	0.031**
Capital cost	0.512	0.162	0.94	0.005***

Dependent Variable: Seeds, Organic manures, Labour cost, Crop rotation and Capital cost

R^2= 0.749, *** and ** indicate the significant at 1% and 5% level of probability respectively

The regression coefficient for seed cost was 0.502, which depicted that with 100% increase in cost on seed production/output could be increased by 50.2%. Similarly with the increase in labour cost by 100% increase in production could be increased by 33.2%. Number of years on crop rotation if increased by 100% the production is increased by 13.1%. If capital cost increased by 100% the production is increased by 51.2%. Since the coefficients value of seeds, organic manures, labour cost, crop rotation and capital cost is 1.47 it exhibits increasing return to scale and the Cobb-Douglas production function is statistically significant. Thus, the alternative hypothesis which states that production function operates under increasing return to scale is accepted.

Table 8. Problems of ginger cultivation

Particulars	Study Area				
	Pongo	Yongyah	Yonyam	Bhumnyu	All Area
Poor rural infrastructure	28.60	35.25	18.51	12.88	23.79
Lack of technical knowledge and skills	11.67	10.46	8.17	13.62	10.98
Problem of pest management	13.35	14.78	12.70	8.54	12.34
Marketing problem	43.67	32.19	28.30	30.89	33.76
Lack of storage facility	84.56	87.46	82.37	76.25	82.66
Lack of proper training by various agency	56.33	52.45	38.19	47.72	48.67
Insufficient supply of manure and mulch	32.88	26.11	18.45	23.91	25.33
Lack of quality planting materials	23.58	18.47	15.34	20.62	19.50

Source: Field Survey Report, 2022

4. Conclusions

Based on the research, it can be concluded that the growth rate of area under cultivation, production and yield of organic ginger is in increasing trend from 2009-10 to 2018-19. The study shows that the organic ginger cultivators are using own resources for farming compared to hired basis. Organic ginger cultivation is highly profitable as the Benefit-Cost Ratio (BCR) was found to be 1.75. The average gross return from organic ginger production was found ₹/ha 1590225. The benefit cost ratio was lowest in Yongam was due to high charges for labour and other external inputs and the highest was in Pongo village. Among all the major cost involve in production of organic ginger seed cost is the highest i.e., 67.6%. Organic ginger farming in Pongo, Yongnyah, Yongam and Bhumnyu was mostly cultivated intercropped with yam, maize, tapioca, pumpkin, cucumber, brinjial, pigeon pea, kidney bean, green chillies and other vegetables (98.43%). The study found that intercropping with maize and vegetables provide good source of income generation, rise in productivity, food security and sustainable environment to the farmers in short periods. The estimated coefficient of factors of production indicated that seed, labour cost, number of years for crop rotation and capital cost has significant positive effects in study areas with 1% and 5% significant level. Farmers perceived that quality seed, pest management and technical knowledge are major three bottlenecks for ginger production. The study found that the cost and quality of seed is the major hindrance for ginger farming in study areas Thus, apart from all the mention problems organic ginger farming is gaining drive for income, employment generation and improving the livelihood of the farming community in the district. So, the government agencies should come forward and provide proper training and ad rem suggestions to the farmers so as to promote organic cultivation of ginger among farmers so as to enable them to enhance their earning capacity among the farmers.

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