Indian Journal of Finance and Economics
Vol. 1, No. 2, **2020** : 97-107

URL : www.arfjournals.com

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ECONOMICS OF TOMATO CULTIVATION IN LONGKHUM VILLAGE, MOKOKCHUNG DISTRICT, NAGALAND

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Received : 24 July 2020; Revised : 14 August 2020; Accepted : 18 September 2020; Published : 30 October 2020

Abstract: Tomato is the most popular vegetable in the world because of its taste, high nutritive value, also for its diversified use and increasing commercial value. It is an important constituent of every Naga (Indian) meal, and its cultivation contributes significantly to livelihood improvement. The demand for tomato is very high and even though Longkhum village leads in production of tomatoes and is also knows for exporting within and outside the state but supply still falls short of demand. Despite the increasing demand, farmers in Longkhum village are unable to meet the demand. The reason for low yield when compared to other states are due to factors like, it is organic, absence of modern machines and ideas, no proper market, infestations by fungi, bacteria and the competing weeds are predominant. In spite of many drawbacks, farmers still earn a good amount of profit from tomato cultivation that has improved the livelihood of the people in Lonkhum village by a great extend. Even though tomato cultivation was found to be very profitable but there is an urgent need to develop biocontrol agents and varieties of tomato that can resist the damage by fungal diseases like early blight, late blight and wilt because, breeding for resistant plant varieties and application of pesticides are insufficient to control.

Keywords: Tomato Cultivation, Economic, Significant, Yield,

Highlights

- Cultivation of tomatoes in Longkhum village
- Efficiency of tomato cultivation
- Lack of modern technologies and ideas
- Need for breeding for resistant plant varieties and application of pesticides

Classification Code: D24; E21; E31; F66; H21; C81.

INTRODUCTION

Nagaland is basically an agriculture economy with almost 70% of its population dependent on agriculture, with rice (Jhum and Terrace)

To cite this article:

B. Imnawapang Longkumer. Economics of Tomato Cultivation in Longkhum Village, Mokokchung District, Nagaland. *Indian Journal of Finance and Economics*, Vol. 1, No. 2, 2020, pp. 97-107

cultivation being the dominant crops covering about 84.4% of the total cropped area. Despite the prevailing changes in agricultural system over the years in India, with introduction of modern machines and technologies, shift from subsistence to commercial farming, and integrated farming system but still a large part of agriculture in Nagaland is still into subsistence farming and they have been practicing and engaging themselves very efficiently in this traditional agricultural methods for survival. However, slowly and steadily there has been a considerable shift of farmers from subsistence farming to more integrated farming system with variety of cash crops being cultivated every season which has been noticeable during the last 10 years. Farmers under Longkhum village in Mokokchung district is one among such that has adopted and switch to cultivation of different varieties of cash crops, specially tomato cultivation which has enabled them to earn better income, improve its livelihood and has also enabled them to meet the demands of the people not only within Mokokchung but the rest of the state.

Tomato is the world's largest vegetable crop and China is the leading producer of tomato followed by India and Turkey[1]. The total area under tomato in the world is 46.16 lakh ha and the global production is to the tune of 1279.93 lakh tones. It is known as protective food both because of its special nutritive value and also because of its wide spread production (Babu *et al.*, 2004). In India, tomato crop ranks next only to potato and brinjal in the production of vegetables. India has a total 789 thousand hectares under tomato crop, with a yield of 22320 thousand tones, with West Bengal, UP and Madhya Pradesh as the leading tomato producing states in India. Tomato is one of the most important vegetable crops cultivated by the people of Northeast region both in hills as well as in the plains. (Pedro and Ferreira, 2007) tomato is composed mainly of water (approximately 90%), soluble and insoluble solids (5-7%), citric and other organic acids and vitamins and minerals. Due to the health benefits as well as economical importance associated with tomato make it one of the most commercially viable of all agricultural commodities. They can be grown in different varieties of soil but is best on well-drained fertile soils. They are cultivated in the open under field conditions, usually staked and supported off the ground, in an effort to minimize losses from rots when the fruit is in contact with the soil. Tomato is used in preserved products like ketch-up, sauce, chutney, soup, paste, puree etc. It can be consumed in many ways, consumed fresh, cooked or processed into various products. As it is short duration crop and gives high yield, it is important from economic point of view and hence area under its cultivation is increasing day by day. Cultivation of tomato like cash crops instead of rice cultivation is showing positive result thereby

helping the farmers in improving their standard of living as well as enabling them in managing a sustainable livelihood (Temjensosang 2017).

OBJECTIVES

The present study was undertaken with the following specific objectives (i) Study the economic efficiency of tomato cultivation in Longkhum village, taking two types of varieties of crops and (ii) Identify the main areas of training in relation to improve and increase production, to encourage farmers to take up tomato cultivation seriously as an important cash crop to increase their income and livelihood, as well as to meet the demands in the state.

METHODOLOGY

Longkhum village under Mokokchung district was purposively selected for the present study, since the village leads in the production of Tomatoes which is a major commercial crop for the area and they also exports to neighboring districts like Kohima and Dimapur and even to the state of Assam. The village is located at an altitude of 1846 m above sea level, 17 km south-west of Mokokchung, in Nagaland, North-East India. The study is based on primary data collected from the year 2019. All together 40 household (Growing different varieties of seeds) were selected through interview method. A pre-tested comprehensive interview schedule was designed for the canvass in the study area. The data has been analyzed using appropriate statistical tools and technique, such as ratios, percentages, proportions. In addition to the above usual statistical measures Regression analysis has been used.

LITERATURE REVIEW

(Tewari *et al* 1974) studied the income and investment behaviour of vegetable and cereal growing farms in mid-hills of Himachal Pradesh and found that, the expenditure on various inputs was found to be higher on vegetable growing farms and the expenditure on fertilizers contributed more than 40 per cent of the total variable cost. However, the gross income of cereal growing farms was less than half of the vegetable growing farms. The analysis suggest that, by improving the quality of land, adopting land development measures and increase in irrigation vegetable growing farms could increase their income. (Mukherjee *et al*. 1991) in their study of economics of cauliflower cultivation in West Bengal found that, except in the case of marginal farms, increase in the size of operational holdings leads to increase in gross returns per hectare for all the other farm size groups.

Again, (Garg and Prasad I974) observed higher net returns per hectare from vegetable farming than food-grains in a study on comparative profitability of various vegetable crops around Kanpur city. The per hectare investment on tomato was found to be 3.64 per cent lower than wheat, but the net income from tomato was 1.5 times more than wheat.

Tomato is one of the important "protective foods" both because of its special nutritive value and widespread production. It is the world's largest vegetable crop after potato and sweet potato, but it tops the list of canned vegetables (Babu *et al.*, 2004). However its cultivation has been limited by an abundant attack of pathogens and analysis of tomato pathogen interactions is very important in order to establish effective control methods (Tsutomu *et al.*, 2007). A huge impact was found on the income of the farmers cultivating vegetables due to the use of commercial hybrid seeds and as a result, the production of tomato and okra has tremendously increased, helping the farmers to increase their farm incomes up to a great margin (Sudha, *et al.*, 2006). While (Soni and Ahmed 1992) in their study found that, cost of cultivation of foodgrains was substantially less in comparison with tomato which was attributed to investment on farm-yard manure (FYM) and labour inputs, and use of chemical fertilizers but tomato was found to have a significantly higher cost-benefit ration than that of foodgrain crops.

Interestingly, (Singh 1990) observed that amongst the important input variables like seed, manure and fertilizers, human labour, plant protection and marketing costs, only plant protection and marketing cost were found as significant input variables in tomato crop. The coefficient of human labour was also a significant factor having a positive effect on the returns of pea crop on small farms. As majority of the coefficients were statistically non-significant for most of the vegetables, the author suggested the choice of correct level of use of resources for better returns. However, (Reddy, *et al.* 2010) talked about the value chains and retailing of fresh vegetables and fruits in Andhra Pradesh and laid emphasis over the success of the new retailing market emerging in the present times. It has been offering greater opportunities to vegetable and fruit growers and they are reaping a large chunk of financial and economic benefits.

DISCUSSIONS AND FINDINGS

Even though jhum cultivation is still practiced by most of the family in Longkhum village as rice being the stable food crop but it is like an amazing story to see how quickly and successfully the farmers have adapted from traditional subsistence farming to commercial farming. Study found that,

along with tomato, crops like cabbage, chili and potato etc. are also cultivated by the farmers due to its economic efficiency and easy for sustainability. Unlike farmers from other villages of the district or the state, almost every household in Logkhum village is into vegetable cultivation, especially tomato due to its increasing commercial value and the ability to get high yield due to its favorable soil and climatic factors. (Temjensosang, 2017) tomato cultivation started with the introduction of hybrid tomato seeds to the villagers by S.I. Aren, a resident of Longkhum village in the year 1999, which let the farmers perceive the idea of tomato cultivation and its potentialities and suitability with the type of soil thereby started cultivating on a large scale.

Table 1: Average Labour Absorption under tomato cultivation (Per Acre)

Operation	*Male*		*Female*		
	Own/family Labour	*Hired Labour*	*Own/family Labour*	*Hired Labour*	*Total Labour*
Ploughing	6	3	5	2	16
Manuring	1	0	1	0	2
Sowing/seed planting	1	0	2	1	4
Irrigation	5	0	10	0	15
Weeding	4	0	10	3	17
Harvesting	5	0	8	3	16
Loading & Transporting	2	0	4	0	6
Total Labour Absorption	24	3	40	9	76

Source: Field Survey 2019

Table 1 show the average labour absorption per acre under tomato cultivation in Longkhum village. From the data, it is evident that, tomato cultivation is labour intensive and out of the total labour consumed, 64.47 percent are found to be female labour, while 35.53 percent are male labours. This indicates clearly that, female play the most dominant role in tomato cultivation unlike jhum cultivation which is dominated by male labours. Weeding, irrigation and harvesting are the activities that absorb the highest number of labour, whereas manuring and sowing seeds are the activities that absorb the least (both male and female). The data also reveals that, tomato cultivation in Longkhum village is a family farming activity, with hardly 15.78 (3.93 male and 11.85 female) percent hired labour involved.

Table 2: Average Cost on Seed, Manure, Vitamins and Water consumption (Per Acre)

Operation	*Consumption per Acre*	*Cost (₹)*	*Total (₹)*
Seed	5 Packets	780 Per Packet	3,900
Manures	40 Tins	50 Per Tin	2,000
Vitamins	3 Kg/ 4 Times	420 Per Kg	5,040
Irrigation	2000 Liters	1000	1,000
Pesticides	2 Bottles	480	960
Total Cost	**12,900**		

Source: Field Survey 2019

Note: Tin refers to the 15 litre edible oil container that is available in the market

As per the table above, the input cost of tomato was found to be quite high when compared to the cost of other foodgrain crops. The data indicates that, farmers on an average spend ₹. 12,900 per acre under tomato cultivation in Longkhum village. Majority of the cost is incurred on buying vitamins or protectant fungicide which control diseases caused by all four major classes of plant pathogens in wide range of the cross. On an average around[1]. 5,040 is incurred on fungicide, followed by seeds ₹. 3,900 which is a hybrid seed. On the other hand, even though many farmers don't use manures but the average use of manures is around 40 tin per acre amounting to ₹ .2000 by those farmers who use manures when the fertility of the land decreases. There is hardly any irrigation problem but sometimes when monsoon is delayed the farmers spend around ₹ .1000 for a truck of water from the village till the farm for irrigation, while the cost on pesticides is the lowest.

Table 3: Varieties of seeds and their average yield (Per Acre)

Name of Seeds	*Yield (Kg)*
Namdari Tomato Seeds	15600
Cristal and Nayak Tomato Seeds	15000

Source: Field Survey 2019

There are three varieties of hybrid seeds used by tomato cultivators in Longkhum village as per Table 3. Among them Namdari seeds is the most commonly used, while the other two are not that much in use these days. As per the data, apart from Namdari giving a yield of 15600 kg per acre, the other two gives almost the same. The main difference of this seeds that was found during the study was, Nayak and Cristal seeds were more prone to sunscald, which means the plant looks healthy and it develops normally but slowly yellow patches appears on the red skin which turns into paper thin white skin or layer turning into unpleasant appearance and taste. Not

only that, but flowers appears on the plant but falls without tomatoes developing, which we call it as blossom drop and the seeds. There were also signs of farmers experiencing blossom end rot, where the plant looks healthy but it turns into an ugly patch black spot once it ripens and when cut off the fruit inside looks mealy. So, all this resulted in fall in demand both in retail and wholesale market, reducing their profit margins. However, farmers using Namdari seeds not only get highest yield per acre but they hardly had any problems. So, almost all the tomato cultivators in Longkhum village use Namdari seeds.

Table 4: Average Economic Efficiency of different seeds (Per Acre)

Varieties	*Expenditure (Labour cost + Input cost)*	*Gross income*	*Net profit/Loss*
Namdari	₹ .30,650 + ₹ .12,900 = ₹ .43,550	₹ .2,65,000	₹ .221,650
Cristal & Nayak	₹ .30,650 + ₹ .12,900 = ₹ .43,550	₹ .2,25,000	₹ .181,450

Source: Field Survey 2019

Out of the 40 respondents, 36 respondents were found using Namdari seeds only, while the 4 respondents were using mixture of both Cristal and Nayak seeds along with Namdari. Data indicates that, input cost are same for farmers using both the type of seeds because the amount of inputs used are same for all the farmers and even though there are slight differences in the price of the seeds used but since the price are different according to the date of manufacture, and most of the farmers use Namdari seeds only and even those 10 percent of the respondents also mix Namdari with other seeds, so the price has been taken on an average based on Namdari seeds. However, there is a difference of [1] .40,000 in gross income between farmers using Namdari seeds and Nayak or Cristal seeds. The main reason for this difference is due to the amount of yield and quality of the tomatoes after the harvest which results in higher demand for Namdari tomatoes compared to the others, making the Namdari tomatoes cultivators fetch a good price in the market. Namdari tomatoes are not only good in quality but also have longer durability that enables the farmers as well as wholesalers and retailers to keep for longer period of time in spite of inadequate storage devices. Even though tomato cultivators are making huge profit but we find that Namdari tomato is more economically efficient than the rest of the village with a net profit difference of ₹ .40,200.

REGRESSION RESULT

Regression result from Table 5 shows that, the R-square value of .842 indicates that the model is a good fit, since it implies that about 84.2 percent of the variation in yield is explained by the independent variables. The

coefficient value of labour indicates that, a one percent increase in labour increases yield by .338 percent. On the other hand, capital is also found to be highly significant at .452, indicating that, a one percent increase in capital results in increase in the yield by .452 percent. However, the coefficient of education and age were found to be positive but not statistically significant.

Table 5: Factor determinants of Tomato Productivity/Yield

Variable	*Un-standard Coefficients*		*Standard Coefficient*		
	B	*Std. Error*	*Beta*	*t*	*Sig.*
Constant	.698	1.534		.478	.051
Labour	.338*	.149	.334	2.167	.000
Capital	.452*	.078	.738	4.695	093
Age	.254	.135	.317	1.470	.105
Education	.785	.633	.256	1.305	.351
R-Square					.842
Adjusted R-Square					.781
Standard Error of the Estimate.07204					

Note: * indicates 1 percent level of significance

ADVANTAGES OF GROWING TOMATO OVER OTHER CROPS

(i) Tomato is a short duration vegetable crop and it can be grown round the year. This will enable the farmers to earn more income and improve their livelihood as well as meet the increasing demand for consumption.

(ii) Tomato is one of the mostly widely grown vegetable crops and is can be cultivated outdoor as well as under indoor conditions. So, with proper training and protection it can be even grown indoor which will solve the problem of irregular monsoon and other climatic factors that destroy the crops most of the time.

(iii) Another important characteristic of tomato cultivation is that, it keeps growing and producing fruits until frost kills the plant. Tomato is well fitted in different cropping systems of cereals, grains, pulses and oilseeds. So, farmers can grow tomato whole round the year.

(iv) Since it gives more yields compared to other vegetable crops like chili and cabbage etc, hence it has high economic value.v.
Tomatoes are nutritionally valuable for their high pro-vitamin A and vitamin C content and rank number one in their nutrient contribution to human diet. Numbers of processed items are

prepared on large scale for consumption as well as for export purpose.

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PROBLEMS AND SUGGESTIONS

(i) The village has the capacity for production and distribution of sufficient tomatoes for the state as well as outside, so proper training should be given to the cultivators for increasing productivity because till now most of the farmers have not received proper training and are cultivating based on their experience and own knowledge and ideas.

(ii) Tomato is such a crop that can be cultivated throughout the season unlike other crops. Farmers can be encouraged to grow more than once to meet the growing demand for tomato as well as it will increase their level of income and create more employment opportunities.

(iii) There is also an urgent need for storage devices as tomatoes and most of the vegetables are easily perishable. Framers find difficult to sell off their produce or sometimes they reduce the price just to sell off the produce with the fear of being getting rotten.

(iv) Most of the farmers don't have any training and knowledge they don't have idea about sunscald problem, poor fruit set, **cat facing**, leaf roll, **blossom drop** and end rot etc, leaving it at the mercy of the weather that causes a decline in yield as the plant sometimes don't even bear fruit. So, farmers need to be trained on these factors particularly along with other types of training.

(v) Need for vegetable processing devices is also another factor that can be look into by the government. Some vegetables and fruits can be processed and make it into jam, sauce etc. and can also be packed into canned products that will reduce spoilage and also increase income of the farmers.

(vi) Better road connectivity with regular transportation and marketing system is also another area that needs to be solved for encouraging the farmers into vegetable cultivation.

(vii) Financial assistance from credit institution can also ease the problems of the farmers to buy inputs, which will boost their productivity.

CONCLUSION

Traditionally farming in Nagaland is mostly for self consumption and for food security but today every household in Longkhum village has a vegetable farm which has helped in steady flow of income throughout the year and improved standard of living. Farmers are now earning a substantial amount of income through vegetable farming, especially tomatoes as the climatic conditions is favourable for the growth of varieties of vegetables. Along with that, the construction and development of agri-linked roads and better organized market system have boosted farming in Longkhum village. Study reveals that, almost 8000 tomato plants can cultivated in one acre of land and the chance of plants to survive and grow healthy tomatoes and give high yield depends on the quality of seeds used along with other inputs. Planting season usually starts from first week of April to second week of April. Weeding usually starts from the month of May and on an average it is done 3 to 4 times during the whole growing season and by June harvesting starts. Farmers in Longkhum village use hybrid seeds and Namdari seeds is the most commonly used seeds and on an average almost 7800 plants are survived per acre if proper inputs are used along with good weather condition, unlike other seeds where hardly 7500 plants can survive per acre. A branch of tomato plant gives an average yield of 2 kg and is sold to wholesalers by ₹ .15 to even ₹ .25 per Kg, which fluctuates during lean and peak periods. Study also shows that, tomato cultivation is very labour intensive with an average of 76 (49 Female and 27 Male) labour man days and is mostly done by family members and very less hired labour. The cost of cultivation is high but at the same time it has a higher cost return when compared to other crops, showing a net profit of ₹ .2,21,650 and ₹ .1,81,450 for Namdari and other types of tomatoes respectively. But much needs to be done on training the farmers as they encounters various common tomato plant problems and to identify them and save the plants from being exposed to various diseases and attack by insects and fungi which is causing a great harm to productivity there by reducing its economic efficiency.

Notes

1. According to the data provided by FAOSTAT, world has produced 182,301,395 tons tomatoes in 2017.

   * Longkhum is called as the 'Vegetable Capital' of Nagaland. It was recorded that during the harvest season farmers produce a total of approximately 230 MT of Tomato, 32 MT of Small Potatoes, 33 MT of Chilly and 71 MT of Cabbage. (*Department of Horticulture, Government of Nagaland).*

   * The Department of Horticulture, Government of Nagaland declared Longkhum village as 'Vegetable Village' in 2004 and 'Potato Village' in 2002.

* Mr. S.I Aren, the pioneer of hybrid tomato cultivation in Longkhum village was awarded the Best Vegetable Farmer award by the Agriculture Technology Management Agency, Mokokchung District in 2009.

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