

Profitability, Inputs Influencing Yields and Constraints Faced by the Tomato (*Lycopersicon esculentum*) Producers: An Empirical Evidence from Moulvibazar District in Bangladesh

ABSTRACT

This study attempts to investigate the economics of tomato production in Moulvibazar district in Bangladesh. In this study, both economic model of description and statistical analysis were used to analyze the data. It was found that tomato cultivation was a profitable business in the study area. Per hectare production was 42.68 m. ton. The average gross cost for tomato production was Tk. 2,80,004/ha. Per hectare gross return of small, medium and large farm were Tk. 5,62,172/ha, Tk. 5,57,908/ha and Tk. 5,44,674/ha, respectively. The overall benefit cost ratio (undiscounted) was found 1.98. Per hectare benefit cost ratio of small, medium and large farm were 2.09, 1.99 and 1.87, respectively, which indicates that tomato production by small farm was more profitable. It was also found that the use of human labor, insecticides, fertilizer and bamboo had significant impact on gross return of tomato production. It was identified from the study that major problems faced by the farmers were: inadequate storage facilities, lack of sufficient credit supply, high interest rate, lack of human labour, inadequate supply of good quality seeds, high prices of fertilizers and insecticides, disease attacks, low price of product during harvesting, lack of marketing facilities and information. Some recommendation were made on the basis of the findings of the study, which were, institutional credit support, increase storage facilities, availability of good quality seeds, ensure fair price and control price fluctuation.

Key words: Tomato production, Profitability, Inputs influencing, Constraints, Kruskal-Wallis

1. INTRODUCTION:

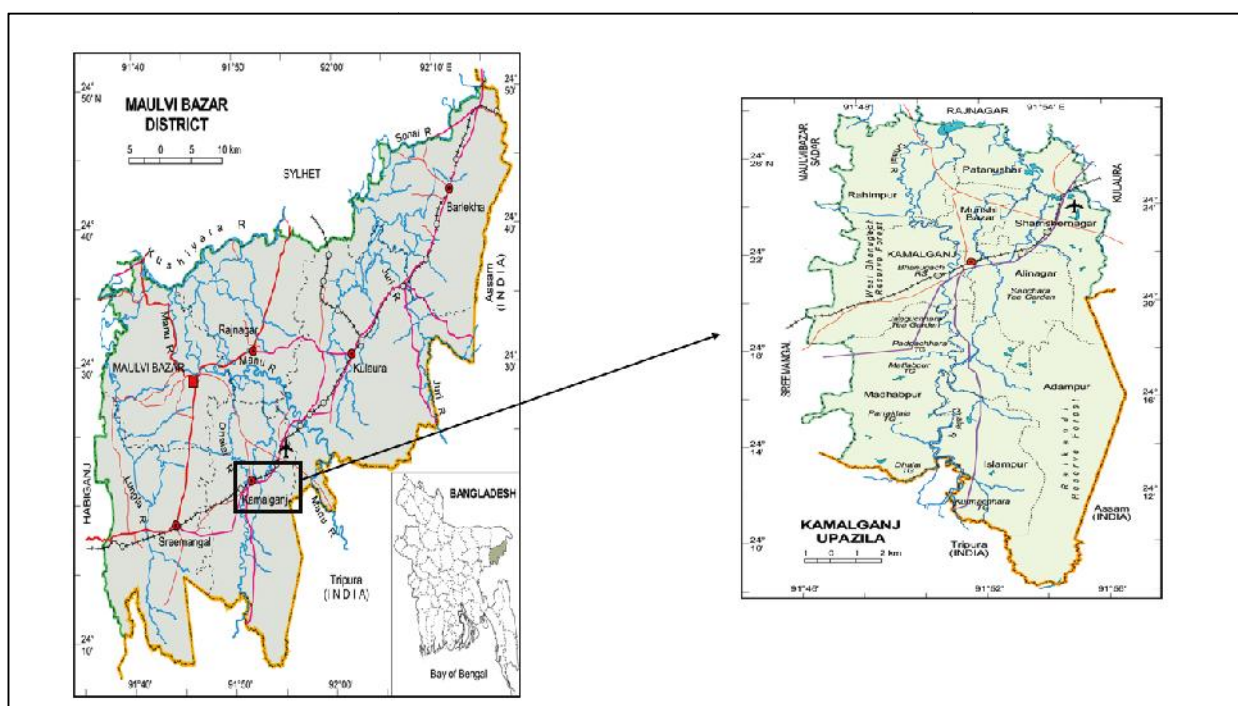
Agriculture, the single largest sector, is the main source of income for a substantial number of people of Bangladesh, about 87% rural household directly or indirectly depends on agriculture (World Bank, 2016). The national growth and development mainly depends on the development of its agriculture and farming overall economic growth of Bangladesh could not be achieved unless it could have achieved a breakthrough in the agricultural sector (Alam, 1991). Agriculture is the higher dominating sector which is very crucial for Bangladesh economy. In fact, agriculture is the backbone of the economy of this country. This sector contributes 11.70% to Gross Domestic Product (GDP) in which 8.35% comes from crops and vegetables (BBS, 2015). The overall direct contribution of the agriculture sector has decreased slightly; it has indirect contribution to the general growth of GDP. It may be noted here that, the GDP growth rate was 6.19% in fiscal year 2007-08. Vegetable is important in Bangladesh for nutrition, economy and food security (Begum et al 2011). Vegetables can be identified as a significant one for this economy for its noteworthy contribution (2.32% to the agricultural GDP) in raising the foreign exchange earnings and occupies an important position among the items exported from Bangladesh. Production of such types high value commodities in the country must be increased to cope with the challenges of malnutrition and low productivity. In this context, production of tomato would be able to play an important role to improve the performance along with crop diversification, particularly from the view point of nutrition and profitability as it placed sixth position in terms of annual total world production (FAO, 2011). Tomato (*Lycopersicon esculentum*),

special type of crop which is mostly grown in winter season in south-east and south west part of Bangladesh and a good source of vitamin A and C (Das et al. 2011). The government of Bangladesh has been pursuing a crop diversification strategy to increase tomato cultivation to meet the demand of increasing population. Among the districts of Bangladesh, Moulvibazar is renowned for agricultural activities and more than 80% families are, directly and indirectly, depending on agriculture (BBS, 2015). Farmers are mainly engaged in rice cultivation, but there are also a big portion of lands which are using for commercial tomato cultivation. So, it is important for the researcher and the producers to know the costs and returns, their input use, contribution of key inputs in cultivating tomato in this specific study area. Almost all of the previous studies on the agricultural activities of this district are focused on rice cultivation related issues. Surprisingly, no research work has been undertaken particularly on cultivating tomato, although many study (Samshunnahar et al. 2016, Baksh et al. 2015, Haque et al. 2012, Sarker and Rashid 2011, Hasan 2011, Mohiuddin et al. 2007, Monsura et al. 2010, Karim et al. 2009, Zaman et al. 2006) has been conducted across the country concerning tomato production and related issues. In this backdrop, the present study has been undertaken to estimate the profitability, inputs affects yields and major constraints face by the farmers. It is expected that the study will provide policy makers, extension workers, farmers, researchers for reviewing the policy options in respect of supporting production of tomato and other competing crops for optimizing the use of scarce national resources.

2. MATERIAL AND METHODS

2.1 Selection of the study area

The area, Kamalganj upazila of Moulvibazar district was purposively selected for the present study. It is situated between 24.10 degree and 24.35 degree north latitude and between 90.35 degree and 91.20-degree east longitude. In order to achieve the objectives of the research, necessary data have been collected from the selected area. Considering the highest production, the present study has been conducted in two unions namely Alinagar and Adampur unions (Union parishad is the smallest administrative of local government of Bangladesh) of Kamalganj upazila of Moulvibazar district.



Source: www.banglapedia.org

2.2 Selection of the sample and data processing

A sample of representative farms which satisfy the objectives of the study was taken into account. In this study, 50 farmers were selected randomly, among which 30 farmers from Alinagar and 20 farmers

from Adampur union. Out of 50 farmers, 18 were small, 25 were medium and 7 were large farmers on the basis of selected farmer's proportion. For validating the response of the respondent 10 key informants interview was taken separately from each unions.

The relevant data from the selected farmers were collected through face-to-face interview by the researcher himself. The questionnaire was checked after each interview, so as to ensure that information to each item had properly recorded. In order to minimize the errors, data were collected in local unit and later those were converted into standard international units.

2.3 Analytical technique

Data were carefully analyzed for achieving the objectives of the study. Both tabular and statistical techniques were used for data analysis. Tabular technique commonly followed to find out the crude association or difference between variables. To find out the economic performance of tomato, the simple statistical model such as the average, percentage, total cost, total return, etc were used.

Gross Return

$$GR_i = \sum_{i=1}^n Q_i P_i$$

Where,

GR_i = Gross Return from i th product (Tk./ha); Q_i = Quantity of the i th product (Kg); P_i = Average price of the i th product (Tk.); $i = 1, 2, 3, \dots, n$

Gross margin

Gross margin has given an estimate of the difference between gross return and total variable costs. That is,

$$GM = GR - TVC$$

Where, GM = Gross margin; GR = Gross return; TVC = Total variable cost

Net return

The following equation was used to determine the net return of tomato production.

$$\Pi = P_Y Y - \sum_{i=1}^n (P_{X_i} X_i) - TFC$$

Where, Π = Net return (Tk./acre); P_Y = Per unit price of the product (Tk./kg); Y = Quantity of the production per acre (kg); P_{X_i} = Per unit price of i^{th} inputs (Tk.); X_i = Quantity of the i^{th} inputs per acre (Kg.); $i = 1, 2, 3, \dots, n$ (number of variable);

Benefit Cost Ratio (BCR)

The BCR was estimated as a ratio of gross returns and gross costs. The formula of calculating BCR (undiscounted) is shown below:

$$\text{Benefit cost ratio} = \text{Gross benefit} / \text{Gross cost}$$

Statistical Technique

The Cobb-Douglas model (Gujrati, 2003) for tomato production respondents was specified as:

$$Y = aX_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_7^{b_7} X_8^{b_8} X_9^{b_9}$$

The Multiple Regression model in logarithm form may be expressed as:

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + b_8 \ln X_8 + b_9 \ln X_9 + U$$

Where,

Y = gross return (Tk./ha); X_1 = human labour cost (Tk./ha); X_2 = power tiller cost (Tk./ha); X_3 = seed cost (Tk./ha); X_4 = insecticides cost (Tk./ha); X_5 = fertilizer cost (Tk./ha); X_6 = irrigation cost (Tk./ha); X_7 = bamboo cost (Tk./ha); X_8 = poly bag cost (Tk./ha); X_9 = land use cost (Tk./ha); a = constant/intercept; $b_1, b_2, \dots, b_9$ = coefficients of respective variables; U = error term; and $\ln$ = natural logarithm

Kruskal-Wallis test

Kruskal-Wallis ranking analysis was used to assess farmer's perception on major problems which faced by farmers to cultivate tomato. This tool was used to measure the responses gathered from farmer's perception on major problems which faced by farmers to cultivate tomato. Fakayode *et al.*, (2012) used Kruskal-Wallis One Way Analysis of Variance (ANOVA) by Ranks to assign priorities to identified constraints to Apiculture.

The equation for estimating the ranks is outlined thus

$$H = \frac{12}{N+1} \sum_{i=1}^{n_i} \frac{1}{n_i} \frac{[R_i - n_i(N+1)/2]^2}{2}$$

Where R_i is the sum of the ranks assigned to observation in the i th sample and $\frac{n_i(N+1)}{2}$, the expected sum of ranks for the i th treatment (Wayne, 1990).

3. RESULT DISCUSSION

3.1 Cost and returns of tomato cultivation

The study estimated the cost of production and return on the basis of different variable inputs used. The major costs associate with the tomato cultivation was laobur, power tiller fertilizer, polybag, insecticides, bamboo, irrigation and land use cost. Laborers required for different farm operations like land preparation, seedling, weeding, application of fertilizer, irrigation, insecticide application, harvesting and carrying, etc. It occupies a large portion of total cost of production. In the study area, the wage rate varied from Tk. 240 to Tk.280 per man-day depending on the time and availability of day labour. The average rate was Tk.260 per man-day. The amount of human labour used for tomato cultivation were 306 man-days per hectare resulting a cost of Tk. 79590 which was 28.42% of total production cost by all farm categories (Table 1). The total average costs of labour were Tk. 79690, Tk. 79820 and Tk. 81900 represent 28.63%, 28.50%, 28.14% of total cost for small, medium and large farms respectively. Large farmers spent more on human labor compared to small and medium farmers because large farmers had adequate fund to hire labour for the production process of tomato. Balanced application of fertilizer is important for proper growth of the plants and it ensure the maximum yields.

Table 1: Cost and return of tomato production (Tk/ha)

Items	Total Cost and Return (tk./ha)	Total Cost and Return (tk./ha)	Total Cost and Return (tk./ha)	Total Cost and Return (tk./ha)
	Small	Medium	Large	Average
A. Gross return				
Main product	562172	557908	544674	554918
B. Variable cost				
Total labour	76960	79820	81900	79560
Power tiller	11565	11942	13255	12254
Seeds	9841	10825	11219	10628
Fertilizer:				
Urea	7500	7900	8600	8000
TSP	7504	7756	8260	7840
MP	7710	8070	8520	8100
Gypsum	2315	2396	2639	2450
Boron	2800	3200	3600	3200
Subtotal	27829	29322	31619	29590
Insecticides	23010	24117	26385	24504
Bamboo	36275	37647	38614	37512
Polybag	2442	2644	2850	2645
Irrigation	8160	9573	10320	9351
Total variable cost	196082	205890	216162	206045
C. Fixed cost				
Interest on operating Capital(10% for 4 months)	3268	3431	3602	3434
Land use cost	69494	70658	71270	70474
Total fixed cost	72762	74089	74872	73908
D. Gross cost (B+C)	268844	279979	291034	279952
E. Gross margin (A-B)	366090	352018	328512	348873
F. Net return (A-D)	293328	277929	253640	274966
G. Benefit cost ratio (A/D) (Undiscounted)	2.09	1.99	1.87	1.98

Source: field Survey, 2017 bank)

*83.70 Taka= 1 USD (23 May 2018, Bangladesh

The second highest cost of production is associated with fertilizer cost. Urea, TSP, MoP, Gypsum and Boron are the main fertilizers for tomato production. Among the three farmers fertilizer cost is higher for large farmer and lowest is for small farmers. Total variable cost was estimated as BDT. 196082, BDT. 205890/ha and BDT. 216162/ha for small, medium and large farmers respectively. The study showed that land use cost per hectare for all farmers was Tk.70474 for tomato cultivation which occupied 26.40% of total cost of tomato production (Table 1). In case of farm categories, it was highest in large farms (Tk. 71270/ha) than that of small farms (Tk. 69494/ha) and medium farms (Tk. 70658/ha). Total gross cost was BDT. 291034/ha for large farmers and BDT. 268844/ha for small farmers. Gross returns was BDT. 562172/ha, BDT. 557908/ha and BDT. 544674/ha respectively for small, medium and large farmers. Net return was calculated by deducting gross cost from total return. Per hectare net return of tomato production under small, medium and large farmers were Tk. 293328/ha, Tk. 277929/ha and Tk. 253640/ha, respectively, which indicates that net return was the highest in small farmers than medium and large farmers. Per hectare net returns of tomato for all categories of farmers was estimated at Tk. 274914/ha. An undiscounted benefit cost ratio (BCR) is a relative measure, which is used to compare benefit per unit of cost. The benefit cost ratio (BCR) was calculated as a ratio of gross returns and gross costs. The BCR of tomato farm was greater than one indicating that tomato farming was profitable. In all farm categories, the highest BCR was revealed small farm holder (2.09) than the medium farm holder (1.99) and large farm holder (1.87). This indicates that small farm holder earned comparatively higher from tomato cultivation as compared to large and medium farm holder. The BCR of tomato for all categories of farms was 1.98

3.2 Effects of inputs on production

To determine the effects of variable inputs, several production function models can be used. The Multiple Regression model was chosen because of its superior properties, particularly in explaining agricultural production behavior. Another special advantage of using Multiple Regression model was that the regression under OLS in logarithm yields coefficients which represents partial elasticity of production and it is simple to calculate and the elasticity of production can directly be obtained from the coefficients.

For producing tomato, different types of variables were employed by the sample farmers. Estimated values of co-efficient and related statistics of the Multiple Regression model are presented in Table 2. It can be observed from the Table 2 that, eight major variables were taken into consideration in the production functions for tomato production. The coefficient of variable X_1 (human labour cost) was 0.536 in tomato production and significant at 5% level with positive sign and it is supported by samshunnahar et al (2016) who also showed that human labour cost was significant at 5%. This implies that keeping other things constant, 1% increase in human labour cost, would lead to an increase of gross return by 0.536% (Table 2). It was happened as we know that tomato production is highly labour intensive and a continuous supervision is needed to get maximum production. At the same time the estimated value of the coefficient of the variable X_2 (Power tiller cost) was 0.164 with positive sign and statistically insignificant. Seed is an important input for maximum yield. High quality seed costs more and increase the yield but a seed with low quality may reduce the average yield of tomato production. In the study the estimated coefficient of seed cost was 0.318 with negative sign and it is also statistically insignificant. Which is the evidence of the inverse relationship between seed cost and yield of tomato. The regression coefficient of insecticides was 0.734 and like seed it has a negative sign but it is significant at 1% level. So 1% increase in insecticides cost, keeping other factors constant, would result in a decrease the gross returns by 0.734%. Also, the negative value of insecticides cost indicates excess use of insecticides. With 1% level of significance the estimated coefficient of fertilizer was 0.684. Since the sign is positive, it indicates that 1% increase in fertilizer cost, keeping other inputs constant, would increase the gross returns by 0.684%. The possible causes of positive sign might be the irrational use of fertilizer in tomato production. The coefficient of variable irrigation cost and bamboo cost was 0.295 and 0.408 with positive sign Bamboo cost was statistically significant at 10% level which indicates that keeping other inputs constant, gross return would be increased by 0.408% if 1% bamboo cost had been increased.

Table 2: Coefficient and related statistics of Multiple Regression model

Explanatory variables	Tomato		
	Estimated coefficient	Standard errors	t-values
Intercepts	1.871	3.102	0.603
Human labour	0.536**	0.258	2.079

Power tiller	0.164	0.224	0.730
Seed	- 0.318	0.254	-1.297
Insecticides	- 0.734***	0.248	-2.955
Fertilizer	0.684***	0.213	3.211
Irrigation	0.295	0.292	1.010
Bamboo	0.408*	0.227	1.797
Polybag	-0.430	0.197	-0.220
Land use cost	-0.376	0.254	1.306
R ²	0.418		
Adjusted R ²	0.305		
F- value	3.688 ***		
Returns to scale $\sum b_i$	2.1		

203 Source: Field Survey, 2017

204 Note: *** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level

205 Both the cost of polybag and land use cost was insignificant and it implies that increase or decrease
 206 of poly bag cost and land use cost will not affect the yield of tomato. The coefficient of determination
 207 (R^2) is a summary that tells how well the sample regression line fit with the data. An important
 208 property of R^2 is that it is a non-decreasing function of the number of explanatory variables present in
 209 the model, as the number of regressor increases, R^2 almost invariably increases and never
 210 decreases. The co-efficient of determination (R^2) was 0.418, which explained that about 42% of the
 211 variation in gross return was explained by the independent variables included in the model. The value
 212 of adjusted R^2 is 0.305 for tomato production. It indicates that after taking into account the degrees of
 213 freedom, the included explanatory variables in the model explained about 31% of the variations in the
 214 depended variables. About 31% of the variation in gross return from tomato production is explained
 215 by the explanatory variables included in the model with all degrees of freedom, and remaining 69% of
 216 the variation in the gross return of tomato production was unexplained. The F - value of the equation
 217 is 3.688 was highly significant at 1% level of significance implying that all the included explanatory
 218 variables were important for explaining the variation in returns of tomato production.

219 3.3 Problems and constraints of tomato production

220 In the study areas tomato farmers faced a number of problems. It was observed that problems and
 221 constraints faced by tomato farmers were not identical and the problems were differed from farmer to
 222 farmer. These problems and constraints affect tomato production as well as profitability. The reasons
 223 behind the facing of constraints is that most of the farmers are not literate and they do not know the
 224 modern technologies which can help to avoid the constraints. From the perception of the respondent
 225 and key informant, the most burning problems of growing tomato were lack of sufficient credit supply,
 226 high interest rate, low price of product during harvesting, lack of storage facilities, good quality seed,
 227 human labour, suitable marketing facilities, grading knowledge, high price of seeds, fertilizers and
 228 insecticides, dominance of intermediaries, disease attacks, loss of production due to theft, burden of
 229 old debt and natural calamity. The farmer's perception on major problems were summarized by using
 230 Kruskal-Wallis One Way Analysis of Variance (ANOVA) by ranks, the major problems as perceived by
 231 the farmers were ranked from 01-14. With 01 and 14 representing the lowest and highest ranked
 232 problem, respectively is as shown by Table 3

233 **Table 3: Summary of Kruskal-wallis test for major problems faced by farmer**

Problem	Mean	Rank
Lack of sufficient credit supply	480.40	4
High interest rate	483.66	3
Lack of good quality seed	476.50	5
Low price of product during harvesting	492.50	2
Lack of storage facilities	493.15	1
Lack of human labour	469.50	6

Lack of suitable marketing facilities	451.43	7
Lack of grading knowledge	248.33	8
High price of seeds, fertilizers and insecticides	227.54	10
Dominance of intermediaries	226.50	11
Disease attacks	221.50	12
Loss of production due to theft	240.05	9
Burden of old debt	191.80	13
Natural calamity	177.54	14
Chi-square	293.60	293.60
Degree of freedom	13	13
Asymp. Sig.	0.000	0.000

234 Source: field Survey, 2017

01-14: Highest to Lowest.

235 Lack of storage facilities (mean 493.15) was the strongest problem in the study areas. Most of the
 236 farmers use traditional way of storage facilities which are not scientific and do not ensure long time
 237 preservation. The key informant of the claimed that no government initiatives has taken to ensure
 238 storage facilities in the near future. Price of product during harvesting (mean 492.50) was the second
 239 highest constraints faced by the respondents. As they has no storage facilities and in the peak season
 240 production is highest, they face excessive supply effect which reduce the price. Respondent said that
 241 sometimes they are to sale per kg tomato at taka 2-3. High interest rate (mean 483.66), lack of
 242 sufficient credit supply (mean 480.40), lack of good quality seed (mean 476.50), lack of human labour
 243 (mean 469.50) were the highest ranked problems as perceived by the respondents while dominance
 244 of intermediaries (mean 226.50), disease attacks (mean 221.50), burden of old debt (mean 191.80),
 245 natural calamity (mean 177.54) were perceived as the lowest ranked problems by the respondents.
 246 But, the key informants has said that natural calamity was one of the prominent problem as most of
 247 the crops damaged during imbalance situation of nature. The table also showed that all the problems
 248 in production of tomato respondents were significant at all levels and that they are statistically
 249 different from one another.

250 4. LIMITATION OF THE STUDY

251 The size of the sample taken may not be adequate due to resources and time constraints. It
 252 became difficult to contact farmers because of peak season of tomato transplanting. Most of the
 253 tomato producers do not keep any records of their cost and return. As a result, the accuracy and
 254 reliability of data fully depend on their memory and sincerity. Since the area coverage is limited
 255 for the research site with very small size of sample producers, the inferences drawn from the
 256 research may not be taken as generalization for other areas of the country.

257

258 5. CONCLUSION AND RECOMMENDATION

259 Now-a-days, tomato is important and leading staple and cash crop and the farmers of
 260 Bangladesh are earning higher profit from tomato production. Using of modern inputs and
 261 production technology are being very determinant and important factors for the tomato
 262 farmers. If these facilities can be made available to farmers in time, yield and production of
 263 tomato may be increased which can help the farmers to increase income and improve their
 264 well being conditions. This study found that due to lack of labour, low price during the
 265 harvest season, lack of storage facilities, availability of capital and high interest rate of credit
 266 etc, were the basic short-coming of production and hampering the increasing of tomato
 267 production in the study area. It confirms another vital reason is that available resources and
 268 appropriate technology is limited. The institutional and infrastructural support, efficient use of
 269 modern techniques and better management of land will help to increase the tomato
 270 production. It can be concluded from the results of the present study that considerable scope
 271 apparently exists in the study area to increase the productivity of tomato as well as for

increasing income, employment and nutritional status of the farmers. This study revealed that tomato growing was more profitable than other cash crops.

Several policy recommendations might be emerged from the results of this research. Regular and adequate supply of quality seed, fertilizer and insecticides should be ensured with reasonable cost. Government and associated agents should take immediate steps to set up scientific storage facilities in these areas and take stringent actions to stable price fluctuation.

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