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ADOPTION AND PROFITABILITY OF SUMMER TOMATO CULTIVATION IN JASHORE DISTRICT OF BANGLADESH

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Abstract

The study assessed the level of adoption and profitability of summer tomato varieties at farm level. Data were collected from 90 randomly selected tomato farmers of Bagherpara, Jashore Sadar and Jhikorgacha upazila of Jashore district. The results indicated that BARI Hybrid Tomato-4 was highly adopted summer tomato variety (75%) followed by BARI Hybrid Tomato-8 (16%) and ACI summer king tomato variety (9%). The adoption level of ploughing, manure and fertilizer use were low, whereas planting time and irrigation were high. Total cost of production of summer tomato was Tk 584822 per hectare whereas Tk 507355 per hectare was variable cost and fixed cost was Tk 77467 per hectare. Among the cost items mancha preparation cost was the highest (26.89 %) and 26.10 % cost was for labor. The average yield of summer tomato was 50.41 t/ha and gross return was 1542300 tk/ha. On the average, benefit cost ratio was found to be 2.64 on full cost basis and 3.04 on cash cost basis. MoP, zipsum and manure were significant effect on summer tomato cultivation. Attack by pest and disease, lack of seed at proper time, lack of agricultural credit and high cost of production were the major constraints for the adoption of summer tomato.

Keywords: Adoption, Profitability, Summer Tomato.

1. Introduction

Bangladesh is an agro-based country where agriculture is considered as backbone of her economy. About 45 percent of total labor force were engaged in agriculture (BBS, 2016). Agriculture plays a vital role through employment generation, poverty alleviation, food security, enhance standard of living by increasing income level of rural population. Many developing countries like Bangladesh benefited from the green revolution in cereal production in the past but were not able to substantially reduce poverty and malnutrition. Vegetable production can help farmers to generate income which eventually alleviate poverty.

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Among the vegetables tomato (*Solanum Lycopersicun*) is one of the most important vegetables in terms of acreage, production, yield, commercial use and consumption. It is the most consumable vegetable crop after potato and sweet potato occupying the top of the list of canned vegetable (Chowdhury, 1979). It is cultivated all over the country due to its adaptability to wide range of soil and climate (Ahmed, 1976). However, the yield of the crop is very low compared to those obtained in some advanced country (Sharfuddin and Siddique, 1985). In Bangladesh congenial atmosphere remains for tomato production during low temperature winter season that is early November is the best time for tomato planting in our country (Hossain *et al.,* 1999). It is a good source of vitamin C (31 mg per 100g), vitamin A, calcium, iron etc (Matin *et al.,* 1996). Although tomato plants can grow under a wide range of climatic conditions, they are extremely sensitive to hot and wet growing conditions, the weather which prevails in the summer to rainy season in Bangladesh. But limited efforts have been given so far to overcome the high temperature barrier preventing fruit set in summer-rainy (hot-humid) season. Its demand for both domestic and foreign markets has increased manifold due to its excellent nutritional and processing qualities (Hossain *et al.,* 1999).

Considering the growing demand and importance of tomato, Bangladesh Agricultural Research Institute (BARI) has taken initiative to develop off-season summer and rainy season tomatoes. So far BARI has developed and released 3 hybrid tomato varieties i.e. BARI Hybrid Tomato-3, BARI Hybrid Tomato-4 and BARI Hybrid Tomato-8 which can be grown during summer and rainy season under poly tunnel. The average yield of BARI Hybrid Tomato was 32.78 t/ha in the Jessore district (Karim *et al*, 2009). But very little information has been generated about the profitability and adoption of hybrid tomato cultivation technologies by the farmers in the country. Generalization from studies conducted in home and abroad (Mohiuddin *et al*., 2007; Zaman *et al*., 2006; Islam, 2005; Rahman *et al.*, 1998; Ali and Gupta, 1978; Gupta and Rao, 1978) regarding the tomato production may not be always applicable due to considerable variation in attributes of the technologies and for various others factors. Fortunately, the farmers of Bagharpara upazila under Jashore district started to adopt this technology as a pioneer farmer since 2005 (Karim *et al.,* 2009). It is recognized that in order to expand the area of this crop as well as to fit this crop in the farmers cropping system, studies are needed to ascertain its cost and return situation in relation to profitability, input use and farmer's resource use efficiency. Keeping all these factors in consideration, the present study was undertaken to provide information through fulfillment of the following objectives.

Objectives

i. To know the adoption status of summer tomato variety along with its cultivation technologies at farm level and to find out the factors affecting their adoptions.

ii. To estimate the input use pattern and profitability of summer tomato cultivation.

iii. To identify the constraints to summer tomato production at farm level.

2. Methodology

2.1 Sample size and sampling technique

The present study was conducted at three upazila namely Bagherpara, Sadar and Jhikorgacha upazila of Jashore district. The study area was purposively selected considering the higher concentration of BARI Hybrid Tomato cultivation during summer season. The study was carried out by using formal survey method. A total of 90 farmers taking 30 from each upazila was randomly selected for interview. Necessary information regarding this study was also collected on input costs, price, yields etc.

2.2 Method of data collection

Data were collected through pre-designed interview schedule during the summer season of 2014. Field investigators under the direct supervision of the researcher collected field level data using pre-tested interview schedule. The unit of data collection was a single hybrid tomato plot of each selected farmers where detailed information regarding this crop cultivation were taken and analysis was done on per hectare basis. Although some of the selected farmers continued to harvest the crop up to December but yield data and other information were taken up to last week of October considering summer period.

2.3 Analytical techniques

Both fixed cost and variable cost were taken into account in calculating cost of summer tomato cultivation. Land use cost was calculated on the basis of per year existing lease value of land. The profitability of tomato cultivation was examined on the basis of gross margin, net return and benefit cost ratio analysis. The adoption categories were developed based on the percentage of respondent farmers with respect to each technology. Adoption level was categories into three: 70-100% as high, 50-69% as medium and <50% as low level of adoption. Collected data were edited, summarized, tabulated and analyzed to fulfill the objectives of the study. Descriptive statistics using different statistical tools like averages, percentages and ratios were used in presenting the results of the study.

Cobb-Douglas production function was used to estimate the contribution of factors to a tomato. The functional form of the Cobb-Douglas production function model was given below.

$$Y = AX_1^{b1}X_2^{2}.....X_n^{bn}e^{ui}$$

The production function was converted to logarithmic form so that it could be solved by least square method i.e.

$$\text{In } Y = a + b_1 \text{In}X_1 + B_2 \text{In}X_2 ..... + b_n \text{In}X_n + U_i$$

The empirical function model is as follows:

$$\text{In } Y = a + b_1 \text{In}X_1 + b_2 \text{In}X_2 + b_3 \text{In}X_3 + b_4 \text{In}X_4 + b_5 \text{In}X_5 + b_6 \text{In}X_6 + b_7 \text{In}X_7 + b_8 \text{In}X_8 + U_i$$

Where, Y= Yield of tomato (ton/ha)

X_1 = Human labour (man-days/ha) ,

X_2 = Seed (kg/ha)

X_3 = Urea (kg/ha)

X_4 = TSP (kg/ha)

X_5 = MoP (kg/ha)

X_6 = Zipsum (kg/ha)

X_7 = Boron (kg/ha)

X_8 = Manure (kg/ha)

a = Intercept,

b_1, b_2 ... ... b_8 + Coefficients of the respective variables to be estimated,

U_i = Error term.

3. Results and Discussions

3.1 Adoption of summer tomato variety

An attempt was made to assess the level of adoption in terms of percent of farmers adopted summer tomato variety at farm level. The scientists of BARI developed some variety of tomato for summer season. But from the study it was appeared that BARI Hybrid Tomato-4 was mostly cultivated in the study area. About 75% farmer cultivates BARI Hybrid Tomato-4 (Table 1). After that BARI Hybrid Tomato-8 was 16% and ACI summer king was 9% also cultivated in the summer season.

Table 1. Percent of adoption of improved summer tomato varieties by the respondent farmers

Variety	Bagharpara	Jashore sadar	Jhikorgacha	All respondent
BARI Hybrid Tomato-4	25	24	26	75
BARI Hybrid Tomato-8	-	9	7	16
ACI Summer King	9	-	-	9

3.2 Adoption of crop management technology

The existing level of technology employed in the production of summer tomato and their adoption level were presented in Table 2. Land preparation includes ploughing, laddering and other operation needed to make the soil suitable for sowing seed. On the average, 28% of the total farmers ploughed their land 4-5 times which was recommended for tomato cultivation. The sowing time of summer tomato was started April and continue upto July. It was revealed that 78% farmers sowing at April to May which was the optimum time for summer tomato. The sowing time of summer tomato was high. All the farmers planting the seedling in line which adoption was high. Necessary inputs of a plant like manure used was high and high level of adoptions. On the other hand all fertilizer such as urea, TSP, MP, Zipsum and boron was highly used by farmer but low level of adoptions, that means farmer used these fertilizer of their recommended dose. All the farmers were used insecticide and hormone in tomato plant for getting higher yield. Again all the farmers making mancha for keeping the plant safe from rain water so that it cannot attack by disease and water stagnant.

Table 2. Percent of adoption of crop management technologies used in summer tomato cultivation

Technology	Bagharpara	Jashore sadar	Jhikorgacha	All respondent	Adoption level
1. Ploughing and laddering (No.)					
Up to 3 Nos.	60	70	40	57	
*4-5 Nos.	30	15	40	28	Low
Above 5 Nos.	10	15	20	15	
2. Seed sowing period					
*April-May	80	80	75	78	High
June-July	20	20	25	22	
3. Seed sowing method					
Broadcasting	0	0	0	0	
*Line sowing	100	100	100	100	High
4. Seed rate (gm/ha)					
*Up to 400	85	90	80	85	High

Technology	Bagharpara	Jashore sadar	Jhikorgacha	All respondent	Adoption level
Above 400	15	10	20	15	
6. Manure (kg/ha)					
*Up to 14000	76	82	85	81	High
Above 14000	24	18	15	19	
7. Urea (kg/ha)					
Below 550	90	87	95	91	
*Above 550	10	13	5	9	Low
8. TSP (kg/ha)					
*Up to 500	32	40	48	40	Low
Above 500	68	60	52	60	
9. MoP (kg/ha)					
*Up to 300	30	40	36	35	Low
Above 300	70	60	64	65	
10. Zipsum (kg/ha)`					
*Up to 70	12	15	10	12	Low
Above 70	88	85	90	88	
11. Boron (kg/ha)					
*Up to 7	42	45	43		Low
Above 7	58	55	57		
12. Pesticide					
Do not use pesticide	0	0	0	0	
*Used pesticides	100	100	100	100	High
13. Hormone					
Do not use hormone	0	0	0	0	
*Used hormone	100	100	100	100	High
*Mancha preparation	100	100	100	100	High

Note: Technology adoption was categorized by percentage of respondent farmers such as 70-100% as high; 50-69% as medium and <50% as low adoption.
* Recommended use or dose

3.3 Input use pattern

Input was the main elements for producing something. In tomato production there need different types of input for getting higher production. The human labor used for producing summer tomato was found to be 838 man-days per hectare (Table 3). Land preparation cost was 9183 Tk./ha. Seed was used 421 gm/ha for cultivating summer tomato. The total quantity of fertilizer required was

1977 kg/ha of which urea, TSP, MoP, Zipsum and Boron were 330 kg/ha, 646 kg/ha, 530 kg/ha, 454 kg/ha and 17 kg/ha respectively. These were equal to the recommended doses. Total cow dung used was 14804 kg per hectare when land was prepared. For better production farmers applied hormone and pesticide at the rate of 24742 Tk./ha and 36505 Tk./ha respectively. Its cultivation needs to prepare mancha which was most costly where bamboo, polithin, nylon rope and sutli incurred 75799 Tk./ha, 65227 Tk./ha, 5825 Tk./ha and 10421 Tk./ha respectively.

Table 3. Input use pattern for cultivating summer tomato

Items	Quantity
Human labour (man-day/ha)	813
Family	610
Hired	203
Land preparation cost (Tk./ha)	9183
Seed (gm/ha)	421
Cowdung (kg/ha)	14804
Fertilizer (kg/ha)	1977
Urea (kg/ha)	330
TSP (kg/ha)	646
MoP (kg/ha)	530
Zipsum (kg/ha)	454
Boron (kg/ha)	17
Hormone (Tk./ha)	24742
Pesticide (Tk./ha)	36505
Irrigation (Tk./ha)	8079
Bamboo (Tk./ha)	75799
Polythene (Tk./ha)	65227
Nylon rope (Tk./ha)	5825
Sutli (Tk./ha)	10421

3.4 Cost and return

For calculating the cost of cultivation of summer tomato, all variable costs like human labour, land preparation, seed, manures, fertilizers, pesticide, hormone, irrigation, mancha preparation were calculated on per hectare basis. The fixed

cost of tomato cultivation included cost of land use and interest on operating capital. The total cost included fixed cost and variable cost. Total cost of production of summer tomato was 584822 Tk./ha where as 507355 Tk./ha was variable cost and fixed cost was 77467 Tk. per hectare (Table 4). The cost of family labour, hired labour, land preparation, seed, fertilizer, manures, hormone, pesticides, irrigation and mancha were 26.10%, 8.67%, 1.57%, 1.97%, 7.17%, 2.53%, 4.23%, 6.24%, 1.38% and 26.89% respectively. Among the cost items mancha preparation was the highest (26.89 %) followed by labour cost (26.10 %).

Table 4. Cost of summer tomato cultivation in the study area

Particular	Cost (Tk./ha)	% of cost
A. Variable cost		
Family labour	152624	26.10
Hired labour	50690	8.67
Land preparation	9183	1.57
Seed	11497	1.97
Fertilizer	41959	7.17
Manures	14804	2.53
Hormone	24742	4.23
Pesticides	36505	6.24
Irrigation	8079	1.38
Mancha preperation	157272	26.89
Total variable cost	507355	86.75
B. Fixed cost		
Land use	52734	9.02
Interest on operating capital	24733	4.23
Total fixed cost	77467	13.25
C. Total cost (A+B)	584822	100.00

3.5 Profitability of hybrid tomato cultivation

Return was calculated by multiplying yield with its price. Return per hectare of tomato cultivation was shown in Table 5. The average yield of summer tomato was 50.41 t/ha. The average gross return was calculated as Tk. 1542300 per hectare. The average price of hybrid tomato upto last week of October was Tk. 30 per kilogram. The average net return was observed to be Tk. 957478. On the average, benefit cost ratio was found to be 2.64.

Table 5: Profitability of summer tomato production

Particulars	Cost and return (Tk./ha)
Total Variable cost	507355
Total cost	584822
Yield (ton/ha)	50.41
Average selling price (Tk/kg)	30.00
Gross return	1542300
Gross margin	1034945
Net margin	957478
Benefit cost ratio	2.64

3.6 Contribution of different inputs to hybrid tomato production

For producing hybrid tomato different types of variable inputs were employed. Initially 8 variables were included in the model. Estimated values of coefficients and related statistics of Cobb-Douglas production function were presented in Table 6. The coefficient of determination (R^2) tells how well the sample regression line fits the data (Gujarati, 1995). Zipsum had positive and significant at 1% level, indicated that 1% increase in the use of zipsum, keeping all other factors remaining constant would increase the yield of tomato by 0.005%. Manure use had negative but significant impact on the yield of tomato. The coefficient of determination (R^2) was 0.58, which indicates that around 58 percent of the variations in gross return were explained by the independent variables included in the model. The F-value of the equation is significant at 1% level implying that the variation in return from summer tomato production mainly depends upon the independent variables included in the model.

Table 6. Estimated coefficients and their related statistics of production function for summer tomato

Explanatory variables	Co-efficient	t-values
Intercept	2.25***	5.65
Human labor (X_1)	0.011	1.55
Seed (X_2)	0.008	0.35
Urea (X_3)	0.002	0.65
TSP (X_4)	0.001	1.45
MoP (X_5)	0.004**	2.55
Zipsum (X_6)	0.005***	4.35
Boron (X_7)	0.015	0.25
Manure (X_8)	-0.005***	-3.25
R^2	0.58	
F value	12.25***	

Note: ***, ** indicate significant at 1% and 5% level respectively

3.7 Constraints to hybrid tomato cultivation

Although hybrid tomato cultivation was opined to be a profitable crop, there were several constraints to its higher production. It was observed from Table 8 that about one half of the farmers reported high price of mancha making materials which was increased their production cost. Most of the farmers (100%) reported that they faced attack of insect and diseases in the summer tomato field which hamper their production as well as their income. Eighty percent farmers opined that timely non-availability of seed, 60% opined on non-availability of agricultural credit, and 50 % farmer opined on high price of input materials.

Table 8: Constraints to summer tomato cultivation in different study areas

Particulars	Percent of responses
1.Attack of insect and disease infestation	100
2. Non-availability of seed in time	80
3. Non-availability of agriculture credit	60
4. High price of input	50
5. High cost of production	50

4. Conclusion

The study assessed the level of adoption and profitability of summer tomato varieties at farm level. Three summer tomato varieties namely BARI Hybrid Tomato-4, BARI Hybrid Tomato-8 and ACI Summer King were found to adopt by the farmers. The levels of adoption of most crop management technologies were found to be high. The productivity of summer tomato variety was high. The gross margin, net return and BCR are high. Attack by pest and disease, lack of seed at proper time, lack of agricultural credit and high cost of production were the major constraints for the adoption of summer tomato. The farmer had no marketing problem in the study area due to high demand of tomato at this season.

5. Recommendations

The following recommendations were forward to increase adoption of summer tomato variety at farmer's level:

- BARI has developed three summer tomato varieties, but its area coverage was very limited. Research organization should take initiatives to disseminate those varieties to the farmers.
- Farmers need proper training to increase summer tomato production. DAE should take initiative to motivate the farmers to cultivate BARI developed varieties and technology through providing training.

- Related organization should ensures supply of proper amount of seed to the farmer for increase cultivation.
- Government should ensure credit facilities through institutional sources for summer tomato cultivation.

References

Ahmed, K. U. 1976. "Phul Phal O Shak Shabji (in Bangla)". 2nd Edition, Alhaj Kamaluddin Ahmed, Banglow No. 2, Farm Gate, Dhaka, Bangladesh. p.470.

Ali, S. M. and B. K. Gupta. 1978. Effect of N, P and K Fertilization on Tomato. Horticulture Abstract, **48**(12), 92.

BBS, 2016. Yearbook of Agricultural Statistics of Bangladesh. Planning Division, Ministry of Planning, Govt. of the People's Republic of Bangladesh, Dhaka.

Chowdhury, B. 1979. Vegetables. 6th Edition, The Director, National Book trust, New Delhi, India. P. 46.

Gupta, A. and G.G. Rao. 1978. Note of response of Spring Planted Tomato to Irrigation and Nitrogen. *Indian Journal Agric. Sci.* **48:** 183-184.

Gujarati, D.N. 1995. Basic Econometrics. Third Edition, New York, McGraw Hill Kogakusha Ltd.

Hossain, M.A., M.A. Goffer, J.C.S. Chowdhury, M.S. Rahman and Hossain, M.I. 1999. A study on postharvest practices and Loss of Tomato in Some selected Areas of Bangladesh. *Bangladesh J. Agril. Res.* **24**(2), 299.

Islam, M.A. 2005. Economic Analysis of Some Selected Crops Under Different Treatment in Saline Soil at Charmajid, Noakhali. Annual research Report, Agril. Economics Division, BARI, Gazipur.

Matin, M.A., A.S.M.A. Huq, M.R. Karim and E. Baksha. 1996. Farm level yield analysis of tomato cultivation in selected areas of Bangladesh: An Economic Profile. *Bangladesh J. Agril. Res.* **21**(1), 50-57.

Mohiuddin, M., M.S. Uddin, M.H. Rashid, K.M.F. Hossain and M.A. Matin. 2007. Adoption and profitability of Improved tomato variety in the Chittagong Region of *Bangladesh. Journal of Soil and Nature*, **1**(3).pp.52-58.

Karim, M.A., M.S. Rahman and M.S. Alam. 2009. Profitability of summer tomato cultivation in Jessore District of Bangladesh. J Agric Rural Dev **7**(1&2), 73-79.

Rahman, M.A., J. Haider, U.K. Shaha, A.R. Chowdhury and M.M.U. Chowdhury. 1998. Economically viable rate of fertilizer and manure for maximizing growth and yield of year round tomato. *Bangladesh J. Agril. Res.* **23**(3).

Sharfuddin, A.F.M. and M.A. Siddique. 1985. Sabji Bigyan. 1st Edition, Bangladesh Agricultural University, Mymensingh. P.4.

Zaman, M.M., A.S.M. Anawarul Huq and M.J.A. Chowdhury. 2006. Production potentiality of summer tomato in Jamalpur region. Int. J. Sustain. Crop Production, **1**(2), 12-15.