

Review

Production and Profitability Intervention of Summer Hybrid Tomato: A Farm Level Review in Bangladesh

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Abstract: Now a days, tomato production in Bangladesh is increasing. But land area for tomato cultivation is not increased. Due to the adoption of the new High Yield Variety (HIV) and hybrid tomato total production is increased. Farmers are willing to produce off-season or summer tomatoes because of their high price. Production of tomatoes is profitable by considering cost and benefit. Summer tomato and hybrid tomato cultivation both are more highly profitable than seasonal tomato production. A large part of tomato farmers is small farmers. They have a small piece of land and most of them are illiterate or have only primary education. The majority of farmers (46%) are young in age. By producing tomato farmer improve their standard of living. The benefit-cost ratio of hybrid tomato production is 4.22 and 4.16 on basis of the full cost, 5.17 and 5.01 on basis of cash cost for the small and medium farmers. Cost per kg. 10.86 tk. and 11.01 tk., return per kg. 45.84 tk. and 45.82 tk. for the small and medium farmers. The total cost of tomato production for the small, medium, and large farmers is tk. 496830, tk. 213660 and tk. 399117 respectively. Total revenue tk. 915600, tk. 393750 and tk. 735525 for small, medium, and large farmers respectively. At the time of tomato production, farmers face many problems like timely availability of fertilizer, insects, disease, the lack of proper marketing channels, etc. With the introduction of the modern variety, farmers are interested in tomato production because tomato is a short-duration and profitable vegetable.

Keywords: Benefit Cost Ratio, Yield, Production, Socio-Economic Condition

Introduction

Agriculture is regarded as the backbone of Bangladesh's economy contributing tk 3,223,938 million in 2018-19 and tk 3,476,381 million in 2019-20 to its Gross Domestic Product (GDP) (BBS, 2012). Agriculture covers 39678 thousand acres of total cultivated land area (BBS, 2012). About 47.30% of the total labor forces are engaged in agriculture directly or indirectly for their livelihoods. It includes crops, vegetables, forestry, fisheries, and livestock. Whereas for small and marginal farmers, vegetables are an important income source and also contribute to the nutrition demand of the consumer (Begum *et al.*, 2011).

Tomato (*Lycopersicon esculentum*) is an excellent source of vitamin A and C, widely and multipurpose grown vegetables. Tomato is consumed as a raw salad, cooked, or as processed food item such as ketchup, jam, jelly, sauce, pickles soup, etc. It originated in the Peruvian and Mexican regions and comes from tropical America. In the 16th century, it spread to other parts of the world. It was probably introduced by the Portuguese in the Indian subcontinent

(Das, 1992). Bangladesh like many other developing countries benefited from the green revolution in cereal production. Farmers benefited from vegetable production which helps to generate income and alleviate poverty. In terms of acreage, yield, production, consumption, and commercial use tomato is one of the most important vegetables. After potato and sweet potato tomato is the most consumable vegetable crop holding and at the top of the list of canned vegetables (Chowdhury, 1979). Since tomato plants grow under an extensive range of climatic conditions and are very sensitive to hot and wet growing conditions. But very little effort has been given so far to overcome the barrier of high temperature in the summer-rainy (hot-humid) season for preventing fruit set. Demand increased in both domestic and foreign markets because of its excellent processing qualities and nutritional value (Hossain *et al.*, 1999). Nowadays land area for tomato cultivation has been extended day by day as a result of the increasing demand for domestic consumption. Compared with other field crops tomato is known as a profitable, less risky, labor-intensive, and relatively short duration life cycles cash crop (Islam, 2005).

Tomato produces in Bangladesh mainly during the winter season. Due to consumer demand, availability of seeds, and high price, under plow farmers are bringing a large amount of land and also sowing in summer tomatoes. As a result, in Bangladesh during 2011-12 tomato was produced 255000 mt. tons and it was 190213 mt. tons in 2009-10 (BBS, 2012). Among various vegetables, tomato production in 2016 has reached 177042 thousand tons which hold about 60% of total world fresh vegetable production (Mitra and Pradhan, 2018). Mohiuddin *et al.* (2007) used Cobb-Douglas and statistical analyses to predict the adoption and profitability of improved tomato variety in the Chittagong region of Bangladesh. They found that the farmers are very conscious of improved tomato variety because of their high production which brings high price, thick skin, long durability with attractive size and color although the adopters also facing several problems like lack of quality seed, weather condition, good quality fertilizer and insecticide for tomato cultivation. The tomato farmers reported the high input price as the major concern to them. Haque *et al.* (2012) do research on Raton and BARI hybrid tomato-5 variety and studied their adoption and profitability in different districts of Bangladesh. The comparative results show these varieties were more profitable than potato, lentil, and mustard. They also investigate how the non-availability of quality seed, technical information, storage services, diseases and insect infestation affects the cultivation. The financial profitability of some BARI authorized crops was investigated by Shiblee *et al.* (2012). They found tomato production highly profitable with above 2 returns over investment. Khatun *et al.* (2012) studied the problems associated with tomato production especially the post-harvest loss in Bangladesh. She found that lack of storage and marketing facilities, farmers of the study area unwillingly sell their produce at low prices.

During the last 10 years due to high-yielding varieties adoption, use of pesticides, training, and extension facilities tomato production has experienced tremendous growth. Despite a winter vegetable, two new varieties of tomato have been introduced by Bangladesh Agricultural Research Institute (BARI), which are grown in the summer season, namely bari hybrid tomato-3 and 4. The average yield is 32.78 tons per hectare of this hybrid summer tomato (Karim *et al.*, 2009). The gross production cost of tomato per hectare was tk. 118000 and gross returns were Tk. 217020 (Aker *et al.*, 2011). Total production of tomatoes was 413610 MT. and an area of 75602 acres in 2014-2015. In the year 2015-2016 total production was 368121 MT and an area of 67535 acres. In the year 2016-2017 total production was 388725 MT and an area of 68366 acres (BBS, 2018).

The previous year's research was done based on the profitability of different varieties of tomato production and also focused on the Major issues of tomato production. But this study emphasizes not only the profitability but also tries to build up a relationship between sociodemographic

characteristics and problem identification. The results of the review will be helpful to the policymaker to formulate future policies considering farmers' production problems and the researcher for further study about the hybrid tomato.

Methodology

Being an exclusive review paper no exact methods of studies are involved in preparation. Therefore, all of the information has been collected from secondary sources. Available documents are gathered from different related research publications, articles, relevant books, reports of different authors and annual reports, etc. Recent information has been collected from different websites through internet browsing. After collecting all necessary information was compiled and arranged chronologically for clarification and better understanding. Studies on different categories of farmers producing tomatoes of different varieties are summarized here for understanding their nature, and social demographics influencing their production and income. Return over investment for tomato production was also analyzed keeping in mind both the summer and hybrid nature of tomatoes. Per unit Tomato production over the last 10 years of different studies was categorized by focusing on different areas of Bangladesh. Problems faced by farmers during cultivation are also identified. Keeping in mind all these sources, the whole study is constructed based on socio-economic characteristics, profitability, and problem identification of different categories of tomato farmers. Although Tomato is a demandable weather-sensitive winter vegetable, it has a year-round demand and especially in summer for its high market price. So, the concept of Hybrid variety in the study bears the extra potential for production growth which gives remarkable directions to the farmers to do a better job.

Results and Discussion

Productions of the farmers are greatly influenced by socio-economic characteristics and background. Farmer characteristics are necessary to know the objective of this paper. Farmer's Socioeconomic characteristics included their age, educational status, family size, and farm size of the respondent. Table 1 shows that tomato farmer age ranged from 20 to above 50 years, the mean of their age is 39.32 years, and the standard deviation is 11.511. Farmers were classified into three categories according to their age. The majority (46%) of the farmers are young. In this table maximum farmers (31%) have primary education while illiterate (27%) and higher secondary (22%). Farmers having secondary education is (20%). On basis of education, tomato farmers were classified under 4 categories. Where the mean is 1.46 and the standard deviation is 1.267. The farmer who has primary education pursued tomato cultivation. Tomato farmer's family size ranged from (family member) 1 to above 7. The average person per family is 5.62 and the standard deviation is 2.196. On basis of family size, tomato farmers

were classified under three categories. Farmer with medium family sizes is the interested group in tomato cultivation. Narrates that tomato farmers were classified into three categories on basis of their farm size. Small farm (83%) which is the maximum. Farmer with the small size of the farm is more interested in tomato cultivation. Mean 1.23 acres and the standard deviation 0.5478.

The Table 2 is Based on different change items. It also shows an income maximum of 7% excellent change found in hybrid tomato grower. Excellent change happened at 3 to 7%, moderate change from 9 to 24% while average change 21 to 52% and no change 19 to 70%. From this table, it is easily understood that the socio-economic condition of the tomato farmers improved with the cultivation of BARI hybrid tomato-3 and 4.

Profitability of Tomato Production

Tomato profitability is calculated on basis of Net profit, net return, Total cost (Variable cost and fixed cost), and benefit-cost ratio.

In Table 3 Tomato cultivation costs per acre of the large, medium, and small farmers are shown. Total cost is equal to the sum of total variable cost and total fixed cost. In small farmers, the total cost is highest (tk. 496830) and lowest in medium farmers (tk. 213660). Among all the farmers the highest production cost is carried out by the smallholder farmers as the production area is small and the farmer has to spend on all input requires for this small area.

The profitability of tomato farmers is shown in Table 4. For a small farmer, productivity is highest (1308 mounds) and lowest (562.5 mounds) in medium farmers. Highest profitability for a small farmer (tk. 418769) and the lowest for a medium farmer (tk. 180090). Small farmer uses more land therefore output is also more. As the tomato

production is done in Bangladesh still now in a primitive way the medium and large farmers lose production than small farmers and also in the small farm holding farmer can take great care of the farm products which is not sometimes possible for a large area. That's the region small farmers still sustained profit by cultivating local variety.

In Table 5 and 6, total production cost was calculated for seed, manure, fertilizer, human labor, hormone, pesticide, irrigation, etc. The total variable cost per hectare of hybrid tomato production was tk. 358577. If only cash cost basis tk. 295182 per hectare that is 82% of the total cost. Considering various costs tunnel cost is a maximum of about 42% of the total cost. Human labor cost (family and hired labor) is the second-highest (20.57%). Manure cost is high for small farmers compared to medium farmers. Irrigation water and fertilizer uses are more in medium farmers than in small farmers. In the case of the hybrid variety, the highest cost bearer is the medium farmer and the lowest cost bearer is the small farmer. As some new production techniques are introduced here the farm area and cost increase simultaneously.

Income from hybrid tomato cultivation is explained in Fig. 1. Return calculated by multiplying yield and its price. The average yield was found more in medium farmers. Average gross return 1502664 tk. per hectare. The average price is 45.83 tk. per kilogram. The average return was observed to be 11, 44,387 tk. on a full cost basis and 12, 07,481 tk. on the cash cost basis of return over variable cost. The benefit-cost ratio is 5.09 on a cash cost basis more than the full cost basis of 4.19.

In Fig. 1, we show, that the return from tomatoes is high compared with the cost of production. In the case of a small farmer, the cost is low but the return is high compared with the medium farmer.

Table 1: Tomato farmer distribution

| Categories | Farmers | Mean | SD |
|------------------------|---------|-------|---------|
| Age | % | | |
| Young (20-35 years) | 46 | | |
| Middle (35-50 years) | 37 | 39.32 | 11.5110 |
| Old (Above 50 years) | 17 | | |
| Total | 100 | | |
| Education | % | | |
| Illiterate | 27 | | |
| Primary | 31 | | |
| Secondary | 20 | 1.46 | 1.2670 |
| Higher secondary | 22 | | |
| Total | 100 | | |
| Family size | | | |
| Small (1-4) | 31 | | |
| Medium (5-6) | 41 | 5.62 | 2.1960 |
| Large (above 7) | 28 | | |
| Total | 100 | | |
| Farm size | | | |
| Small (0.01-0.33 acre) | 83 | | |
| Medium (0.34-1.0 acre) | 11 | 1.23 | 0.5478 |
| Large (above 7 acre) | 6 | | |
| Total | 100 | | |

Source: Parvin (2017)

Table 2: Socio economic changes of tomato farmers

| Items | Nature of changes (%) | | | | Total |
|--|-----------------------|----------|---------|----|-------|
| | Excellent | Moderate | Average | No | |
| Food and nutrition | 5 | 19 | 40 | 36 | 100 |
| Housing condition | - | 9 | 21 | 70 | 100 |
| Using sanitary latrine | - | 11 | 31 | 58 | 100 |
| Clothing | 5 | 15 | 38 | 43 | 100 |
| Household furniture | - | 12 | 23 | 65 | 100 |
| Knowledge about summer tomato production | 3 | 21 | 52 | 24 | 100 |
| Income | 7 | 24 | 50 | 19 | 100 |

Source: Karim *et al.* (2009)

Table 3: Tomato cultivation cost per acre

| Cost head | Small | Medium | Large | Total |
|---------------------------------------|--------|--------|--------|---------|
| Land preparation | 41298 | 17760 | 33176 | 92234 |
| Seed cost | 23614 | 10155 | 18970 | 52739 |
| Cow dung cost | 6557 | 2820 | 5268 | 14645 |
| Fertilizer (Urea/TSP/MP/Gypsum/Borax) | 66882 | 28763 | 53728 | 149373 |
| Labor cost | 118016 | 50753 | 94806 | 263575 |
| Insecticides/Pesticides | 20719 | 8910 | 16644 | 46273 |
| Irrigation | 10464 | 4500 | 8406 | 23370 |
| Total variable cost | 287550 | 123660 | 230997 | 642207 |
| Land value | 209280 | 90000 | 168120 | 467400 |
| Total fixed cost | 209280 | 90000 | 168120 | 467400 |
| Total cost = (Variable + Fixed) cost | 496830 | 213660 | 399117 | 1109607 |

*The above table in Units BDT Taka (Bangladesh currency 1USD = 80.40 BDT) Source: Parvin (2017)

Table 4: Benefit cost ratio and profitability of tomato cultivation per acre

| Item | Small farmer | Medium farmer | Large farmer | Total |
|-----------------------|--------------|---------------|--------------|------------|
| Total land use (acre) | 17.44 | 7.50 | 14.01 | 38.95 |
| Tomato output (mound) | 1308.00 | 562.50 | 1050.75 | 2921.25 |
| Tomato TK per 40 kg | 700.00 | 700.00 | 700.00 | 2100.00 |
| Total revenue | 915600.00 | 393750.00 | 735525.00 | 2044875.00 |
| Total cost | 496830.00 | 213660.00 | 399117.00 | 1109607.00 |
| Net profit | 418769.00 | 180090.00 | 336408.00 | 935267.00 |
| Benefit Cost Ratio | 1.84 | 1.84 | 1.84 | 1.84 |

*In this above table (1 mound = 40 kg) Source: Parvin (2017)

Table 5: Hybrid tomato cultivation cost

| Cost items (Tk/ha) | Small | Medium | All | Percentage |
|-----------------------|--------|--------|--------|------------|
| Family labor | 64641 | 62149 | 63395 | 17.68 |
| Hired labor | 8461 | 12290 | 10375 | 2.89 |
| Total | 73101 | 74439 | 73770 | 20.57 |
| Land preparation cost | 6526 | 6662 | 6594 | 1.84 |
| Seed cost | 8188 | 8114 | 8151 | 2.27 |
| Fertilizer | 26795 | 28175 | 27485 | 7.66 |
| Manure | 4362 | 2361 | 3362 | 0.94 |
| Tunnel cost | 146380 | 155941 | 151160 | 42.16 |
| Irrigation cost | 6476 | 6827 | 6652 | 1.86 |
| Hormone | 35504 | 36037 | 35771 | 9.98 |
| Insecticide cost | 45003 | 46263 | 45633 | 12.73 |
| Total variable cost: | | | | |
| Full cost basis | 352335 | 364820 | 358577 | 100.00 |
| Cash cost basis | 287694 | 302671 | 295182 | |

Source: Karim *et al.* (2009)

The above figure points out the possibility of high profit from the production of hybrid tomatoes. Small farm size consumes highest profit compare to the lowest cost of production, which indicates per unit productivity of tomato for smallholder is highest.

Table 7 shows that the total cost of tomato production in one hectare of land is 297936 tk. Cost is more in polyethylene which is 46% of the total cost. Human labor cost (43350 tk) is 15% of the total cost. The total yield is 28240 kg per hectare and the gross return is 988400 tk. The net return of the farmer is 690464 tk. The Benefit-Cost Ratio (BCR) of producing summer tomatoes is 3.32.

In the following Fig. 2 cost of polyethylene 46% which is the maximum. Human labor is 15% and bamboo 10% of the total variable cost. Seed cost is negligible compared with all other variable costs.

The cost of summer tomato is in listed in Table 8. The total cost included variable costs and fixed costs. Total production cost 584822 tk./ha. Total variable cost 507355 tk./ha and total fixed cost 77467 tk. /ha. Among all costs, the highest is 26.89% for maccha preparation. Family labor is 26.1% which is the second-highest cost. Land preparation, seed, and irrigation cost are 1.57, 1.97, and 1.38%. Among all costs, irrigation cost is the lowest.

Table 9 shows the comparison between cost and return of summer tomato. The average yield is 50.41 tons/ha. Average gross return tk.1542300 per hectare. The benefit-cost ratio is calculated, by total revenue divided by total cost. Benefit cot ratio of 2.64 that's means summer tomato production is profitable.

Table no 10 exposes the yield and return of tomato production in a specific district of Bangladesh. The variable cost of the farm is directly related to the income of the farm. Variable cost varies with farm size. Per acre gross return for small, medium, and large farmers were tk. 104180, tk. 95000, and tk. 82600, for small, medium, and large farmers, respectively. The Gross return (tk. 104180) for the small farmer is higher than a large and medium farmer. Per acre net return Tk.

46978, tk. 45356 and Tk. 35354 for small, medium, and large farmers, respectively. The Benefit-Cost Ratio (BCR) per acre for small farmers is 1.82, for medium farmers 1.91, and for large farmers, 1.74. Net return is higher for small farmers than for large and medium farmers. So, tomato production is profitable for small farmers compared to large and medium farmers.

Table 11 and Fig. 3 combinedly is constructed to show the division-wise tomato production and area. In the year 2014-15 highest production in the Rajshahi division and lowest production in the Mymensing division. In the year 2015-16 highest production in the Rajshahi division and the lowest in the Barishal division. In the year 2016-17 highest production was in the Rajshahi division and the lowest in the Barishal division. It is crystal clear that the Geographically production of tomatoes in Rajshahi is highest among all the divisions in Bangladesh as weather control is one of the main factors for producing tomatoes.

Production of tomatoes is increased over the year in the area. The total area of tomato cultivation decreased in the year 2015-16 and increased in the year 2016-17. The total area of tomato cultivation is more in the year 2014-15 than in other years.

Problems Faced by the Farmer

Though hybrid tomato cultivation was founded as a profitable crop there were various constraints faced by the farmer. By question asked for tomato farmers problems were identified, edited, and summarized. Table no 12 summarized the problems identified by the hybrid tomato farmers. A maximum of 48% of farmer faced tunnel materials was high in price. Attack of insect and diseases faced by 40% of the farmer. 40% of farmers reported that the timely non-availability of hormones affects tomato production. 36% of tomato farmers faced the problem of the timely non-availability of seed.

Table 6: Return from hybrid tomato cultivation

| Particulars | Small | Medium | All |
|---------------------------|------------|------------|------------|
| Yield (t/ha) | 32.45 | 33.12 | 32.78 |
| Gross return | 1487645.00 | 1517682.00 | 1502664.00 |
| Total variable cost | | | |
| Full cost basis | 352335.00 | 364820.00 | 358577.00 |
| Cash cost basis | 287694.00 | 302671.00 | 295182.00 |
| Return over variable cost | | | |
| Full cost basis | 1135311.00 | 1152862.00 | 1144087.00 |
| Cash cost basis | 1199951.00 | 1215011.00 | 1207481.00 |
| Benefit-cost ratio | | | |
| Full cost basis | 4.22 | 4.16 | 4.19 |
| Cash cost basis | 5.17 | 5.01 | 5.09 |
| Cost per kilogram | 10.86 | 11.01 | 10.94 |
| Return per kilogram | 45.84 | 45.82 | 45.83 |

Source: Karim *et al.* (2009)

Table 7: Per hectare production cost and return of summer tomato

| Particulars | Unit | Quantity | Value (BDT) |
|-------------------------------|------|----------|-------------|
| Human labour | Days | 578 | 43350.00 |
| Power tiller | BDT | 2435 | 2435.00 |
| Seed | gm | 200 | 600.00 |
| Bamboo (<i>Talla bash</i>) | No. | 649 | 9740.00 |
| Bamboo (<i>Barbasha</i>) | No. | 974 | 29221.00 |
| Polyethylene | yard | 3571 | 135698.00 |
| Nylon (Rope) | Kg | 203 | 20300.00 |
| <i>Sutlee</i> | Kg | 284 | 8520.00 |
| Cowdung | Kg | 10000 | 10000.00 |
| Urea | Kg | 306 | 1836.00 |
| TSP | Kg | 170 | 2550.00 |
| MP | Kg | 170 | 2380.00 |
| Insecticide | BDT | 20292 | 20292.00 |
| Int on operating capital | BDT | 5978 | 5978.00 |
| Total Variable Cost (TVC) | BDT | | 292936.00 |
| Rental value of land | BDT | | 5000.00 |
| Total Cost (TC) | BDT | | 297936.00 |
| Total production/Gross Return | Kg | 28240 | 988400.00 |
| Gross margin | BDT | | 695464.00 |
| Net Return | BDT | | 690464.00 |
| BCR | | | 3.32 |

Source: Zaman *et al.* (2006)

Table 8: Cost of summer tomato cultivation

| Particular | Cost (Tk./ha) | % of cost |
|-------------------------------|---------------|---------------|
| A. Variable cost | | |
| Family labor | 15262 | 26.10 |
| Hired labor | 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 preparation | 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 |

Source: Hajong *et al.* (2018)

Table 9: Cost and return of summer tomato production

| Particulars | Cost and return (Tk./ha) |
|-------------------------------|--------------------------|
| Total variable cost | 507355.00 |
| Total cost | 584822.00 |
| Yield (ton/ha) | 50.41 |
| Average selling price (Tk/kg) | 30.00 |
| Gross return | 1542300.00 |
| Gross margin | 1034945.00 |
| Net margin | 957478.00 |
| Benefit-cost ratio | 2.64 |

Source: Hajong *et al.* (2018)

Table 10: Yield and return of tomato production in Rajshahi district

| Items | Small farmers | Medium farmers | Large farmers | All farmers |
|-------------------------------|---------------|----------------|---------------|-------------|
| Green tomato/acre (kg) | 4855.00 | 4378.00 | 3892.00 | 4375.00 |
| Ripe tomato/acre (kg) | 354.00 | 372.00 | 238.00 | 321.00 |
| Gross return/acre (Tk) | 104180.00 | 95000.00 | 82600.00 | 93920.00 |
| Total variable cost acre/(TK) | 53019.00 | 45538.00 | 43153.00 | 46482.00 |
| Total cost/acre (Tk) | 57202.00 | 49644.00 | 47246.00 | 50609.00 |
| Gross margin/acre (Tk) | 51161.00 | 49462.00 | 39447.00 | 47438.00 |
| Net return/acre (Tk) | 46978.00 | 45356.00 | 35354.00 | 43311.00 |
| Benefit cost ratio | 1.82 | 1.91 | 1.74 | 1.85 |

Source: Samshunnahar *et al.* (2016)

Table 11: Area and production of tomatoes from year 2014-15 to 2016-17

| Division | 2014-15 | | 2015-16 | | 2016-17 | |
|------------|-------------|-----------------|-------------|-----------------|-------------|-----------------|
| | Area (acre) | Production (MT) | Area (acre) | Production (MT) | Area (acre) | Production (MT) |
| Barishal | 2390 | 6951 | 2547 | 6920 | 2839 | 7687 |
| Chittagong | 16277 | 64937 | 16459 | 65109 | 15189 | 60974 |
| Dhaka | 14457 | 75553 | 14712 | 78884 | 10592 | 55921 |
| Khulna | 7228 | 29439 | 7156 | 30296 | 7439 | 31766 |
| Rajshahi | 23332 | 148656 | 13265 | 85376 | 13595 | 87928 |
| Rangpur | 7959 | 67258 | 8964 | 77932 | 9234 | 80885 |
| Sylhet | 3959 | 20816 | 4432 | 23604 | 5060 | 28826 |
| Mymensing | 3913 | 2324 | 4352 | 27496 | 4418 | 34738 |
| Bangladesh | 75602 | 413610 | 67535 | 368121 | 68366 | 388725 |

Source: BBS (2018)

Table 12: Problems faced by a farmer in hybrid tomato cultivation

| Item | Percent of response | | |
|------------------------------------|---------------------|--------|-----------|
| | Small | Medium | All farms |
| Timely non-availability of seed | 38 | 31 | 36 |
| Attack of insect and diseases | 41 | 38 | 40 |
| The high price of fertilizer | 10 | 8 | 10 |
| The high price of insecticide | 17 | 15 | 17 |
| Timely non-availability of hormone | 41 | 38 | 40 |
| The high price of tunnel materials | 48 | 46 | 48 |

Source: Karim *et al.* (2009)



Fig. 1: Cost and return per kilogram Source: Karim *et al.* (2009)

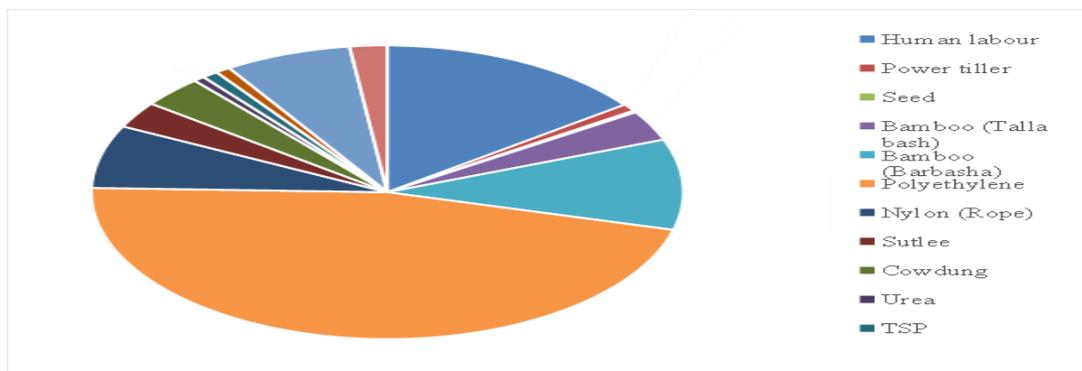


Fig. 2: Percentage of total variable cost Source: Zaman *et al.* (2006)

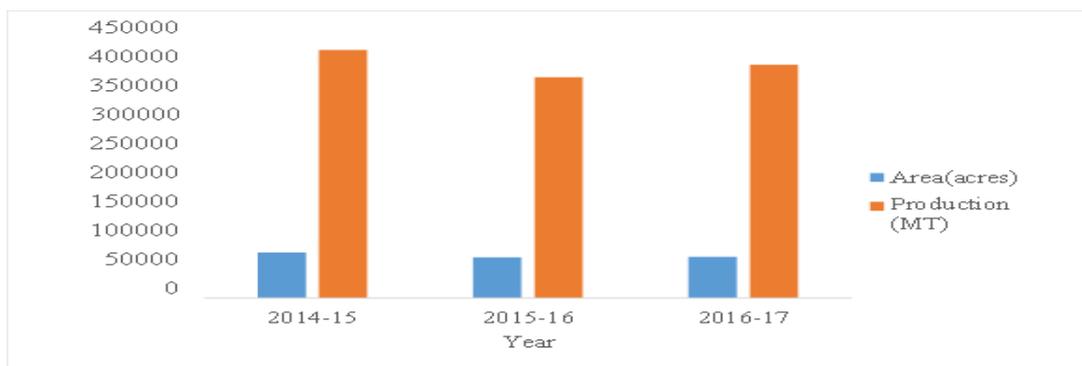


Fig. 3: Tomato production and area over the year in Bangladesh Source: BBS (2018)

Conclusion

By summarizing this review paper, we can say that in the last 10 years the production of tomatoes is in an increasing trend. Cultivable land remains the same but the total production of tomatoes is increased. The introduction of hybrid tomatoes increases the productivity of tomatoes more than the old or traditional variety. Off-season tomato like summer tomato which is profitable because the price is high compared with seasonal tomato. Most of the tomato farmers are small farmers. Some are medium farmers but large farmers are limited. The small farmer has a small piece of land and their total production is low. Off-season tomato is highly profitable. Farmer gets more price compared to their production cost. By cultivating modern variety and off-season tomatoes farmers able to make their livelihood. Comparing benefit-cost tomatoes is profitable for the farmer to cultivate. A benefit-Cost Ratio of more than 1 means that tomato production is profitable. The benefit-cost ratio of hybrid tomatoes is higher than summer and traditional varieties. There are also some drawbacks to tomato cultivation in Bangladesh. As most the tomato farmers are small farmers with the small size of land. Small farmers faced many problems with cultivated

tomatoes. Low price in the harvest season, lack of developed marketing channel, lack of good quality seed. In the agriculture sector labor crisis is a significant problem in recent years. Adequate labor is not available at the time of growing and harvesting. By considering all these situations, overall tomato production increases over the year. Farmers are willing to produce tomatoes because of their profitability. From the farmer's socio-economic background analyses the maximum number of tomato farmers 46% are young in age. Farmers who cultivate tomatoes most of them are illiterate (27%) and have primary education (31%). According to the size of the family, the maxima are medium (41%) and small farmer (31%). The basis on farm size maximum farmer (83%) is a small farmer. The total cost of tomato production for the small, medium, and the large farmer is tk. 496830, tk. 213660 and tk. 399117 respectively. Total revenue tk. 915600, tk. 393750 and tk. 735525 for the small, medium, and large farmers. The benefit-cost ratio of hybrid tomato production is 4.22 and 4.16 on basis of the full cost, 5.17 and 5.01 on basis of cash cost for the small and medium farmers. Cost per kg. 10.86 tk. and 11.01 tk., return per kg. 45.84 tk. and 45.82 tk. for the small and medium farmers. For summer tomato, total cost tk. 297936 and total production tk. 988400 per acre. The benefit-cost ratio

is 3.32. BCR is higher in summer hybrid tomatoes than in other varieties of summer tomatoes. Since most of the farmers are small farmers, illiterate and only primary educated they lack knowledge about modern variety, lack information about the new technology of cultivation, and also have lacking knowledge in proper marketing channels which maximum time drive them sale their product at a non-profit price. These limitations of farmers should be identified carefully to be solved through diversified future research.

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Author's Contributions

Shubhankar Das: Drafted the article or revised it critically for important intellectual content.

Mashrat Jahan: Conception and design of the article.

Ethics

This article contains secondary information and all the sources were acknowledged and well cited in the reference section.

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