ISSN 0258-7122 (Print), 2408-8293 (Online)
Bangladesh J. Agril. Res. 49(1): 11-27, March 2024

VALUE CHAIN ANALYSIS OF BARI SUMMER TOMATO IN THE SOUTH-WEST REGION OF BANGLADESH

M. R. HASAN[1], MONIRUZZAMAN[2], M. KHATUN[3]
F. RAHMAN[4] AND M. A. RASHID[5]

Abstract

Summer tomato, a high-value crop with significant market demand faces challenges such as disease susceptibility, inadequate seed, poor market management, and increased product losses. A study was conducted from July to December 2023 in the areas of Jashore, Khulna, and Satkhira to assess the value chain of BARI Summer tomato production and marketing, evaluate value addition at different stages, examine profitability, and assess marketing efficiency. A total of 180 producers and 45 market actors taking 60 producers and 15 actors from each district of Jashore, Satkhira and Khulna was randomly selected following a purposive and multistage random sampling approach by using primary data. Relevant secondary data were also collected from government publications, annual reports, seminar papers, journals, books and websites. The study analyzed it as profitable with a BCR of 2.89 and yields of 35.85 t/ha and Tk. 44.90/kg. Major actors included input suppliers, producers, traders, processors, and consumers. Also identified seven marketing channels, with Channel IV having the highest gross marketing margin at 28.00, and Channel III having the lowest at 18.20. Channel II had the highest net marketing margin at Tk. 10.75/kg, followed by Channel IV and Channel VI. Channel III had the highest marketing efficiency at 2.58, followed by Channel VII, Channel I, and Channel V. Channel VII offered the highest price for tomato producers at Tk. 50.25/kg, enhancing summer tomato production and improving the value chain. Factors such as insect infestation, limited seed supply, high raw material costs, lack of minimum price fixing, intermediaries, capital shortages, standardization, and illegal revenue collection major hindered summer tomato production and marketing.

Keywords: BARI summer tomato, BCR, marketing channel, marketing margin, value chain map, value addition, marketing efficiency.

Introduction

Bangladesh is one of the world's most populated countries with a population of 173.95 million (WPP, 2024). A total of 40% of the labour force depends directly or indirectly on agriculture for their livelihoods (Sen, 2024). Crops, vegetables, forestry, fisheries, and livestock are all included in it while vegetables are a significant source of income for small and marginal farmers. Vegetables also help consumers fulfill their nutritional requirements (Begum *et al*., 2011). According to the FAO of the United Nations, Bangladesh is now 3rd in the world vegetables

[1&4]Scientific Officer, Agricultural Economics Division, Bangladesh Agricultural Research Institute (BARI), Gazipur, [2&3]Senior Scientific Officer, Agricultural Economics Division, BARI, Gazipur, [5]Chief Scientific Officer, Agricultural Economics Division, BARI, Gazipur, Bangladesh.

production (Islam, 2021 and Maruf *et al*., 2021). Tomato is one of the most important vegetables in Bangladesh, the third largest tomato-producing country in South Asia (Sarma and Ali, 2019).

Tomato (*Solanum lycopersicum* L.) belongs to the Solanaceae family and is one of the most popular and nutritious vegetable crops cultivated worldwide including Bangladesh. Tomato and tomato-based foods provide a wide variety of nutrients and many health-related benefits to the body (Arab and Steck, 2000). Tomato contains a higher amount of lycopene, a type of carotenoid with antioxidant properties which is beneficial in reducing the incidence of some chronic diseases (Basu and Imrahn, 2007) like cancer and many other cardiovascular disorders (Freeman and Reimers, 2011). Tomato production has increased tremendously growth in last ten years due to adoption of high-yielding varieties, timely used of pesticides, training, and extension facilities (Mitra and Yunus, 2018). Despite it being a winter vegetable, Bangladesh Agricultural Research Institute (BARI) has released three new popular hybrid summer tomato varieties, namely BARI Hybrid Tomato-4, -8 and -11, which have yield potentiality of 40, 35-40, and 48-50 t/ha, respectively (Azad *et al*., 2020). The hybrid summer tomato (var. BARI Hybrid Tomato-3, -4, and -8) has an average production of 50.41 tons per hectare (Hajong *et al.*, 2018). The benefit-cost ratio of hybrid tomato production for small and medium farmers were 4.22 and 4.16 on the basis of full cost, 5.17 and 5.01 on the basis of cash cost, respectively (Das and Jahan, 2022).

Total production of tomato was 469204.49 MT over an area of 31151.07 ha in 2022-2023 (Anon., 2024). Now-a-days land area for tomato cultivation has been extended day by day due to 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 cash crop with a growing season of 90-120 days (Das and Jahan, 2022 and Azad *et al*., 2020). Tomato was selected for the value chain analysis because it is a significant high-value crop in Bangladesh. It has significant post-harvest losses (Khatun and Rahman, 2020) in addition to (i) strong market demand, (ii) excellent production potential and (iii) including a huge number of small and underprivileged farmers (Sarma and Ali, 2019). Limitations encompass unfavorable local and export markets, varietal susceptibility to diseases, inadequate seed, insufficient services, inadequate technological expertise, poor market management, and value decrease via increased product losses at each stage in the tomato value chain (Sarma and Ali, 2019).

Tomato value chains are creating shared value to enhance marketing success. This study provided valuable information on the tomato value chain that would help the appropriate organizations decide when and how to intervene in the process of developing the tomato value chain and creating suitable strategies and policies. The outcomes of this study would be helpful to governmental and non-governmental organizations that are implementing programs aimed at developing the value chain subsector. The main focus of the research was to conduct a value

chain analysis of tomato in the south-west region, to supply useful information to support the growth of the tomato sector's share. The specific objectives of the study were as follows:

i. To draw a value chain map of BARI summer tomato production and marketing;

ii. To assess value addition at various stages of the summer tomato marketing channels;

iii. To examine the marketing efficiency of different marketing channels; and

iv. To identify constraints faced by the producers and market actors.

Materials and Methods

Study area selection

The study was conducted at summer tomato growing areas in Jashore, Khulna, and Satkhira in the south-west region of Bangladesh from July to December, 2023 and data were purposively selected

for the collection of primary level data for this study. Again, three major markets were selected from the aforesaid districts for the collection of primary-level marketing data. The studied markets were Basundia in Jashore Sadar, Sunadanga at Koyra Upazila in Khulna, and Sultanpur Boro Bazar in Satkhira Sadar.

Selection of sample and sampling technique

Both primary and secondary data were used in this study. Primary data were collected from tomato producers and tomato traders at different levels. A total of 180 producers and 45 market actors taking 60 producers and 15 actors from each selected district were randomly selected for the collection of primary data. Again, relevant secondary data were collected from government publications, annual reports, seminar papers, journals, books, and websites.

Data analysis

Survey data were coded where relevant, loaded into a database system through Microsoft Excel and were analyzed using STATA-15. Descriptive statistics were used to define the variables and broad marketing costs were calculated by following approach defined by Dawe (2008).

For the calculation of total production cost, both variable and fixed costs were taken into consideration. Variable costs included the costs for seed, human labour, land preparation, fertilizers, manure, irrigation, pesticides, canopies preparations, interest on operating capital and depreciation. The fixed costs included mainly land use cost, family labour. The following equation was used to calculate the net return of summer tomato producer in the study areas.

Net return of the producer (Eq. 1) (Sharma *et al*., 2023).

$$\Pi = P_F . Q_F - (TVC + TFC) \text{ ---------- } (1)$$

Where Π = Net return of producer (Tk./ha); P_F = Price of tomato (Tk./kg); Q_F = Quantity of tomato (t/ha); TVC = Total variable cost of tomato cultivation; TFC = Total fixed cost of tomato cultivation.

Gross return was calculated by multiplying the total volume of output by per-unit price of the commodity at the time of harvest. The following equation was used to estimate gross return (GR) (Eq. 2) (Shahriar, 2024).

$$GR = \Sigma Pb . Qb \text{ ---------- } (2)$$

Where Pb = Price of tomato (Tk./ha); Qb = Quantity of tomato (t/ha)

The following equation was used to assess the gross margin (Eq. 3) (Biswas *et al*., 2022).

$$GM = TR - VC \text{ ---------- } (3)$$

Where GM = Gross margin; TR = Total return; VC = Variable cost

Undiscounted BCR was estimated by following formula (Eq. 4) (Shahriar, 2024).

$$\text{Benefit cost ratio (BCR)} = \frac{GR}{TC} \text{ ---------- } (4)$$

Where GR = Gross return; TC = Total cost of production.

Depreciation cost: Around 40% of the materials used for canopies preparation (such as transparent polythene, pieces of bamboos like ‘makhal’and ‘barak’, bow, clamp, pope, jute twine, etc) in the first year for summer tomato cultivation can be reused in e next year. Therefore, 40% value was considered as depreciation in the present study.

Interest on operating capital was calculated according to Sharma *et al*. (2023).

Interest on operating capital (IOC) = {Operating capital × Interest rate (I) × Time required (t)} /2

Where I = interest rate (%) and t = length of tomato crop period in years

Note: Variable cost of production was considered as operating capital.

Value chain analysis

Analysis of the value chain included identifying all the functions performed in a specific commodity sector, organizing them into the sequence, and analyzing each function about both the preceding steps and subsequent ones (Rayhan *et al*., 2021; Sarma and Ali, 2019; McCormick and Schmitz, 2005). The total marketing cost incurred by the farmers and market actors in a channel was estimated by Eq. 5 (Lamba *et al*., 2023).

$$C = C_f + Cm_1 + Cm_2 + Cm_3 + \dots\dots + C_{mi} \quad \text{--------------------- (5)}$$

Where C = Total cost of tomato marketing in a channel; C_f = Cost paid by the producer when the commodity moves; C_{mi} = Cost incurred by the i^{th} intermediary in the process of buying and selling of tomato in a channel, (i = 1, 2, 3, … ... n).

The gross marketing margin and net marketing margin of different value chain actors were estimated by Eq. 6 &7 (Acharya and Agarwal, 2004).

$$GMM = \text{Sales price} - \text{Purchase price} \quad \dots\dots\dots \text{(6)}$$

$$NMM = GMM - MC \quad \dots\dots\dots \text{(7)}$$

Where GMM = Gross marketing margin (Tk./kg); NMM = Net marketing margin; MC = Marketing cost (Tk./kg)

$$\text{Value Addition (\%)} = \frac{\text{Sales price} - \text{Purchase price}}{\text{Purchase price}} \times 100$$

Acharya's method of marketing efficiency is an optimum measure of marketing efficiency, especially for judging the efficiency of alternate marketing channels. Marketing efficiency was estimated by applying Acharya's index, which is defined by the following Eq. 8 (Acharya, 2004; Lamba *et al*., 2023).

$$ME = \frac{FP}{MC + MM} \quad \text{--- (8)}$$

Where ME = Marketing efficiency; FP = Net price received by producers (purchase price); MC = Marketing cost; MM = Total marketing margin of intermediaries. A higher value of ME denotes a higher level of efficiency and vice versa.

Results and Discussion

Cost and return

Costs act as a major consideration in the producers' decision-making process. Production costs include both variable costs and fixed costs. In Jashore district, the total production cost of summer tomato was Tk. 654328/ha, for which the total variable cost (TVC) was Tk. 479923/ha, and the total fixed cost (TFC) was Tk. 174425/ha. (Table 1). Based on total cost of production, among variable costs canopies preparation cost accounted for the largest share (26.79%) followed by depreciation cost (10.71%), hired labour (9.96%) and hormone & pesticides (9.55%) and irrigation cost accounted for the lowest share (1.34%) and, for fixed cost family labour and land use contributed 19.22% and 7.43%, respectively in this district. In the context of Satkhira district, the total production cost was Tk. 643705/ha, for which TVC and TFC were Tk. 452413/ha and Tk. 191292/ha, respectively. In terms of TVC, the cost of canopies preparation covered maximum 26.73% of the total cost of production followed by hormone & pesticides cost (9.11%), fertilizer cost (8.44%) and depreciation cost (10.60%); whereas, family

labour cost contributed 24.22% and land use cost contributed 5.49% to total cost of cultivation among TFC in Satkhira district. In the study site of Khulna district, the total production cost was Tk. 381816/ha, for which TVC was Tk. 221874/ha and TFC was Tk. 159942/ha. Among TVC, cost of canopies preparation was the major cost of production cost (16.35%) followed by hormones & pesticides (9.27%), fertilizer cost (8.25%), hired labour cost (6.55%), and depreciation cost (6.54%), whereas, in terms of TFC, family labour cost covered 35.47% and land use cost covered 6.42% of total production cost of summer tomato production in Khulna district. Based on above results, it is evident that the Jashore district had the highest total cost of production followed by Satkhira district and the lowest total cost of production was in the district of Khulna. The low production cost was in Khulna district because besides, shrimp cultivation, vegetables like tomato, brinjal, watermelon and bitter gourd were grown in this district as additional crops in those edge places surrounding the water bodies where shrimp was produced. On average, the total production cost of summer tomato was Tk. 559949.7/ha, for which TVC and TFC were Tk. 384736.7/ha and Tk. 175219.7/ha, respectively (Table 1). The average cost of canopies preparation and hormone & pesticides covered 24.39% and 9.32% of total average cost of summer tomato cultivation, respectively.

The average depreciation cost contributed 9.72%, fertilizer cost 7.88%, hired labour cost 7.88%, family labour 24.83%, land use 6.46%, seed cost 2.22%, manure cost 2.20%, land cleaning & preparation cost 1.99%, irrigation cost 1.24%, IOC cost contributed 1.87% to the total cost production (Table 1).

In the districts of Jashore, Satkhira, and Khulna, summer tomato yields were 42.53, 39.54, and 25.48 t/ha, respectively, and in those 3 districts, tomato price were 46.70, 45.45, and 42.55 tk./kg, respectively (Table 2). The maximum gross return was observed in Jashore district (Tk. 1986151/ha) followed by Satkhira district (Tk. 1797093/ha) and the lowest margin was in Khulna district (Tk. 1084174/ha). Gross margin was also found highest in Jashore (Tk. 1506228/ha) followed by Satkhira (Tk. 1344680/ha) and the lowest gross margin was recorded in Khulna (Tk. 862300/ha). In three districts, a similar trend in net return was also observed. The highest net return was recorded in Jashore (Tk. 1331823/ha) followed by Sathkira (Tk. 1153388/ha) and the lowest was in Khulna (Tk. 702358/ha). In the districts of Jashore, Satkhira and Khulna, benefit-cost ratio (BCR) was 3.03, 2.79, and 2.84, respectively. On average, the yield of summer tomato over yields of Jashore, Satkhira and Khulna was 35.85 t/ha and total average cost of production was Tk. 559949.7/ha. So, the average cost of summer tomato production per kg was Tk. 15.62. The average gross return, average gross margin, and average net return were Tk.1622472.7/ha, Tk. 1237736/ha, and Tk. 1062523/ha, respectively. On average, benefit-cost ratio (BCR) was found to be 2.89 (Table 2). Hajong *et al.* (2018) reported that they obtained gross return of Tk. 1542300 /ha and BCR of 2.64 (full cost basis) and 3.04 (cash cost basis). Parvin (2017) obtained net return of Tk. 311755.7/acre and BCR of 1.84 from BARI summer tomato cultivation.

Table 1. Cost of summer tomato production (Tk/ha) in the study areas

Cost items	Jashore	Satkhira	Khulna	Average
A. Variable cost				
Hired labour	65200 (9.96)	42100 (6.54)	25000 (6.55)	44100 (7.88)
Land cleaning & preparation	9800 (1.50)	10152 (1.58)	13500 (3.54)	11150.7 (1.99)
Seed	15000 (2.29)	13500 (2.10)	8750 (2.29)	12416.7 (2.22)
Fertilizer	46569 (7.12)	54310 (8.44)	31500 (8.25)	44126.3 (7.88)
Manure	14500 (2.22)	12000 (1.86)	10540 (2.76)	12346.7 (2.20)
Hormone & pesticides	62500 (9.55)	58650 (9.11)	35410 (9.27)	52186.7 (9.32)
Irrigation	8750 (1.34)	9540 (1.48)	2500 (0.65)	6930 (1.24)
Canopies preparation	175270 (26.79)	172054 (26.73)	62400 (16.35)	136574.7 (24.39)
Interest on operating capital (IOC)	12226 (1.87)	11885 (1.85)	7314 (1.92)	10475 (1.87)
Depreciation	70108 (10.71)	68222 (10.60)	24960 (6.54)	54430 (9.72)
Total variable cost (TVC)	**479923 (73.35)**	**452413 (70.28)**	**221874 (58.11)**	**384736.7 (68.71)**
B. Fixed cost				
Land use	48645 (7.43)	35400 (5.49)	24500 (6.42)	36182 (6.46)
Family labour	125780 (19.22)	155892 (24.22)	135442 (35.47)	139038 (24.83)
Total fixed cost (TFC)	**174425 (26.66)**	**191292 (29.72)**	**15994 (41.89%)**	**175219.7 (31.29)**
C. Total production cost (TC)	654328 (100)	643705 (100)	381816 (100)	559949.7 (100)

Note: Figures in the parenthesis are the percentage of total cost of production.

Source: Author's calculation from the Field Survey, 2023.

Table 2. Yield, gross return, and net return of summer tomato in the study areas

Particulars	Jashore	Satkhira	Khulna	Average
Yield (t/ha)	42.53	39.54	25.48	35.85
Price (Tk./kg)	46.70	45.45	42.55	44.90
Gross return (Tk./ha)	1986151	1797093	1084174	1622472.7
Total variable cost (Tk./ha)	479923	452413	221874	384736.7
Total fixed cost (Tk./ha)	174425	191292	159942	175219.7
Total production cost (Tk./ha)	654328	643705	381816	559949.7
Gross margin (Tk./ha)	1506228	1344680	862300	1237736
Net return (Tk./ha)	1331823	1153388	702358	1062523
Benefit-cost ratio (BCR)	3.03	2.79	2.84	2.89

Source: Author's calculation from the Field Survey, 2023.

Value chain mapping

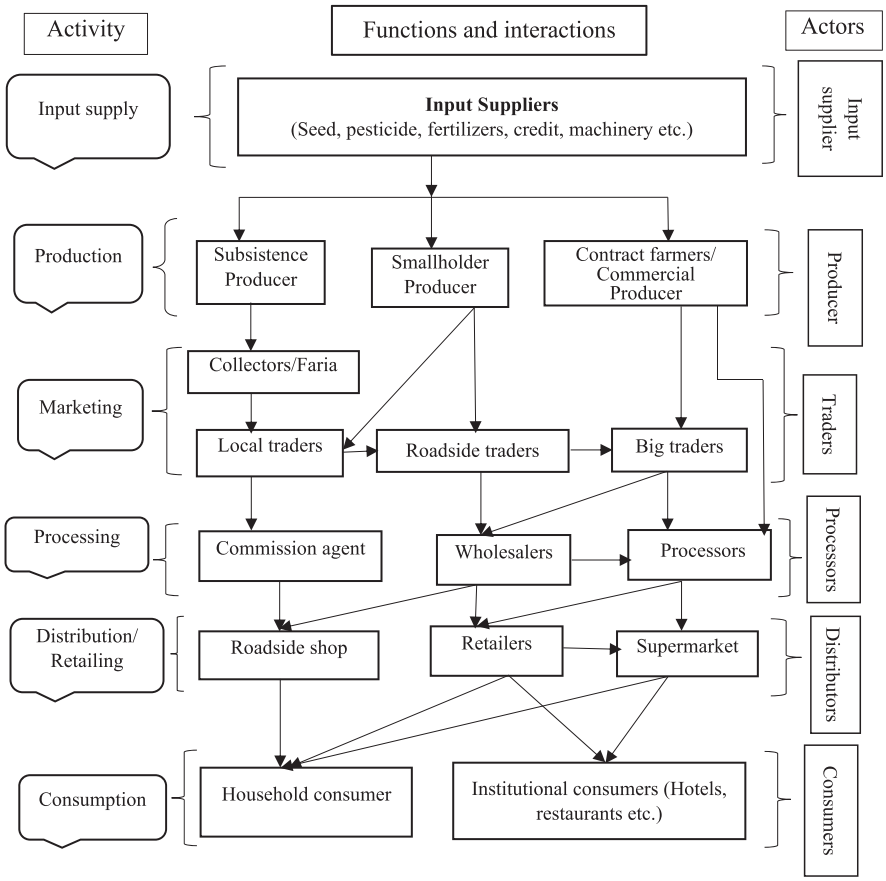
Value chain mapping makes it possible to see how a product moves via different players from production to the final consumer (McCormick and Schmitz, 2005). Studying all of the actors in the summer tomato value chain and being aware of their connections and functions are also important. The summer tomato's present value chain map in the study areas is shown in Figure 1.

It presents a visual representation of a tomato as it passes through multiple stages and processors on its way from manufacturing to customers. The links that follow are displayed vertically, starting on the left and moving rightward. Major-chain functions are enumerated in the top head. The supply of inputs, production, marketing, processing, distribution/retailing, and consumption were the activities in this instance given vertically on the left side of Figure 1. The actors who were engaged in performing the various roles are shown in a horizontal flow from the left to the right. The key actors in summer tomato value chain were input suppliers, producers, traders, processors, distributors and consumers given vertically in the right side of the Figure 1. The people pictured on the left are known as enablers, and they help the actors perform their roles. The majority of the facilitators are the formal, informal, and private institutions. Several participants and tasks in the value chain may fall under the purview of the enablers' roles. As the Figure 1 illustrates, some performers are limited to performing a single function, while others can fulfill multiple roles. For instance, the local traders deliver the goods to the wholesalers or processors after collecting them from the farmers.

Input suppliers: Input suppliers are manufacturers of agricultural inputs like seeds, fertilizers, manure, hormone, pesticides, polythene, bamboos, mulch sheets, etc for summer tomato production. They sell their products through company dealers and provide technical guidance. They maintain good relationship with producers and act as informal sources of finance. Public and private extension

services, banks and microfinance institutions provide extension services, credit and information about tomato production schemes. Input suppliers include fertilizer, seed and agribusiness companies, government distributors, small wholesalers and retail shops.

Producers: In the summer tomato value chain, the producer is the first link, collecting and transporting products to the second agent. They make the decisions on what to grow, produce and sell. Production systems can be classified into three categories: large-scale commercial production, small-scale commercial production and subsistence production. Subsistence farming involves producing small-scale of crops production for household consumption, whereas commercial farmers, both large and small, sell their produce to middlemen. Big farmers now have greater availability to market information due to communication technology during the last two to three years.



Source: Field Survey (Focus Group Discussion), 2023

Figure 1. Linkage and flow of summer tomato value chain in the study area.

Primary collector: Farmers transport their summer tomatoes to particular areas in the community, where sellers collect to transport them to marketplaces. Tomatoes and other vegetables are collected from producers by local or outside retailers and transported to urban markets. Without a road system, producers use hired labor or family members for transportation. The tomatoes are purchased by wholesalers or collectors, who then transport them to markets.

Commission agent: A commission agent is a person who, acting on behalf of an owner and receiving compensation for each transaction, provides the goods of the owner in his care and sells them, incurring liability for both the transportation of the goods to the buyer and the payment of the purchase price to the person who sold them.

Traders: Summer tomatoes from different remote cities or markets are directly purchased and sold by local traders, who then redistribute them to wholesalers at a profit. They frequently work as commission representatives for commercial processors or distributors. Producers who collect tomatoes from other producers at the farm gate to distribute them to the customers and shops are known as roadside traders. About 25% of the produce (tomato) grown in the study areas is sold by producers to roadside retailers, who then resell it to wholesalers, retailers, and consumers. They must be essential and have a thorough understanding of excess regions. Just a few roadside sellers who represent a threat to wholesalers. They hire traders to collect tomatoes on behalf of them as compensation for a commission when they are not to meet their demand in quantity.

Wholesalers: Wholesalers are market participants who buy large quantities of summer tomatoes and resell them to other traders. They purchase tomatoes from roadside traders and producers in the study area and spend their full time in wholesale buying throughout the year. They use vehicles for transportation when the amount supplied is large or purchase other crops to fill the vehicle. They play a role in influencing buyers and they set daily prices based on information from friends and mass media in Jashore, Khulna and Satkhira.

Processors: In Bangladesh, processors are secondary industries that create tomato-based products/foods including ketchup, sauce and paste. During market overproduction and peak seasons, they purchase fresh tomatoes from wholesalers and retailers. Through contract farming, large processors such as PRAN buy tomatoes directly from farmers. The two most processed foods in Bangladesh are ketchup and tomato sauce, of which PRAN is the biggest manufacturer. Processed tomato products are also made by other processors as Square, Golden Harvest, BD Foods, Sajeeb and Aftab Foods.

Distributors: Distributors generally purchase processed tomato products from producers to supply supermarkets and small grocery stores. Generally, they offer foods/products from different suppliers with different retailing types.

Supermarkets: Although supermarket culture is still relatively young in Bangladesh, it is expanding quickly. Together with other fruits and vegetables, some of them are also in the retail sale of processed and fresh tomato products. For the transportation of fresh tomatoes, some producers get in contact with supermarkets directly in big cities like Dhaka, Jashore, and Khulna, while some retailers buy fresh tomatoes directly from the wholesalers.

Retailers: Supermarkets and other large-scale shops are among the retailers who distribute huge supplies of foods to customers in small quantities, mostly for large breakdowns. Through a variety of channels, including supermarkets, upscale fruit and vegetable stores, and local grocery stores, they offer tomatoes to consumers. Retailers usually purchase products in smaller amounts with larger profit margins from the wholesalers, selling both processed and fresh products. They meet the requirements and desires of consumers and generate possibilities for value addition through promotional strategies. They represent an essential last connection in the summer tomato supply chain.

Consumers: The vegetable market chain ends with a business-to-consumer (B2C) channel model, in which buyers purchase products for their personal use. Producers to wholesalers and retailers to wholesalers are common intersections in the market chain. The retail price reduces with chain length. Customs, purchasing power and consuming habits all have significant effects on the potential market for agricultural commodities. Major marketing channels identified in the study areas are given below:

Major marketing channels

I. Producer → Collector/Faria → Local trader → Commission agent → Roadside shop →Consumer

II. Producer →Collector/Faria→ Local trader → Roadside trader → Wholesaler →Retailer →Consumer

III. Producer → Roadside trader → Wholesaler → Retailer → Consumer

IV. Producer→ Roadside trader → Wholesaler → Processor→ Retailer → Consumer

V. Producer → Big trader → Processor → Super market → Consumer

VI. Producer → Big trader → Processor → Retailer → Super market →Consumer

VII. producer → Processor → Super market → Consumer

Around 75% of summer tomatoes reach the final consumer through Channel I and Channel III.

Table 3. GMM (Tk./kg), net marketing margin (Tk/kg), and marketing efficiency

Channel	Actors	Purchase Price	Sales Price	GMM	Marketing Cost	NMM	Value addition (%)	ME
1	*2*	*3*	*4*	*5=4-3*	*6*	*7=5-6*	*8=5/3*	*9=3/(6+7)*
Channel I	Faria	45.20	50.77	5.57	3.05	2.52	12.32	2.18
	Trader	50.77	56.45	5.68	3.79	1.89	11.19	
	Commission agent	56.45	58.40	1.95	1.10	0.85	3.45	
	Roadside shop	58.40	65.92	7.52	4.05	3.47	12.88	
	Total			20.72	11.99	8.73		
Channel II	Faria	45.00	48.90	3.90	1.72	2.18	8.67	1.82
	Local trader	48.90	52.64	3.74	2.35	1.39	7.65	
	Roadside trader	52.64	58.19	5.55	3.02	2.53	10.54	
	Wholesaler	58.19	61.20	3.01	2.04	0.97	5.17	
	Retailer	61.20	68.85	7.65	3.91	3.74	12.5	
	Total			23.85	14.03	10.75		
Channel III	Roadside trader	47.00	53.98	6.98	4.90	2.08	14.85	2.58
	Wholesaler	53.98	57.50	3.52	2.25	1.27	6.52	
	Retailer	57.50	65.20	7.7	4.65	3.05	13.39	
	Total			18.2	11.80	6.4		
Channel IV	Roadside trader	42.50	45.75	3.25	2.28	0.97	7.65	1.47
	Wholesaler	45.75	50.00	4.25	2.90	1.35	9.29	
	Processor	50.00	62.10	12.10	10.25	1.85	24.2	
	Retailer	62.10	70.50	8.4	3.45	5.95	13.53	
	Total			28.00	18.88	10.12		

Channel	Actors	Purchase Price	Sales Price	GMM	Marketing Cost	NMM	Value addition (%)	ME
1	*2*	*3*	*4*	*5=4-3*	*6*	*7=5-6*	*8=5/3*	*9=3/(6+7)*
Channel V	Big trader	48.50	53.28	4.78	3.08	1.70	9.86	2.16
	Processor	53.28	61.05	7.77	5.25	2.52	14.58	
	Super market	61.05	71.00	9.95	6.53	3.42	16.30	
	Total			22.50	14.86	7.64		
Channel VI	Big trader	48.09	53.00	4.91	3.69	1.22	10.21	1.98
	Processor	53.00	58.85	5.85	4.89	0.96	11.04	
	Retailer	58.85	63.25	4.40	3.05	1.35	7.48	
	Super market	63.25	72.40	9.15	6.33	2.82	14.47	
	Total			24.31	17.96	6.35		
Channel VII	Processor	50.25	60.04	9.79	7.74	2.05	19.48	2.48
	Super market	60.04	71.52	11.48	6.35	4.13	19.12	
	Total			21.27	14.09	6.18		

GMM= Gross marketing margin; NMM = Net marketing margin; ME= Marketing efficiency

Source: Author's calculation from the Field Survey, 2023.

A significant indicator of efficiency is the amount and makeup of the marketing margin. Table 3 shows the gross marketing margins (GMM), marketing costs (MC), net marketing margin (NMM) margins, value addition and marketing efficiency (ME) for the respective channels. The effectiveness of different marketing channels were carried out based on different performance indicators in different channels using a composite index formula. Maximum GMM was noted in Chanel IV (28 Tk./kg) followed by Channel VI (24.31 Tk./kg), Channel II (23.85 Tk./kg), Channel V (22.50 Tk./kg), Channel VII (21.27 Tk./kg) and Channel I (20.72 Tk./kg) and the lowest GMM was in Channel III (18.20 Tk./kg). The highest NMM was recorded in Channel II (10.75 Tk./kg) closely followed by Channel IV (10.12 Tk./kg) and then followed by Channel I (8.73 Tk./kg), Channel V (7.64 Tk./kg), Channel III (6.40 Tk./kg), Channel VI (6.35 Tk./kg) and the lowest was found in Channel VII (6.18 Tk./kg). Maximum ME was recorded in Channel III (2.58) closely followed by Channel VII (2.48) and then followed by Channel I (2.18), Channel V (2.16), Channel VI (1.98), Channel II (1.82), and the lowest ME was noted in Channel IV (1.47). The findings showed that common marketing routes are traders→ wholesalers→ retailers→ consumers. The above results confirmed that, in the summer tomato-producing areas, the marketing Channel II, IV, and VI were not especially effective. From the Channels II and IV, producers received lower prices (45 Tk./kg in Channel II and 42.50 Tk./kg in Channel IV) than other channels. Producers obtained the highest price of summer tomato from the Channel VII (50.25 Tk./kg) which was closely followed by Channel V (48.50 Tk./kg), Channel VI (48.09 Tk./kg), and Channel III (47 Tk./kg). Channels VII, III, I, and V were revealed as the efficient marketing channels due to their highest ME (2.48, 2.58, 2.18, and 2.16, respectively). Channel VII had the highest value addition in processor (19.48%)→supermarket (19.12%) followed by Channel III (roadside trader: 14.85%→ wholesaler:6.52%→ retailer:13.39%), Channel I (faria;12.32%→ trader:11.19%→ commission agent: 3.45%→roadside shop:12.88%), and channel V (big trader:9.86%→ processor: 14.58%→ supermarket: 16.30%). Selling directly to the processors to the consumer was the producers' response to marketing Channel VII and it was revealed to be the most appealing (Table 3). Based on the data mentioned above, it can be established that producers' shares were very low in Channels II and IV. The government should prioritize the development of channels I, III, V, and VII to support the increased marketing efforts in these study areas and so raise the proportion of producers. The research findings of Rayhan *et al*. (2021) and Gunwant *et al*. (2012), which found that the fewer the market actors involved, the higher the marketing efficiency, further support this results. They reported that the producer→ processor→ consumer channel is shown to have the highest marketing efficiency.

Constraints faced by producers and market actors

In the study following constraints were identified through a questionnaire survey and open discussion with tomato producers and relevant stakeholders. The constraints were stated bellow:

Table 4. Constraints faced by the producers and market actors in the study areas

Constraints		% of respondent	Rank
i.	***Producers' level:***		
1)	Lack of good quality summer tomato seeds in the market	90	1
2)	High cost of tomato farming inputs	75	2
3)	Very poor access to low-interest credit facilities	68	3
4)	Prevalence of tomato diseases and pests	65	4
5)	Lack of modern technical knowledge	59	5
6)	Lack of storage facilities	51	6
7)	Lack of proper supervision	49	7
8)	Labour shortage	38	8
ii.	***Actors' level:***		
1)	High cost of transportation	89	1
2)	Lack of granted sale channel/ Unstable price	85	2
3)	Illegal revenue collection on the roads by the police, touts, and other security agencies	84	3
4)	Lack of training on modern marketing systems	75	4
5)	Post-harvest loss	73	5
6)	Poor packaging of tomato	60	6

At producers' level, among the constraints lack of good quality summer tomato seeds in the market ranked 1st, high cost of tomato farming units rank 2nd and very poor access to low interest credit facilities ranked 3rd and so on (Table 4). At market actors' level, high cost of transportation, lack of granted sale channel and illegal revenue collection on the roads by the police, touts and other security agencies ranked 1st, 2nd and 3rd, respectively.

Conclusion and Recommendations

The study explores value chain analysis in Jashore, Satkhira, and Khulna districts of Bangladesh. The findings reveal that the production of BARI hybrid summer tomato was profitable endeavor. Channel VII had the highest price paid to the producers of summer tomato, at Tk. 50.25/kg and the highest marketing efficiency of this channel was 2.48. Channels I, III, V, and VII were the most desired and effective marketing channels. These are- Channel I: Producer→ Faria→ Local trader→ Commission agent→ Roadside shop→ Consumer; Channel III: Producer→ Roadside trader→ Wholesaler→ Retailer→ Consumer; Channel V: Producer→ Big trader→ Processor→ Super market→ Consumer and Channel VII: Producer→ processor→ Super market→ Consumer. According to the findings of the study, a lot of opportunities to improve summer tomato production and develop

the tomato value chain. The cultivation and marketing of tomatoes involved a huge number of labour. Therefore, an established framework for summer tomato production and its sale may undoubtedly benefit producers and actors financially. Given the high profitability, the government may decide to implement awareness-raising campaigns and provide training through the Department of Agricultural Extension (DAE) and Department of Agricultural Marketing (DAM) to facilitate the growth of high-value vegetable like tomato in the south-west region. Channel III was comparatively well-established in the study areas. Therefore, the government should prioritize the development of channels V and VII situations to support the increased marketing efforts in these areas to increase the proportion of the summer tomato producers. To develop an improved and more dynamic marketing channel that benefits producers and market actors, further research should be done in those areas to provide ideas and information.

References

Acharya, A. 2004. *Agricultural Marketing in India* (4th ed.). New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd. India. 506p.

Acharya, S. S. and N. L. Agarwal. 2004. *Agricultural Marketing in India (*4th ed.). Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, India. 381p.

Anonymous. 2024. Yearbook of Agricultural Statistics-2023. 35th Series. Bangladesh Bureau of Statistics (BBS) Statistics and Informatics Division (SID) Ministry of Planning Government of the People's Republic of Bangladesh. www.bbs.gov.bd. pp. 321.

Arab, L. and S. Steck. 2000. Lycopene and cardiovascular disease. *The American J. Clini. Nutri.* **71**(6): 1691S-1695S.

Azad, A. K., M. Miaruddin, M. A. wahab, M. H. R. Sheikh, B. L. Nag and M. H. H. Rahman. 2020. *Krishi Projukti Hatboi* (Handbook on Agro-Technology) (9th Ed.). Bangladesh Agricultural Research Institute (BARI), Gazipur-1701. pp. 127-129.

Basu, A. and V. Imrhan. 2007. Tomatoes versus lycopene in oxidative stress and carcinogenesis: conclusions from clinical trials. *European J. Clini. Nutri.* **61**(3): 295–303.

Begum, M. E. A., M. N. Islam, Q. M. Alam and S. M. B. Hossain. 2011. Profitability of some BARI released crop varieties in some locations of Bangladesh. *Bangladesh J. Agril. Res.* **36** (1): 111-122. https://doi.org/10.3329/bjar.v36i1.9235

Biswas, R., M. M. U. Molla, M. F. E. Alam, M. Zonayet and R. A. Castanho. 2022. Profitability analysis and input use efficiency of maize cultivation in selected areas of Bangladesh. *Land* **12**(1):23.

Das, S. and M. Jahan. 2022. Production and profitability intervention of summer hybrid Tomato: A farm level review in Bangladesh. *Amer. J. Econ. & Business Adminis.* **14**: 21-30. http://doi.10.3844/ajebasp.2022.21.30

Dawe, D. (Ed.). (2012). *The rice crisis: Markets, policies and food security*. Routledge.

Freeman, B. B. and K. Reimers. 2011. Tomato consumption and health: emerging benefits. *Amer. J. Lifestyle Medic.* **5**(2): 182–191.

Gunwant, V. K., M. Hussain, R. C. Purohit, S. M. F. Ali and D. Rana. 2012. A comparative study of production and marketing practices of vegetables in Nainital and US Nagar district of the state of Uttarakhand, India. *Inter. J. Adv. in Computing and Info. Tech.* **1**(6): 569-578.

Hajong, P., B. Sikder S. Mandol and M. A. Islam. 2018. Adoption and profitability of summer tomato cultivation in Jashore district. Bangladesh. *Bangladesh J. Agril. Res*. **43**(4): 575-585. https://doi.org/10.3329/bjar.v43i4.39154

Islam, F. 2021. Bangladesh among world's top 10 in 13 sectors. The Prothom Alo. Online Ed. Publish on 27 March 2021. https://en.prothomalo.com/business/bangladesh-among-worlds-top-10-in-13-sectors.

Khatun, M. and M. S. Rahman. 2020. Postharvest loss assessment of tomato in selected locations of Bangladesh. *Bangladesh J. Agril. Res.* **45**(1): 43-52

Lamba, H. K., S. C. Srivastava, R. Kumar, S. Rundla, M. L. Jat and Narendra. 2023. Estimation of marketing cost and marketing margin under different channel of pear millet marketing in Morena District of Madhya Pradesh. *Inter. J. Stat. and App. Math*. **8**(5): 1122-1126. https://www.mathsjournal.com/pdf/2023/vol8issue5S/PartP/S-8-5-118-388.pdf.

Maruf, S. A., J. U. Ahmed and J. A. Khan. 2021. Prospect of off-seasonal vegetable production in Bangladesh: a socioeconomic diagnosis. *Quality & Quantity* 1-23.

McCormick and H. Schmitz. 2005. *Value chain analysis for policymakers and practitioners*. International Labour Office and Rockefeller Foundation, Geneva, Switzerland.

Mitra, S. and M. Yunus. 2018. Determinants of tomato farmer's efficiency in Mymensingh district of Bangladesh: Data Envelopment Analysis approach. *J. Bangladesh Agril. Univ*. **16**(1): 93–97. http:// doi.10.3329/jbau.v16i1.36487

Parvin, M. M. 2017. Farmer's profitability of tomato cultivation in the socio-economic context of Bangladesh: A study at Rangpur district. *Inter. J. Appl. Res.* **3**(6): 09-15.

Rayhan, S. J., J. M. Islam, M. M. H. Kazal and M. Kamruzzaman. 2021. Value chain analysis of brinjal in the Chittagong Hill tract of Bangladesh. *Asian J. Agril.l Ext. Econ. & Socio.* **39**(3**):** 145-157. http:// doi.10.9734/AJAEES/2021/v39i330555

Sarma, P. K. and M. H. Ali. 2019. Value chain analysis of tomato: A case study in Jessore District of Bangladesh. *Inter. J. Sci. & Res. (IJSR)* **8**(2): 924-932. http:// doi.10.21275/ART20194747

Sen, B. 2024. Agriculture should get top priority in the budget: economists. Retrieved July 28, 2024, from http://www.thedailystarnews. com/star_business_report.htm.

Shahriar, S. M. 2024. An economic study and resource use efficiency of Brinjal production in Bangladesh. *Journal of Agriculture, Food and Environ. (JAFE)* **5**(3): 7-13. https://doi.org/10.47440/JAFE.2024.5302

Sharma, D., M. J. Alam, I. A. Begum and S. Ding. 2023. A Value Chain Analysis of Cauliflower and Tomato in Bangladesh. *Sustainability.* **15**(14): 11395. https://doi.org./10.3390/su151411395

WPP. 2024. World Population Prospects: The 2024 Revision. U.N. Department of Economic and Social Affairs- Population Division. https://www.worldometers.info/world-population/ Bangladesh-population.