FACTORS INFLUENCING MARKETED SURPLUS OF TOMATOES IN PUNJAB, PAKISTAN

Manan ASLAM[1,2*], Hamza AKHTAR[2*], Mudassar YASIN[2], Muhammad Ali IMRAN[2*], Mahboob RIAZ [3]**

[1]Jiangsu University, School of Management, Zhenjiang, Jiangsu, China. E-mail: 5103210214@ujs.edu.cn, manan.aslam@mnsuam.edu.pk
[2]Muhammad Nawaz Shareef, University of Agriculture, Multan, *Department of Agribusiness and Entrepreneurship Development, **Department of Outreach and Continuing Education Pakistan, E-mails: manan.aslam@mnsuam.edu.pk, hamzaakhtar277@gmail.com, mudassar.yasin@mnsuam.edu.pk, ali.imran@mnsuam.edu.pk
[3]University College of Management and Sciences (UCMS) Khanewal, Pakistan, E-mail: mehboobriaz2413@gmail.com

Corresponding author: manan.aslam@mnsuam.edu.pk, 5103210214@ujs.edu.cn

Abstract

Many vegetables are grown throughout Pakistan's provinces, but tomatoes, potatoes, cauliflower and onions are among the most common ones. Pakistan has a 150 thousand acres of tomato farming, producing 57094 tonnes of tomatoes per year, making it the world's 35th largest producer. Due to importance of tomatoes in our daily routine, there is need to explore marketing system of tunnel grown tomatoes, analyze current marketing margins, as well as to quantify the impact of significant variables affecting marketed surplus of tomatoes. The study was confined to areas of the district Lodhran because there is an increasing trend to produce tomatoes by using tunnel system in the region. Then Lodhran tehsil was chosen purposively. After selecting region then 100 tomato farmers (50 tunnel growers and 50 non tunnel growers), 20 commission agents, 20 wholesalers, 20 retailers, and 100 tomato consumers were chosen as sampled respondents. Convenient sampling technique was used to select the sample. The frequencies and percentage of sampled respondents was calculated by using descriptive statistics. The impact of factors affecting tunnel tomato growers' marketed surplus was determined by using multiple regression analysis. The regression results showed that the selected traits (experience, area, marketing cost, sale price, and distance from the output market) are influencing significantly on the marketed surplus. So, both public and private sectors should engage to organize and rain the tomato farmers regarding tunnel farming in the region.

Key words: tunnel grown tomatoes, marketing system, tunnel growers, output market, marketed surplus

INTRODUCTION

All necessary nutrients, such as vitamins, minerals, and fibers, are found in the food we eat daily. Most of the food we eat nowadays is not suitable for our bodies. Vegetables have long been thought to be a source of nutrients and good immunity. A person who consumes the recommended number of fruits and vegetables is disease-free. Vegetables are an all-important part of a diet because they keep our stomachs satisfied for a longer time (Government of Pakistan, 2022) [12].
Tomatoes are an important part of a kitchen dairies. Important minerals, vital amino acids, carbohydrates, dietary fibers and vitamins are present in them. Tomatoes have high levels of vitamins (B and C) as well as minerals (phosphorus and iron). Tomatoes might be used raw in salads or cooked in sauces, dishes and soups. Purées, juices, and ketchup may be made from them. Tomatoes, both canned and dried, are important processed food items. Though yellow tomatoes have higher the quantity of vitamin A rather than red tomatoes, red tomatoes include lycopene, an antioxidant that may protect against carcinogens (Government of Pakistan, 2020) [13]. In all the provinces of Pakistan production of tomatoes is twice a year. Once it is cultivated in the spring and second it is cultivated in autumn. From 2017 through 2018 total production of tomato crops over an area of 41,731 hectares was 414,645 tons. Cultivation of tomatoes during 2017-2018 in Punjab, Khyber Pakhtunkhwa (KPK), Sindh, and Baluchistan

over an area of 2,874, 3,135, 24,968, 5,354 hectares with 109,445, 85,446, 182,198, 37,556 tons' production respectively (Hassan et al., 2018) [17].

Tomato cultivation is mostly done in small farming areas in Pakistan. Tomato cultivation in the small fields produces the most benefit to the producers and provides job opportunities to the people of rural areas but its yield is lower in Pakistan (Mari et al., 2007) [22].

The portion of production that actually makes it onto the market is known as the "marketed surplus." Marketed surplus is the money that remains with the farmer after covering family expenses, gifts, payments in kind, and on-farm waste (Gupta and Arora, 2015) [15]. In certain definitions of marketed surplus, distressed sales—in which grain is sold soon after harvesting to meet debt commitments and later replenished or repurchased—are included; nevertheless, they are deducted from marketable excess. In this situation, marketable surplus is the net amount following repurchases, whereas marketed excess would be a gross phrase. Farmers' reactions to price fluctuations can guide appropriate agricultural price policy, which in turn may serve as a catalyst for growing agricultural output (Goyal and Berg, 2017; Rifin, 2022) [14, 28].

The establishment of appropriate policies with respect to prices, exports, imports and marketing and overall rural and national development goals can greatly benefit from an understanding of the behavior and variables driving marketed surplus (Chatha and Singh, 2013; Dhindsa and Singh, 2013) [8, 11]. In non-market subsistence agriculture, surplus produce can be given away or transferred in kind, and any remaining goods can be sold in the market (Hariss, 2011; Dhindsa and Singh, 2013) [18, 11]. Small and medium farmers held a significant portion of their production of food for household needs, according to research on the pattern of marketable surplus of food grains by farm size. Compared to small farmers, major farmers sold a disproportionately high quotient of their marketed surplus of wheat during the post-harvest period. Later, the (Krishna, 2015) [21] model-generated feasible ranges of market pricing for wheat in Punjab were compared by

(Behrman, 2017) [7]. It was discovered that although the models converged when the majority of production was sold, they might actually diverge in magnitude and sign when less than half of the output was sold. Furthermore, when marketed surplus was expressed as a percentage of output, some empirical data suggested that medium-sized farms marketed a smaller percentage of their surplus than very small and very big farms did (Aslam et al., 2013) [3]. Therefore, by keeping in view the importance of research topic the study in hand is designed to explore factors influencing marketed surplus of tomatoes in district Lodhran.

Literature Review

The literature regarding marketing system of tomatoes more specifically marketed surplus has been scanned from developed and developing nations.

Aminu (2009) [2] observed that experience and a good rapport with the commission agents and farmers matters a lot in a normal vegetable marketing system. According to Olukosi et al. (2005) [25], the marketing task entailed the movement of goods from producers to consumers. The marketing function guaranteed that customers received the product in the form, location, and time that they prefer. Marketing increased the productivity of all sectors of the economy by stimulating output, business, and specialization. As a country's economy increases, the divide between farmers and consumers widens, making marketing more difficult to operate (Badar et al., 2021) [5]. Tomato had a significant ability to increase profitability of associated stakeholders and reduce poverty. Undoubtedly, a large number of people would be employed in its production, handling, shipping, distribution, and marketing. Tomatoes could be sold domestically or processed and exported to other West African nations. The marketability of agricultural products played a big role in increasing production. An effective market not only connected sellers and buyers in adjusting to current supply and demand situations, but also played a dynamic role in encouraging output consumption, which was critical to economic development (Haruna et al., 2012) [19]. Among the several vegetables cultivated

in Pakistan, the tomato was definitely the most significant, both in terms of production and consumption (Adejobi et al., 2011) [1]. Consumer preferences for consumption and purchase, as well as consumer priority ratings for key tomato quality criteria, collected. Descriptive statistics, analysis of variance, and post-hoc testing used to analyze the collected data. The findings revealed both parallels and differences in fresh tomato consumption and purchase preferences in three cities. In most of the experience, safety, and marketing criteria, the survey found no statistically significant variations in consumer preferences (Bashir, 2003; Cholan, 2007) [4, 10]. When it came to search attributes, consumers had a wide range of preferences. According to the findings, tomato value chain actors should deliver their products in accordance with the needs of their target markets. They must enhance their production, harvesting, and marketing procedures, as well as their collaboration, to produce fresh, undamaged, and immaculate tomatoes. The report also recommended linked public-sector entities to address consumer needs when planning their support operations, because the profitability of tomato value chain stakeholders, particularly growers, could not be increased until these needs are met. The marketed surplus also predicted and found that many variables were influencing the marketed surplus (Bhatia, 2002; Gupta and Arora, 2000; Chauhan and Chhabra, 2005; Joshi, 2012; Maske et al., 2012; Rahim et al., 2007) [6, 15, 9, 20, 23, 26]. Tomato quality (*Solanum lycopersicum* L. syn name *Lycopersicon esculentum*) is mostly revealed by discussing suitable handling practices during post-harvest activities such as harvest, grading, packaging, and shipping. The current study was designed to examine tomato crop in the markets of Lahore district. During the investigation, it discovered that the goods had degraded by 25% due to the packing material, 10% due to transportation, 5% due to distribution, and particularly high post-harvest losses of up to 30% and sometimes the entire lots were lost (Saeed and Khan, 2019) [29]. Rehman and Jan (2020) [27] in their study calculated the post-harvest losses in the tomato crop grown in the Peshawar valley during Kharif 2016. Data gathered at random from 68 tomato growers in the area. Tomato crop post-harvest losses in the Peshawar estimated to be 20% of overall production. Most of the losses happened during crop harvesting, handling, and transportation to markets, among other things. Farmers in the area need to be educated on the latest packing techniques, tomato crop processing procedures, and innovative techniques and methods of post-harvest handling to minimize these losses.

The purpose of the paper

Therefore, by keeping in view the importance of research topic the study in hand is designed to explore factors influencing marketed surplus of tomatoes in district Lodhran, Punjab, Pakistan.

MATERIALS AND METHODS

It is important to undertake research to investigate current marketing margins and the involvement of various players in the supply chain, as well as to quantify the influence of main variables affecting marketed surplus of tomatoes. The nature of the problem calls for a much larger scale, such as that of a province or a country, however due to apparent time and budget constraints; the study will be limited to regions of the Lodhran district because there is an increasing trend to produce tomatoes by using tunnel system in the region. Then the tehsil of Lodhran was chosen. So, 100 tomato farmers (50 tunnel growers and 50 non tunnel growers) were chosen as a representative sample of farmers, commission agents, wholesalers, retailers, and consumers. Convenience sampling technique was employed to select the sample. The frequencies and percentages of sample responses calculated using descriptive statistics. The influence of main factors affecting tomato farmers' marketed surplus was determined by using multiple regression analysis.

To analyze the result of present study the descriptive statistics used to find out the percentage and frequencies of different stakeholders in the marketing chain of the tomatoes."

The following is how the dependent and independent variables are related:

$$"Y = f(Xi)………………....(1)$$

where: "
Y = Marketed surplus (Maunds)"
X_i = Vector of quantitative variables i = 6"

Equation 2 can be expressed in more detail as

$$"Y_i = \beta o\ X_i{}^{\beta i} e^{\mu} …………………(2)$$

The equation 3 can be explained further as;

$$"Y = \beta o\ X_1{}^{\beta 1} X_2{}^{\beta 2} X_3{}^{\beta 3} X_4{}^{\beta 4} X_5{}^{\beta 5} X_6{}^{\beta 6} e^{\mu}$$
$$………………………...........(3)$$

Equation 4 can be expressed as by taking the natural log on both sides

$$lnY = \beta o + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + \beta_6 lnX_{6+} \beta_7 D + \mu….(4)$$

where:
X_1= Education of farmers (Years of schooling)
X_2= Farming experience of farmers (Years)
X_3= Area under tomatoes cultivation (Acres)
X_4 = Marketing cost (Rupees per kgs)
X_5 = Sale price (Rupees per kgs)
X_6 = Distance from wholesale market (Km)
D=0, if not employing tunnel farming
D=1, if employing tunnel farming
βs are the elasticity's, βo is the intercept, and μ is the random error
NL = Natural log

RESULTS AND DISCUSSIONS

As per our findings, out of 50 tunnel tomatoes grown people, 50 (representing 100%) of people are those who said that our initial investment for tomato cultivation is high, out of 50 tunnel tomato grown people, 50 (representing 100%) of people are those who say that the temperature control for growing tunnel tomatoes, out of 50 tunnel tomato grown people, 47 (representing 94%) of people are those who said that production is high in tunnel forming. out of 50 tunnel tomato grown people, 37 (representing 74%) of people are those who said that the tunnel grown tomatoes is more profitable. out of 50 tunnel tomato grown people, 46 (representing 92%) of people are those who said that tunnel grown tomatoes weight more than conventional grown tomatoes out of 50 tunnel tomato grown people, 42 (representing 84%) of people are those who said that the tunnel farming tomatoes shelf life is better than as compared to conventional grown tomatoes. out of 50 tunnel tomato grown people, 49 (representing 98%) of people are those who said that in tunnel grown tomatoes less usages of pesticides as compared to conventional grown tomatoes. out of 50 tunnel tomato grown people, 50 (representing 100%) of people are those who said that they have sow our crop early. out of 50 tunnel tomato grown people, 45 (representing 90%) of people are those who said that they must send our crops to the market early to sell them. out of 50 tunnel tomato grown people, 41 (representing 82%) of people are those who said that a tomato planted in a tunnel sells for a good price out of 50 conventional tomatoes grown people, 20 (representing 40%) of people are those who said that our initial investment for tomato cultivation is high, out of 50 conventional tomato grown people, 0 (representing 0%) of people are those who say that the temperature control for growing tunnel tomatoes, out of 50 conventional tomato grown people, 25 (representing 50%) of people are those who said that production is high in conventional forming. out of 50 conventional tomato grown people, 30 (representing 60%) of people are those who said that the conventional grown tomatoes is more profitable. out of 50 conventional tomato grown people, 22 (representing 44%) of people are those who said that conventional grown tomatoes weight more than tunnel grown tomatoes. out of 50 conventional tomato grown people, 27 (representing 54%) of people are those who said that the conventional farming tomatoes shelf life is better than as compared to tunnel grown tomatoes. out of 50 conventional tomato grown people, 10 (representing 20%) of people are those who said that in conventional grown tomatoes less usages of pesticides as compared to tunnel grown tomatoes. out of 50 conventional tomato grown people, 28 (representing 56%) of people are those who said that they have sow our crop early. out of 50 conventional tomato grown people, 28

(representing 56%) of people are those who said that they must send our crops to the market early to sell them. out of 50 conventional tomato grown people, 25 (representing 50%) of people are those who said that a tomato planted in a conventional sell for a good price.

Table 1. Detail Comparison between Tunnel Grown Tomatoes and Conventional Grown Tomatoes

Factors	Tunnel Grown Tomatoes	Conventional Grown Tomatoes
High initial investment	50 (100%)	0 (0%)
Controlled Temperature	50 (100%)	0 (0%)
High Production	47 (94%)	25 (50%)
More Profitable	37 (74%)	30 (60%)
Tomatoes Weight	46 (92%)	22 (44%)
Shelf life	42 (84%)	27 (54%)
Lesser use of pesticides	49 (98%)	10 (20%)
Early sowing	50 (100%)	28 (56%)
Early availability in the market for sale	45 (90%)	28 (56%)
Premium Prices	41 (82%)	25 (50%)

Source: Authors' own calculations

The double log form of regression model was applied to evaluate the connection between the dependent variable (marketed surplus) and the independent variables (education, experience, family size, area under tomato crops, marketing cost, sale price and distance from the output market). This relationship was suggested by the scattered plot between the dependent and independent variables. To describe the data of the dependent variable (marketed surplus) and independent variables, descriptive statistics (minimum, maximum, mean, and standard deviation) were utilized (education, experience, family, size, area under tomato crops, marketing cost, sale price and distance from the output market). Table 2 includes the information in summary form.

Table 2. Descriptive Statistics of the Data Used for Model Estimation in Brief

Factors	Max.	Min.	Std. Dev.	Mean Value
Education of tomato farmers (Years of Schooling)	16	0	4.893	7.83
Experience of farmers (Years)	60	4	15.133	22.35
Area under tomato crop (acres)	60	2	13.728	12.09
Marketing cost (Rs./ Maund)	20	10	3.334	14.10
Sale price (Rs. / Maund)	2,000	1,200	161.325	1675.00
Distance from market (Km)	12	1	2.699	5.50
Marketed surplus (Maund)	2,685	20	493.217	330.88

Source: Author's own calculations.

Strong correlations between the independent variables are called collinearity (or multi collinearity), and they are an undesirable circumstance.

Tolerance is a statistic used to quantify the degree of linear relationship between the independent variables (multi collinear).

The tolerance is equal to the variance inflation factor, or VIF. The variance of the regression coefficient rises with the VIF, making the estimate unstable.

Multi collinearity is indicated by high VIF scores. Multi collinearity is a concern if the value of VIF is more than 10. All VIF values in our analysis were less than 10, which demonstrated that the data set had no multi collinearity.

The coefficient of determination is also known as R^2. We learn how much of the variation in the dependent variable is explained by the independent factors taken together. R^2 has a range of 0 and 1, and the closer it is to 1, the better the model fits (Gujrati and Porter, 2008) [16]. Our study' R^2 value was 0.558, meaning that all of the independent variables together were able to account for 55% of the change in the dependent variable, which was the marketed surplus of tomatoes. This figure also indicated that the remaining 45% of the dependent variable's change was due to some other factors, the effects of which the model was unable to account for it.

Table 3. Collinearity Statistics

Variables	Tolerance Level	VIF Factor
Qualification of farmer (years of schooling)	.477	2.095
Farming experience (No. of years)	.504	1.982
Family Size (No.)	.958	1.044
Cultivation area under tomato crop (acreage)	.445	2.247
Marketing expenses (Rs./ Maund)	.958	1.044
Sale price (Rs./ Maund)	.435	2.300
Distance from the market (kilometers)	.714	1.401

Source: Authors' own calculation.

Adjusted R^2 denotes degree of freedom adjustment. For cross-sectional data, it is employed.
adjustment. For cross-sectional data, it is employed.
In our investigation, the adjusted R^2 value was 0.515, which is significant. The adjusted R^2 score indicates that, when all other variables were held constant, all independent variables

explained 51% of the variation in the dependent variable. According to the F-ratio, all independent variables may or may not be significant contributors to variation in the dependent variable. Our analysis' extremely significant F-value of 30.330 (p 0.05) demonstrated why the model was generally appropriate.
Considering the findings, it may be assumed that the tomato growers' sold surplus, in the absence of an impact from independent factors, could be 8.790 hundred mounds. Education is seen as an important socioeconomic factor since it improves farmers' capacity to sell more produce. The positive sign of the education coefficient was 0.187 (p >0.05). According to the coefficient of variation, if all other variables remained constant, there could be a 0.187 Percent rise in the marketed surplus of tomato producers for every one percent increase in education (Years of Schooling).

Table 4. Summary of Results of Regression Analysis

"Factors	"Coefficient"	Standard-Error"	"T-Value"	"Significance (P-value)"
(Constant)	-8.790	3.354	-2.621	.010
Education of farmer (years of schooling)	.187	.127	1.478	.143[NS]
Experience of farmers (years)	.338	.154	2.198	.030**
Family Size	.098	.138	.708	.480[NS]
Area under tomato crop (acres)	.309	.159	1.940	.512[NS]
Marketing costs (Rs./ Maund)	-.326	.147	-2.213	.029**
Sale price (Rs./ Maund)	2.183	.466	4.686	.001***
Distance from the Output market (km)	-.287	0.101	-2.854	.005***
Dummy Variable	.100	.122	1.370	.001[***]
R Square	.558			
Adjusted R Square	.515			
F- Value	30.330			

Source: Authors' own calculations.

The price a farmer receives depends on their level of farming experience. Farmers with more experience can sell the tomato (marketed excess) in huge quantities for a reasonable price. The agricultural experience coefficient was significant and had a positive sign of 0.338 (p 0.05). According to the coefficient of

variation, with all other parameters remaining constant, there may be a 0.338 Percent rise in the marketed surplus of tomato producers for every one percent increase in farming experience (Years).
Family size is an important demographic factor since it improves farmers' capacity to sell more

produce. The positive sign of the education coefficient was 0.098 (p >0.05). According to the coefficient of variation, if all other variables remained constant, there could be a 0.098 percent rise in the marketed surplus of tomato producers for every one Percent increase in family size (No).

Given that it enables farmers to produce more tomatoes, the area beneath tomatoes is regarded as a crucial factor. The area coefficient of 0.309 (p <0.05) had a non-significant sign. According to the coefficient of variation, if all other variables remained constant, there could be a 0.309 percent rise in the marketed surplus of tomato growers for every one percent increase in the area under tomato production (acres). The marketing cost coefficient, which was negligible at -.326 (p>0.05), had a negative sign. According to the coefficient of variation, if all other variables remained constant, there could be a -.326 percent rise in the marketed surplus of tomato growers for every one percent decrease in marketing cost (Rs. Per maund). Sale price is a key factor in determining how much surplus tomatoes are marketed by tomato farmers. Farmers grow more and more tomatoes as a result of market price increases for tomatoes, increasing the market excess. Nosheen and Iqbal also support this finding (2008) [24]. The output price correlation coefficient was positive but negligible at 2.183 (p>0.05). The coefficient of variation stated that, if all other variables remained constant, for every one Percent increase in the sale price (Rs. / maund) of tomatoes, there might be an increase of 2.183 percent in the marketed surplus of tomato growers. Farmers' chances of selling their produce in a particular market are impacted by their distance from the wholesale market.

The distance coefficient from the wholesale market was -.287 (p 0.05), which had a strong negative sign. According to the coefficient of variation, there may be an increase in the marketed surplus of tomato growers for every one percent reduction in distance from the wholesale market (Rs. / maund), if all other factors remain constant.

Dummy variable has taken to check the impact of tunnel and conventional farming practices.

The value =1 is taken if farmer employs tunnel farming and value =0 if farmer uses conventional farming. The coefficient value was .10 (p 0.05), which had a strong positive sign. According to the coefficient of variation, there may be an increase in the marketed surplus of tomato growers for every one unit increase in production via tunnel farming if all other factors remain constant.

CONCLUSIONS

The present marketing system of tunnel tomato needs a lot of improvement to prove its real potential. Some recommendations to improve marketing of tunnel tomatoes as long distance from production area to market and losses due to poor condition also cause reduction in marketed surplus, production is declining due to various possible factors as reduction in area according to our results. The farmers should enhance tunnel grown tomatoes so that the marketed surplus would be high as farming community would be able to fetch premium prices. According to our research, the selected traits (experience, area, marketing cost, sale price, and distance from the output market) are influencing significantly on the marketed surplus. So, both public and private sectors should engage to organize/train the tomato farmers regarding tunnel sowing.

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