

Research Paper

Value Chain Analysis of Tomato (*Solanum lycopersicum* L.) in Lalitpur, Nepal

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ABSTRACT

Tomato (*Solanum lycopersicum* L.) is a leading vegetable crop with good market potentiality in Nepal. The knowledge of commodity flow and actors play a pivotal role to identify the gaps for improving competitiveness. A study was carried out to assess the contemporary status of the value chain for tomatoes in Lalitpur, Nepal in 2020. A total of 60 households were sampled from two rural municipalities, viz. Konjyosom and Bagmati and a municipality: the Godavari, were selected by using proportionate stratified random sampling technique; they were interviewed with a pre-tested, semi-structured interview schedule. 10 traders (wholesalers, retailers) were selected to study the marketing aspect. Secondary data was collected from peer-reviewed journals, websites, organization publications, AKC, and PMAMP profiles. Tomato producers, traders, and extension agents were the source for primary data. Descriptive statistics and chi-square test was used for data analysis using SPSS and MS-Excel software. Findings showed that all the three study sites bear a high potential for good profits through tomato production. The B:C ratio of 1.61 was found in the study area highlights that tomato cultivation is a profitable enterprise for the farmers as well as the traders. The market margin was NRs.32/kg and the producer's share is 46.6% percent in the most used market channel. Middlemen had a major influence on the pricing of tomatoes. The low market price was a major marketing problem faced by the producers followed by market unavailability, price fluctuation, perishable nature, lack of transportation. Despite these problems, farmers interested to grow tomatoes and were satisfied with the production. The study found out that tomato farming could be a highly profitable enterprise in Lalitpur if special support is provided from agriculture offices. Thus, from the study, it is recommended to improve transport facility, market price information, packaging, storage, grading, to fetch a higher price of tomatoes, that would benefit all actors in the value chain.

HIGHLIGHTS

- ① Technological advancement seemed to support the production of tomatoes within the study area.
- ② Advanced value chain activities had not yet been practiced due to lack of awareness regarding the importance of product diversification and unavailability of the food-processing industry.
- ③ Higher profits could be attained with the improvement of production technology, management of marketing system, and extension of linkage between service receiver and producers.

Keywords: Value chain, tomato, Marketing, Price, Problems, Producer's share

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Agriculture is the major economic activity of the Nepalese population accounts for two-thirds of the occupation of the total population is engaged in the agriculture sector (G.C & Ghimire, 2018). Horticulture is one of the important parts of the agricultural sector and contributes around 16% to the AGDP (MoAC, 2012-2013). Vegetable production is an indispensable part of Nepal's farming system for food security and a source of income.

Tomato (*Solanum lycopersicum* L.) is a crucial source of phosphorus, potassium, magnesium, iron, and vitamins. They are the third most important source of vitamin C and the fourth important source of vitamin A in our diets (Bhowmik *et al.* 2012). Tomato is the third most important vegetable after Cauliflower and Cabbage, in terms of production and area in Nepal. Varied agro-climatic regions in Nepal at different times through each year allow year-round production of tomatoes in the country (Sigei *et al.* 2014). Additionally, with the introduction of improved varieties, tomato production has become more suitable for many seasons (Ghimire, Subedi, & Green, 2000). In Nepal, tomato is cultivated in about 20,000 hectares (ha) and about 0.3 million Mt of tomato is produced annually in the country (MoAD, 2014).

The total area under Tomato cultivation is 184 ha; a production of 4191 MT and productivity of 22.78 t/ha (MOF, 2018/19) in Lalitpur in the fiscal year 2018/19. Tomato cultivation has been the major source of income in Lalitpur. The major tomato-producing areas in the district include: Thecho, Lele, Devichaur area of Godavari Municipality, Sankhu, and nearby area of Konjyosam Rural municipality and Malta area of Bagmati Rural Municipality. The tomatoes are sold to districts like Kabhrepalanchowk, Kathmandu, Nuwakot, and Bhaktapur; however, the district has not been able to meet the demands for which Kathmandu has been importing tomatoes from other regions. Tomato marketing has become highly complex and difficult due to the presence of a large number of middlemen, different types of physical, social, economic, and facilitating marketing functions and services. There is no provision of cold storage facility and farmers and traders are unaware of the processing knowledge. There are several unanswered questions related to the tomato marketing chain: the status of tomato input supply, production, and marketing; the common trade link

among various actors, and marketing channels; the key backlogs and opportunities in the market-oriented production of tomatoes.

A value chain analysis covers the total range of activities as a product reaches the consumers from the outset, through different phases of input, transport, and transformation of the product (Airline, 2015; Kaplinsky & Morris, 2001). The detailed mapping of goods and services allows each firm to figure out the role and importance role of the actors for understanding the systemic competitiveness (Kaplinsky & Morris, 2001). The product flow relationship is crucial to find out the voids in the commodity value chain for increasing chain efficiency.

The present study was designed as an effort to study different components of the tomato production, marketing, and consumption mannerism to answer the crucial questions, and identify the strengths and weaknesses related to tomato growers in the Lalitpur district, and recommend better solutions for all actors of the channel and aid in further investigation.

MATERIALS AND METHODS

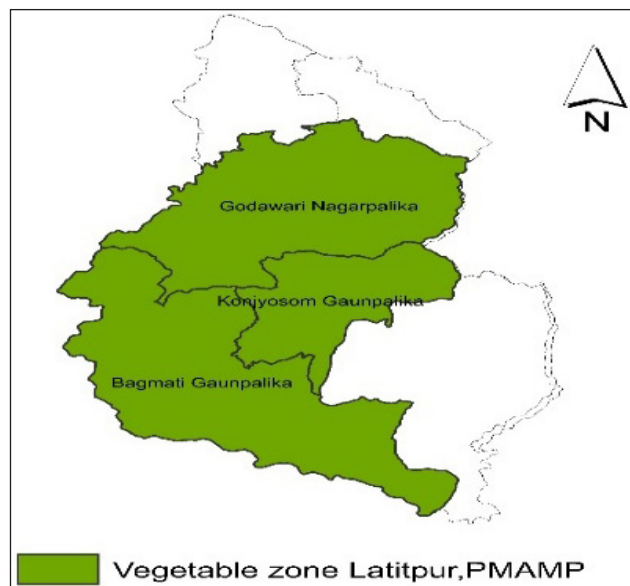
Site selection

The sites Konjyosom Rural Municipality, Godavari Municipality, and Bagmati Rural Municipality in Lalitpur were purposively selected based on area and number of tomatoes growing farmers, and affiliation with PMAMP Vegetable Zone, Project Implementation Unit, Bhaktapur. Lalitpur district (27 32° N latitude; 84 18° E longitude) has an altitude ranging from 300-2700 masl (AKC, 2019), which has recently been designated as the Vegetable zone under PMAMP. The district is surrounded by Kathmandu on the East, Bhaktapur, and Kathmandu on the North, Kavrepalanchowk on the West, and Makwanpur on the South.

Sample and sampling techniques

The respondents included four major stakeholders: farmers, local collectors, wholesalers, and retailers. The list of tomato-growing farmers from each growing site was provided by Vegetable Zone, Thecho. 60 farmers were selected using a proportionate stratified random sampling technique. Additionally, 10 traders were purposively selected

and interviewed from the study areas. This included Local traders, wholesalers, and retailers were identified, who were selected for interview.



Source: Ekantipur, 2017

Fig. 1: Diagram showing the map of study areas in Lalitpur district, 2020

Data collection

Primary data was collected using Key Informant Survey (KIS), Questionnaire Survey, Focus Group Discussion (FGD). A semi-structured questionnaire was prepared by combining close-ended and open-ended questions., after a pretesting of the interview schedule. Key Informant Survey was conducted among the leading farmers and members of Rural Municipalities, Municipalities, Local traders, agricultural officers of Lalitpur district, and representatives of cooperatives. Household surveys provided qualitative and quantitative data based on the semi-structured questionnaire. Triangulation was done in order to accommodate respondents from different backgrounds or positions (Kanj, Macgregor, & Tacoli, 2005). Focus Group Discussions (FGDs) were conducted using the checklist method, after the end of the survey to verify the result obtained from the household survey.

In order to supplement the data from primary sources, various published and unpublished sources from proceeding of various NGOs and INGOs, cooperatives, reports of Agriculture Knowledge Centre (AKC), PMAMP profile, Nepal Agriculture

Research Centre (NARC), Market Development Directorate (MDD), Ministry of Agriculture and Livestock Development (MoALD), Agro-Enterprise Centre (AEC), Center Bureau of Statistics (CBS), Heifer International and USAID Nepal.

Data Analysis

All the collected data were tabulated in Microsoft Excel. Analysis was performed using Statistical Package for Social Sciences (SPSS) and Microsoft Excel (MS Excel). ANOVA and Chi-square test were used for descriptive statistics, and interpretation was done based on the statistical inferences. SWOT analysis was carried out from the information collected from the primary sources.

Benefit-Cost Analysis was done after calculating the total cost and the gross returns from the tomato. Total cost was calculated by adding all the variable costs and fixed costs. The summary of expressions used were:

- ♦ Benefit-cost ratio = Gross Return/Total Variable Cost
- ♦ Gross return = Total quantity of tomato marketed (kg)* price per unit of tomato
- ♦ Total Variable Cost = Cost of FYM + Human Labor Cost + Power Cost

Marketing Margin

Marketing margin is the difference between farm gate price received by the farmers and the price paid by the consumer i.e. retailer's price (Tomek & Robinson, 1981).

$$\text{Marketing margin} = \text{Retailer's Price (Pr)} - \text{Farmgate price (Pf)}$$

For calculating Marketing Efficiency, modified method as suggested as: (Acharya & Agarwal, 2004)

$$ME = FP / (MC + MM)$$

Where, ME = Marketing efficiency

FP = Net price received by the farmer

MC = Total Marketing cost

MM = Total marketing margin

Producer's share is the price received by the producers expressed as the percentage of the retail

price, i.e. the price paid by the consumers. It can be calculated as;

$$Ps = (Pf/Pr) * 100$$

Where, Ps = producer's share

Pr = Retailer's price

Pf = Producer's price

Indexing

Indexing or scaling technique was used to provide a measure of the farmer's viewpoint and extremity concerning the importance given to the different production and marketing problems. The categories were scored where the total score gave respondent's attitude, which was the sum of the total score of respondents using a five-point scale (1, 0.8, 0.6, 0.4, 0.2) indicating extremely severe, moderately severe, severe, less severe and not severe respectively.

$$I_{prob} = \sum(Si * fi / N)$$

where,

I_{prob} = Index Value for Intensity of problem; \sum = Summation; Si = Scale value; Fi = Frequency of importance given by the respondent; N = Total number of respondents

Previously, the technique was used by Subedi *et al.* (2019) and Kalauni and Joshi (2020) to identify and rank the problems associated with the commodity under study.

Value Chain Analysis

A value chain depicts the full range of wide activities required to bring a product or service from conception, through various phases of production (physical transformation and producer services), delivery to final customers, and final disposal after use (Hellin & Meijer, n.d.).

The different existing value chains in the study area were drawn and analyzed. The cost of production and price paid to the concerned stakeholders was determined and the margin to each actor in the value chain was calculated. Similarly, the producer's share and marketing margin was also calculated for each different chain in the study area. Also, the price spread at each step of the value chain was analyzed.

SWOT Analysis

SWOT analysis studies the Strength, Weaknesses, Opportunities, and Threats as a strategic planning tool for interventions and project planning. Questions were asked to list out the internal and external factors to identify the commodities' competitive advantage in the area (Shrestha & Shrestha, 2018).

RESULTS AND DISCUSSION

Table 1 shows the socio-demographic characteristics of tomato farmers in the respective study areas. Comparatively more males were associated with tomato farming compared to females. The population varied among the prevalent ethnic groups (Brahmin/Chhetri/Janajati/ Dalits). Also, the farmers have been cultivating in their lands in the majority, while a few have been taking land under lease.

Value Chain Analysis of Tomato

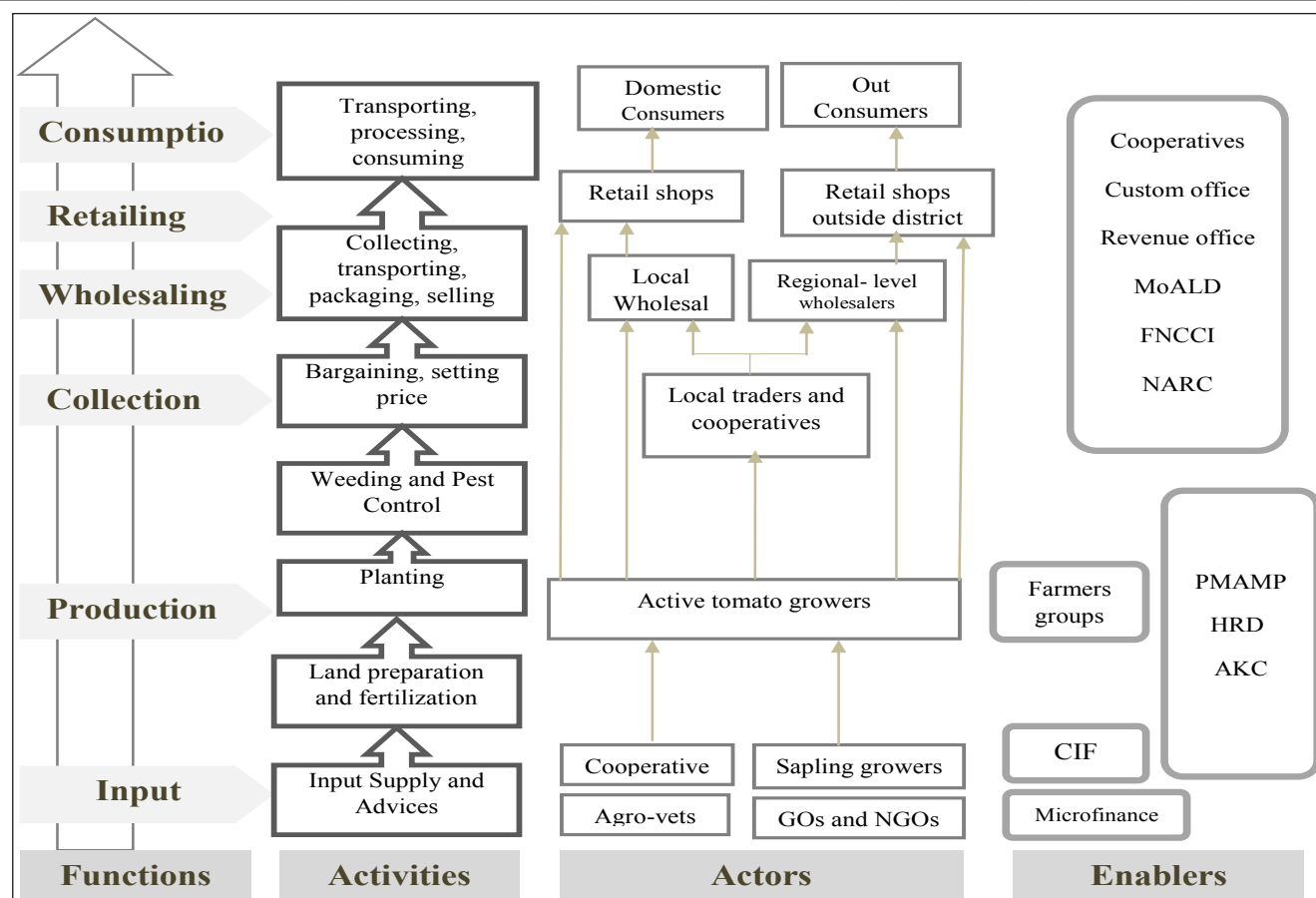
Value Chain Mapping

The information collected in the process was used to construct a value chain map. The value chain map graphically follows the product through its entire process and categories and quantifies the activities through which it passes (Taylor, 2005). It addresses the primary issues at an individual level of a supply chain, rather than as a group or location (Dempsey & Campbell, 2007). Based on the information collected, the value chain involved the input suppliers, producers, traders (wholesalers, retailers), and consumers as the major actors. The value chain comprises of basically three inter-linked components (Hellin & Meijer, n.d.):

- ♦ Value chain actors: they form the main component of the chain who transact the main product.
- ♦ Enabling environment: the critical factors which strengthen the value chain, its environment, and conditions; they consist of authorities, research agencies, and institutions.
- ♦ Service providers. They potentially support the value chain through services including input supplies, information, financial services, transport product development, and diversification.

Table 1: Socio-demographic characteristics of tomato farmers in Lalitpur, Nepal, 2020

Variable	Category	Konjosyam	Godavari	Bagmati	Chi-square	P-value
Sex	Male	13	13	16	6.936	0.031**
	Female	10	7	1		
Age	24-30	4	5	2	52.956	0.591
	31-40	9	5	4		
	41-50	7	7	7		
	51-62	2	3	4		
Education level	Illiterate	0	2	0	11.939	0.451
	Literate	3	3	0		
	Primary	1	0	0		
	Secondary	1	0	2		
	Higher secondary	14	12	12		
	Bachelors	3	3	2		
	Beyond bachelors	1	0	1		
Caste/Ethnicity	Brahmin	11	11	13	9.03	0.172
	Chhetri	6	1	1		
	Janajati	6	7	3		
	Dalits	0	1	0		
Condition of land	Owned	18	17	12	3.848	0.427
	Leased	5	2	3		
	Both	0	1	2		
Number of family members involved	1 to 2	14	9	12	10.821	0.544
	3 to 5	9	9	5		
	More than 5	0	1	0		

**Fig. 2:** Diagram showing the value chain for tomato in Lalitpur district, 2020

Value chain actors and their functions

Input Suppliers

Input suppliers are the foundation for a good value chain. Agricultural inputs: seed, fertilizer, tools, and agrochemicals were the major suppliers that decides the output and profits. Agrovets were the primary contact for agricultural input supply and information. Farmers received inputs/information regarding cultivation, price, and suggestion from AKC, NGOs, PMAMP, and other GOs farmer groups and cooperatives.

Producers

The farmers responsible to transform input supply into output included: subsistence and commercial producers. Farmers in the subsistence level include the ones who sell their surplus produce to local outlets (*Haats*); they use some for the produces for domestic consumption. Commercial farmers produce their products on a larger scale and sell to collectors.

Collectors and traders

Collectors and traders are responsible for transiting farmer-grown tomatoes from the producers to the wholesale markets. Collectors generally include co-operatives who are the center of the collection; they facilitate include buying from farmers, assembling, and selling the commodity to middlemen, to wholesale markets.

Wholesaler

Wholesalers purchase from traders and sell them after storage for a few days. Nearby markets include Balkhu Vegetable Market, Kalimati Vegetable Markets. Such markets generally require government support or are operated by local market management committees. They sell the products to retailers, hotels, and other consuming bodies.

Retailer

Retailers collect commodities from wholesalers and sell them to the consumers. They are responsible for buying tomatoes from wholesalers; transporting, grading, and selling them to consumers at a higher price.

Local Collector

Local collectors are also prevalent in value addition in tomatoes in Lalitpur district. They collect tomatoes at a specified center from a group of vegetables and transfer to the wholesale market. Local Collectors are present in areas like Chapagun, Devichaur.

Consumers

Consumers are the ultimate actors in the value chain. They include the residents of Kathmandu Valley. Domestic households, restaurants, hotels consume a majority of the produce in regular intervals.

Enablers and Facilitators

At the enabler level, these actors support the major actors in terms of knowledge, research, extension, technology development, professional standard maintenance, promotion, joint marketing, or advocacy. To the farmers, Agriculture Knowledge Center and Agriculture Division within the Local bodywork to develop and disseminate different technologies in seasonal and off-season tomatoes. Few microfinance cooperatives also assisted the farmers by providing loans. PMAMP Vegetable zone, Lalitpur effectively helped farmers with training, subsidy provision, input supply assistance, field guidance, soil testing for all vegetables including tomatoes.

Cost of production and return

Cost of production denotes the outlay of funds for the procurement of inputs and labor employed. The cost of cultivation of tomato included: labor, manure, fertilizer, seed, irrigation, pesticides, etc.

Here, human labor was calculated in terms of man-days and converted into monetary terms valuating at the prevailing wage rate. Human labor was required for operations such as: nursery bed preparation, transplanting, weeding, harvesting, pesticide application, etc. Besides these, land rent was considered as a fixed cost incurred during tomato cultivation.

The results revealed that the average cost of production was NRs. 568,160/ha while the average total return was NRs. 914,737/ha (Table 2). The benefit-cost ratio was 1.61 which indicates that

one rupee invested in tomato cultivation gives 1.61 rupees. Thus, tomato cultivation was found to be a profitable enterprise in the study area.

Table 2: Cost distribution of tomato in Lalitpur, Nepal, 2020

Particulars	Cost Incurred (per 0.3 Ha) (In NRs.)	Cost Per Hectare (In NRs.)
Chemical Fertilizer	19650	65,500
Labour	21615	72,050
Seed	12776	42,588
FYM	7860	26,200
Land Preparation	40872	136,240
Pesticide	7860	26,200
Weeding	5895	19,650
HCP	15720	52,400
Tunnel	11475	38,252
Total Fixed Cost	26724	89,080
TOTAL	170448	568,160

Table 3: Economic indicators showing productivity and profitability of tomato farming in Lalitpur, Nepal, 2020

Particulars	Amount (NRs.)
Total cost (NRs/ha)	568160
Average Price (NRs/kg)	28
Gross Revenue (NRs/ha)	914737
Net Profit	346577
B:C Ratio	1.61

Marketing channels

A marketing channel is the route taken by the goods as they move from producers to ultimate consumers (Stanton, 1975). They portray agencies by which the seller markets his product to the ultimate consumers (Howard, 1975). There are mainly five marketing channels used by the farmers of the study area.

1. Producers → Local traders → Wholesaler → Retailer → Consumer
2. Producers → Local traders → Retailer → Consumer
3. Producers → Wholesaler → Retailer → Consumer
4. Producers → Retailer → Consumer
5. Producers → Consumer

Among these, channel 1 is the most used marketing channel in Lalitpur district because local collectors are available within the village and in Chapagaun area (nearest market of the study area). The wholesaler in continuous touch with local collectors picks tomatoes in their own vehicle. As each actor gets good profit, everyone is involved in this marketing channel making it effective and the most popular. However, Channel 2 and 3 are also prevalent in some places of the study area.

Market Margin and Producer's Share

Market margin is the difference between the price paid by the consumer and the price received by the farmers. Similarly, the producer's share is the proportion of the consumer's payment received by the producers. Lower marketing margin and higher producer's share ensure the efficiency of the marketing system hence they are the indicators of efficiency of the existing marketing system. The study shows that the marketing margin of tomatoes was NRs. 28/Kg (Fig. 3).

Marketing margin (MM) = consumer's price (Pc) – Price received by the farmers (Pf)

$$= 60 - 28$$

$$= \text{NRs. } 32/\text{kg}$$

Producer's share = (Pf/Pc) * 100%

$$= (28/60) * 100\%$$

$$= 46\%$$

Marketing Margin of Value Chain Actors in mostly used Marketing Channel

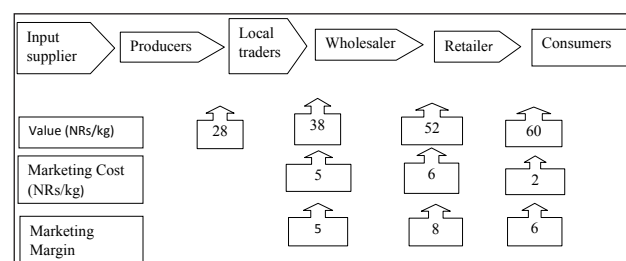


Fig. 3: Marketing margin of value chain actors in mostly used market channel in Lalitpur, Nepal, 2020

Price spread

Price-spread is the difference between the actual price received by the producers, the price paid by the consumers, costs incurred, and margins earned

by the various market intermediaries during the process of marketing.

Price Spread = Price paid by consumer – Price received by producer

$$= 60-28$$

$$= \text{NRs.}32/\text{kg}$$

The price spread for tomato was found to be NRs. 32 per kg.

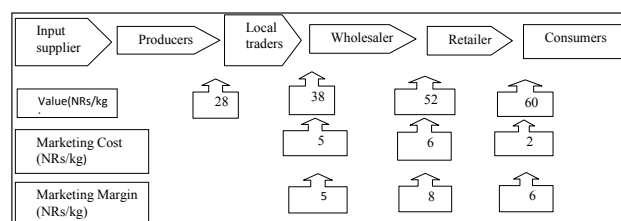


Fig. 4: Price spread for value chain actors in mostly used market channel in Lalitpur, Nepal, 2020

Problems in tomato production

Table 4 shows the seriousness of the production problems based on indexing. The values showed that diseases and pest was the major problem for

the tomato growers in the region, followed by the high price of inputs, and the unavailability of inputs in time. Irrigation and lack of credit were ranked amongst the least influencing problems.

Problems in tomato Marketing

The value obtained from the rank scale showed that low price is the major problem and transportation was the least problematic (Table 5). The relative seriousness faced by the farmers due to low price was followed by market unavailability, lack of storage facility, perishability nature, and transportation problems.

Price satisfaction level

The satisfaction level of the respondent towards last year's price into four levels (Highly satisfied, Satisfied, moderately satisfied, and Dissatisfied), revealed that the majority of farmers were dissatisfied (40 percent) followed by moderately satisfied and none of the respondents were highly satisfied (Table 6).

Table 4: Ranking of the production problems of tomato faced by farmers in Lalitpur, Nepal, 2020

Items	P1 (0.2)	P2 (0.4)	P3 (0.6)	P4 (0.8)	P5 (1)	Total	Weightage	Index
Disease and Pest	10	5	7	18	20	60	42.6	1
High Price of inputs	10	11	16	13	10	60	36.4	2
Unavailability of Inputs in Time	13	13	9	11	14	60	36	3
Irrigation	9	16	16	12	7	60	34.4	4
Lack of Credit	14	15	13	10	8	60	32.6	5

Source: Field Survey (2020).

Note: Figure in the parenthesis indicates score values and 'P' refers to Priority.

Table 5: Ranking of the marketing problems of tomato in Lalitpur, Nepal, 2020

Items	P1(0.2)	P2(0.4)	P3(0.6)	P4(0.8)	P5(1)	Total	Weightage	Index
Low Price	24	18	12	4	2	60	47.6	1
Market Unavailability	11	22	8	12	7	60	39.6	2
Price Fluctuation	20	7	9	7	17	60	37.2	3
Perishable Nature	4	16	21	18	1	60	36.8	4
Lack of Transportation	1	6	11	18	24	60	23.4	5

Source: Field Survey (2020).

Note: Figure in the parenthesis indicate score values and 'P' refers to Priority.

Table 6: Satisfaction level of the respondents towards the last year price (2019)

Satisfaction level	Frequency	Percentage
Highly satisfied	0	0
Satisfied	13	22
Moderately satisfied	23	38
Dissatisfied	24	40
Total	60	100

SWOT ANALYSIS

The tomato production and marketing sector in the study site has the following strength, weaknesses, opportunities, and threats according to the study in Lalitpur, Nepal, 2020.

Strengths	Weaknesses
Production: <ul style="list-style-type: none"> ♦ Climatic suitability and fertile land ♦ Less Investment and time consuming ♦ The comparative advantage over other vegetables ♦ Srijana variety is found to be better yielding in the region. Marketing: <ul style="list-style-type: none"> ♦ Good earning because of high return. ♦ High demand for vegetables within Kathmandu ♦ Proximity to Market (10-30 km) 	Production: <ul style="list-style-type: none"> ♦ Lack of improved knowledge, training, post-harvest handling, grading, packaging ♦ Limited Irrigation facility ♦ Low volume of production ♦ Expensive Input material ♦ Lack of labor and increased wage demand. Marketing: <ul style="list-style-type: none"> ♦ Inadequate market information and management. ♦ Lack of local collection center & price regulation mechanism ♦ Weak bargaining capacity among farmers
Opportunities	Threats
Production: <ul style="list-style-type: none"> ♦ Support from PMAMP, AKC ♦ Favorable agriculture policies and support of inputs ♦ Increasing demand for tomato Marketing: <ul style="list-style-type: none"> ♦ Increasing affordability and consciousness of local people for consumption of vegetables ♦ Relatively high price ♦ Product diversification 	Production: <ul style="list-style-type: none"> ♦ High Incidence of disease and pest ♦ High cost of quality inputs ♦ Vulnerable to hailstones, wind, and heavy rain Marketing: <ul style="list-style-type: none"> ♦ Inconsistent internal and external demand ♦ Monopoly of traders on the pricing of products ♦ Fluctuation in price the inflow of low-priced tomatoes from terai

CONCLUSION

It can be inferred based on the study that Godavari Municipality, Konjyosom Rural Municipality, and Bagmati Rural Municipality are the potential areas of tomato for their edaphic and climatic suitability. An average gross margin of NRs. 32/ha and a B:C ratio of 1.61 in the study area highlights the comparative advantage of tomato cultivation in the region. Recent technological advancement seems to support the production of tomatoes within the study area well. Advanced value chain activities have not yet been practiced at all due to a lack of awareness regarding the importance of product diversification and the unavailability of the food-processing industry. Wholesalers were the most profitable trader and played a significant role in determining the price of Tomato. Higher profits could be attained with the improvement of production technology, management of the marketing system, and extension of linkage between service receivers and producers. The study reveals that the areas for improvement in the tomato value chain include transport facility, market price information, packaging, storage, grading, to fetch a good price of the commodity.

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