## Original Research Article

# Economics of Tomato (*Solanumlycopersicum.L)* Production UnderPlastic Tunnel Technology in Peri-urban Areas of Kathmandu, Nepal


## ABSTRACT

**Aims:** To examine the socio-demographic condition, economic aspects of tomato production in plastic tunnels, involving problems and evaluation of the benefit-cost ratio.
**Study design:**semi-structured questionnaire.
**Place and Duration of Study:**Conducted from May 5 to July 10, 2023, gathered data from 100 tunnel tomato growers from random sampling method from 3 wards in Chandragiri municipality, Kathmandu.
**Methodology:**We included 100tunnel tomato growers(58men, 42 women; age range 30-60 years). This study combined primary and secondary data sources. Primary data were collected from tomato farmers in Chandragiri municipality's VDCs through face-to-face interviews using a pre-tested semi-structured questionnaire. Secondary data were sourced from various publications and reports, both published and unpublished. The semi-structured interviews featured open-ended questions designed to gather detailed information on socio-economic factors, demographics, resource availability, technical aspects, economic status, farm attributes, and farmers' views on the advantages and challenges of tomato cultivation under plastic tunnels.
**Results:**Showed that price fluctuation was the major problem ranking number 1 in the pivotal table. Most farmers (47.6%) were affected by blight and 48.8% by leaf miners. High labor cost NRs. 85438.57 increased the cost of production which was NRs 219366.42 but still farmers were benefitted with benefit cost ratio of 2.10, gross margin NRs. 2614795.04 and net profit NRs. 1771544.32. The research highlights the viability of tomato production in plastic tunnels, urging action on key constraints for potential growth.
**Conclusion:**The use of plastic tunnel technology for tomato cultivation has become more popular among farmers in the peri-urban areas of Kathmandu Valley, providing year-round production and substantial economic benefits. This technology enables continuous growth of tomatoes and other vegetables, improving income during off-seasons and enhancing rural livelihoods. Although the study found tomato farming to be profitable despite high labor costs, farmers encounter numerous challenges, including natural disasters, pest infestations, disease, poor market access, and labor demands. Market-related problems such as fluctuating prices, middleman monopolies, and a lack of adequate storage and collection facilities further complicate the sale of produce, causing significant surplus losses. However, the study identifies several opportunities to improve tomato production for farmers in Chandragiri.


**Comment [U1]:** Writing the abstract in this manner is not common in international journals. Rather, it is written in one paragraph, not multiple paragraphs.


*Keywords: Survey, tunnel-farming, net margin, gross margin, BC ratio*


## 1. INTRODUCTION

Agriculture is a cornerstone of Nepal's economy, providing essential food, income, and employment for many people in rural areas. Although only 21% of the available agricultural land is farmed, agriculture contributes 24.12% to the GDP and remains the primary employment source. The country is geographically segmented into Terai (23% of land), Hill (42%), and Mountain (35%) regions [1]. The varied climate enables the simultaneous cultivation of both warm and cool-season crops. Major cereals like rice, maize, and wheat are produced, and tomatoes, along with other vegetables such as

potatoes, brinjals, carrots, and cauliflower, are widely cultivated for commercial purposes [2]. Tomato is a key vegetable crop in Nepal, scientifically named *Solanumlycopersicum* and commonly known as tomato. Linnaeus assigned the name Solanumlycopersicum in 1753, with "Solanum" derived from the Latin "solamen," meaning "comforting," and "lycopersicum" translating to "wolf peach." In Nepal, vegetable cultivation, including tomatoes, is often more profitable than growing grains due to its lower land requirement and quicker production cycle [3].

During the fiscal year 2078/79, vegetables were cultivated on a vast expanse of 289,000 hectares of land, yielding around 4,153,000 metric tons of produce. Notably, there was a 4.01% increase in production compared to the preceding fiscal year, 2077/78 [4]. Talking about tomato, it ranks third most significantly cultivated vegetable in terms of both land and production volume after cauliflower. It covers an area of 22,600 hectare and production of 616 Metric tons [5]. Tomato plants typically grow 1-3 meters and have a weak steam. It is perennial in its native habitat. Often grown outside as a seasonal crop. Its fruit is of berry type. Fruit is red in color and commonly known as tomato plant. It has been originated in south America, its use as a food is originated in Mexico and spread throughout the world following Spanish colonization of Americas. However, since it is not as sweet as other fruit it can be taken as salad, it can also be used as pickle [6]. Most of the varieties produces red fruits but there are some varieties of tomato that produces yellow, orange, pink, purple, green and white colored fruits[7]. Tomato is the world's third-largest plant in terms of production, following potato and onion [8]. Its many varieties are now widely grown, sometimes in greenhouse in cooler climate. Sufficient sunlight and water with proper drainage is best for the tomato production. It is popular for canning due to its high acidic content [9]. Tomatoes are rich in vitamin A and C and naturally low in calorie [10]. The pigment that makes the tomato red called lycopene [11], which prevent the many types of cancer [12]. The best source of lycopene is found in processed tomato products, such as ketchup and other tomato products. China is the highest tomato producing country followed by India and united states respectively [13].

Tunnel farming is an affordable and straightforward method for managing microclimates, enabling the cultivation of vegetable crops year-round, which has proven to be a highly profitable venture. The regional agriculture research station at Lumle in Kaski developed an offseason tomato cultivation technology using plastic house 25 years ago [14]. The innovation of this plastic house technology, primarily originating from RARS in Lumle and HRD in Khumaltar, has become increasingly favors in areas including Kaski, Syanja, Palpa, and Kathmandu valley. The plastic
house is well-suited for regions situated at elevations ranging from 1000 to 1400 masl. The plastic house technology provides several advantages, namely increased crop productivity, improves soil fertility maintenance, regulated temperature and humidity, safeguarding against wildlife and pest, enhances water conservation, and higher overall returns [15]. Continuous advancements in technology and production practices are being pursued by research institutions, emphasizing improved methods for agricultural productivity. These developments encompass enhanced cultivation practices like usage of superior varieties, optimized seed rates, spacing, sowing and transplanting schedules, as well as the adoption of plastic and poly house technologies. Recommendations also cover the optimal use of fertilizers, improved strategies for weed and pest management, efficient irrigation techniques, and refined methods for post-harvest handling and transportation. Despite these innovations, many farmers face numerous constraints that hinder their production levels. Challenges related to marketing, such as lengthy supply chains, intermediary involvement, and insufficient market information, contribute to the complexity. Price variability further exacerbates the situation, while inadequate knowledge of value chains and inefficient dissemination of market information often result in reduced profitability. In contrast to certain other nations, the Nepalese government does not support off-season tomato cultivation practices. Challenges persist in terms of inadequate training, inconsistent subsidy allocation and insurance coverage, and limited access to quality inputs and low-interest loans, with genuine farmers sometimes losing out to others who exploit available resources. Keeping its view, this study aims to consider the profitability of tomato production under plastic tunnel and its problems during production and marketing along with socio-economic condition of Chandragiri municipality, Kathmandu.

## 2. MATERIAL AND METHODS

The research was carried out in the hilly Central Development Region of Nepal, which is renowned for its substantial vegetable cultivation. Considering the fact that plastic tunnel farming of tomatoes is widespread among farmers in this region in recent years. The study site is selected as it become one of the most potent tunnel tomatoes producing area due to its fertile land, irrigation facilities, road and market accessibility and other facilities. Household survey was carried out from 5$^{th}$ May to 10$^{th}$ July, 2023. Three wards (ward 1= ChouketarDahachok, ward 2= BaadBhanjyang and ward 3= Thankot) were purposively selected as they were recognized as commercial tomato growers and 100 farmers were randomly selected for surveying and used as sampling frame who were listed in the municipality office of Chandragiri municipality. Pre- tested semi -structured questionnaire were administrated among the sampled farmers applying face to face interview technique. A pre-tested semi-structured questionnaire was employed to interview sampled farmers in person and to collected reliable data for fulfilling objectives. Interview timings were adjusted to suit the farmers' schedules.

**Comment [U2]:** ?????????????????????????????? What is this????????????????

**Comment [U3]:** ?????????????????????? I couldn't understand it.

**Comment [U4]:** What is the percentage of the sample from the original population? It is very important to mention the number of members of the community from which the samples were collected

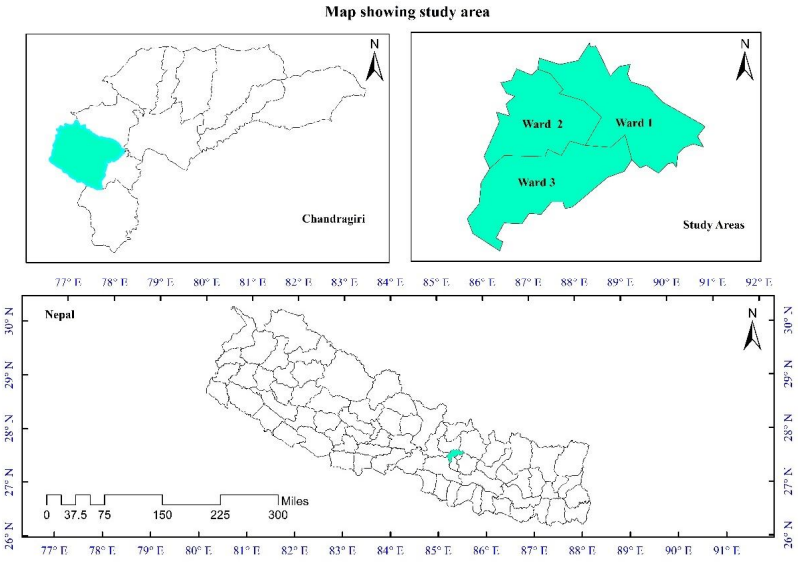



Figure 1: Map showing study area

Both primary and secondary data were employed in this study. Primary data were collected from farmers who grow tomatoes under plastic tunnels in selected VDCs of Chandragiri municipality of Kathmandu Valley. The data collection process utilized a pre-tested semi-structured questionnaire administered through face-to-face interviews. Secondary data were gathered from various published and unpublished sources such as journals, books, reports, and unpublished documents. The semi-structured interview schedule was developed with open-ended questions intended to gather information on socio-economic factors, demographics, resource availability, technical aspects, economic status, farm characteristics, farmers' perceptions, and knowledge regarding tomato cultivation under plastic tunnel technology, including the advantages and challenges associated with it. The data gathered from interviews were first recorded using Computer software Package "MS Excel" and analysis was done through SPSS. Descriptive statistics, such as mean, percentage, and frequency distributions, were employed to describe economic conditions and farm attributes. Analyzed data was then presented in tables, graphs and pie-chart.

## Methods and techniques of data analysis

### 2.1 Socio-demographic variables

Socio demographic variables like age, gender, education level, land holdings and category of farmers were analyzed by using descriptive statistics like frequency, percentage, mean, standard deviation, etc.

### 2.2 Marketing channel

Based on the information obtained from producer, trader and consumers marketing channel was drawn that shows the linkage between input suppliers, producer, local collector/trader, wholesaler, retailer, and consumers. Marketing channel was drawn to identify the effectiveness of the existing marketing channel and to realize and solve the problems during marketing.

### 2.3 Problem ranking

It was done by using Forced ranking technique to know the rank of different constraints faced by farmers during tomato production and marketing. The index was prepared on the basis of responded frequencies. The frequency of response for each problem was tabulated in a table for each problem, then scale value for each rank was calculated. Problem faced by the farmers were ranked by scaling techniques. The formula used for indexing is as below [16],

$I_{imp} = \sum Si\ fi\ /N$

where, $I_{imp}$ = index of importance

$S_i = i^{th}$ scale value (i= 1,2, 3, 4 and 5),

$F_i$ = frequency of $i^{th}$ importance given by the respondents

N= total number of respondents.

### 2.4 Economic variables

Different economic variables were analyzed to the profitability of tomato farming. The cost of production was analyzed by considering all variable costs and fixed costs. The variable cost includes seed cost, fertilizer cost, manure cost, other chemical cost, preparation cost, cost for human resource used, bagging and transportation cost. The fixed cost includes the cost incurred by land as rental value. Total cost of production was calculated by summing up all the expenditure of variable and fixed inputs.

Total cost of production = ∑ of cost incurred in all variable inputs + ∑ of cost incurred in all fixed inputs.

#### 2.4.1 Benefit-Cost ratio

B:C ratio is the ratio of gross income and total cost of production. It can be calculated as, B:C ratio= gross income / total cost of production

Where, gross income = per kg of tomato × quantity of tomato marketed and total cost of production = total variable cost + total fixed price.

#### 2.4.2 Gross revenue

Gross revenue is obtained by multiplying the selling price of tomato with its quantity.

#### 2.4.3 Net profit

Net profit is obtained when we subtract indirect expenses from gross profit, where is gross profit is obtained by subtracting direct expenses from revenue.

#### 2.4.4Gross margin and net margin

Gross margin is the difference between the gross return and the variable cost incurred during production. The gross margin tells us about whether the cost incurred during production is covered by the value of the product or not. It can be calculated as,

gross margin = gross return - total variable cost incurred.

where,

Gross return = Per kg price of tomato × Quantity of tomato market

Net margin = Gross return - Total cost of production

Total cost of production = Total variable cost + Total fixed cost.

## 3. RESULTS AND DISCUSSION

### 3.1 Socio-demographic condition

The socio-economic makeup of the respondents includes aspects like how the population is spread out, gender ratios, marital status, family sizes, levels of education, primary jobs, land ownership status, sources to get agriculture inputs and availability of labor. The majority of respondents accounting for 74 in number were aged between 31 and 59 years old. Males outnumbered females, with 58 respondents compared to 42. Educational attainment ranged from illiteracy to bachelor's degrees and higher. Most respondents lived in nuclear families (65) with married (80) and unmarried (20). Labor availability was considered easy by 57 respondents with foreign employment noted as a primary factor contributing to labor shortages. 43 respondents had more than ten years of experience. Additionally, 19 respondents claim that they themselves substituted agricultural labor and 55 respondents got sources of agriculture inputs from agro-vets while 8 respondents got from governments.

**Comment [U5]:** The ratio of total income to total production cost

**Comment [U6]:** The researcher mentioned that the number of participants is 100, not 74

**Comment [U7]:** What the meaning of this word? Nuclear?? It is preferable to clarify its meaning

Table 1: Socio-demographic condition

| Age group | Frequency | Gender | Frequency |
|---|---|---|---|
| <31 | 15 | Male | 58 |
| 31-59 | 74 | Female | 42 |
| >59 | 11 | Total | 100 |
| Total | 100 | | |
| Marital status | Frequency | Family type | |
| Married | 80 | Nuclear | 65 |
| Unmarried | 20 | Joint | 35 |
| Total | 100 | Total | 100 |
| Education level | Frequency | Availability of Labor | Frequency |
| Illiterate | 14 | Easily | 57 |
| Primary Level | 31 | Difficulty | 18 |
| Secondary Level | 38 | Very difficulty | 6 |
| Bachelor and above | 17 | Managed by family labor | 19 |
| Total | 100 | Total | 100 |
| Year of experience | Frequency | Sources to get agriculture inputs | Frequency |
| <10 years | 17 | Agro-vets | 55 |
| 5-10 years | 40 | Cooperatives | 26 |
| >10 years | 43 | Governments | 8 |
| Total | 100 | Others | 11 |
| | | Total | 100 |

### 3.2 Whom to sell the product

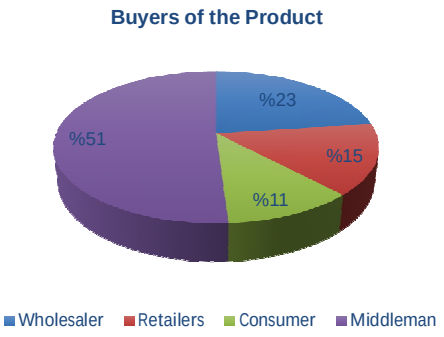
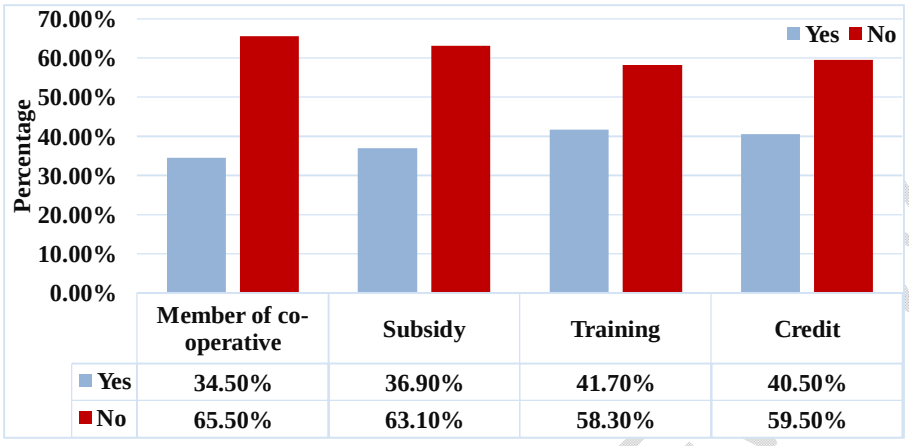



Figure 2: Buyers of the Product

It was found that majority of the producer sell their product to middleman (51.2%), followed by wholesaler (22.6%), Retailers (15%) and Consumers (11%). More than half of the farmers of this study area sells their produce to the wholesale market via middleman to ensure the market of their produce. Whereas the rest of the farmers closer to the market sell their produce directly to the retailers and very few of the farmers sell the produce to consumers from their farm.

### 3.3 Access to agricultural services and facilities

Farmer's access to training, membership in farmer's group/cooperatives, subsidy and credit facilities are important to build and strengthen the capacity of the farmers. These services also contribute to agricultural sustainability, livelihood improvement and well-being of populations in the study areas. In the study area, only 41.7% of respondents had received training related to Tomato production but majority of the respondents i.e., 58.3%, had not received any training related to tomato production. Similarly, 34.5% respondents were members of farmers group or cooperatives whereas remaining 65.5% did not have any membership of farmers group or cooperatives.




| | Member of co-operative | Subsidy | Training | Credit |
|---|---|---|---|---|
| Yes | 34.50% | 36.90% | 41.70% | 40.50% |
| No | 65.50% | 63.10% | 58.30% | 59.50% |

Figure 3: Bar diagram showing farmers access to agricultural services and facilities

### 3.4Reason to adopt plastic tunnel

The major reason for adopting plastic tunnel was protection from extreme weather conditions as observed from the responses of 42 farmers. Whereas 19 farmers grew their tomatoes in plastic tunnel for the protection from biotic factors like insect pest and diseases. Likewise, number of farmers adopting tunnel farming for the protection from rain, hailstone and as a hobby were 22, 12 and 5 respectively.

### 3.5 Impact on household income from tomato cultivation

Among the households in the study area, 66% noted a slight rise in income due to tomato cultivation in plastic tunnels. Meanwhile, 10% had a considerable income increase, 17% saw no change, 5% experienced a slight decline and 2% recorded a significant decrease.

### 3.6 Marketing channel

Effective marketing channel is the most important during tomato marketing. The involvement of the middle person increases the price to be paid by the consumers and reduces the farm gate price. Most of the farmers i.e 48% respondents in the study area were found to adopt Channel IV where producer sell their produce to middleman who in turn sell tomato to the wholesaler and then to retailer and finally to consumer, 23% respondents sell their produce to the wholesaler who in turn sell tomato to the retailers and then to consumer. 17% of respondents sell their produce to retailers and then to consumer. 12% of respondents in the study area were found adopting Channel I where producer directly sell their produce to the consumer.

### 3.7 Information source on market price of tomato

Access to market price data empowers producers to negotiate more effectively with traders, potentially securing better prices. It is evident that the main source of information regarding market price of tomato in this study area was social media (39%) and friends and relatives (32%) and other sources like middleman (18%), co-operatives (11%) as well.

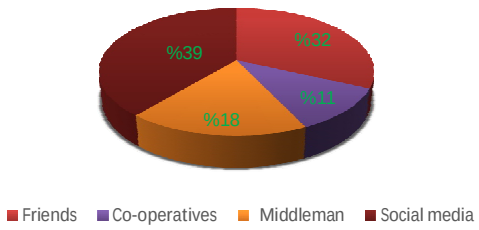


Figure 4: Information source on market price of tomato

### 3.8Major diseases of tomato

Incidence of disease was one of the major problems faced by the farmers in the area. Majority of the farmers (47%) said that Late blight/early blight was the major disease occurring in the farm. It was followed by viral disease (24%) and damping off (17%). Similarly, 12% farmer said wilt was the major disease in the farm.

### 3.9 Major insect and pest

Table 2: Major insect pest prevailing in the study area

**Comment [U8]:** It is preferable to remove Table 2 from the research and limit it to the researcher's explanation

| Reason to adopt plastic tunnel | Frequency | Impact on household income | Frequency | Marketing channel | Frequency | Major diseases of tomato | frequency | Major insect and pest | frequency |
|---|---|---|---|---|---|---|---|---|---|
| Protection from extreme weather conditions | 42 | significant increase | 10 | Channel I (Producer-consumer) | 12 | Late blight/early blight | 47 | Tomato leaf miner | 49 |
| Protection from hailstone | 12 | slight increase | 66 | Channel II (Producer-Retailer-Consumer) | 17 | Viral diseases | 24 | Fruit borer | 33 |
| Protection from rain | 22 | no change | 17 | Channel III (Producer-Wholesaler-Retailer-consumer) | 23 | Damping off | 17 | Whitefly | 17 |
| Protection from insect and disease | 19 | Slight decrease | 5 | Channel IV (Producer-middleman-wholesaler-retailer-consumer) | 48 | wilt | 12 | Aphid | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Hobby | 5 | Significant decrease | 2 | | | | | | |

Insects and pest are the major factors which cause heavy loss of production. Majority of the farmers (49%) said that leaf miner was the major insect of tomato in their farm. Similarly, 33% farmers said Fruit borer causes heavy loss in their farm. Whiteflies were major problem for 17% respondents. Aphid was main problem for 1% respondent.

## 3.10 Problems associated with tomato cultivation

### 3.10.1 Ranking of the problem faced by farmers during tomato production

A simple indexing technique was used to analyse the major production problem. Natural hazards such as erratic rain, hailstone, extreme temperature etc were the major problems faced by farmers during production which led to flower fall and hindrance in pollination process, consequently resulting in loss of production. The second most significant problem was incidence of diseases-pest. Also, poor market access and high cost of input and unavailability of quality seeds were also reported as problems by many farmers. Poor irrigation is least significant problem for tomato production by the farmers of the study areas.

Table 3: Ranking of the problem faced by farmers during tomato production

| Problems | Priorities given by respondents | | | | | Total score $=\Sigma S_i f_i$ | Imp= $\Sigma S_i f_i/N$ | Rank |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | | | |
| Poor market access and high cost of input | 59 | 11 | 18 | 7 | 5 | 82.4 | 0.824 | III |
| Incidence of disease pest | 54 | 33 | 6 | 4 | 3 | 86.2 | 0.862 | II |
| Poor irrigation facility | 16 | 10 | 11 | 24 | 39 | 48 | 0.48 | V |
| Unavailability of quality seeds | 33 | 37 | 4 | 9 | 17 | 72 | 0.72 | IV |
| Natural hazard | 83 | 6 | 3 | 4 | 4 | 92 | 0.92 | I |

**Comment [U9]:** I think the researcher should have used a five-point Likert scale and tested the answers of the sample members through the following:
Calculating the arithmetic mean of the sample members' answers
Calculating the standard deviation of the sample members' answers
percentage
t-test

### 3.10.2 Ranking of the problem faced by farmers during marketing

**Comment [U10]:** It is not possible to judge the credibility of the sample members' answers except by testing those answers. Otherwise, the sample members' answers will be subject to chance. Therefore, I recommend conducting a five-point Likert test.

Every business, including farming, revolves around two core functions: production and marketing. Even with excellent production capabilities, insufficient attention to marketing can lead to minimal income. Therefore, it is crucial for tomato farmers to be well-informed about marketing challenges. In the study area, farmers faced several significant issues, with fluctuating market prices being the most severe (index value: 0.874) as there is unstable government policies and seasonal variations, while lack of technical knowledge relatively posed the least severe challenge (index value: 0.584). The second most critical issues included poor bargaining power and the monopoly of middlemen (index value: 0.746), followed by inadequate storage and collection facilities. Furthermore, farmers struggled with limited access to crucial market information.

Table 4: Ranking of the problem faced by farmers during marketing

| PROBLEMS | Priorities given by the respondents | | | | | Total score = $\Sigma S_i f_i$ | Imp = $\Sigma S_i f_i/N$ | Rank |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Lack of market information | 14 | 25 | 26 | 20 | 15 | 60.6 | 0.606 | IV |
| Fluctuation in market price | 61 | 25 | 7 | 4 | 3 | 87.4 | 0.874 | I |
| Poor bargaining power and monopoly of middleman | 38 | 27 | 13 | 14 | 8 | 74.6 | 0.746 | II |
| Lack of technical knowledge | 12 | 19 | 37 | 13 | 19 | 58.4 | 0.584 | V |
| Lack of storage and collection centers | 30 | 28 | 13 | 11 | 18 | 68.2 | 0.682 | III |

### 3.11Economic analysis

An economic assessment of tomato farming involved determining land allocation, production levels, production costs, income generated from sales, and benefit-cost ratios using a simplified method. All data was systematically analyzed per hectare or annually

### 3.11.1 Cost of production

The cost of producing tomatoes under plastic tunnel conditions was analyzed by dividing it into variable costs and fixed costs. All fixed expenses were calculated per hectare.

#### *3.11.1.1 Fixed cost*

Every cost associated with fixed inputs utilized in tomato production under the plastic tunnel method was carefully computed. Rent on land and constructing materials were considered on fixed cost for one hectare of land and obtained NRs 348000/ha per year.

**Comment [U11]:** The costs of depreciation and interest on capital must be included among the fixed costs

#### *3.11.1.2 Variable cost*

The variable costs of tomato farming per hectare were calculated by totaling the financial outlay for all variable inputs, which encompass seeds, fertilizers, manures, pesticides, labor, intercultural operation and harvesting.

### 3.11.2 Total cost of production

The overall expenses for cultivating tomatoes per hectare within a plastic tunnel include both the variable and fixed costs of all inputs utilized. Research findings indicate that the yearly total cost of tomato production per hectare was NRs. 843250.72 with total production of 42614kg/ha. The cost of production per kg of tomato was NRs 37.38

Table 5: Cost of Production

| **Inputs** | **Cost (NRs/hectare)** | **% Share in cost of production** |
|---|---|---|
| **Variable cost** | | |
| Land Preparation | 124390.1 | 14.75 |
| Seed | 15072.54 | 1.78 |
| Nursery Preparation | 10079.8 | 1.20 |
| Transplantation | 10579.5 | 1.26 |
| Fertilizers | | |
| FYM | 110079.8 | 13.05 |
| Urea | 4867.08 | 0.58 |
| DAP | 18320.87 | 2.17 |

| | | |
|---|---|---|
| MOP | 4642.55 | 0.55 |
| Micronutrient | 11558.95 | 1.37 |
| Poultry manure | 16654.69 | 1.98 |
| Pesticide | 35210.8 | 4.18 |
| Labour cost | | |
| Intercultural operation | 110079.8 | 13.05 |
| Harvesting | 23714.24 | 2.81 |
| **Total variable cost** | 495250.72 | **58.73** |
| **Fixed cost** | | |
| Land rent | 30000 | 3.56 |
| Construction costs (including pipe, plastic, fitting materials etc) | 318000 | 37.71 |
| **Total fixed cost** | 348000 | 41.27 |
| **Total cost** | 843250.72 | **100** |
| **Cost of production per Kg (NRs)** | **37.82** | |
| **Total production** | 42614kg/ha | |

**3.11.3 Price of from tomato**

Tomatoes, being perishable, face daily price variations due to unpredictable production and demand cycles. Those grown in greenhouses are mainly available off-season, with peak production occurring over seven months from July/August to January/February. The highest average farm gate and retail prices are seen from September to November when field-grown tomatoes are scarce, festivals, consumers favor their quality and size. Conversely, prices are lowest in July/August and January/February. Field-grown tomatoes from various parts of the country are cheaper and more readily available from March to June.

**Comment [U12]:** I suggest that the researcher indicate the dates of cultivation of these types of tomato using the plastic tunnel method

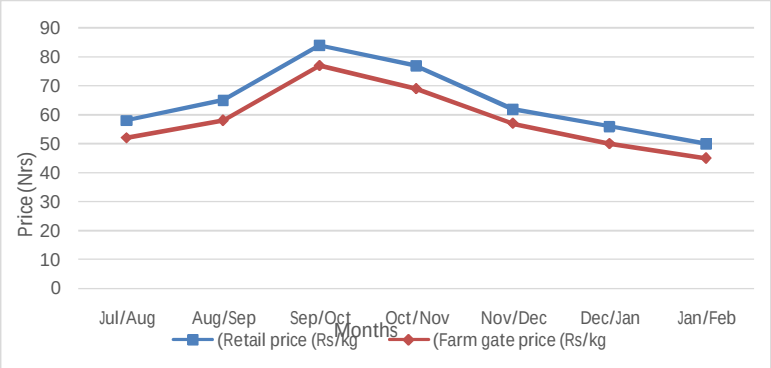



Figure 5: Market Price of tomato

**3.11.4Economics of production**

***3.11.4.1 Returns from tomato production***

The study computed the gross return from tomato production, which represents the total monetary worth of the harvested yield. It was found that the gross return per hectare per year for tomatoes grown under a plastic tunnel was NRs. 2,614,795.04.

Profit from tomato production

Profit in tomato production under a plastic tunnel is calculated as the difference between total revenue and total costs, which include both fixed and variable costs. Fixed costs encompass construction costs and land rent. The study revealed a net return of NRs. 1771544.32 per hectare per year.

***3.11.4.2 Benefit cost ratio of tomato production***

The benefit-cost ratio assesses the efficiency of recovering production costs through product earnings and provides a straightforward measure of return on investment. It also serves to evaluate the overall value of a project or business. Based on the study, the average benefit-cost ratio for tomato production using plastic tunnel technology per hectare was 2.10.

Table 6: Economics of production

| **Particulars** | **Amount** |
|---|---|
| **Total cost of production (NRs/ha)** | 843250.72 |
| **Average production (kg/ha)** | 42614 |
| **Average Price (NRs/kg)** | 61.36 |
| **Gross revenue (NRs/ha)** | 2614795.04 |
| **Net profit (NRs/ha)** | 1771544.32 |
| **Benefit cost ratio** | 2.10 |

## 4. CONCLUSION

Tomato cultivation using plastic tunnel technology has become increasingly popular among farmers in peri-urban areas around Kathmandu valley, offering year-round production opportunities and significant economic benefits for households. The technology not only supports continuous tomato and vegetable growth but also enhances income generation during off-seasons, thereby improving rural livelihoods. Despite the high costs associated with labor, the study revealed tomato farming to be a profitable enterprise in the area under review. Farmers frequently encounter challenges such as natural hazards, disease and pest infestations, poor markets access, and labor-intensive production processes. Market-related issues, including fluctuation in market price, monopoly of middleman, lack of storage and collection centers and lack of technical knowledge, further complicate tomato sales. The absence of adequate storage facilities results in significant losses of surplus produce after harvest. However, the study identifies many opportunities for enhancing tomato production that could benefit farmers in Chandragiri.

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