# DEMAND AND SUPPLY SITUATION OF TOMATO IN NEPAL

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Ministry of Agriculture Development
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# FOREWORD

Agriculture Development Strategy, 2015-35 is prioritized horticultural crops for import substitution and trade surplus. Horticultural crops are of great importance for increasing the share of agriculture in gross domestic product of the country. Commercialization of high value and low volume crops farming in the country is getting momentum at present. Majority of the farmers are shifting from the farming of agronomic crops to the horticultural crops nowadays. In this aspect, fruit farming is gaining popularity among the farmers of Terai, mid-hills and High hills of Nepal. Though farmers are trying to be commercial, there is lack of sufficient research and experiment in the fruit farming because these crops are perennial in nature. It is necessary to understand the farm conditions and household characteristics under which they are operating in order to help the farmers in production planning and resource utilization. In order to assist them substantial information has to be generate and analyzed by farm as far as possible. Profitability of the farm business is a pre-condition for attracting farmers for increasing the agricultural production in the country. Comparing the demand and suplly of tomato are necessary to device national policies for making the farm production viable. This is first attempt to publish demand and supply situation of tomato in Nepal. This report is published to help the farmers, agribusiness operators, researchers, academicians, executives and policy makers for the first time.

I am highly grateful to those farmers and agribusiness operators who provided useful information on the survey for this study. I fully appreciate the efforts and hard works of staffs involved in field survey, review of secondary books, literature review data analysis and writing this report. Special thanks go to dedicated Agricultural Economist Mr. Maniratna Aryal for his hard work in preparing this report. I am also thankful to Senior Statistical Officer Dinesh Bhattarai for helping in the data management and field work. I also acknowledge the help of all the staffs under this programme for their direct and indirect help in completing this study.

I welcome reviews, comments and criticisms on this report from the users so that we can improve it further in the coming years.

**Netra Bahadur Bhandari**

For Chief

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# ABBREVIATIONS AND ACRONYMS

| | | |
|---|---|---|
| ABPMDD | : | Agribusiness Promotion and Marketing Development Directorate |
| ABPSD | : | Agribusiness Promotion and Statistics Division |
| ADBL | : | Agriculture Development Bank limited |
| AEC | : | Agro Enterprise Center |
| BS | : | Bikram Sambat |
| CBS | : | Central Bureau of Statistics |
| DADO | : | District Agriculture Development Office |
| DDC | : | District Development Committee |
| DoA | : | Department of Agriculture |
| GO | : | Governmental Organizations |
| GoN | : | Government of Nepal |
| Ha | : | Hectare |
| KFVWM | : | Kalimati Fruits & Vegetables Wholesale Market |
| Kg | : | Kilogram |
| MoAD | : | Ministry of Agriculture Development |
| MRSMP | : | Market Research and Statistics Management Program |
| Mt | : | Metric Ton |
| NARC | : | Nepal Agricultural Research Council |
| NGO | : | Non-Government Organization |
| PRA | : | Participatory Rural Appraisal |
| RRA | : | Rapid Rural Appraisal |
| PACT | : | Project for Agriculture Commercialization and Trade |
| VDC | : | Village Development Committee |
| VDD | : | Vegetable Development Directorate |

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# SECTION A

## 1. INTRODUCTION

### 1.1 Background

Tomato (*Lycopersicum esculentum*) belongs to the family, Solanaceae. The plants typically grow 1–3 meters (3–10 ft) in height and have a weak stem that often sprawls over the ground and vines over other plants. It is a perennial in its native habitat, often grown outdoors as a seasonal crop. It is edible, often red fruit/berry, commonly known as a tomato plant. Originated in the South American Andes, its use as a food originated in Mexico, and spread throughout the world following the Spanish colonization of the Americas. Botanically, tomato is the ovary of a flowering plant, therefore it is a fruit, or more specifically, a berry. However, since it is not as sweet as other fruits and is most often served in salads or as a part of main dish - most people refer to it as a vegetable. China being the largest producer (One quarter)of tomato, followed by India and the United States. There are different varieties of tomato mostly producing red fruit, but there are also some tomato varieties that produce yellow, orange, pink, purple, green and white fruit. Tomato plants vary in size from small cherry tomatoes to elongated plum tomatoes. An average common tomato weighs approximately 100 grams. Its many varieties are now widely grown, sometimes in greenhouses in cooler climates. Production of tomato, needs sufficient sunshine and water with good drainage facility. It has multiple culinary uses and its' high acidic content makes it very popular for canning. Tomatoes are high in Vitamin A and C and naturally low in calories. They are also an excellent source of lycopene, which is the pigment that makes tomatoes red and has been

linked to the prevention of many types of cancer. These free radicals are what can potentially lead to cancer, heart disease and premature aging. The best sources of lycopene are found in processed tomato products, such as ketchup and other tomato products. The world dedicated 4.8 million hectares in 2012 for tomato cultivation and the total production was about 161.8 million tonnes. The average world farm yield for tomato was 33.6 tonnes per hectare, in 2012. Tomato farms in the Netherlands were the most productive in 2012, with a nationwide average of 476 tonnes per hectare, followed by Belgium (463 tonnes per hectare) and Iceland (429 tonnes per hectare).

In 2012, tomato production was valued at 58 billion dollars and tomatoes were the eighth most valuable agricultural product worldwide. According to FAOSTAT, the top producers of tomatoes (in tonnes) were:

Table 1 : Top producers of Tomato in the world

| Rank | Country | Production(MT) |
|---|---|---|
| 1 | China | 50,000,000 |
| 2 | India | 17,500,000 |
| 3 | United States | 13,206,950 |
| 4 | Turkey | 11,350,000 |
| 5 | Egypt | 8,625,219 |
| 6 | Iran | 6,000,000 |
| 7 | Italy | 5,131,977 |
| 8 | Spain | 4,007,000 |
| 9 | Brazil | 3,873,985 |
| 10 | Mexico | 3,433,567 |

There are around 7,500 tomato varieties grown for various purposes. Heirloom tomatoes are becoming increasingly popular, particularly among home gardeners and organic producers, since they tend to produce more interesting and flavorful crops at the cost of disease resistance and productivity. In 1973, Israeli scientists developed the world's first long

shelf-life commercial tomato varieties. Hybrid plants remain common, since they tend to be heavier producers, and sometimes combine unusual characteristics of heirloom tomatoes with the ruggedness of conventional commercial tomatoes.

Majority of Nepalese people depend on agriculture for their livelihoods. This sector alone contributed about 33.7% of nation's GDP in the year 2014/15 (World Bank, 2014). Government has prioritized agriculture sector and expended NRs. 2650 million in 2014/15 which was 18.18% higher than the previous year and the agriculture budget increased by 35.56% in 2011 compared to 2010 (MoAD, 2015). Despite the priority given to agricultural sector for the last many years, the country's rural poverty and backwardness has not changed significantly over the years. In the year 2014/15, the average economic growth will be confined to 0.77 percent and the growth rate of the agriculture sector is only 1.3 percent due to devastating earthquake and blockade by India. Traditional and conventional subsistence farming system, lack of rural infrastructures facilities, lack of market information system, inadequate technological extension as well as marketing support system, unavailability of sufficient quantity of quality production inputs, and weak linkages among the stakeholders are hindering the rapid development of the agriculture sector. Nevertheless, agriculture commercialization and production of high value crops is gradually increasing. Fresh seasonal and off-season vegetables have been categorized as high value crops. The Agriculture Perspective Plan (APP) designated vegetable crops as one of the priority crops for Nepal's agriculture development. Different promotional campaigning for the commercial production of vegetables has been initiated by government as well as private sector to increase the income of farmers and generation of employment opportunities at rural areas of the country resulting into significant increment of vegetable production. In the year 2013/014, the area of vegetable crops was 2,54,932 ha, total production was recorded at 34,21,035 mt (Table-4) and the yield was recorded at 13,419 kg/ha.

## 1.2 Agriculture and GDP contribution

The Central Bureau of Statistics (CBS) has come up with preliminary estimates of national accounts for FY 2014. It projects real GDP growth (basic prices) at 5.2% in FY 2014, up from 3.5% revised estimated for FY 2013 but lower than the government's target of 5.5% targeted in the FY 2014 budget. The main driver of growth is projected to be services sector (growth of 6.1%), followed by agriculture sector (growth of 4.7%, up from a sluggish 1.1% in FY 2013) and industry sector (growth of 2.7%).The size of the economy is projected to be US$19.4 billion in FY 2014, slightly up from US$19.2 billion in FY 2013. In Nepalese rupee, the size of the economy in FY 2014 is projected to be NRs 1.9 trillion.

Table 2 : GDP of different sectors of Nepal, 2015

| GDP_NEPAL | FY 2012 | FY 2013 | FY 2014 |
|---|---|---|---|
| GDP growth rate (basic prices) | 4.6 | 3.5 | 5.2 |
| Agriculture | 4.6 | 1.1 | 4.7 |
| Industry | 3.0 | 2.5 | 2.7 |
| Services | 5.0 | 5.2 | 6.1 |
| Composition of GDP (%) | | | |
| Agriculture | 35.8 | 34.5 | 33.7 |
| Industry | 14.4 | 14.6 | 14.0 |
| Services | 49.8 | 51.0 | 52.2 |
| GDP (current producers prices) | | | |
| GDP, NRs billion | 1527.3 | 1692.6 | 1928.5 |
| GDP, $ billion | 18.9 | 19.2 | 19.4 |

Due to devastating earthquake that occurred in the beginning of this year, not only the GDP slumped but it rendered physical damage equivalent to one third of the GDP. Therefore, overall economic growth in FY 2013/14 which was estimated to grow by 6 percent was confined to only at 3 percent (MOF, 2015). A 6 percent of economic growth was targeted in the current FY expecting that after the declaration of new Constitution, all efforts will be concentrated on economic and social development; positive environment will be created for the Government for internal and foreign investment

through the economic reform program, construction of development will be resumed and economic activities will be expanded through the increment of Government and private investment for post-earthquake reconstruction. However, it is expected that the economic growth of this year will be confined to 2 percent due to obstruction of supply system and thereby substantive reduction of economic activities and adverse impact of both agriculture and non-agriculture sectors. Economic growth is expected to further decline if the situation of blockade, strike and obstruction of supply system continues.

Agricultural growth is expected to be around 1.3 percent in the current year 2015 whereas it was 1.9 percent in the last FY 2014. Because of unfavorable weather which impacted summer crops, production of maize and rice is expected to decline by 10 and 5 percent respectively. Maize accounts for 7 percent contribution on agro-production whereas rice accounts for 21 percent. Wheat production is expected to decline by 30% in the absence of supply of regular chemical fertilizer. Country's annual food grain requirement is 5.34 million metric tons. Its stock was 1,55,000 tons in last mid July. Such decline in production has created challenges in maintaining food security.

In Nepal, there is a great potentiality of growing large number of vegetable crops because of the availability of a wide range of agroclimatic and topographical conditions from subtropical, temperate to cold climate. Such diverse agro-ecological zones favor the successful cultivation of vegetable round the year in the country. Nepal produces vegetables worth NRs 55 billion annually and around 70 percent of total household of country are being involving in vegetable farming with about NRs 12 billion investment in farming every year. Terai is the major vegetable growing area with an annual production of 1,437,921 mt, followed by hilly region with 1,261,041 mt. Of the total production, 39 percent (1.10 million mt.) is used for household consumption and 61 percent (1.71 million mt) for sale (PACT, 2012). Among the various potential vegetables, tomato is the major one

from Terai to hills of Nepal. It is most important vegetable crop having high market potentialities. While open field cultivation during Autumn-Winter is common in Terai, inner Terai and foot hills, cultivation inside plastic tunnels in Summer-Rainy season in the hills is getting popularity which is sold as off-season product fetching higher prices in Terai of Nepal and nearby Indian markets. Thus, there is comparative advantage for mid hills and high hills for income generation and improve the livelihood through tomato farming.

### 1.3 Production Environment

Tomatoes can be grown optimally in deep, medium textured sandy loam or loamy, fertile and well-drained soils. Sites that have good air movement (to reduce disease) and that are free from problem weeds are preferred. The degree to which the soil adequately provides physical support and anchorage, soil nutrients, and water depends upon topography, soil type, soil structure and soil management practices. The extent to which the root systems of tomato plants develop is influenced by the soil profile. Tomatoes are considered to be deep rooted crop. The majority of roots, however, are in the upper 12 to 24 inches of soil. Since root development is severely limited by compacted soil, proper land preparation should eliminate or significantly reduce soil compaction and hard pans. Tomatoes are usually transplanted into plastic mulch on raised beds. A raised bed will warm up more quickly in the spring and therefore will enhance earlier growth. Since tomatoes grow poorly in excessively wet soils, a raised bed facilitates drainage and helps prevent water logging in low areas or in poorly drained soils. The negative aspect is that tomatoes planted on raised beds may require more irrigation during drought conditions. Tomato production is common in most of the farming communities of Nepal. It is the most popular and high value vegetable crop of Nepal. Fresh tomato as well as processed products has high market demand in Nepal and also Nepalese tomato has good marketing opportunities in bordering Indian market, especially during off-season. Tomatoes are a warm season crop and are sensitive to frost. They are

usually cultivated in sub-tropical and warm temperate climates. Suitable range of temperature is 23°C-27°C and temperatures below 15°C and above 35°C are not desirable. Temperature affects germination, crop standing and ultimately affects yield, quality and thereby prices. The required temperature regime exists in different agro-climatic regions of Nepal at different times of the year that allows almost year-round production by utilizing different geographical regions of the country. Tomatoes come in a number of varieties, size and shape. Each variety has its own shape, color, size, timing of cultivation, duration of harvesting, yield, disease resistance, etc.

Table-3 presents the varieties of officially released by the Ministry of Agriculture and their yield potentials with recommendation domain. Some popular tomato varieties among farmers in Nepal are Abinash, Allrounder, Trishul, Sirjana, Shamjhana, Dhanalaxmi Indira, Roma, Pusa Ruby, NBL-1, and others. Among them, Srijana, Samjhana, NBL-1, Allrounder, and Pusa Ruby are the most popular varieties in Central Development Region of the country.

Table 3: Released and Registered Tomato Varieties, 1960-2016

| Name of Released Varieties | Year of release | Yield Potential (Mt/ha) | Maturity (Days) | Recommended Domain | Origin |
|---|---|---|---|---|---|
| Srijana | 2010 | 10 | 70-80 | Mid Hill and Terai | Nepal |
| Roma | 1995 | 12-15 | 65-70 | Mid Hill and Terai | |
| Manprekas | 1995 | 20-40 | 80-90 | Mid Hill and Terai | |
| NBL-1 | 1990 | 20-30 | 65-70 | High & Mid Hill, Terai | |
| Pusa Ruby | 1990 | 15.0 | 60 | High & Mid Hill and Terai | India |

*Source: Krishi Diary, 2015*

Tomato is labor intensive crop, wage alone constituting half of the total

cost of production. Production peaks in summer in the Hills (from May to September) when it is off-season in Terai. On the other hand, it can be produced in the Terai in winter (from November to March) when it is too cold in the Hills. Market demand and prices also vary with season and locations of the country. Most of the tomato produced in Nepal is used for kitchen purpose, only small quantity used for industrial purpose. Import of fresh tomato as well as tomato paste for industrial purpose from India and China is in practice to make tomato ketchup. Tomato consumption has been increasing in Nepal during recent past resulting in high market demand throughout the year. The trend of using plastic house for off season tomato production has been increasing. Though this practice needs higher investment, it also means higher profit due to higher yield and higher prices compared to open field cultivation.

### 1.4 Rational of the Study

Vegetable is considered as high value commodity in Nepalese agriculture and it is one of the priority value chain and high income generating crop producing in open field as well as in plastic house. Understanding present level of tomato production, processing and marketing and establishing base line in tomato and its value chain development is necessary for assessing the success of ongoing government supported projects and proper planning of such projects to be provided support in future. It is also important that we understand potentials and constraints in technology acquisition, input supply, production, processing, marketing and policy related issues. The product flow and relationship among the actors is crucial to find out the gap for increasing chain efficiency of the product. Present study is an effort to analyze existing scenario of tomato, national level demand and supply situation, value chain and recommend market oriented solution for further intervention.

### 1.5 Objectives of the Study

The main objective of this study is to analyze the demand and supply of

tomato at National level and suggest a value chain development plan for tomato sub-sector. The Specific objectives include:

- To assess the demand and supply of tomato at national level;
- To understand the present scenario of market dynamics of tomato and tomato products;
- To identify the actors, stakeholders and institutions involved in tomato value chain;
- To identify the major constraints hindering development of tomato value chain;
- To suggest sustainable solutions for tomato value chain development.

### 1.6 Methodology

Both the primary and secondary information were used in assessing the demand and supply of tomato and its value chain. Secondary information were collected by visiting district agriculture development office (DADO) in districts, regional and central level organizations like Ministry of agriculture development (MoAD) and central bureau of statistics (CBS). Publication of concerned stakeholders and unpublished office records were collected and analyzed. Information was also collected by visiting related websites. Two types of tomato production systems: open field cultivation in Terai region and plastic house cultivation in mid hill region were accessed by the study team. Purposive sampling technique was used to select study sites. Primary information were collected by visiting the different actors of tomato value chain and information collected by using pretested simple checklist prepared for this purpose. Interactions were held with different level of development stakeholders, value chain actors, membership based organizations, scientists, government officials, politicians and policy level people and their opinions and concerns were collected and included in the report. Input supply level information was collected from agro-vets, cooperatives and farmers. Production level information was collected from tomato producer groups. Marketing and value addition level information

were collected from farmers, cooperatives, collectors, traders and processor. Focus group discussion was also done for understanding present scenario of tomato production and marketing systems and future plan of tomato value chain development. Simple checklists were used to guide the study team to focus discussions on related topics. The information gathered were verified and triangulated among various stakeholders.

### 1.7 Limitations

The study is limited to the overall statistics of demand and supply of tomato and value chain of the tomato subsector (open field & tunnel) focusing on open field farming in Terai area and tunnel farming in hill and valley. No detailed survey was conducted and relevant information were collected from stakeholders using PRA, RRA tools and limited household surveys for the assessment of consumption pattern and used the data released by National living standard survey (NLSS-III) for demand assessment.

## RESULTS AND DISCUSSION

### 2.1 Production and Marketing

The tomato (*Lycopersicum esculentum*) is an herbaceous, usually sprawling plant in the Solanaceae or nightshade family, as are its close cousin's tobacco, chili peppers, potato, and eggplant. It is a perennial, often grown outdoors as a seasonal crop. The plant typically reaches to 1-3 m (3 to 10 ft) in height, with a weak, woody stem that often vines over other plants. Tomato production is sensitive to temperature— the optimal temperature is 23°-27°C. Temperatures lower than 15°C or higher than 35°C (and night temperatures above 21°C) are detrimental to fruit setting. Tomatoes grow best in warm temperatures with a sufficient light. Low levels of light (less than 15% of summer light levels) will greatly reduce fruit yield in fall or winter crops in greenhouses. The required temperature regime exists in different agro-climatic regions of Nepal at different times of the year allowing almost year-round production in the country. There are two main groups viz. processing tomato—normally cultivated in open fields and table tomato—cultivated in open fields or in greenhouses. With ideal level of inputs and management practices open field cultivation can produce 100-120 mt/ha, while greenhouse cultivation can yield up to 500 mt/ha. Different qualities are demanded by the market from each tomato type. Mainly, the brix (measure of the carbohydrate level in the fruit juices) is counted in processing tomato and consumer taste and shelf life are dominant characteristics preferred in table tomato.

#### 2.1.1 Production and Productivity

Almost all of the Terai and lower parts of the Hill districts are climatically suitable for tomato cultivation. Tomato cultivation is also found in lower parts of mountain districts. The national figures show that tomato was cultivated on a total 19,726 ha producing 2,98,594 mt in 2012/13 and decreased to 17, 273 ha producing 2,32,897 mt in 2013/14. Average productivity was reported to be 15.1 mt/ha in 2012/13 and reduced to 13.5

in 2013/14 which is quite low compared to other Asian countries. This may be because majority of tomato production was done at subsistence farming condition, cultivated without proper care or intercropped with other crops. Among the 15 ecological/development belts, Central hill (which includes Kathmandu valley) produced largest volume of tomato followed by Eastern hills and Central Terai. Detailed development regions and ecological belt wise area, production and yield of tomato are presented in Table 4.

Table 4: Area, Production and Productivity Trend of Tomato in Nepal, 1991/92-2013/14

| Year | Area (ha) | Production (Mt) | Yield (Kg/Ha) |
|---|---|---|---|
| 1991/92 | 140500 | 1127884 | 8028 |
| 1992/93 | 140500 | 1179000 | 8391 |
| 1993/94 | 140500 | 1197496 | 8523 |
| 1994/95 | 140500 | 1211507 | 8623 |
| 1995/96 | 144368 | 1327298 | 9194 |
| 1996/97 | 146503 | 1357435 | 9266 |
| 1997/98 | 149979 | 1449472 | 9664 |
| 1998/99 | 140177 | 1342567 | 9578 |
| 1999/00 | 149030 | 1489665 | 9996 |
| 2000/01 | 157162 | 1652979 | 10518 |
| 2001/02 | 161048 | 1738086 | 10792 |
| 2002/03 | 165988 | 1799973 | 10844 |
| 2003/04 | 172586 | 1890100 | 10952 |
| 2004/05 | 180823 | 2065193 | 11421 |
| 2005/06 | 189832 | 2190100 | 11537 |
| 2006/07 | 191922 | 2298689 | 11977 |
| 2007/08 | 208108 | 2538904 | 12200 |
| 2008/09 | 225154 | 2754406 | 12233 |
| 2009/00 | 235098 | 3003821 | 12777 |
| 2010/11 | 244102 | 3203563 | 13124 |
| 2011/12 | 245037 | 3298816 | 13463 |
| 2012/13 | 246392 | 3301684 | 13400 |
| 2013/14 | 254932 | 3421035 | 13419 |

Table 5: Area, Production and Yield of Tomato by Region (2012/13-2013/14)

| Ecological belt | Development region | 2012/13 | | | 2013/14 | | |
|---|---|---|---|---|---|---|---|
| | | Area (ha) | Production (mt) | Yield (mt/ha) | Area (ha) | Production (mt) | Yield (mt/ha) |
| **Mountains** | | **906** | **10544** | **11.6** | **915** | **10407** | **10.6** |
| | Eastern | 101 | 973 | 9.6 | 110 | 1086 | 10 |
| | Central | 527 | 6499 | 12.3 | 532 | 6481 | 12 |
| | Western | 51 | 694 | 13.6 | 38 | 509 | 13 |
| | Midwestern | 94 | 704 | 7.5 | 85 | 514 | 6 |
| | Farwestern | 133 | 1674 | 12.6 | 150 | 1817 | 12 |
| **Hills** | | **11417** | **166708** | **14.6** | **9284** | **146778** | **15.6** |
| | Eastern | 2499 | 48957 | 19.6 | 2689 | 52066 | 19 |
| | Central | 6604 | 80692 | 12.2 | 4157 | 55813 | 13 |
| | Western | 1426 | 25171 | 17.7 | 1417 | 24989 | 18 |
| | Midwestern | 522 | 6464 | 12.4 | 653 | 8506 | 13 |
| | Farwestern | 366 | 5424 | 14.8 | 368 | 5404 | 15 |
| **Terai** | | **7403** | **121342** | **16.4** | **7085** | **113613** | **15.98** |
| | Eastern | 1899 | 30679 | 16.2 | 1535 | 27156 | 18 |
| | Central | 2984 | 44608 | 14.9 | 2596 | 37902 | 14.9 |
| | Western | 937 | 21057 | 22.5 | 994 | 21632 | 22 |
| | Midwestern | 1435 | 23148 | 16.1 | 1280 | 21268 | 17 |
| | Farwestern | 148 | 1850 | 12.5 | 680 | 5655 | 8 |
| **Nepal** | | **19726** | **298594** | **15.1** | **17274** | **232896** | **14.6** |
| | Eastern | 4499 | 80609 | 17.9 | 4324 | 80308 | 19 |
| | Central | 10115 | 131799 | 13.0 | 7285 | 62294 | 9 |
| | Western | 2414 | 46922 | 19.4 | 2449 | 47130 | 19 |
| | Midwestern | 2051 | 30316 | 14.8 | 2018 | 30288 | 15 |
| | Farwestern | 647 | 8948 | 13.8 | 1198 | 12876 | 11 |

*Source: Monitoring, Evaluation and Statistics Division, 2016.*

### 2.1.2 Production Process

Tomatoes production generally comprises five basic operations such as seedling production, bed preparation, transplantation, intercultural (weeding, staking, fertilization, and pesticide application), irrigation and harvesting. Mechanization is limited in land preparation and irrigation

activities. Land preparation is done using tractor in Terai and hand tractor in the hills in limited scale. Pumpsets and electric motors are often used for irrigation. While open field cultivation is common in Terai, plastic tunnels are used in the hills for off-season tomato production. Drip irrigation and sprinklers are introduced in recent past which are found efficient in locations where irrigation water is a limiting factor.

### 2.1.3 Post harvest Management

Grading, and packaging for safe transport are the major activities for maintaining quality of the product. But this part has yet to received due consideration, especially at farm level. It was found that small scale growers were not interested in grading and proper packaging, whereas 80 percent of commercial farmers were found to use plastic crates for packaging and then transportation. All wholesalers and about 90 percent retailers use grading of their products before selling as they are aware that graded tomato fetch high prices. Similarly, plastic crates have been used for safe keeping and transportation of the product. Producers also use traditional packaging such as doko (bamboo basket). Although plastic crates are more expensive than bamboo basket, traders use plastic crates as they help reduce the losses during handling (loading, unloading and transportation). Almost all traders (wholesalers and retailers) mostly like mature ripe tomato of large size with good fresh content. This type of tomato is needed especially for raw use (salad) in hotels and restaurants. Household level consumers prefer to buy small sized tomato for pickle.

## 2.3 Demand, Supply and consumption trend of Tomato in Nepal

Table 6: Percentage of tomato consumption by source

| Region | Home production | Purchase |
|---|---|---|
| **Nepal** | **21.8** | **78.2** |
| Eastern | 27.0 | 73.0 |
| Central | 9.2 | 90.9 |

| | | |
|---|---|---|
| Western | 20.6 | 79.4 |
| Mid-western | 51.0 | 49.0 |
| Far-western | 51.7 | 48.3 |
| **Belts** | | |
| Mountain | 51.2 | 48.8 |
| Hill | 24.7 | 75.3 |
| Terai | 13.5 | 86.5 |

*Source: NLSS_III, CBS, Nepal*

The results showed that consumption of tomato is highest in central development region through purchase (90.9%) followed by western, eastern (around 78-79%) but the far western and western region purchase less than 50% of their requirement. The mountain belts purchase less than 50% of their demand of tomato while hill has around 75% demand meet by purchased tomato and Terai belt has higher purchased tomato (86.5%) (Table 6). The reason is around 50% of the population resides in Terai belt and higher the population, the demand will be higher. Besides this, around 40-50 lakhs population resides in Kathmandu valley only. Majority of the population resides in urban areas whose tomato demand meet by purchase through market.

The Terai belt are unable to produce tomato during rainy reason due to flooding and the Terai belt is known as the granary of cereals and all land is covered by paddy. So, only one winter season is allowed to produce tomato. The supply is less than demand of tomato in Terai. So, the source is purchased rather than home production.

Table 7: Consumption of tomato (Person per Kg)

| | Tomato | | | Population Estimate | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Region | Kg/day | Kg/month | Kg/year | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
| **Nepal** | **0.033** | **0.984** | **11.97** | **26494504** | **26873066** | **27257347** | **27646053** | **28037904** | **28431494** |
| Eastern | 0.034 | 1.025 | 12.476 | 5811555 | 5872242 | 5933563 | 5995524 | 6058132 | 6121394 |
| Central | 0.033 | 0.997 | 12.126 | 9656985 | 9828062 | 10002171 | 10179363 | 10359695 | 10543221 |
| Western | 0.033 | 0.984 | 11.972 | 4926765 | 4972953 | 5019574 | 5066633 | 5114132 | 5162077 |
| Mid-western | 0.032 | 0.967 | 11.768 | 3546682 | 3604219 | 3662690 | 3722109 | 3782492 | 3843855 |
| Far-western | 0.027 | 0.812 | 9.875 | 2552517 | 2592905 | 2633931 | 2675607 | 2717942 | 2760947 |
| **Belts** | | | | | | | | | |
| Mountain | 0.028 | 0.835 | 10.165 | 1781792 | 1795993 | 1810308 | 1824737 | 1839280 | 1853940 |
| Hill | 0.032 | 0.968 | 11.780 | 11394007 | 11517048 | 11641418 | 11767131 | 11894201 | 12022644 |
| Terai | 0.034 | 1.018 | 12.388 | 13318705 | 13557247 | 13800061 | 14047224 | 14298814 | 14554910 |

The results showed that average consumption of tomato is around 12 kg per year per person (Tale 7). The far western region has the lowest consumption of tomato (9.875 Kg) per year per person compared to other four development region (around 12 Kg). In case of belts, mountain belt has lowest consumption of tomato (10.835 Kg per year per person) compared to other hill and Terai belts (around 12 Kg).

Table 8: Estimated Tomato Requirement

| | 2012 | | | 2013 | | | 2014 | | | 2015 | | | 2016 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Region | mt/day | mt/ month | mt/year | mt/ day | mt/ month | mt/year | mt/day | mt/ month | mt/year | mt/ day | mt/ month | mt/ year | mt/ day | mt/ month | mt/year |
| **Nepal** | **881.5** | **26444.8** | **321744.5** | **894.1** | **26822.9** | **326345.4** | **906.8** | **27205.4** | **330999.3** | **919.7** | **27591.0** | **335690.8** | **932.6** | **27978.3** | **340403.2** |
| Eastern | 200.7 | 6021.5 | 73261.7 | 202.8 | 6084.4 | 74026.7 | 204.9 | 6147.9 | 74799.7 | 207.1 | 6212.1 | 75580.8 | 209.2 | 6277.0 | 76370.1 |
| Central | 326.5 | 9795.4 | 119177.1 | 332.3 | 9968.9 | 121288.3 | 338.2 | 10145.5 | 123437.0 | 344.2 | 10325.2 | 125623.7 | 350.3 | 10508.2 | 127849.2 |
| Western | 163.1 | 4893.2 | 59534.2 | 164.6 | 4939.1 | 60092.3 | 166.2 | 4985.4 | 60655.6 | 167.7 | 5032.1 | 61224.3 | 169.3 | 5079.3 | 61798.3 |
| Mid-western | 116.2 | 3486.0 | 42413.3 | 118.1 | 3542.6 | 43101.4 | 120.0 | 3600.1 | 43800.6 | 121.9 | 3658.5 | 44511.2 | 123.9 | 3717.8 | 45233.3 |
| Far-western | 70.2 | 2104.6 | 25606.2 | 71.3 | 2137.9 | 26011.4 | 72.4 | 2171.7 | 26423.0 | 73.5 | 2206.1 | 26841.0 | 74.7 | 2241.0 | 27265.7 |
| **Belts** | | | | | | | | | | | | | | | |
| Mountain | 50.0 | 1500.5 | 18256.3 | 50.4 | 1512.5 | 18401.8 | 50.8 | 1524.5 | 18548.4 | 51.2 | 1536.7 | 18696.3 | 51.6 | 1548.9 | 18845.3 |
| Hill | 371.7 | 11150.6 | 135665.1 | 375.7 | 11271.0 | 137130.1 | 379.8 | 11392.7 | 138610.9 | 383.9 | 11515.7 | 140107.7 | 388.0 | 11640.1 | 141620.7 |
| Terai | 460.1 | 13804.0 | 167948.9 | 468.4 | 14051.3 | 170957.0 | 476.8 | 14302.9 | 174018.8 | 485.3 | 14559.1 | 177135.6 | 494.0 | 14819.9 | 180308.1 |

Nepal required 881.5 mt of tomato for consumption daily in 2012, the demand will reach to 932.6 mt in 2016. Far western region required 70.2 mt, the lowest compared to other regions for daily consumption in 2012 while it reached to 74.7 mt per day in 2016. Mountain belt consumed lowest tomato (50 mt per day) in 2012 compared to Terai 460 mt per day. The tomato demand in mountain will reached to 51.6 mt per day in 2016 while the tomato demand in Terai will reached to 494 mt per day in 2016 (Table 8).

### 2.1.4 Trade

A study conducted by Central Bureau of Statistics (2010) indicates that 57 percent of tomato production is consumed by producers themselves and remaining 43 percent inters into market chain. On this basis nearly 128,395 mt of domestic production was traded out of which 27 mt was exported to India and nearly, 8,006 mt was imported from India in the year 2012/13. This means that a total of 136,374 mt was traded in the country. Large quantity of processed tomato products such as purée, paste, ketchup and sauces being imported from several countries including India, China and Thailand are not included in above figures. Kathmandu is one of the major domestic markets for tomato at national level. Most of the tomato is distributed from the Kalimati Fruit and Vegetable Wholesale (KFVW) market in Kathmandu. The volume of trade from the Kalimati market in various years reveals an increasing trend in the quantity traded. Data available from KFVWM showed that the market traded a total of 27,758.6mt tomato in the year 2069 BS (13 April 2012 to 13 April 2013). The total amount of tomato inside valley marketing is in increasing trend but the imported value from india is also increasing. The amount of tomato imported from India was 5.28% in 2012/13 but it was found 12.75% in 2014/15.

Table 9 : Tomato trade at Kalimati market

| **Tomato Trade** | **2012/13** | **2013/14** | **2014/15** |
|---|---|---|---|
| Tomato Big (mt) | 4693.37 | 4657.66 | 3577.39 |
| Tomato Small (mt) | 21052.26 | 20534.02 | 24761.71 |
| **Total Marketing** (mt) | **27758.63** | **27205.68** | **30354.1** |
| India source (mt) | 1464.54 | 3533.87 | 3870.20 |
| Nepali source (mt) | 26294.09(94.72) | 23671.82(87.01) | 26483.9(87.25) |

Note: The data inside the parentheses are percentage

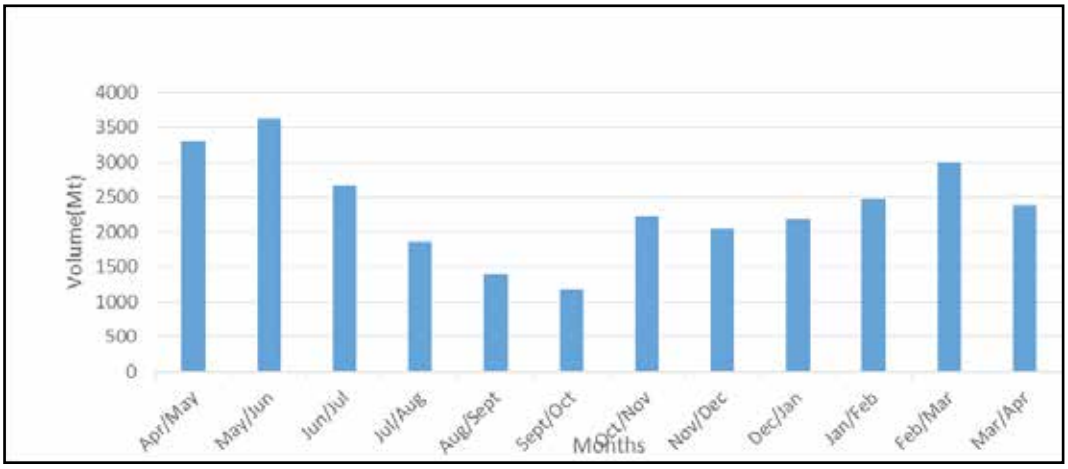


Figure 1: Monthly trade of Tomato in KFVW Market in 2071 (2014/15)

The other important markets for tomato are Birtamod, Biratnagar, Dharan, Itahari, Rajbiraj, Lahan, Birgunj, Narayanghat, Butwal, Pokhara, Lamahi and Nepalgunj. However, tomato is marketd in every small or big market, Haat (periodical market) and even in village centers. In major markets door to door supply is also made by hawkers. Tomato is generally transported from production areas and collection centers to markets mainly on pick up, truck and bus. No specialized vehicles are used for transportation of perishable commodity such as tomato. Farmers were selling tomato at farm level because of good road network. Wholesalers were found to go to the farmer's field to buy tomato with their own vehicle. Retailers were found to transport tomato from wholesale market centers to the retail markets by

pick-up van and auto rickshaw, tempo etc. Retailers were also found using bicycle, motorbike and mobile trading cart "thela" for transporting tomato.

### 2.1.5 Marketing Channel

There are generally five channels used in the marketing system at open field as well as tunnel produced tomatoes. Almost 75 percent of the marketed tomato flows through Producer-Village level collector-Wholesaler-Retail traders (Table 10).

Table 10: Flow of tomato through different channels

| Trade System | Trade Flow | Volume in % |
|---|---|---|
| 1 | Grower-Village level collector-District level wholesaler-Traders | 78 |
| 2 | Grower-village level collector-Market center level collector- WholesalerTraders | 10 |
| 3 | Grower-Market center level collectorWholesaler-Traders | 4 |
| 4 | Grower-District level wholesaler-Traders | 3 |
| 5 | Grower-Market center level collector -Traders | 5 |

*Source: Interaction with stakeholders at field level, 2015.*

## 3. COSTS AND BENEFITS

### 3.1 Production Level

Initial investment in plastic house construction is the major cost of production for plastic house tomato. Seeds, fertilizers, pesticides, wages, and irrigation are other major cost items in production of plastic house and open field tomato. According to stakeholders interviewed during field study, the average farm gate price for tomato was Rs 20.25 per Kg during January-February 2015. Local collectors spent about Rs 2.75 per kg in collection, packaging, storage and transportation. They sold the

product to wholesalers at about Rs 28 per kg, making a profit of almost Rs 5.25 per kg. Finally, average retail price in major market was Rs 42 per kg. Considering packaging, transportation and handling cost of Rs 5 per kg, it is obvious that intermediaries received large part of profit in fresh tomato chain. Traders reported that the high difference between producer and consumer price was due to high transportation cost and storage loss. It was estimated that post harvest losses in fresh tomato was about five percent each at producers, collectors, wholesalers and retailers level. Higher land productivity is maintained by higher use of chemical fertilizers and pesticides. Frequent spraying with fungicide is common in tomato farming. Farmers are collecting stacking and livestock bedding materials from the forest. Livestock bedding material, after decomposition adds the value of farm yard manure/compost. Though farmers normally produce compost using own resources, it is also traded in commercial production sites at Rs1.25 per Kg. Production cost is high in plastic house farming as construction of plastic house involves high cost. Fertilizer and pesticide cost is lower in tunnel farming compared to the open field cultivation. Detailed production cost of tomato in open field condition and under plastic houses are presented in Table 10 and Table 12.

Table 10: Average cost of production ( Per Ha) and Benefit of Main Season Tomato cultivation in Open Field Condition (Bhaktapur), 2015/16

| Particulars | Units | Quantity | Rs/Unit | Total |
|---|---|---|---|---|
| **A. AVERAGE COST OF PRODUCTION** | | | | |
| **1. Variable Cost** | **Rs.** | | | **190710.00** |
| a. Human Labor | Days | 240 | 500.00 | 120000.00 |
| b. Bullock Labor | Days | 0 | 0.00 | 0.00 |
| c. Power Tiller Use | Hours | 12 | 550.00 | 6600.00 |
| d. Pumpset Use | Hours | 14 | 250.00 | 3500.00 |

| | | | | |
|---|---|---|---|---|
| e. Sprayer Use | Hours | 18 | 25.00 | 450.00 |
| f. Seed | Kg. | 0.15 | 5000.00 | 750.00 |
| g. Manure | Kg. | 10205 | 1.00 | 10205.00 |
| h. Fertilizer | | | | 0.00 |
| Urea | Kg. | 70 | 23.00 | 1610.00 |
| D.A.P | Kg. | 80 | 50.00 | 4000.00 |
| Potash | Kg. | 35 | 36.00 | 1260.00 |
| i. Plant Protection Chemicals | Rs. | | | 2000.00 |
| j. Management Cost | Rs. | | | 3000.00 |
| k. Land Lease | Rs. | | | 30000.00 |
| l. Interest on Variable Cost | Rs. | | | 7335.00 |
| **2. Fixed Cost** | **Rs.** | | | **265.00** |
| a. Land Tax | Rs. | | | 55.00 |
| b. Water Tax | Rs. | | | |
| c. Repair and Maintenance | Rs. | | | 90.00 |
| d. Depreciation | Rs. | | | 120.00 |
| **3. Total Costs** | **Rs.** | | | **190975.00** |
| **4. Gross Income at Farm Gate** | **Rs.** | | | **478960.00** |
| a. Main Product | Kg. | 23948 | 20.00 | 478960.00 |
| **5. Net Profit at Farm Gate** | Rs. | | | **287985.00** |
| **6. Production Cost Per Quintal** | Rs. | | | **797.46** |
| **B. MARKETING AT NEAREST WHOLESALE MARKET** | | | | |
| **a. Marketing Cost** | **Rs.** | | | **11974.00** |
| **b. Value at Market** | **Kg.** | 21553.2 | 21.75 | **468782.10** |
| **c.Net Profit** | **Rs.** | | | **265833.10** |

*Source : MRSMP, 2014/15*

Table 11: Cost of production and net profit from Main season Tomato cultivation, 2014/15

| Districts | Yield | Total cost | Value of main product | | Gross Income | Cost | Net Profit | | B/C ratio |
|---|---|---|---|---|---|---|---|---|---|
| | | | Farmgate | Market | | | Farmgate | Market | |
| | Kg/Ha | Rs/Ha | Rs/Ha | Rs/Ha | Rs/Ha | Rs/Qt | Rs/Ha | Rs/Ha | |
| Lalitpur | 23450 | 178790.4 | 474862.5 | 443205 | 474862.5 | 762.4 | 296072.1 | 252689.6 | 2.66 |
| Dhading | 23490 | 156045 | 465102 | 443961 | 465102 | 664.3 | 276171 | 276171 | 2.98 |
| Lamjung | 23523 | 159557.8 | 552790.5 | 517623.6 | 552790.5 | 678.3 | 346304.3 | 346304.3 | 3.46 |
| Illam | 21805 | 150018.2 | 529861.5 | 499443.5 | 529861.5 | 688 | 338522.8 | 338522.8 | 3.53 |
| Dhanusa | 22850 | 141873.8 | 337037.5 | 317729.3 | 337037.5 | 620.9 | 164430.5 | 164430.5 | 2.38 |
| Average | 23023.6 | 157257 | 471930.8 | 444392.5 | 471930.8 | 682.8 | 275623.6 | 275623.6 | 3 |

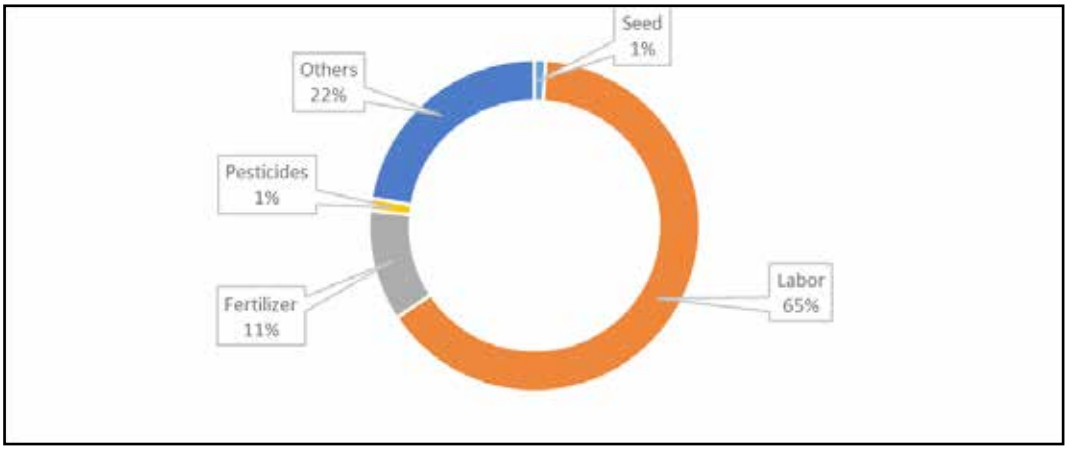


Figure 2: Share of different cost items for tomato production per hectare in open field

Major cost of production of tomato in open field comprises five major cost items. They are seed, wage labor, fertilizer, pesticides, manure and stacking. Wage was recorded to be the highest costcomponent that comprised of 65% of total cost, followed by land rent, management cost and interest (22%), manure and fertilizers (11%), seed (1%) and pesticides (1%) (Figure 2).

Table 12: Off Season Tomato Cultivation Under Plastic Tunnel in Lalitpur, 2015/16

(Tunnel size : 5 m X 20 m)

| Particulars | Units | Quantity | Rs/Unit | Total |
|---|---|---|---|---|
| **A. AVERAGE COST OF PRODUCTION** | | | | |
| **1. Variable Cost** | **Rs.** | | | **35063.84** |
| a. Human Labor | | | | |
| Shed Making Labors | Days | 5 | 650.00 | 3250.00 |
| Field Labors | Days | 20 | 450.00 | 9000.00 |
| b. Plastic Sheets | Meters | 120 | 50.00 | 6000.00 |
| c. Bamboo Poles | No. | 30 | 150.00 | 4500.00 |
| d. Ropes | Kg. | 2 | 100.00 | 200.00 |
| e. Nails | Kg. | 1 | 100.00 | 100.00 |
| f. Electricity Use | Rs. | | | 300.00 |
| g. Sprayer Use | Hours | 12 | 20.00 | 240.00 |
| h. Seed | gm | 3 | 350.00 | 1050.00 |
| i. Manure | | | | 0.00 |
| Oil Cakes | Kg. | 5 | 20.00 | 100.00 |
| Organic Manures | Kg. | 42 | 2.00 | 84.00 |
| j. Fertilizer | | | | 0.00 |
| Urea | Kg. | 10 | 25.00 | 250.00 |
| D.A.P | Kg. | 5 | 50.00 | 250.00 |
| Potash | Kg. | 3 | 36.00 | 108.00 |
| Multiplex | | | | 150.00 |
| Zinc & Borex | | | | 100.00 |
| k. Plant Protection Chemicals | Rs. | | | 100.00 |
| l. Management Cost | Rs. | | | 3000.00 |
| m. Land Lease | Rs. | | | 2000.00 |
| n. Others | Rs. | | | 525.00 |
| o. Interest on Variable Cost | Rs. | | | 3756.84 |
| **2. Fixed Cost** | **Rs.** | | | **132.00** |
| a. Land Tax | Rs. | | | 27.00 |

| | | | | |
|---|---|---|---|---|
| b. Water Tax | Rs. | | | 0.00 |
| c. Repair and Maintenance | Rs. | | | 45.00 |
| d. Depreciation | Rs. | | | 60.00 |
| **3. Total Costs** | **Rs.** | | | **35195.84** |
| **4. Gross Income at Farm Gate** | **Rs.** | | | |
| a. Main Product | **Kg.** | 2312.50 | 20.00 | **46250.00** |
| No of Plants | No. | 250 | | |
| Production Per Plants | Kg. | 250 | 9.25 | 2312.50 |
| **5. Net Profit at Farm Gate** | Rs. | | | **11054.16** |
| **6. Production Cost Per Quintal** | Rs. | | | **1521.98** |
| **B. MARKETING AT NEAREST WHOLESALE MARKET** | | | | |
| **a. Marketing Cost** | **Rs.** | | | **1156.25** |
| **b. Value at Market** | **Kg.** | 2081.25 | 21.75 | **45267.19** |
| **c.Net Profit** | **Rs.** | | | **8915.10** |

### 3.2 Post harvest Level

Major cost items at post harvest handling are collection, transportation, grading, packaging, storage and taxes/duties. It was reported that transportation by primary collectors costs Rs 1.75 per kg, wholesalers spend another Rs 1 per kg and retailers spend 0.50 per kg in transportation. Packaging is normally done by collectors that spend Rs 0.50 per kg. Storage cost was Rs 0.25 each at assembling, wholesaling and retailing level. Local duties/ taxes accounted other Rs 0.70 per kg. The major cost in post harvest handling of tomato was losses which accounted Rs 0.60 per kg at farm level, Rs 0.98 per kg in collection level, Rs 1.43 per kg at wholesaler's level and Rs 1.80 per kg at retailers level (Table 13).

While cost of handling per unit of product is more or less same among open field and tunnel cultivated tomato, major differences arise due to producers cost and losses which is assumed to be about 5 percent of the total costs as summarized in Table 10.

Table 13: Costs and Benefits of Different Stakeholders in Tomato Production and Trade (Open field)

| Activities | Unit | Producer | Primary Trader | Wholesaler | Retailer |
|---|---|---|---|---|---|
| Production cost | Rs/kg | 13.87 | | | |
| Procurement price | Rs/kg | | 17.32 | 26.75 | 35.31 |
| Packaging cost | Rs/kg | | 0.50 | | |
| Transportation cost | Rs/kg | | 1.75 | 1.00 | 0.50 |
| Storage cost | Rs/kg | | 0.25 | 0.25 | 0.25 |
| Taxes/duties | Rs/kg | | | 0.50 | 0.20 |
| Post harvest Losses | Rs/kg | 0.60 | 0.98 | 1.43 | 1.8 |
| Total cost | Rs/kg | 14.40 | 20.47 | 29.90 | 38.06 |
| Sales price | Rs/kg | 17.32 | 26.75 | 35.31 | 42.00 |

*Source : Interaction with stakeholders at field level, 2015.*

## 4. PRICES AND PAYMENT SYSTEM

Producers do not have control on pricing of potato. Buyers usually fix the price of tomato depending upon domestic market demand and export/import opportunities.Wholesalers/traders observe the market signals, instruct commission agents accordingly and collect through those commission agents or directly from producers. There is no contract farming systems adopted among producers and buyers though there is often some commitment to buy according to going market price. There is also no system of price fixation before harvest and buy back guarantee to the producers, which is often, used in fruit crops such as orange. Some cooperatives and local traders also buy from producers with assurance that a fixed proportion of prices to be prevailed at terminal market on expected sales date will be provided to producers.

Payment system differs by stakeholders and locations. The commission agents generally buy in credit from producers and pay when they get payment from wholesalers. The wholesalers normally sell to the retailers in credit and get payment within mutually agreed date. Stakeholders reported

that the informal payment system prevailing in domestic market often created disputes in the past, which were resolved by mutual understanding or through mediator within the chain.

There is huge demand of fresh tomato in Indian markets during June to October which is off-season in plain areas of bordering states of India. However, Nepal is unable to catch up those big markets due to Indian restriction for Nepali agro products. Though small amount of tomato goes to India during those months through informal channels, most of the benefits go to intermediaries operating either side of the border.

There is no modern inbuilt system to provide market information to producers. Public agencies provide information on ongoing market prices in major markets through FM, TV and print media, but such information has little relevance to producers as it may change by the time farmer gets his product to market. There is no system to provide demand and price projections.

Tomato being highly perishable the price is not stable in comparison of other vegetables. Difference between monthly minimum and maximum price was recorded from Rs 21 per kg in May 2012 to Rs 43 per kg in April 2013 in KFVWM (Figure 3). Traders in KFVWM reported that price differences of up to Rs 20 per kg were observed within a day mainly because of mismatch between demand and supply. It was also revealed that bigger size tomato are sold at higher prices compared to smaller size as bigger sizes are preferred by restaurants and processors.

As per price information gathered from Kalimati market, average prices are highest during August when there is almost no open field production and lowest during March when major supply comes from open field cultivated in Terai. Average monthly maximum and minimum prices in KFVWM are presented in Figure 2 and price difference between small and big size tomato in the same market is presented in Figure 3.

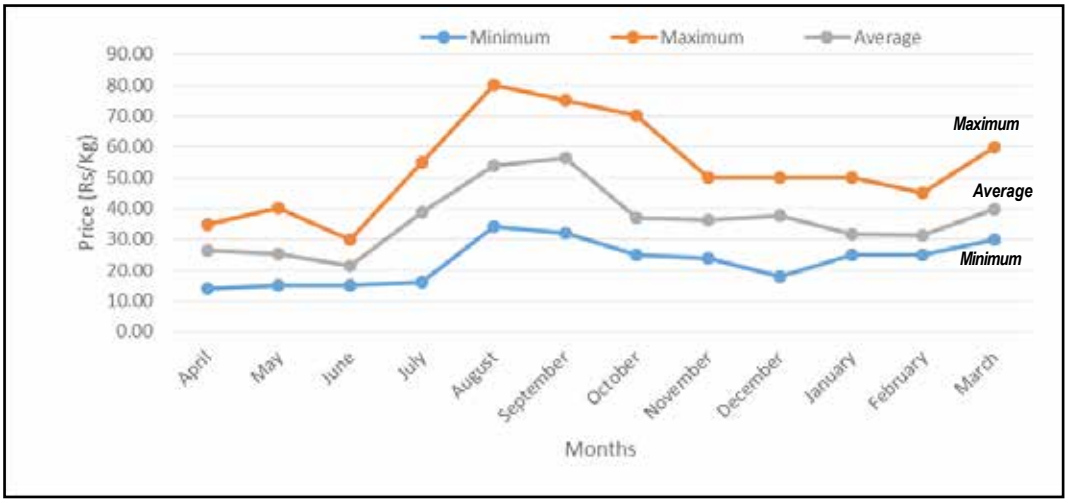


Figure 3: Monthly Minimum prices of Big Tomato in KFVWM, 2013/14

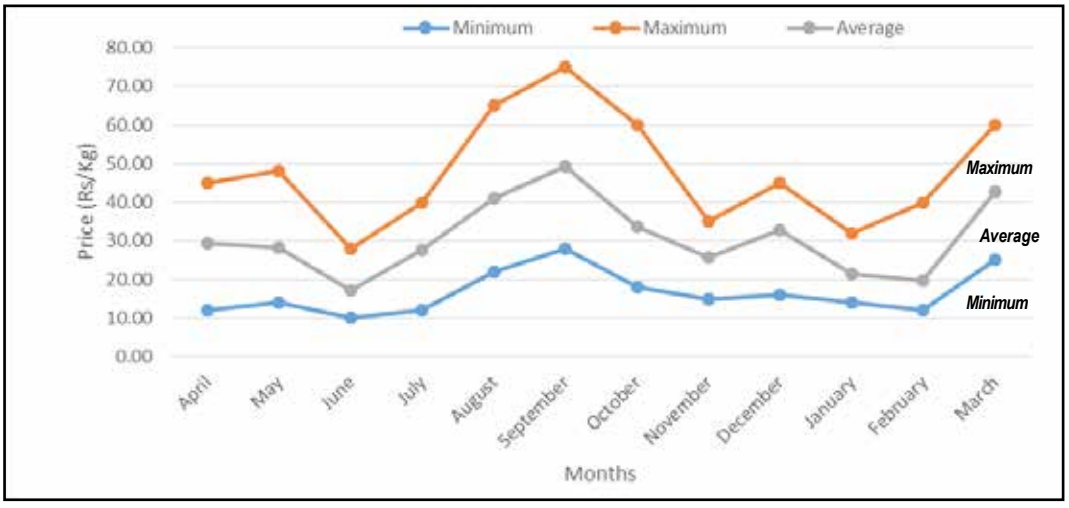


Figure 4: Monthly average prices of small Tomato in KFVWM, 2013/14

The average price is found lowest Rs 20-25 per Kg during April-June and around 30-40 during December-March, then the average price increased upto Rs 60 per kg in remaining months but range of price of big tomato is found Rs 20-60 during the whole year (Figure 3).

The average price is found lowest Rs 18 per Kg in June, January and February, then the average price increased upto Rs 50 per kg in remaining months but range of price of small tomato is found Rs 18-50 during the whole year (Figure 4).

Table 14 : Monthly prices of Big and Small Tomato at Kalimati markets, 2013/14

| Months | Tomato Big | | | Tomato Small | | |
|---|---|---|---|---|---|---|
| | Minimum | Maximum | Average | Minimum | Maximum | Average |
| April | 14.00 | 35.00 | 26.54 | 12.00 | 45.00 | 29.35 |
| May | 15.00 | 40.00 | 25.23 | 14.00 | 48.00 | 28.21 |
| June | 15.00 | 30.00 | 21.32 | 10.00 | 28.00 | 17.10 |
| July | 16.00 | 55.00 | 38.76 | 12.00 | 40.00 | 27.72 |
| August | 34.00 | 80.00 | 54.06 | 22.00 | 65.00 | 41.12 |
| September | 32.00 | 75.00 | 56.27 | 28.00 | 75.00 | 49.35 |
| October | 25.00 | 70.00 | 36.85 | 18.00 | 60.00 | 33.51 |
| November | 24.00 | 50.00 | 36.40 | 15.00 | 35.00 | 25.78 |
| December | 18.00 | 50.00 | 37.85 | 16.00 | 45.00 | 32.89 |
| January | 25.00 | 50.00 | 31.82 | 14.00 | 32.00 | 21.34 |
| February | 25.00 | 45.00 | 31.25 | 12.00 | 40.00 | 19.61 |
| March | 30.00 | 60.00 | 39.96 | 25.00 | 60.00 | 42.62 |

# SECTION B

## 5. VALUE CHAIN AND VALUE ADDITION

Tomato is a traditional vegetable crop that enters every kitchen irrespective of socio-economic status, though regularity and quantity may differ among them. It is being cultivated and traded in almost every corner of the country. This also means that large number of stakeholders is involved in tomato value chain. Despite its popularity and large number of stake holders overall tomato value chains are loosely organized, except in major market centers. Major actors in fresh tomato value chain can be grouped into five as per their role in the chain. They are: input suppliers, producers, intermediate traders/collectors, wholesalers, and retailers (Figure 5).

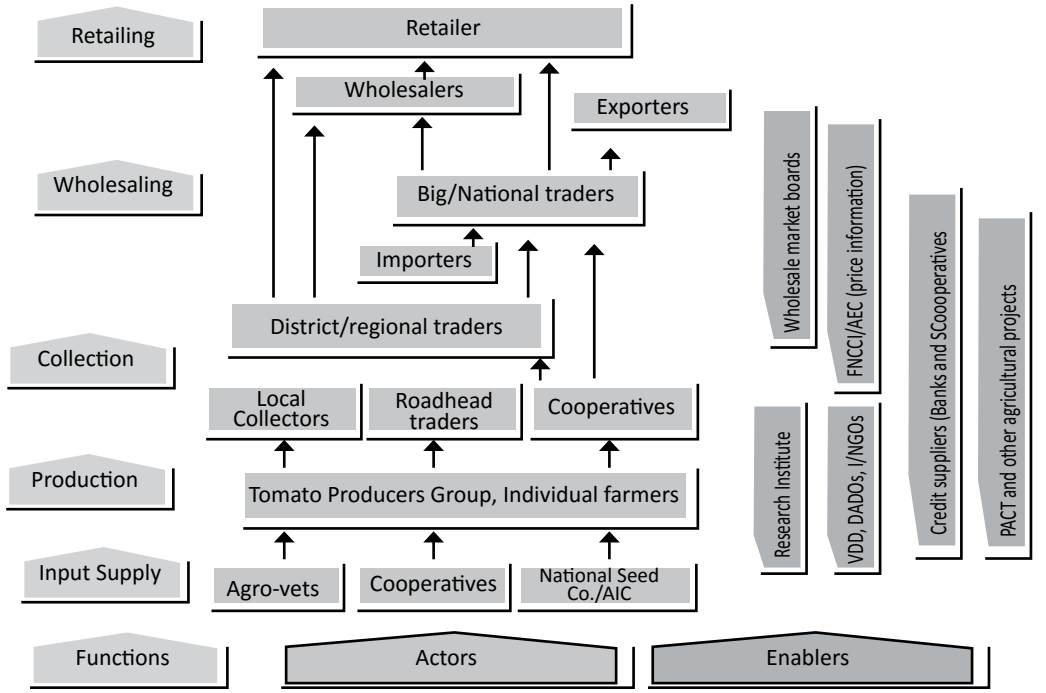


Figure 5: Value Chain Map of Fresh Tomato

In addition to producers and traders there are several stakeholders involved in tomato value chains. They include agricultural inputs and implement suppliers, suppliers of plastic and frame for plastic houses, suppliers of crates and baskets, skilled/unskilled workers and enablers including organized sector that develop/disseminate technology and credit to farmers, processors and traders. Details of those stakeholders is presented in Chapter two of this report and summarized in value chain map in Figure 5.

Though commercial producers are located near the major town and major highways, subsistence and semi-commercial farmers are scattered. Almost every grocery in villages' traded tomato during production season. In major markets such as Kathmandu, Dharan, Birtamod and Narayanghat there are well-established traders that deal tomato together with other vegetables. Tomato is traded round the year in those markets, while it is season business in smaller markets away from roads.

Value addition is done by each of the value chain stakeholders from producers to retail outlets. Information collected through household survey shows that cost of production of off season tomato was Rs 20.18 including post harvest losses at farm level. Producers sold the product at an average price of Rs 27 per kg which fetched average retail price of Rs 50 per kg at Kathmandu market, i.e. 85 percent increase from producers' price to consumers' price (Table 11).

Table 15: Value Addition in Off-season Tomato Production and marketing

| | Producer | Primary Trader | Wholesaler | Retailer |
|---|---|---|---|---|
| Production cost/ Procurement price | 20.18 | 27.00 | 35.00 | 42.62 |
| Other costs | 1.00 | 3.70 | 3.60 | 3.10 |
| Total Cost | 21.18 | 30.70 | 38.60 | 45.72 |
| Sales price | 27.00 | 35.00 | 42.62 | 50.00 |
| Value addition | 6.82 | 8.00 | 7.62 | 7.38 |

| | | | | |
|---|---|---|---|---|
| Profit | 5.82 | 4.30 | 4.02 | 4.28 |
| Profit as % of sales price | 22 | 12 | 9 | 9 |
| Profit as % of total cost | 27 | 14 | 10 | 9 |
| Share in profit | 32 | 23 | 22 | 23 |

## 6. MAJOR STAKEHOLDERS

Several stakeholders are functional in different segments of the tomato value chains. Major functions include input supply, production under plastic house and open field conditions, transportation, primary trading, wholesaling, retailing and import/export. A few farmers and village level cottage industry entrepreneurs also process fresh tomato into pickle, sauce and ketchup by using small scale pulping machine and some of them dry tomato locally during peak production season for consumption in lean season of the year. There are very few large scale processing facilities in the country. Followings are major actors involved in tomato value chain functioning and governance.

### 6.1 Input Suppliers

Basic inputs such as seed, fertilizers, pesticides and agriculture tools/ equipments are supplied by agro-vets. It is estimated that about 15 national level and 230 local level agro-vets are supplying production inputs to tomato producers in Central Development Region (PACT, 2014). Producers reported that some of the cooperatives and local shops also supply those inputs. Only few of the agro-vets and large scale traders supply appropriate plastic sheets and raw materials for the construction of plastic house, as it requires specific quality materials. Moreover, government and non-government agencies are also providing technical knowhow and inputs to some extent to the producers as an incentive/support. Though farmers normally prepare FYM/compost using own resources, purchase of vermicompost and poultry manure was reported by commercial tomato farmers, especially in the hills.

### 6.2 Producers

Tomato is one of the most popular vegetable cultivated by almost all of the households in the Terai to mid-hills of Nepal, mostly for home consumption. Commercial production was, however, limited to Terai and nearby urban areas in the hills until a decade ago. With expansion of roads, increase income level, change in consumption pattern and rapid urbanization, tomato market demand increased and production initiated in new locations. Tunnel production technology gained momentum in mid hills and even small farmers started tomato cultivation in tunnel. Open field production is practiced mainly in Terai region as well as hill areas but tunnel production is mainly practiced in hill areas during off season. Most of the tunnel farming is concentrated around the market centers and along the major roadsides. It is estimated that there were 3,000 farmers cultivating tomato in 1,880 ha and producing approximately 35,992 mt tomato in 2013/14 (ABPSD Nepal, 2014).

### 6.3 Traders

Marketing of tomato is very crucial activity as it needs proper handling and quick movement. It was reported that some of the producers in semi-urban areas and along the major highways take their product to nearby market, themselves. Rest of the product passes through different types of traders such as:

#### 6.3.1 Primary Collectors

Normally farmers bring their products to specific location within village where traders collect them and transport it to desired markets. Such collection and transporting activity is carried out either by local trader, outside trader regularly visiting the location or some local cooperatives. They collect tomato together with other vegetables from growers at pre-specified locations and send to urban markets such as Kalimati (Kathmandu) or district head quarters. Producers not having road network use family or

hired labor to transport up to nearest road heads where collectors or agents of wholesalers buy the product and transport to desired markets.

### 6.3.2 Wholesalers

Traders involving in wholesaling of tomato are mainly involved in large scale transaction of tomato. They purchase tomato either from local collector or their agents and supply to the retailer. Some of them act as national level traders or exporter also. Those wholesaler are based at major urban centers, have reasonable storage space, have good network with other traders (at local and distant market) and also with importer/exporters.

### 6.3.3 Exporters/Importers

Tomato produced during main season is not exported as the harvesting time in Nepal and bordering states of India are more or less the same. Part of off-season (summer) tomato is exported to Indian markets in Uttar Pradesh, Bihar and West Bengal as tomato production in those areas during summer/rainy season is limited to controlled environment only, making it expensive. Similarly, tomato is also imported from India whenever local production is not enough or there is large difference in prices. Some of the large scale wholesalers are involved in such export and import. During interactions with stakeholders it was revealed that successful exporters/ importers are those that operate their business in either side of the border.

### 6.3.4 Retailers

There are no retailers that trade tomato only. Retailing of tomato is done by vegetable traders and grocers. They buy required quantity from wholesalers and directly from farmers in isolated cases. Vegetable retailers are found in every corner of major markets. There are also some venders that sell tomato along with other vegetables door to door. In general retailers buy 50 to 100 kg at a time and sale to the consumers.

### 6.3.5 Supermarkets

Supermarket culture is relatively new in Nepal, but they are growing very fast. Some of them are also involved in the retailing of the fresh as well as processed tomato products, together with other vegetables and fruits. Some of the producer directly contact with supermarket in large cities such as Kathmandu and Pokhara for supply of fresh tomato while some of supermarkets purchase fresh tomato from the wholesalers. There are also some traders those sale only IPM tomato products, organic vegetables including tomato. Though their number is limited, they are getting popularity in recent past, especially among the foreigners and high economic status people in Kathmandu.

## 6.4 Processors

In spite of the potentialities of tomato to convert into juice, sauce, pickles, dried cakes etc to add significant value, there are very few processing industries in the country. Due to the excess demand of fresh tomato, processing activities is not prioritized by the stakeholders. The study conducted during 2015-16 shows that demand for tomato ketchup, sauce, dust from local hotel and restaurant is high but either skill of production and market promotion are lacking or the available quantity is not sufficient for large scale processing.

## 6.5 Enablers

### 6.5.1 Department of Agriculture

District Agriculture Development Offices (DADOs) under Department of Agriculture (DOA) are functional in all 75 districts. DADOs are at the center of all activities related to agriculture in associated districts. They operate extension services and provide technical knowhow to individual farmers, groups, traders and to cooperatives.

### 6.5.2 Agribusiness Promotion and Marketing Development Directorate

At the national level, Agribusiness Promotion and Marketing Development Directorate (ABPMDD) is responsible, differ from three programs under ABPMDD, for developing market infrastructure, promote agribusiness and develop capacity of various stakeholders/target groups involved in agribusiness and marketing, agribusiness promotion and market research. The DOA through DADOs is implementing various activities on vegetable promotion mainly focusing at the production level. Establishment of hat bazar, wholesale markets, collection centers, cooperative farming and marketing are some of the highlighted programs. There are 926 hat bazaars, 482 collection centers, 190 retail markets and 26 wholesale markets established in Nepal upto 2015.

Table 16: Total number of market infrastructure, 2015

| | Hat bazaar | Collection center | Retail market | Wholesale | Total |
|---|---|---|---|---|---|
| Eastern | 541 | 46 | 45 | 5 | 637 |
| Central | 232 | 158 | 97 | 15 | 502 |
| Western | 102 | 138 | 25 | 2 | 267 |
| Mid western | 35 | 91 | 5 | 3 | 134 |
| Far western | 16 | 49 | 18 | 1 | 84 |
| **Total** | **926** | **482** | **190** | **26** | **1624** |

***Source : ABPMDD, 2015***

### 6.5.3 Market Research and Statistics Management Program (MRSMP)

This organization is responsible to conduct field survey and analyse the B/C ratio of all type of crops. Besides this, market & marketing research is the fundamental function to recommend suggestions to farmers/producers, traders and consumers.

### 6.5.4 Vegetable Development Directorate (VDD)

The objective of this agency is to promote vegetable by improving production and productivity, promoting export of vegetables, substituting vegetable imports, and increasing farmers' income. Collection and selection

of varieties, technology generation, production and distribution of seeds, quality planting materials, and providing training and technical know-how to the farmers are some of the key activities of this directorate.

### 6.5.5 Nepal Agricultural Research Council (NARC)

NARC is responsible for agriculture research in Nepal. Horticulture research division, Khumaltar is mandated for vegetable research in Nepal. NARC also conducts Research and Development activities through its commodity research programs, regional agricultural research stations, agricultural research Stations, agro-ecological outreach sites located at different parts of Nepal.

### 6.5.6 Department of Cooperatives

The Department of cooperatives (DOC) is responsible for management of cooperative movement in the country. Majority of the cooperatives, registered with an objective of agriculture development are involved in in vegetable production including tomato. Some of cooperatives are also involved in trading of fresh vegetable as well as micro/household level processing of tomato.

### 6.5.7 Development Projects/Programs

There are several agriculture development related projects being implemented in the country. Project for Agriculture Commercialization and Trade (PACT), RISMFP and HVAP are some of them. These projects aim to increase competitiveness of smallholder farmers and the agribusiness sector in selected commodity value chains in the country. The project uses a competitive matching grant scheme under which commercial agro enterprises, commodity associations and cooperatives working actively to expand their business on selected commodities, can submit their investment proposals for project's matching grant. High Value Agriculture Project (HVAP), High Mountain Agribusiness and Livelihood Improvement (HIMALI) Project, Nepal Agriculture and Food Security Project (NAFSP) and several regional level agricultural development projects are helping

farmers in livelihoods development activities. Nepal Agriculture Research and Development Fund (NARDF) also provide funds to various research and development projects conducted by government extension offices, NARC, and different NGOs.

### 6.5.8 Federation of Nepalese Chambers of Commerce and Industry (FNCCI)

FNCCI is an umbrella organization of the Nepalese private sector. It was established in 1965 with the aim of promoting business and Industry while protecting the rights and interests of business and Industrial communities. FNCCI has been playing key role in promoting business and Industry in the Country. Agro Enterprise Centre (AEC), an independent institution under FNCCI, is dedicated to agricultural enterprise development.

### 6.5.9 Financial Institutions

Agricultural Development Bank, Nepal (ADBL) was established with the main objective of providing institutional credit for enhancing the production and productivity of the agricultural sector. Besides this, the GON has made it mandatory that all of the financial institutions must invest specified percentage of their total lending in agriculture sector. There are several other GO, I/NGOs and agencies that support production, processing and marketing of vegetables including tomato.

### 6.5.10 Fruits & Vegetable Markets

Kalimati fruits & vegetables market is the pioneer organized terminal wholesale market where wholesalers, retailers, importer/exporters trade fruit and vegetables including tomato. It was established in 1987. There are 123 wholesalers actively involved in the agri-business significantly contributing in the tomato value chain promotion and development. There are 31 other fruit and vegetable wholesale markets managed under Public-Private Partnership approach.

# 7. SCOPE FOR THE DEVELOPMENT

## 7.1 Potentials

Nepal has comparative advantages in producing tomato crop, which is evident with year round production through use of agro-climatic opportunities, established marketing network and increasing demand. There are tremendous opportunities of expanding tomato area and its productivity through adoption of appropriate technology. Tomato being labor intensive crop there is high scope of employment generation in the country. Activities such as transplanting, weeding, harvesting does not require high skill and are easier making such activities suitable for women. Some of the major potentials for development are :

### a. Increased Productivity

Available data shows that a total of 2,98,594 mt tomato was produced in Nepal in 2012/13 using 19,726 hectare land, meaning that average productivity was about 15 tons per hectare which is much lower than potentials. Information collected during survey shows that the yield can be at least doubled by using improved/ hybrid seed and improved management practices. There is scope of increasing tomato area in Terai as well as hills for cultivation in different seasons.

### b. Off-season Supply

Nepal has natural advantage of cultivating vegetables in hills when there is no possibility of producing them in the Terai of Nepal and nearby India and Bangladesh without controlled environment. This provides good opportunities to get off-season prices.

### c. Product Diversification

Most of the tomato produced in Nepal is consumed as fresh vegetable. Almost all of the tomato products are imported every year in large quantity.

While price of raw tomato goes as high as Rs 75 per kg in off-season it hardly fetches Rs 5 per kg during major harvesting time in Terai. This provides ample opportunity of diversifying tomato into ketchup, juice, pickle and puree for import substitution and export promotion.

**d. Post Harvest Losses Reduction**

The post harvest losses in tomato are estimated to be some 20 to 25 percent of harvested amount. This means loss of almost 7,50,00 tons per year. It is possible to reduce the loss substantially by training concerned stakeholders on post harvest handling practices, provision of appropriate store houses, and arranging to allow vehicles that transport vegetables to move freely during shutdowns which is very common in recent past.

**7.2 Constraints**

In spite of high productivity and quality tomato production potentials, the country has not been able to be self-sufficient in this product. The major constraints in commercial tomato production are unavailability of quality inputs, disease/pest problem, poor transportation, lack of infrastructure and inappropriate marketing management.

**Diseases/Pests**

Producers reported that one of their problems was disease/pest in tomato farm. Every year new diseases are seen, may be due to seeds brought from different country without proper screening.

**Quality inputs**

Quality hybrid seed is one of the major inputs components in offseason tomato cultivation. Almost all of the hybrid seed is imported by different agencies. There is no quality control mechanism in place to check quality and suitability of imported seeds. Similar is the case with fertilizers and

pesticides. Farmers reported that the agrochemicals available in market are not effective in controlling diseases/pests.

**Low bargaining power**

Collective bargaining increases the power of producers during procurement of inputs as well as when selling the goods. It also helps to increase the volume of tomato during each transaction and decreases the transaction and transportation costs. However, most of the farmers do tomato marketing individually despite the existence of formal and informal groups. Apart from that, farmers are devoid of reliable and timely market information.

**Competition with Indian Tomato**

Nepalese tomato has to compete heavily with Indian product during main production season in Terai. Government incentive including subsidy in inputs and irrigation facility results in lower cost of production per unit in India which is not provided in Nepal.

**Multiple taxes and unofficial payments**

As per the Local Self-Governance act (1999), there is a provision for collecting taxes by the DDC from where the product originated. However, various DDC along the transportation route are charging taxes on the products coming from other district, illegally. Similarly, many political groups and local clubs are charging money unofficially during transportation.

**Infrastructure**

Tomato is a seasonal crop and perishable in nature. Due to the lack of proper storage facilities, producers are forced to sell the product immediately after harvest. Similarly, there are limited collection centers at production sites adding difficulty in handling the product properly. Some of the market centers are not physically and structurally suitable to carry out the day to day market activities. Farmers often find it difficult to get transport to

markets. The product is mostly transported using local bus or other vehicles without proper arrangement, which results into high transport losses. Lack of established collection centers and small volume of traded commodities are the other problems to bring the product from remote hills.

**Land leases Problem**

Mostly tomato is cultivated in leased land near major roads and urban centers where rent is surging due to urbanization. Moreover, landowners are reluctant to go for long term agreement with producers. Absence of strong land leasing policy, legal loopholes and danger of losing land by renting out are the other disincentives to lend owners to rent-out their land.

**Production credit**

Because of high initial cost involved in tunnel making for off-season tomato, substantial amount is required. Producers are unable to borrow from formal sources as financial institutions need collateral against loan. As most of the off-season tomato is cultivated on leased land, such land cannot be used as collateral.

## 8. POSSIBLE AREAS OF INTERVENTION

Past experience of tomato production and trade in Nepal shows that this sub-sector requires multi-dimensional development plan to harness the potentials. Following are some of the major programs that will yield desirable results. A well equipped research center need to be established with major research thrust on identification/development of varieties suitable for different altitude, aspects and soil types. Appropriate method for controlling diseases and other pest control is urgently required. Research is also required on most suitable varieties that can yield quality tomato in term of size and keeping quality throughout the year. Besides, technical research and marketing research is equally important especially for export market.

Lack of appropriate storage facility compels the producers to sell the product immediately after harvest. Lack of road infrastructure in remote inner parts of rural area has also made it difficult and expensive to produce and transport tomato to road head. The government needs to provide conducive environment to attract investment in those sectors.

Special privilege should be provided to transport company who develop vehicle body appropriate to transport perishable product including tomato. Off-season tomato export is potential in India and Bangladesh. In the absence of proper high level coordination Nepalese traders are unable to transport the product to India and Bangladesh, most potential market of off-season tomato. Government intervention is necessary to ease the trade.

## 9. SUMMARY AND CONCLUSION

Tomato is a traditional vegetable crop of Nepal. Its importance in Nepalese culture can be understood from the fact that it reaches to kitchen of every Nepalese household, irrespective of economic status and ethnicity, the difference being only of quantity and regularity.

Diverse agro-ecological conditions in Nepal within short latitudinal distance offered comparative niche advantages for production of tomato in different seasons. There is great feasibility of production of off-season tomato along the mid-hills ecology. The market potential of such tomato is good both within and outside the country such as Tibet of China, bordering states of India and Bangladesh.

Mostly seeds of hybrid varieties imported from abroad like Thailand, India, Korea, and Japan are used in the production of off-season tomato. There is no strong research and testing of these hybrid varieties before introduction to the farmers' field.

Considering large number of farmers, specially small and marginal farmers in the hills, being involved in tomato (off season) cultivation and large scope

of export in international market, Project for Agricultural Commercialization and Trade has considered it as one of the thematic areas from the beginning of the project and has continued supporting this subsector development.

The major problems observed in the tomato/vegetables export from Nepal were quick quality deterioration due to high moisture content, faulty packaging and packaging materials, and lack of proper grading and proper handling during transportation. Hence, research is needed on quality production and also improvement in packaging, storage, transportation and handling. The off-season vegetable producing farmers' groups need to be provided technical support in the production of quality seeds within the country and production of fresh tomato in potential pockets with no or minimum use of inorganic chemicals.

Opportunities in this subsector include scope of increasing the production area and overall productivity; increasing price through improved post-harvest practices like cleaning, grading & sorting; product and market diversification; import substitution; increasing employ of women and disadvantaged groups in production as well as processing activities; and increasing earning of foreign currency through export.

The main constraints in tomato sub sector development are lack of modern production technology, production and postharvest infrastructure, processing facilities, quality control mechanism and appropriate transportation facilities such containers designed for transportation of perishable products.

The public sector should encourage farmers with certain subsidy on irrigation, and postharvest handling along with support on infrastructure development like poly house. Farmers are lured toward tomato farming but they lack technical knowhow. Furthermore, tomato based industries should be promoted with especial benefit packages along with enabling environment for export of processed product.

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# Appendices

Annex 1 : Nutrient content of Tomato (Nutritional value per 100 gm)

| SN | Particulars | Weight |
|---|---|---|
| 1 | **Energy** | 74 kJ (18 kcal) |
| 2 | **Carbohydrates** | 3.9 g |
| 3 | **Sugars** | 2.6 g |
| 4 | **Dietary fiber** | 1.2 g |
| 5 | **Fat** | 0.2 g |
| 6 | **Protein** | 0.9 g |
| | **Vitamins** | |
| 7 | **Vitamin A equiv.**<br>**beta-carotene**<br>**lutein zeaxanthin** | (5%) 42 µg<br>(4%) 449 µg<br>123 µg |
| 8 | **Thiamine (B1)** | (3%) 0.037 mg |
| 9 | **Niacin (B3)** | (4%) 0.594 mg |
| 10 | **Vitamin B6** | (6%) 0.08 mg |
| 11 | **Vitamin C** | (17%) 14 mg |
| 12 | **Vitamin E** | (4%)0.54 µg |
| 13 | **Vitamin K** | (8%) 7.9 µg |
| | **Minerals** | |
| 14 | **Magnesium** | (3%)11 mg |
| 15 | **Manganese** | (5%)0.114 mg |
| 16 | **Phosphorus** | (3%)24 mg |
| 17 | **Potassium** | (5%)237 mg |
| | **Other constituents** | |
| 19 | **Water** | 94.5 g |
| 20 | **Lycopene** | 2573 µg |
| Units<br>µg = micrograms<br>mg = milligrams<br>IU = International units | | Percentages are roughly approximated using US recommendations for adults. |

*Source: USDA Nutrient Database*