A Case Study on
Tomato Cultivation, Marketing System and Post Harvest Scenario of Rupandehi District

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Introduction:

The tomato is the edible, often red fruit/berry of the nightshade *Solanum lycopersicum*, commonly known as a tomato plant. The species originated in the South America and its use as a food originated in Mexico, and spread throughout the world following the Spanish colonization of the Americas. Its many varieties are now widely grown, sometimes in greenhouses in cooler climates.

The tomato is consumed in diverse ways, including raw, as an ingredient in many dishes, sauces, salads, and drinks. While it is botanically a fruit, it is considered a vegetable for culinary purposes which have caused some confusion. The fruit is rich in lycopene, which may have beneficial health effects.

The tomato belongs to the nightshade family, Solanaceae. The plants typically grow to 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, although often grown outdoors in temperate climates as an annual. An average common tomato weighs approximately 100 grams.

Cultivation:

The tomato is now grown worldwide for its edible fruits, with thousands of cultivars having been selected with varying fruit types, and for optimum growth in differing growing conditions. Cultivated tomatoes vary in size, from tomatberries, about 5 mm in diameter, through cherry tomatoes, about the same 1–2 cm (0.4–0.8 in) size as the wild tomato, up to beefsteak tomatoes 10 cm (4 in) or more in diameter. The most widely grown commercial tomatoes tend to be in the 5–6 cm (2.0–2.4 in) diameter range. Most cultivars produce red fruit, but a number of cultivars with yellow, orange, pink, purple, green, black, or white fruit are also available. Multicolored and striped fruit can also be quite striking. Tomatoes grown for canning and sauces are often elongated, 7–9 cm (3–4 in) long and 4–5 cm (1.6–2.0 in) diameter; they are known as plum tomatoes, and have a lower water content. Roma-type tomatoes are important cultivars in the Sacramento Valley.
Tomatoes are one of the most common garden fruits in the United States and, along with zucchini, have a reputation for outproducing the needs of the grower.

Quite a few seed merchants and banks provide a large selection of heirloom seeds. The definition of an heirloom tomato is vague, but unlike commercial hybrids, all are self-pollinators that have bred true for 40 years or more.

About 150 million tons of tomatoes were produced in the world in 2009. China, the largest producer, accounted for about one quarter of the global output, followed by United States and India. For one variety, plum or processing tomatoes, California accounts for 90% of U.S. production and 35% of world production.
Varieties:

There are around 7500 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.

There is also a considerable gap between commercial and home-gardener cultivars. Home cultivars are often bred for flavor to the exclusion of all other qualities, while commercial cultivars are bred for factors like consistent size and shape, disease and pest resistance, suitability for mechanized picking and shipping, and ability to ripen after picking.

Tomatoes grow well with seven hours of sunlight a day. A fertilizer with an NPK ratio of 5-10-10 is often sold as tomato fertilizer or vegetable fertilizer, although manure and compost are also used.

Diseases and Pests

Tomato cultivars vary widely in their resistance to disease. Modern hybrids focus on improving disease resistance over the heirloom plants. One common tomato disease is tobacco mosaic virus. Handling cigarettes and other tobacco products which are infected can result in transmission of the virus to tomato plants. Various forms of mildew and blight are also common tomato afflictions, which is why tomato cultivars are often marked with a combination of letters that refer to specific disease resistance. The most common letters are: V – verticillium wilt, F – fusarium wilt strain I, FF – fusarium wilt strain I and II, N – nematodes, T – tobacco mosaic virus, and A – alternaria.

Another particularly dreaded disease is curly top, carried by the beet leafhopper, which interrupts the lifecycle, ruining a nightshade plant as a crop. As the name implies, it has the symptom of making the top leaves of the plant wrinkle up and grow abnormally.
Some common tomato pests are stink bugs, cutworms, tomato hornworms and tobacco hornworms, aphids, cabbage loopers, whiteflies, tomato fruitworms, flea beetles, red spider mite, slugs, and Colorado potato beetles.

Tomato plants produce the plant peptide hormone systemin after an insect attack. Systemin activates defensive mechanisms, such as the production of protease inhibitors to slow the growth of insects. The hormone was first identified in tomatoes, but similar proteins have been identified in other species since.

![Tomato fruit worm feeding on unripe tomato](image)

**Fig: Tomato fruit worm feeding on unripe tomato**

**Picking and ripening**

To facilitate transportation and storage, tomatoes are often picked unripe (green) and ripened in storage with ethylene. Unripe tomatoes are firm. As they ripen they soften until reaching the ripe state where they are red or orange in color and slightly soft to the touch. Ethylene is a hydrocarbon gas produced by many fruits that acts as the molecular cue to begin the ripening process. Tomatoes ripened in this way tend to keep longer, but have poorer flavor and a mealier, starchier texture than tomatoes ripened on the plant. They may be recognized by their color, which is more pink or orange than the other ripe tomatoes' deep red, depending on variety.

At home, fully ripe tomatoes can be stored in the refrigerator, but are best kept at room temperature. Tomatoes stored cold remain edible, but tend to
lose their flavor permanently. Tomatoes stored stem down may also keep from rotting too quickly.

**Consumption**

The tomato is now grown and eaten around the world. It is used in diverse ways, including raw in salads, and processed into ketchup or tomato soup. Unripe green tomatoes can also be breaded and fried, used to make salsa, or pickled. Tomato juice is sold as a drink, and is used in cocktails such as the Bloody Mary. Tomatoes are acidic, making them especially easy to preserve in home canning whole, in pieces, as tomato sauce or paste. The fruit is also preserved by drying, often in the sun, and sold either in bags or in jars with oil. Tomatoes are used extensively in Mediterranean cuisine. They are a key ingredient in pizza, and are commonly used in pasta sauces. They are also used in gazpacho (Spanish cuisine) and pa amb tomàquet (Catalan cuisine). Though it is botanically a berry, a subset of fruit, the tomato is a vegetable for culinary purposes, because of its savory flavor.

Fig: Bunch of tomatoes in vine
It is a bitter truth that majority of Nepalese people (66.6 %) depend on agriculture for their livelihood, but the agriculture sector itself is in dilapidated condition. The present government has correctly depicted the overwhelmingly rural character for Nepal's massive poverty in its budget of 2008-2009. Despite the priority given to agricultural sector and huge money doled out in the sector for the last many years, the country's rural poverty and backwardness have worsened over the years. Continuation of conventional subsistence type of agriculture, big gap between haves and have-nots, poor rural infrastructures, inadequate technological extension and marketing support and services, lack of production inputs in terms of quantity, quality and timely, unorganized institutions of producers and other related stakeholders with weak linkage among them, land scarcity relative to population growth (per capita land availability 0.6 ha in 1954, where as 0.1 ha in 2005), all have played vital role to accentuate rural poverty continuously resulting in the problem of food security, under-employment, poverty and malnutrition. The present government has laid emphasis on making "New Nepal" through bringing
revolution and radical change in agriculture sector. For this, the policy of transforming subsistence agriculture into commercial agriculture has been put forth as the fundamental basis for country's economic development. Commercialization, modernization and mechanization of agriculture are understood to provide large number of farming community with a respectable occupation and dependable employment opportunities. The radically modified agriculture is supposed to bring felt positive change in the living level of people and thus, the country will make economic development in a leap-frogging way. The effective implementation of targeted program is estimated to bring 7% economic growth in 2008-2009. Likewise the agricultural and non-agricultural growth rate expected to reach 4.5 and 8.3% respectively in the current fiscal year. Fresh seasonal and off-seasonal vegetables have been categorized as high value crops and promotion of commercial production of fresh vegetables are essential for increasing the income of farmers, providing them with employment opportunities including the women farmers, and enhancing their accessibility to food security. Hence, in Nepal vegetables are specific agricultural commodity promotion of which could significantly drive rural growth in some market accessible areas of project districts under Commercial Agriculture Development Project. The Agriculture Perspective Plan (APP) has also designated vegetable crops as one of the priority crops for Nepal's agriculture development. Thus, efforts need be made to undertake all the necessary measures to develop the crop commercially benefiting the producers at large. The systematic identification of the constraints and obstacles as well as the opportunities faced by the vegetable producers in fully exploiting the crop is increasingly seen by related development personnel and technicians as an important component of any strategy for achieving the targeted growth. It is a well known fact that there exist a large number of actors who are involved from production to marketing to processing and to end users. The study, therefore, aims to obtain a more detailed understanding of the actors, activities, costs, processes and opportunities related to the flow of the studied product and associated services, starting with farmers and ending with the targeted buyers and/or consumers. These issues need to be understood to identify critical constraints, opportunities and entry points for agro enterprise and investment intervention. The information gained through market chain analysis also helps in identifying the best market chain to work
on a specific client and in locating key market chain actors who will buy produce. The knowledge obtained will play a critical role in designing, implementing, evaluating and scaling up enterprises. Nonetheless, the lack of market access that many rural farmers face is considered to be a major constraint to combating poverty. Thus, it is of paramount importance of facilitating market access to small scale producers as well as developing chain competitiveness and efficiency in order to improve rural livelihoods. So, with the goal of increasing understanding on the operations and market developments the study was performed. The study was also aimed to analyze the various chain functions within the commodity and to identify points for leveraged intervention within the sector's value chain. The rest of this report begins with a brief discussion about the methodology of the study, followed by production status, marketing ways, pricing, product handling, existing value chains, constraints with suggestions, recommendations and conclusion.

MAJOR ISSUES AND PROBLEMS

Numerous problems and issues were identified during the desk study and field investigations. The major problems applicable to the three major players, i.e., the processing industry, the traders, and the producers, are organized separately and presented below.

PROCESSING INDUSTRY

• Commercial farming is not well developed in Nepal as compared to Indian market. There is a lack of commercial attitude and entrepreneurship in Nepalese farmers.

• Nepali Tomato cannot compete with the Indian and Chinese tomato mainly due to very high cost of production, small scale of production and uncertainty of production volume.

• The quality of the fresh tomato produced in Nepal is not suitable for the industry.

• The DDCs impose exceptionally high taxes, causing the raw material to be very expensive.
• Various political and non-political groups like Khumbuan, Limbuan and various extremist groups in the Terai extort taxes.

• Lack of facilities in quality testing lab. Recently, the industry had got an order for its products worth US$ 3000 during the Olympic Games in China but failed to supply them due to the inability of the Government to issue quality assurance certificate.

• There is a severe lack of coordination among producers, supporters, and government agencies.

• Lack of skilled labor, and even unskilled labor lately, is causing difficulties in expanding the industry.

• Labor Act for agricultural farming and processing should be separate as the industry runs on a seasonal basis and employing a large labor force permanently undermines the viability of the industry.

• Most of the materials like pouches, labels, bottles, packaging materials have to be imported from India.

• Role of Government should be to assure the product quality rather than to control the industry.

• Quality testing (criteria/indicators for quality control) of products and issuance of quality test certificate must be made on time (Rijal Tashi failed to supply its products during Olympic game in China due to unavailability of such services on time).

• Local and DDC taxes must be reduced. At present the industry pays up to Rs 16000 local taxes for supplying/bringing one truck of product to/from Kathmandu.

• Due to high cost of electricity local farmers cannot compete with Indian products as electricity for agricultural farming and processing is highly subsidized in India.

• Credit: ADBL should formulate a policy to support commercial scale production
**TRADERS**

- Retail market and marketing system is not well managed.
- Insufficient warehouse facility. Warehouses constructed with the support of Government and non-government agencies have insufficient space.
- Lack of proper management of vegetable wastes.
- Labor unavailability and high cost (Rs 200 with lunch and breakfast daily).
- Increasing cost of transportation (mainly due to scarcity of fuel, strikes, and carteling by the transporters).
- Unavailability of institutional credit. The traders must borrow at the rate of up to 60% interest from local money lenders.
- Present physical infrastructure is insufficient and the traders are frequently compelled to do their business under the open sky. Basic facilities in the market places and collection centres like proper sheds, warehouses, drinking water, etc. must be expanded.
- The recent Koshi flood blocked transportation in western part (Rajbiraj, Janakpur, Birgunj, Narayanghat), resulting in lack of trade and low prices even in the festival season.
- Frequent road blockades and strikes have resulted in high transportation costs, including the proper charges.
- Supply, in general, is about 40 to 50% less than demand.
- Tax collection at so many places and at very high rates.
- Tomato being perishable in nature, losses due to wastage are very high.
- Lack of awareness about proper packaging and grading is causing high losses.

**PRODUCER/FARMER**

- Very high cost of inputs (fertilizer, plant protection chemicals, seed, labor).
- Lack of irrigation leads to mostly rainfed cultivation and low productivity.
- Inferior quality and adulteration of inputs: seeds, fertilizers, pesticides.
• High cost for staking. The average cost for staking is Rs 2 to 5 per plant.

• Lack of technical knowledge about planting, pesticide application, crop management, harvesting, packaging, grading, etc.

• Labor unavailability and high cost (up to Rs 200 with lunch and breakfast daily)

• Tomato blight disease during winter and long rainy periods

• Increasing cost of transportation (mainly due to scarcity of fuel and frequent strikes)

• Lack of proper packaging, sorting, and grading techniques.

**OBJECTIVE OF THE WORK**

The objective of this case study was

• to identify the cultivation practices of tomato on farmers level in Rupandehi district of Nepal.

• to identify the research gap on tomato in Rupandehi district of Nepal.

• to identify the market scenario of tomato in Rupandehi district of Nepal.

• to identify the post harvest scenario of tomato in Rupandehi district of Nepal.

**METHODOLOGY**

The method adopted in the study relied on semi-structured informal interviews with key informants and a number of participants at different stages of the market chain including the producers of the studied commodity. The interview approach provided the survey team with an opportunity to gather required information from several market chain actors, working on production in question. The methodology was applied for (1) gaining a view of how the commodity is produced, organized, operates and performs; (2) identifying various constraints and opportunities; (3) identifying specific market chains that are most appropriate for a client group and investor; and (4) prescribing interventions in the organization, technology and management of the
commodity. The study also focused on identifying the best points of leverage within a market chain by investing to improve market chain performance. Such leverage may focus on technology, specific chain actor performance, improving business development services and changing policies.

DISCUSSION

The tomato (Solanum lycopersicum, syn. Lycopersicon lycopersicum) is a herbaceous, usually sprawling plant in the Solanaceae or nightshade family, as are its close cousins tobacco, chili peppers, potato, and eggplant. It is a perennial, often grown outdoors in temperate climates as an annual, typically reaching to 1-3m (3 to 10 ft) in height, with a weak, woody stem that often vines over other plants.

Tomatoes are a warm season crop and are sensitive to frost. They are usually cultivated in sub-tropical and warm temperate climatic regimes and thrive well in temperatures 10°C to 30°C. Optimum range of temperature is 21°C-24°C and temperatures below 16°C and above 27°C are not desirable. Temperature affects germination, crop standing and ultimately affects yield, quality and price. The required temperature regime exists in different agro-climatic regions of Nepal at different times of the year and almost year-round production is possible in different geographical regions of the country. Tomatoes come in a number of varieties with highly standardized cultivation practices. Each variety has its own shape, color, size, timing of cultivation, duration of harvesting, yield, disease resistance, etc. The accompanying Table lists some of the varieties officially released by the Ministry of Agriculture and their yield potentials. These varieties have production potentials two to six times the average yield at the national level. Abinash and Allrounder are the most popular varieties in the project districts. Abinash has a good yield (up to 18 MT / ha at Research Station), but the fruits are soft and difficult to transport. Allrounder is a hybrid variety and is gaining popularity because the fruits are firm and can be transported easily. These two varieties and another variety Trishul are Indian varieties. Popular Nepali varieties are Sirjana, Dhanalaxmi and Indra.
CULTIVATION PRACTICES

Tomatoes produced in the project districts go through five basic operations – 1) seedling production, 2) bed preparation, 3) transplantation, 4) weeding/staking/fertilization/pesticide application/irrigation and 5) harvesting. Figure 1 shows a generalized flow diagram of the entire production process. Mechanization does not exist in the Hills whereas in the Terai some farmers use tractors to plough land for bed preparation and pumps for irrigation. Information collected at the field level revealed that 80 percent of tomato farmers in the Terai districts used bullocks to plough the land and only 10 percent used tractors. The remaining 10 percent ploughed manually with hoes. Hand held sprayers are used for pesticide application both in the Terai and in the Hills.

Fig: Production analysis
Fig: Production Chain

COST OF PRODUCTION

Table shows the costs of production of tomato in Terai districts of the project area. A comparison of the two tables shows that the cost of cultivation is higher in the Hills than in Terai, but the benefits are also higher in the Hills. Labor comprises the largest cost component (50% of the total cost) indicating that tomato production in the Hills is indeed labor intensive. The only mechanized operation is spraying insecticides and occasional sprinkler or drip irrigation. The next largest cost component indicated as “others” in includes costs for spraying insecticides and for staking the plants. Each individual tomato plant is staked with bamboo strips or sticks collected from the forests. As the plant population is 16,000 to 20,000 per per hectare, an equal number of stakes is also required. The next highest share of the cost goes for organic
manure (13%). The cost of chemical fertilizers is only 3% of the total cost whereas pesticides consume 6%. Eight percent of the total cost goes for seeds. The hybrid seeds are very costly. The seeds of Abinash variety, for instance, costs Rs. 1 Lakh per kg and Allrounder costs Rs. 65,000. The seed rate is about 120 grams per ha.

Table: Cost of production of tomato (per hectare) in Terai region (Rupandehi District)

<table>
<thead>
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<th>Rs.</th>
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<tbody>
<tr>
<td>Total All Costs</td>
<td>82,650</td>
</tr>
<tr>
<td>Interest @10 % for 6 months</td>
<td>4,133</td>
</tr>
<tr>
<td>Total production costs</td>
<td>86,783</td>
</tr>
<tr>
<td>Production and profit (per hectare):</td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td>36000 kg</td>
</tr>
<tr>
<td>Average price</td>
<td>5 /kg</td>
</tr>
<tr>
<td>Income</td>
<td>1,80,000</td>
</tr>
<tr>
<td>Profit per hectare</td>
<td>93,217</td>
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<tr>
<td>Benefit Cost Ratio (BCR)</td>
<td>2.07</td>
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</tbody>
</table>

TECHNOLOGY AND PRODUCTION STATUS

Farmers follow traditional production methods. Uses of hybrid seeds, chemical fertilizers and pesticides have become common but there is no standardization in the use of technology. Technical support and monitoring from research and extension is poor. The producers hardly follow any post harvest operations and heavy losses are incurred during transportation due to lack of improper packaging materials. This results in losses in both quality and quantity of fruits and much of the burden of such losses are born by the producer, as the transporters and traders pass this loss on to the farmers. As mentioned earlier, tomato production is highly labor intensive and has a high potential for employment generation. The tomato farmers in the project area have not been able to gain any benefit due to the existence of one of the country’s largest processing industries in the area because the products are not suitable for the industry. It is indeed an irony that on the one hand the farmers are unable to sell to the industry and on the other hand the industry must import
tomatoes from India and tomato paste from China to run its factory. This is probably due to lack of communication between the industry and the producers about what is really needed. The producers try to minimize risk by growing Allrounder variety which is easier to transport due to its firmness, but is not quite suitable for the industry. The Abinash variety, which is juicy and pulpy, is suitable for the industry, but farmers are reluctant to produce it because it gets easily damaged during transportation and cannot be stored for a long time. Agencies involved in research and technology generation must urgently look into this anomaly.

<table>
<thead>
<tr>
<th>Box 1: Comparison between Allrounder and Abinash varieties of Tomato</th>
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<tbody>
<tr>
<td><strong>Allrounder:</strong></td>
</tr>
<tr>
<td>• Firm and fleshy</td>
</tr>
<tr>
<td>• Very little juice</td>
</tr>
<tr>
<td>• Less perishable and easy to transport</td>
</tr>
<tr>
<td>• Good for table purpose</td>
</tr>
<tr>
<td>• Not suitable for processing industry</td>
</tr>
</tbody>
</table>

**MARKET SCENARIO**

Figure shows the channel through which tomato moves in the market from production to the consumer in the project area and beyond and an estimated share of each actor in the chain.
Most of the tomato produced in the area goes to the road head traders, either directly from the consumers or through local collectors. Very little of the produce (only about 5%) goes to the local and district haat bazaars (weekly markets). Of the 85% collected by the roadhead traders, about 60% goes to the big regional wholesalers known as the Gaddi, and 21% to other district level wholesalers. As mentioned earlier, very little of the locally produced tomato (about 8%) finds its way to the big processor, which imports more than 90% of its requirement from India. About 60% of the product (tomato ketchup, juice, puree, etc.) of the industry (which contains only 5% of locally produced tomato) goes to Kathmandu and the remaining 40% (3% of local production) is consumed in other parts of the country, mainly in the cities and urban areas like Pokhara, Dharan, Biratnagar, Bhairahawa, Janakpur, Nepalgunj, Damak, Birtamod, Bhadrapur, Narayanghat, and Birgunj (considering total output of the industry as 100%). Of the 70% of the produce received by the big regional
wholesalers from various sources, half (35%) goes to other district level wholesalers, 31% to retailers in Nepal, and up to about 4% to the Rijal Tashi Industry. The district level wholesalers receive about 56% of the produce and send 50% (almost 90% of what they receive) to the Nepali retailers and the remaining 6% to Indian commission agents. These Indian commission agents sell about 4% to the wholesalers in India and 2% to retailers.

CONCLUSION AND RECOMMENDATION

Cultivation of tomatoes in the Western Development Region, especially in Rupendehi district appears to have great potential and the sub-sector is growing in terms of area expansion, value addition and market expansion. Moreover, tomato farming in the Hill districts is emerging as a highly profitable enterprise and more and more farmers are attracted towards commercial cultivation of tomato. Tomato cultivation has proved to have a high potential for employment generation at local level in general and for women and rural poor in particular. Despite these encouraging trends, the market is experiencing typical constraints of a growing and immature market.

The tomato subsector shows the following characteristics:

• Increased price of major raw materials such as seeds, fertilizer, pesticides, fuel.

• Severe price competition with imported fresh tomato from India.

• Limited value addition.

• Supply and price variation due to seasonality of the product.

• Lack of proper information on market demand.

• Heavy wastage during road blockades and strikes.

• Losses due to inappropriate packaging and transportation.

To address these classic problems of an agricultural commodity, the world today emphasizes value-added agriculture. Value addition of tomato can be created in any one or a combination of the following measures:
- A change in the physical state or form (such as making tomatoes into paste, puree, juice or ketchup).
- Production of tomato in a manner that enhances its value (such as off-season tomato or organic tomato).
- The physical segregation for enhancement of the value/product differentiation (such as an identity preserved marketing system.
- Tomatoes of high hill/mountain/altitude).
- Storage of tomato so that it enhances value when the product is not available and market price is high (cold storage).
- Increase export to Indian market.