



Value Chain Study of Tomato Of Karnal, Haryana

2017-18



By

National Horticultural Research & Development Foundation

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We sincerely hope and believe that the findings and recommendations of this report will help to further the cause of Honorable Prime Minister's vision of doubling farmers' income by 2022 as well as provide relevant insights in dovetailing to the recently initiated 'Operation Greens' under the Union Budget 2018-19. We believe this report will serve as a valuable resource, providing the necessary framework to inform various stakeholders across the tomato value chain in Haryana as well as other states across India updating of live hood at farmer.

(Dr,P.K. Gupta)

Director NHRDF



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ABBREVIATIONS/ ACRONYMS

APMC	Agricultural Produce Market Committee
AP	Andhra Pradesh
CSSRI	Central Soil Salinity Research Institute
CAGR	Compound Annual Growth Rate
DWR	Directorate of Wheat Research
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
FPO	Farmer Producer Organization
HAU	Haryana Agricultural University
ICAR	Indian Council of Agricultural Research
IARI	Indian Agricultural Research Institute
IPM	Integrated Pest Management
INM	Integrated Nutrient Management
KCC	Kissan Call Centre
NDRI	National Dairy Research Institute
NHRDF	National Horticultural Research & Development Foundation
MP	Madhya Pradesh
MSP	Minimum Support Price
NBAGR	National Bureau of Animal Genetics Resources
NCR	National Capital Region
NHB	National Horticulture Board
OBC	Other Backward Class
RRS	Regional Research Station
ST	Scheduled Tribe
SBI	Sugarcane Breeding Institute
SC	Scheduled Caste
VCs	Value Chains



EXECUTIVE SUMMARY

Tomato, scientifically called *Lycopersicon esculentum* is important due to its nutritional value, as its commercial value increased, there has been an increase in selection and breeding of the tomato to improve yield and adapt it into different agro-climatic environments. Total world production of tomato fresh fruit in 2014 was about 223.47 million tons with China producing 105,309,827 tons. India is the second largest tomato growing country after China. As per FAOSTAT, 2014, India produces 18735.91 thousand tons of tomato which is 8% of total world production in an area of 882.03 thousand hectares which in turn is 14.6 % of total area under tomato in the world. Other leading countries in tomato production are United States, Turkey, Egypt, Iran and Italy.

In India, tomato is mainly grown in two seasons across the country – June to September (*khari*) and October to February (*rabi*) whereas in some regions it is produced throughout the year. The southern and central states contribute maximum to the total tomato production in the country including the states of Andhra Pradesh, Madhya Pradesh, Karnataka, Gujarat, Maharashtra and Odisha. Haryana is on 11th position in tomato production and produces approximate 3.11% of the total production of the India. Average yield of tomato in India has increased from 15.90 t/ha in 2001 to 25.47 t/ha in 2016-17 and this is because of the increase in availability of better inputs, seeds and use of better cultivation methods. In some states, yield is comparatively higher than all-India average because of favourable weather conditions in those states.

Marketing of tomato in India is generally done by middlemen like commission agents and traders who are present in vegetable markets but they are least interested in farmer's or consumer's well-being. These middlemen are supposed to play a vital role in matching demand with supply in the market. Therefore, to understand the gaps in value chain of tomato and measures required to improve the livelihood of tomato growers and other stakeholders of the area, "Value Chain Study of Tomato" is conducted in the district of Karnal, Haryana with a sample size of 200 farmers and 50 other stakeholders such as mandi traders, stockiest, exporters, inputs suppliers, wholesalers, retailers and APMC officials. The sample size was taken from 6 blocks of Karnal district. Further, 5 villages from each block and 33 to 34 farmers from each block distributed in five villages.

Karnal is one of historical districts of Haryana. It is known all over the world for production of rice, wheat and milk as also known for agricultural research Institutions like ICAR-National Dairy Research Institute (NDRI), ICAR-Central Soil Salinity Research Institute (CSSRI), ICAR-Directorate of Wheat Research (DWR), RRS-National Horticultural Research & Development Foundation (NHRDF), ICAR-National Bureau of Animal Genetics Resources (NBAGR), ICAR-Regional Centre of Sugarcane Breeding



Institute (SBI), RRS-ICAR-Indian Agriculture Research Institute and Centre of Excellence for Vegetables. Also, as per the Department of Horticulture, Karnal, Padhana in Nilokheri block, Gularpur in Nissing block and Dhanora in Indri block have highest area under tomato cultivation and the average yield of tomato in these areas goes up to 50 to 54 t/ha.

During the survey, it is observed that most of the farmers were small and marginal with average income of Rs. 2.80 lakh per annum. In the district, farmers reported that they are doing tomato farming from last 10 to 11 years because of the availability of sufficient resources for tomato cultivation and high demand in market with good profit margin. The average cost of cultivation they reported was Rs. 34,495/acre with the average yield of 149 q/acre. The average selling price they reported was Rs. 495/q and market expenses they incurred Rs. 130/q. Hence, the net profit received by tomato growers was Rs. 133/q. Major varieties grown in the area were HimSona (50%) from Syngenta, 524 (21%) from Namdhari Seeds Pvt Ltd. and Abhilash (6%) from Seminis (Monsanto). Reasons behind choosing these varieties were higher yield and easy availability. None of the ICAR varieties were used by the respondent farmers ever. Blight, Armyworm and Marodai.e. Leaf curl were the most widely spread pests and diseases prevalent in the area which had affected tomato production. The study reveals that there was about 13.34% losses in tomato value chain at the farmers' level. Maximum losses occur at the cleaning, grading, weighing and packaging stage (6.21%) followed by harvesting (4.80%). During transportation, loss in tomato is about 2.33%. There is no storage loss observed at farmer's level. At trader's level, the average loss reported was 3.4% which was mainly due to handling, weighing, loading and delay in marketing. At the wholesaler's and retailer's level, average losses were about 6.89 and 8.63% respectively, and the reasons of the losses found were sorting, grading, weighing and delay in marketing.

Tomato processing is the best way to protect the crop otherwise loss percentage would always be at high due to its perishability. When enquired about processing industries nearby the villages of the respondents, we came to know that the state does not have any processing units for tomato, even none of the farmers reported about primary processing units and collection centre. Though, India is the second largest producer of tomato with 11% global share, it processes less than 1% of its produce compared to 26% in other major producing countries. This results in the loss of value to the farmer, consumer and the economy. In 2015, about 41 million tons of tomato was processed globally out of which only 130,000 tons was processed in India which comprises 0.3% of the global tomato processing market. Thus, India could potentially process much more of the crop. An annual growth rate of over 12% in India's tomato production over the past 5 years also indicates strong interest amongst farmers to grow tomato as a major commercial crop.



1 INTRODUCTION

Tomato (*Lycopersicon esculentum*) is one of the most important vegetables in India. It is extremely perishable and cannot be preserved in fresh stage. Huge post-harvest losses of the harvested tomatoes occur due to inadequate storage facilities, which brings substantial loss to the growers and hence to the national economy. India is the world's second largest tomato producer after China but processes less than 1% of its production. This impacts farmers by way of high post-harvest losses and low returns during periods of market glut. Preservation of tomatoes as semi-processing system not only takes care of the marketable surplus but also ensures the supply of raw materials for finished products like sauce, ketchup, drink and other processed products. Demand in India for processed tomato products is also growing at an annual rate of about 30% for the last 3 years.

In India, marketing of tomato is generally done by middlemen like commission agents and traders who are present in vegetable markets but least interested in farmer's or consumer's well-being. Market commission agents operate at market level and pay a fixed percent of charges to the government. Traders, on the other hand, are wholesalers who purchase tomato from one market or directly from farmers and sell to markets of other states to realize the profits on their purchase. Market commissioning agents maintain a good relationship with the same professionals operating at other markets all over India. These middlemen are supposed to play a vital role in matching demand with supply in the market. For these middlemen, majority of the Indian population living in urban areas who are engaged in non-farm industrial activities with high incomes, are major markets with a high demand for vegetables like tomato. Middlemen get highest profit from these people and their latent huge demand is satisfied by supply from rural villages that are major producers and supplier of tomato. But, due to lower price offered by middlemen/traders, the producers' share in consumer is very little in case of perishable vegetables like tomato. Besides lower share of producers, other problems like low productivity of crops, rapid change in climatic conditions, lack of inadequate availability of improved inputs & technology, higher losses due to insect pest & disease attack and lack of credit & marketing facilities are also faced by growers. Thus, for a sustainable growth of tomato production in India it is essential to maintain profitability to tomato growers in the country.

Karnal is one of historical districts of Haryana. It is also known as a city of 'Daanveer Karnal'. It is known all over the world for production of rice, wheat and milk as also known for agricultural research institutions like ICAR-National Dairy Research Institute (NDRI), ICAR-Central Soil Salinity Research Institute (CSSRI), ICAR-Directorate of Wheat Research (DWR), RRS-National Horticultural



Research & Development Foundation (NHRDF), ICAR-National Bureau of Animal Genetics Resources (NBAGR), ICAR-Regional Centre of Sugarcane Breeding Institute (SBI), RRS-ICAR-Indian Agriculture Research Institute and Centre of Excellence for Vegetables. In Haryana, commercial cultivation of vegetables under protected cultivation has started after the launching of National Horticulture Mission in 2005 but it has taken the boost after the setting up of Centre of Excellence for Vegetables at Gharaunda in Karnal district. Therefore, to assess the impact of these agricultural institutes in the district and to understand the gaps in value chain and measures required to improve the value chain of tomato in Karnal district, National Horticultural Research & Development Foundation (NHRDF) has assigned a study on "Value Chain of Tomato in Karnal District, Haryana to Indian Agribusiness Systems Limited or Agriwatch.

The National Horticultural Research and Development Foundation (NHRDF) was established by National Agricultural Co-operative Marketing Federation of India Ltd. (NAFED) and its Associate Shippers of onion on 3 November, 1977 under Societies Registration Act, 1860 at New Delhi with a vision of "enriching Indian Horticulture by developing and disseminating advance technologies for making India as a global leader in horticulture sector by enhancing the production, productivity and minimizing post-harvest losses of onion, garlic and other export-oriented horticultural crops, which will facilitate to meet the domestic needs and make India the global leader in export. The NHRDF is a voluntary centre of All India Coordinated Research Project on Vegetable Crops and All India Network Research Project on Onion and Garlic of the Indian Council of Agricultural Research. NHRDF is also a National Level Agency under Mission for Integrated Development of Horticulture and National Vegetable Initiative for Urban Cluster, of Department of Agriculture and Cooperation, Ministry of Agriculture and farmer welfare, Government of India, New Delhi. The mandate of the NHRDF is to:

- ✚ Undertake / conduct research or provide facilities in research and scientific investigations for the growth and development of varieties of different export-oriented horticultural crops.
- ✚ Establish institutes, laboratories, research centres, model farms, and study teams for promoting better quality and higher yield of horticultural produce, better packaging, suitable transportation and shipping to improve the shelf-life of the produce as also to conduct experiments and provide funds for such research work and to educate farmers and disseminate technical know-how and results derived by conducting training programmes, seminars, farmers' meets etc.
- ✚ Investigate and conduct research experiments for assessing demands of the horticultural produce of the Indian origin in foreign countries by conducting extensive survey and undertake research and development of horticultural produce with export potential and to



motivate farmers to grow such varieties of horticultural produce with the object of further developing horticultural exports from India.

- ✦ Prepare, edit, print, publish and circulate books, research papers and periodicals bearing upon the growth and development of horticultural produce or other scientific and research activities connected therewith, and to establish and maintain collections, libraries, statistics, scientific data and other information relating thereto.
- ✦ Conduct all aspects of scientific research and developmental activities in the field of horticulture or otherwise conducive to the objectives of the NHRDF provided that none of the activities of NHRDF will be undertaken for profit nor shall it involve any profit motive. However, the NHRDF may receive nominal service charges, wherever found necessary in the interest of maintaining financial stability of the NHRDF.
- ✦ The NHRDF shall provide extended services to the farmers in the form of research and developmental activities such as seed development, vermicomposting, bio-pesticide production and distribution and other laboratory services for which NHRDF may collect revenue from the farmers so as to establish a revolving fund or credit to corpus fund for further expansion of research and developmental activities.

1.1 Objectives

The main objective of this study is to understand the gaps in value chain of tomato and measures required to improve the livelihood of tomato growers and other stakeholders of the area. The objectives of the study are:

- Identification of on-farm and logistic constraints
- To assess current state of tomato supply chain in the district
- To work out cost of production and margin distribution among stakeholders
- To assess losses/wastage from harvest to consumption
- Identifying Key areas of intervention and policy recommendation
- To study constraints in market linkage

2 APPROACH AND METHODOLOGY

2.1 Approach

The approach adopted for this study was to analyze both the secondary data as well as primary data collected through interviewing farmers, stockists, mandi traders, APMC officials, exporters, input suppliers, wholesalers and retailers to arrive at the conclusion as per the study objectives, particularly the usefulness to the farmers. For this study the following steps were primarily adopted:

- Collection and review of secondary data like country/state/district level database, reports, documents, Government policies, plans and programmes.
- Development of questionnaires and checklists for primary data collection.
- Mobilization of the study team.
- Expert interaction and interview with APMC officials, exporters, traders and mandi agents.
- Field survey in the selected areas to arrive at a conclusive analysis of the emerging scenario.
- Analysis of secondary and primary data using appropriate tools.

2.2 Methodology

To fulfil the objectives of the study, both quantitative and qualitative analysis methods have been employed to provide strong evidence of achievements against the key review questions. In the last stage, report is structured in line with client requirements and it gives concise summaries of findings pertaining to project indicators yielding expected outcome, clear conclusions and well thought out recommendations based on both internal factors & external factors. The value chain study was carried out mainly through primary data collection by:

- Qualitative interviews of value chain participants
- Quantitative data through structured questionnaire

Questionnaires are designed on the basis of following scope of work:

- On-farm constraints
- Non-farm constraints
- Logistics constraints
- Current state of tomato supply chain in the district
- Cost of production and margins distribution among stakeholders
- Losses/wastage from harvest to consumption
- Key areas of intervention and policy recommendation
- Constraints in market linkages



2.2.1 Sample Design and Sample Selection

For collection of primary data, field survey has been undertaken with the following stakeholders:

- Farmers
- Stockists
- Mandi Traders
- APMC Officials
- Exporters
- Seed/Input Suppliers
- Wholesalers and
- Retailers

The value chain study of tomato, Karnal district of Haryana was done with sample size of 250 samples. The sample size was taken from 6 blocks of Karnal district. Further, 5 villages from each block and 33 to 34 farmers from each block distributed in five villages. Thus, farmer's sample size was approximately 200 in Karnal. Other stakeholders were approximately 50 for tomato crop. Details of different stakeholders surveyed during the study are as follows.

Table 1: Stakeholder-wise Sample Size

Participants	Sample Size
Farmers	200
Stockists	8
Mandi Traders	8
APMC Officials	2
Exporters	8
Seed/Input Suppliers	8
Wholesalers	8
Retailers	8
Total	250

Purposive Random Sampling Method has been adopted to conduct field survey. The samples have been collected from all the identified blocks and villages. The sample is representative and has covered all categories of farmers. The sampling has been done with the existing tomato growers and taking into account the condition of the farming community in the selected areas of the targeted crop.



3 TOMATO OVERVIEW

Tomato is one of the most important "protective foods" because of its special nutritive value. It is one of the most versatile vegetables with wide usage in Indian culinary tradition. Tomato is used for soup, salad, pickles, ketchup, puree, sauces and also in many other ways. It is also used as a salad vegetable. Tomato has very few competitors in the value addition chain of processing. In the world, India is the second largest tomato producing country after China. As per FAOSTAT, 2014, India produces 18735.91 thousand tons of tomato which is 8% of total world production in an area of 882.03 thousand hectares which in turn is 14.6 % of total area under tomato in the world. In India, tomato is mainly grown in two seasons across the country – June to September (*khariif*) and October to February (*rabi*) whereas in some regions it is produced throughout the years except for 1 or 2 months based on the climatic conditions.

3.1 Area, Production and Yield of Tomato in India

In India, there is a sizeable increase in area under tomato and production during last 15 years. The area under tomato increased from 478.80 thousand ha in 2002-03 to 797.00 thousand ha in 2016-17, while the production has increased from 7616.70 thousand metric ton in 2002-02 to 20708.00 thousand metric ton in 2016-17, which indicates that area and production of tomato in India are growing at the Compound Annual Growth Rate (CAGR) of 3.46 and 6.90 %, respectively.

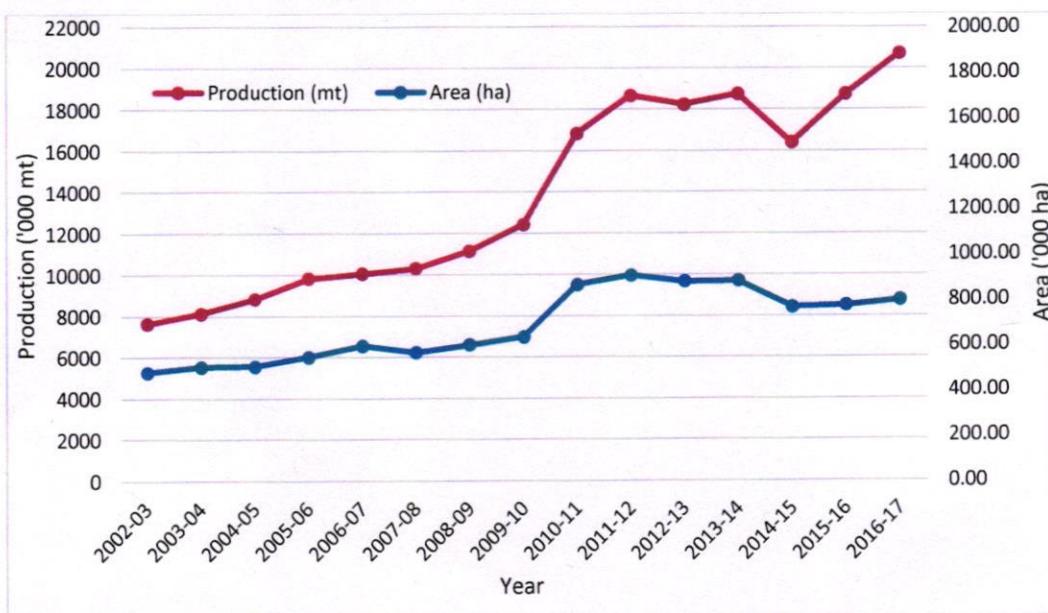


Figure 1: Year-wise All India Tomato Area and Production (2002-2016)

Source: NHB (Indian Horticulture Database, 2014 & Horticulture Crop Estimates for the year 2014-15, 2015-16 & 2016-17)

Tomato production has continuously increased during last 15 years because of higher demand, increase in consumption and higher rate of return. All India average tomato production is about 18-18.5 million metric ton every year. Tomato yield is the highest in the states of Himachal Pradesh, Uttar Pradesh and Andhra Pradesh with values of 43.98, 39.49 and 37.86 t/ha, respectively.

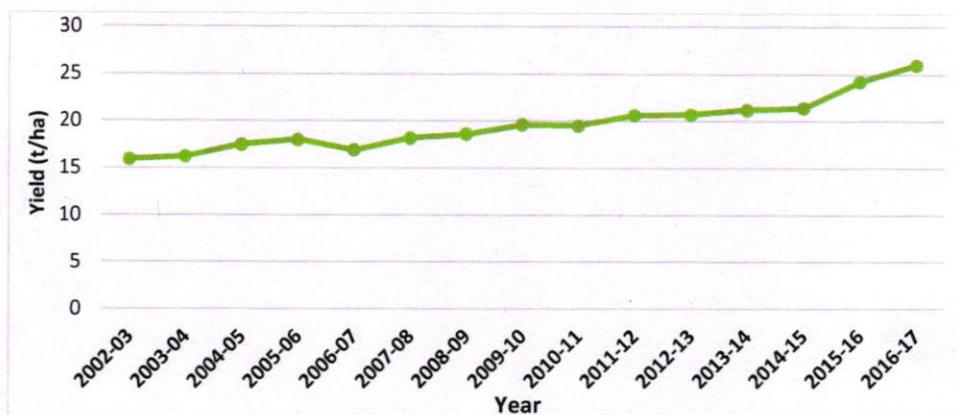


Figure 2: Tomato Yield Trend from 2002 to 2016 of the Country

Source: NHB (Indian Horticulture Database, 2014 & Horticulture Crop Estimates for the year 2014-15, 2015-16 & 2016-17)

Figure 2 shows the yield trend over last one decade. Average yield of tomato in India has increased from 15.90 t/ha in 2001 to 25.47 t/ha in 2016-17 and this is because of the increase in availability of better inputs, seeds and use of better cultivation methods. In some states, yield is comparatively higher than all-India average because of favourable weather conditions in those states.

Table 2: State-wise Area, Production and Productivity of Tomato (2016-17)

State	Area ('000 ha)	Production (in '000 mt)	Yield (t/ha)
Andhra Pradesh	49.79	4481.01	37.86
Madhya Pradesh	95.40	2719.57	31.02
Karnataka	60.45	1916.86	33.55
Gujarat	48.76	1411.85	28.43
Odisha	90.99	1311.21	14.2
West Bengal	57.35	1233.03	21.07
Maharashtra	50.71	1124.89	22.07
Chhattisgarh	62.33	1082.34	16.55
Bihar	46.21	1009.60	21.85
Uttar Pradesh	20.99	831.51	39.49
Haryana	31.82	643.59	20.23
Tamil Nadu	26.34	629.16	21.67
Telangana	37.97	520.47	25.44
Himachal Pradesh	11.06	473.28	43.98
Assam	18.18	393.60	25.2
Jharkhand	19.75	231.46	12.68
Other	68.78	695.03	14.68
Total	796.87	20708.44	25.47

Source: Ministry of Agriculture and Farmer Welfare, 2016-17



The above table number 2 shows that Madhya Pradesh has the largest area under tomato followed by Odisha, Chhattisgarh, Karnataka and West Bengal. In terms of production, Andhra Pradesh, Madhya Pradesh, Karnataka and Gujarat are the largest tomato producing regions because of higher yield in these states. Haryana's yield is close to India's average but it is much lower than the yield of Himachal Pradesh, Uttar Pradesh, Andhra Pradesh, MP, Karnataka and Gujarat. This indicates further scope for increase in production in the state with same acreage. In terms of acreage, Haryana has a share of 3.99% only in 2016-17. The chart number 3 given below shows the percent share of acreage of other states in India.

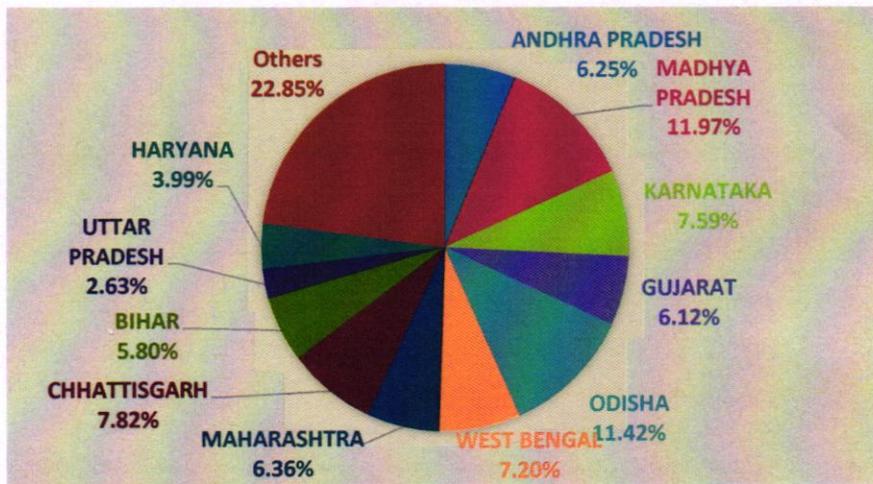


Figure 3: State-wise Percent Share of Tomato Acreage in India (2016-17)

Source: Ministry of Agriculture and Farmer Welfare, 2016-17

The southern and central states contribute maximum to the total tomato production in India including the states of Andhra Pradesh, Madhya Pradesh, Karnataka, Gujarat, Maharashtra and Odisha. Haryana is on 11th positions in tomato production and produces approximate 3.11% of the total production of the India. Andhra Pradesh is leading in tomato production followed by Madhya Pradesh, Karnataka, Gujarat, Odisha, West Bengal and Maharashtra in 2016-17 which is shown in the chart number 4 below.

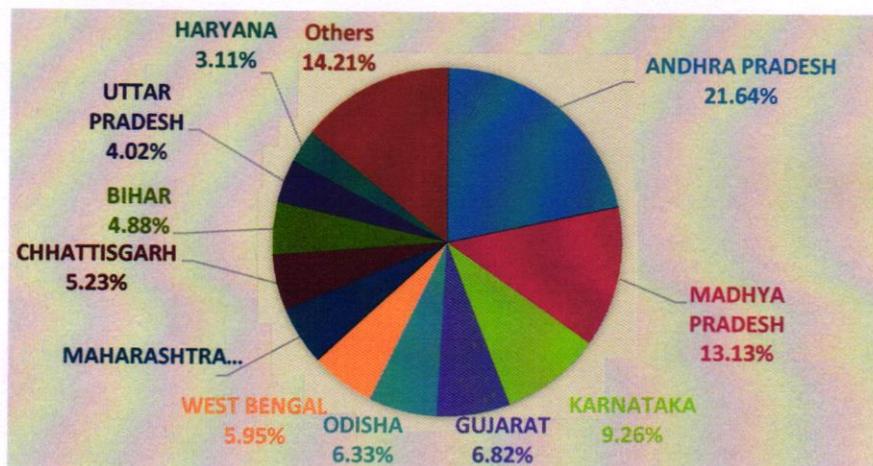


Figure 4: State-wise Production of Tomato in India (2016-17)

Source: Ministry of Agriculture and Farmer Welfare, 2016-17

3.2 Area, Production and Yield of Tomato in Haryana

Haryana contributes approximately 4% of the total area and production of tomato in the country. Tomato from Haryana mainly covers markets of Delhi NCR, Rajasthan and other nearby states. Haryana's average area is approximately 29000 ha with an average yield of 20-23 t/ha. However, we can see that there is lot of fluctuation in average yield over the years.

Table 3: Year-wise Area, Production and Yield of Tomato in Haryana

S.No.	Year	Area ('000 ha)	Production ('000 mt)	Yield (t/ha)
1	2012-13	27.61	400.81	14.52
2	2013-14	29.42	627.28	21.32
3	2015-16	29.03	675.38	23.26
4	2016-17**	31.82	643.59	20.23

Source: NHRDF, & **Ministry of Agriculture and Farmer Welfare, 2016-17

3.2.1 About Haryana and Karnal

Haryana is one of the state in northern India. The city of Chandigarh is its capital. It is bordered by Punjab and Himachal Pradesh to the north and by Rajasthan to the west and south. The river Yamuna defines its eastern border with Uttar Pradesh. Haryana surrounds the country's capital Delhi on three sides, forming the northern, western and southern borders of Delhi. Latitude and longitude coordinates of the state are 29.065773 and 76.040497 respectively with the GPS coordinates of 29° 3' 56.7828" N and 76° 2' 25.7892" E. The state of Haryana has been split into four divisions for governmental reasons and these are the Rohtak, Ambala, Hisar and Gurugram Division. The state comprises 47 subdivisions, 22 districts, 45 sub-tehsils, 6 tehsils, and 116 blocks. Karnal district comes under Rohtak sub-division.

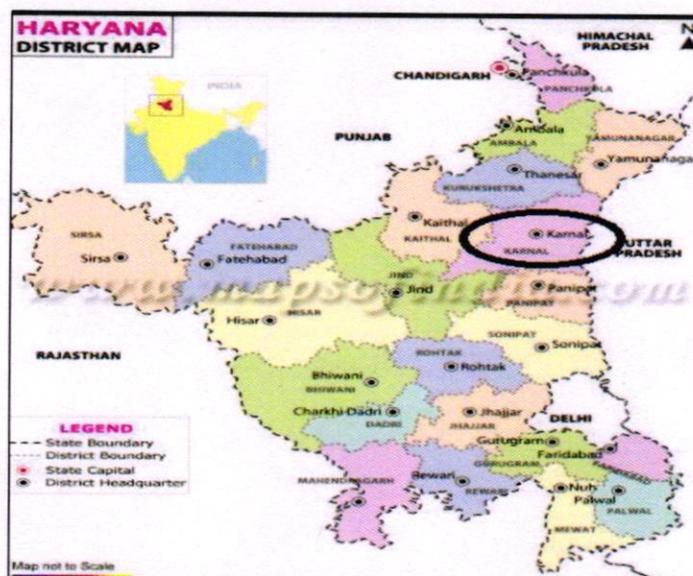


Figure 5: Political Map of Haryana

Karnal is one of historical districts of Haryana. It is also known as the city of 'DaanveerKarn'. It is known all over the world for the production of rice, wheat and milk as known for agricultural research institutions like ICAR-National Dairy Research Institute (NDRI), ICAR-Central Soil Salinity Research Institute (CSSRI), ICAR-Directorate of Wheat Research (DWR), RRS-National Horticultural Research & Development Foundation (NHRDF), ICAR-National Bureau of Animal Genetic Resources (NBAGR), ICAR-Regional Centre of Sugarcane Breeding Institute (SBI) and Centre of Excellence for Vegetables. Major crops grown in Haryana are paddy, wheat, tomato and sugarcane. Commercial cultivation of vegetables under protected cultivation has started after the launching of National Horticulture Mission in 2005 but has taken the boost after the setting up of Centre of Excellence for Vegetables at Gharaunda in Karnal district under Indo-Israel Project. With this facility, scientists from Israel brought the technology of protected cultivation to Haryana. Currently, there are 26 such Indo-Israel centers in the country. Nearly 2000 farmers have benefited through this partnership in Haryana alone. More than 1800 acres of land is now under protected cultivation in the state. Therefore, for value chain study of tomato, Karnal was selected as benchmark district for Haryana state.

Karnal district of Haryana alone produces 43587 tons of tomato from an area of 2515 ha. It is at 4th position in tomato production in the state and contributes approximately 8% of the total area under cultivation and produces around 6.77% of total production of the state. In the state, around 1% of tomato production comes from protected cultivation and the yield of tomato under protected cultivation is also very high as compared to open field. In the state, Bhiwani, Karnal and Panipat have



the highest area under protected cultivation. Mewatis the highest tomato producing district with the highest area under tomato cultivation. District-wise area and production of tomato in Haryana is shown in the table number 4 below.

Table 4: District-wise Area and Production of Tomato in Haryana (2016-17)

S.No.	District Name	Open Field			Protected Cultivation			Total	
		Area (ha)	Production (t)	Productivity (t/ha)	Area (ha)	Production (t)	Productivity (t/ha)	Area (ha)	Production (t)
1	Panchkula	1444	15245	10.56	6	285	47.50	1450	15530
2	Ambala	1785	18806	10.54	5	245	49.00	1790	19051
3	Y/Nagar	3920	98200	25.05	0	0	0.00	3920	98200
4	K/Keshtra	997	10790	10.82	3	120	40.00	1000	10910
5	Kaithal	409	11110	27.16	1	70	70.00	410	11180
6	Karnal	2500	42600	17.04	15	987	65.80	2515	43587
7	Panipat	1371	25500	18.60	22	928	42.18	1393	26428
8	Sonipat	2170	56200	25.90	6.3	605	96.03	2176.3	56805
9	Rohtak	1601	34672	21.66	0	0	0.00	1601	34672
10	Jhajjar	750	12370	16.49	8	540	67.50	758	12910
11	Faridabad	580	14700	25.34	1	70	70.00	581	14770
12	Narnaul	595	6785	11.40	2	125	62.50	597	6910
13	Rewari	465	8810	18.95	0	0	0.00	465	8810
14	Gurugram	2215	25315	11.43	3	50	16.67	2218	25365
15	Bhiwani	1437	16965	11.81	42	1020	24.29	1479	17985
16	Hisar	695	14400	20.72	0	0	0.00	695	14400
17	Fatehabad	750	11780	15.71	3.4	55	16.18	753.4	11835
18	Sirsa	535	10544	19.71	2	75	37.50	537	10619
19	Jind	1650	39643	24.03	0	0	0.00	1650	39643
20	Mewat	5340	150312	28.15	0	0	0.00	5340	150312
21	Palwal	490	13480	27.51	2	190	95.00	492	13670
		31699	638227	20.13	121.7	5365	44.08	31820.7	643592

Source: Horticulture Department, Government of Haryana, 2016-17

3.2.1.1 Trend in Tomato Cultivation in Karnal District

A. Year-wise trend of area under tomato in Karnal:

The graph below shows a trend in area during last 16 years which indicates that the area is continuously increasing because of higher demand and profit along with favourable climatic conditions. However, it has decreased during last 2 years. The exact reason for this fall could not be established. From trade sources, it is because of the lower price realization in previous years when arrivals are at peak from the state. Last year (2016), price of tomato was Rs. 2-3 per kg in wholesale market. Farmers were forced to throw away their produce and some even scattered it on the roads to protest against the government.

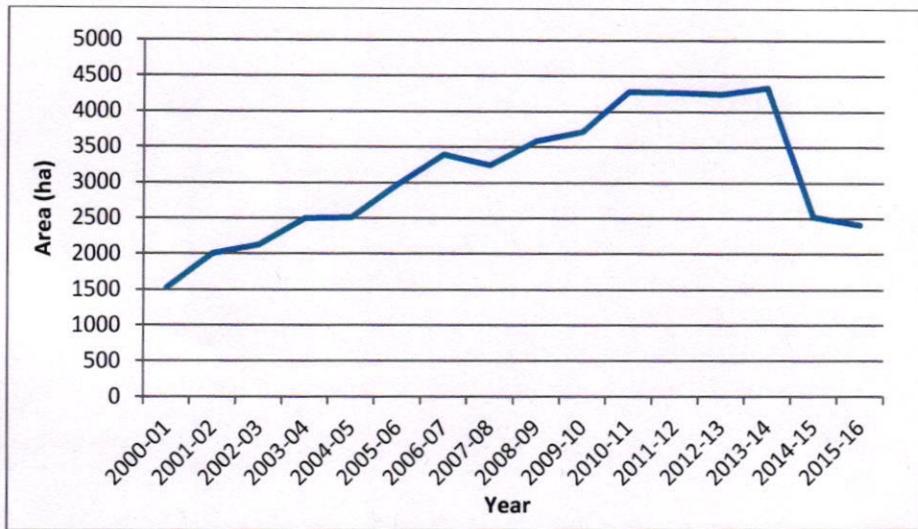


Figure 6: Year-wise Trend of Area under Tomato in Karnal

Source: Horticulture Department, Government of Haryana, 2016-17

B. Year-wise Production Trend of Tomato in Karnal:

The graph number 7 given below depicts the trend in tomato production in Karnal district from the year 2000 to 2016. Production is continuously decreasing for last two years because of lower acreage.

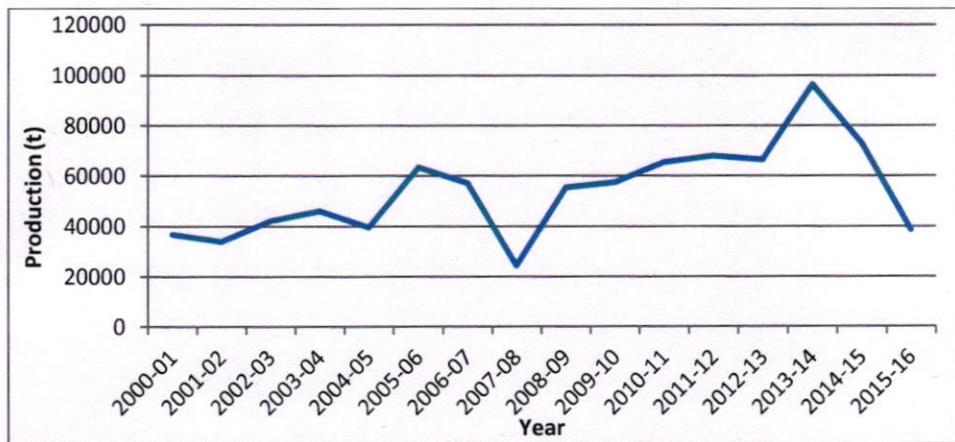


Figure 7: Year-wise Production Trend of Tomato in Karnal

Source: Horticulture Department, Government of Haryana, 2016-17

C. Tomato Yield in Karnal

Average yield of tomato in Haryana varies from 24.47 t/ha in 2014-15 to 20.13 t/ha in 2016-17 while in Karnal, it was 28.95 t/ha in 2014-15 but in 2015-16 and 2016-17, it was only 16 to 17 tons per hectare in open field and 66 to 88 t/ha under protected cultivation as shown in the table number 5 below.

Table 5: Tomato Yield in Karnal District

Year	Tomato Yield in Karnal District (t/ha)	
	Open Field	Protected Cultivation
2014-15	28.95	
2015-16	15.95	88.00



2016-17	17.04	65.80
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Source: Horticulture Department, Government of Haryana, 2016-17

But, as per the primary survey, average yield of tomato in the district goes up to 40.72t/ha and block Nissing has the highest yield of tomato in the district which is more than district average. Other blocks like Gharaunda, Indri, Karnal and Nilokhedhi have nearly same tomato yield but less than district average which is shown in the table number 6 below.

Table 6: Block-wise Average Yield of Tomato in Karnal (As per Primary Data)

Block	Average Yield (t/ha)
Assandh	NA
Gharaunda	38.29
Indri	35.37
Karnal	38.90
Nilokhedi	37.52
Nissing	53.52
Average	40.72

As per the Department of Horticulture, Karnal, Padhana in Nilokheri block, Gularpur in Nissing block and Dhanora in Indri block have highest area under tomato cultivation and average yield of tomato in these areas goes up to 50 to 54 t/ha.

4 STATUS OF FARMERS AND ECONOMICS OF TOMATO PRODUCTION IN KARNAL

The information on costs and returns of crops can be useful to assess the economic condition of farming community in terms of employment and wage structure to assess the quality of life of agricultural labourers. Hence, cost of cultivation survey is an important mechanism for data generation on cost and return structure of crops. Accordingly, survey was conducted in this study to collect the relevant information related to socio-economic characteristics, their classification, income pattern, and cost per unit area for the sample tomato growers in the state.

4.1 Socio-economic Characteristics of Tomato Farmers

The important socio-economic characteristics of tomato sample farmers are presented in Table-7. More than 65% of the sample population was educated till primary and High School, 14% of the population is educated till Sr. Secondary. Only 5% of the sample population is graduate and above and 13% of the sample population is illiterate. So, broadly it could be inferred that more than 85% of the sample population are educated to a certain level.

The family size is also an indicator of the socio-economic status in addition to land holdings. The average family size of the sample farmers was seven members per household. Nearly 59 per cent of the family of sample population is nuclear with only two generations of the family and the rest (41 per



cent) are joint families where more than two generations of the family are residing in the same household. As categorical classification is concerned, 54% of the sample population is under "General" category, 42% is under "OBC" category and only 4% is under "SC" category.

Table 7: Socio-economic Characteristics of Farmers

Particulars	Respondents (n=201)	Percentage
1. Educational status		
A. Illiterate	25	13%
B. Literate/Primary	70	35%
C. High School	68	34%
D. Sr. Secondary	28	14%
E. Graduate and Above	9	5%
2. Average Family Size	7	
3. Family Type		
A. Joint	83	41%
B. Nuclear	118	59%
4. Categorical Classification		
A. General	109	54%
B. OBC	84	42%
C. SC	8	4%

4.2 Land Holding and Income of Tomato Farmers

From the following table number 8 & 9, it can be inferred that 30% of the sample population are small with average landholding of 1-2 ha, 28% are medium farmers with average land holding of 4-10 ha and 24% semi-medium with average land holding of 2-4 ha. Large farmers are very few in our sample respondents *i.e.* only 3% and marginal farmers in the sample population were 16%.

It is also clear from the table that marginal farmers are the least earning group among all the groups. Average income of the sample farmers calculated is Rs. 2.83 lakh per annum.

Table 8: Average Annual Income of Sample Farmers

Farmer Category as per landholding	Respondents (n=201)	Percentage of total	Average Income (Rs.)
Marginal (below 1 ha)	32	16	128281
Small (1-2 ha)	60	30	213033
Semi medium (2-4 ha)	47	24	258085
Medium (4-10 ha)	55	27	383889
Large (> 10 ha)	6	3	431667
Average Income (lakhRs.)			2.83

The table number 9 given below describes the income level of sample population from which it can be understood that 55.22% of the sample population belongs to middle income group, 34.33% belongs to low income group and only 10.45% belongs to high income group. More than 80% of the sample



population is falling under low and middle income groups and there was no affluent person in our entire study.

Table 9: Classification of Farmers (On the Basis of Income Group)

Income classification		
Income Groups	Respondents(n=201)	Percent of total
Low Income (less than 1.5 lakh)	69	34
Middle Income (1.5 to 4.8 lakh)	111	55
High Income (4.8 to 9.0 lakh)	21	11
Affluent (more than 9.0 lakh)	0	0



5 VALUE CHAIN ANALYSIS-TOMATO IN KARNAL

The value chain analysis was conducted by adopting a comprehensive approach in which apart from using secondary information from various sources, primary information was collected through face to face interviews of various stakeholders. Such data were used for gap analysis, identification of interventions and opportunities for strengthening VCs.

Field survey was conducted for analyzing the tomato value chain to assess its competitiveness and potential across different parts of the country. Karnal is identified as an important competing district based on the area and production ranking. It is ranked third in terms of acreage under tomato farming, and the same has been used to benchmark practices.

5.1 Economics of Tomato Cultivation

In the tablenumber 10 given below costs and returns per acre of tomato cultivation pertaining to the reference year 2016-2017 are presented for the studied district. Out of the total cost, major items are “cost of human labour” which accounted for 45% and “cost of pesticides and weedicides” which accounted for 19% of the total followed by “cost of manure and fertilizer” which was 18%. Tomato farmers in the study area got an average yield of 149 q/acre and they could be able to sell tomato at an average price of Rs. 4000-6000 per ton.

Table 10: Cost of Cultivation and Return Structure of Tomato for Karnal Sample Growers (2016-17)

S.No.	Particulars	Input Cost (Rs./acre)	Percent Contribution
1	Cost of seed/ planting material	4453	13
2	Cost of human labours (sowing to harvesting)	15545	45
3	Cost of manure & fertilizer s	6358	18
4	Cost of pesticides & weedicides	6503	19
5	Cost of irrigation	1138	3
6	Fencing or others to support plants	498	1
	Total cost of production	34,495	

The average yield calculated from the survey for the year 2016-17 for the district came to 149q/acre and average cost of cultivation Rs. 34,495/acre. So, the average cost of cultivation incurred by tomato growers will be Rs. 232/q. The average selling price reported by tomato growers was Rs. 495/q and market expenses they incurred Rs. 130/q. Hence, net profit received by tomato growers will be Rs. 133/q.



Table 11: Farmers' Income from Tomato in 2016-17

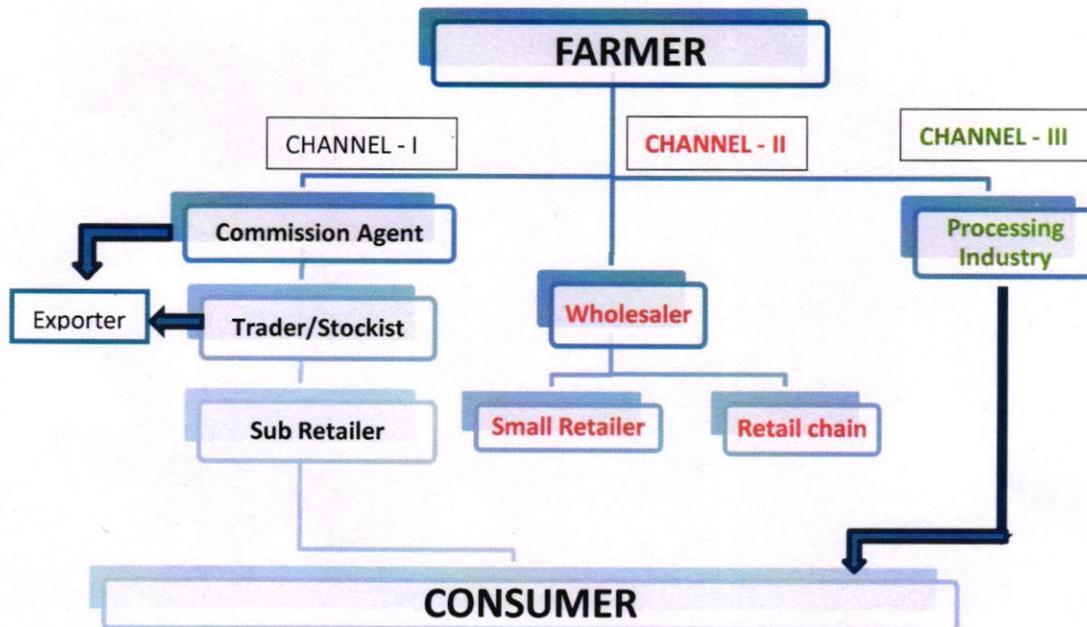
Farmer's Net Income	
Average cost of cultivation for 2016-17 (Rs./acre)	34,495
Average yield for the year 2016-17 (q/acre)	149
Total cost occurred for Tomato (Rs./q)	232
Total Price receive in the market (Rs/q)	495
Market Expenses (Rs./q)	130
Net price received by the farmer (Rs./q)	365
Net profit (Rs./q)	133
Profit percentage	+37%

5.2 Value Chain Mapping and Stakeholders Involved in Tomato Value Chain

The value chain analysis is the process of breaking a chain into various components in order to better understand its structure and functioning. This section shows the results from value chain mapping and actors involved in various marketing channels for tomato in the study area.

The value chains of tomato and tomato products were organized and presented in a systematic way in the value chain map. Overall, the tomato value chain mainly comprise of input suppliers, producers, commission agents, wholesalers, collection centers, central warehouses, vendors, processors, retailers, distributors, exporters and consumers.

We can see all the possible routes through which tomato can travel from farm to fork. There are mainly three common supply chains of tomato out of which, channel- II is the most preferred one as reported by most of the farmers except marginal group because they mostly prefer channel –I. Since marginal farmers have lower production because of small lands, they are forced to sell about 90% of their produce to traders or wholesalers through commission agents. Only 5-10% of the produce is sold directly through the mandi due to immediate cash requirements as depicted in the figure below.



5.2.1 Functionaries in the Supply Chain

5.2.1.1 Farmers

Producers are actual growers of fresh tomato from different categories of landholdings. They are the most valued actors in the tomato value chain. They generally purchase necessary inputs like seeds, fertilizers, pesticides from agro-dealers. In case of Karnal, majority of the farmers buy seeds from the Agri-input dealer. As reported, none of the sample respondents had any tie-up with processors for tomato contract farming.

5.2.1.2 Commission Agents

Commission agents are authorized traders in the APMC who facilitate the sale of tomato from producers to buyers (wholesalers, retailers, processors) on open bidding (auction) method to fix prices for the tomato. Commission agents are the common link between farmers and buyers of local as well as distant markets. They also provide credit to trusted farmers and make commitment to sell their produce during harvest season, but in our case none of the respondents sample has taken any kind of credit help from commission agents.



5.2.1.3 Wholesalers

Wholesalers are the important buyers in the market who generally procure tomato in larger quantities and supply to retailers (both organized and unorganized), processors and exporters. They usually store the produce for short period and disseminate.

5.2.1.4 Retailers

Retailers are the sellers of tomato to the end users *i.e.* consumers through multiple channels such as small grocery stores, exclusive fruits and vegetable shops, supermarkets and exporters. They normally buy from wholesalers and sell both fresh tomato and other tomato processed products in smaller quantities with a higher profit margin.

5.2.1.5 Processors

Processors are the secondary processing industries. The tomato processed products made by the processors include tomato paste, sauce and ketchup. They usually collect fresh tomato from wholesalers in APMCs and vendors in major tomato production areas during peak season and glut in market at cheaper prices.

5.2.1.6 Exporters

Exporters perform the sale of fresh tomato and processed tomato paste in the international markets. Few of the wholesalers in Karnal APMC, supply fresh tomato to the exporters outside the state, and they usually export to the neighbouring countries like Bangladesh and Myanmar.

5.3 Cost and Returns in Tomato Value Chain Marketing Systems

The margin for an ownership level is calculated using the values of the buying cost, selling cost, cost of value addition on the date of observation and the loss at that level.



	FARMER Gross price received by Farmer Rs./q 495 Farmer's expenses Rs./q 130
	TRADER Trader's gross profit Rs./q 141 Trader's expenses Rs./q 83 Trader's margin Rs./q 58
	WHOLESALER Wholesaler's gross profit Rs./q 206 Wholesaler's expenses Rs./q 116 Wholesaler's margin Rs./q 90
	RETAILER Retailer's gross profit Rs./q 311 Retailer's expenses Rs./q 119 Retailer's margin Rs./q 192
	CONSUMER Purchase price - Rs. 1153/q

Figure 8: Cost and Returns at each Stakeholder's Level after Harvesting of Tomato

Farmer invests in primary grading and transportation of the produce to the APMC markets and sells the produce to traders/wholesalers through commission agents. Since, it is a highly perishable commodity, it is not stored at producer's level. Primary grading is done by the farmers too and then transportation charge is an extra added cost in the case of tomato.

Traders again do the grading and packing as per the demand and quality. Tomato needs grading and sorting at each level of its value chain. Wholesaler/trader usually stores tomato for very short period and then it is sold to another stakeholder *i.e.* to retailer or to the processing industry for the purpose of puree preparation.

From the above figure number 8, it can be noticed that expense in tomato value chain is higher at each level of stakeholder because there is considerable amount of loss at each level. Nevertheless, the expenses are highest at farmer's level (Rs. 130/q) followed by retailers (Rs.119/q), wholesalers (Rs. 116/q) and traders (Rs. 83/q). Retailer is taking the highest amount of gross profit and margin and one of the reasons behind it is the higher risk, investment in terms of time and capital involved.



5.3.1 Margin Distribution among Various Intermediaries in Supply Chain

The table number 12 given below represents the share of various components of the chain in the total margin along the chain. The margin has been calculated considering the input cost, cost of selling and cost of value addition at that level of ownership and it does not include the various marketing expenses occurring at different levels of the supply chain. The following table number 12 provides detailed breakup of all the costs incurred at each level of the value chain with each stakeholder.

Table 12: Price Buildup of Tomato

Stakeholder	Post-harvest Activities	Price Realization at Different Levels	Wastage per kg (%)	Activity-wise Cost (Rs./kg)
	Farmer's Profit (Rs./kg)	1.34		
Farmer	Cost of Cultivation			2.32
	Transportation, Loading & Unloading Cost			0.64
	Cost Incurred during Cleaning and Grading			0.16
	Total Losses (During Harvesting, Transportation, Cleaning & Sorting, Grading, Storage and Marketing)		10.00%	0.50
	Selling Price of Farmer (Rs./kg)	4.95		
	Traders/Commission Agents	Loading and Unloading Charges		
Packaging Material Cost				0.15
Weighing Charges				0.01
Mandi Fee				0.00
Wastage during Sorting, Cleaning & Transportation			6.06%	0.30
Commission				0.25
Margin (Average 10%)				0.58
Selling Price (Rs./kg)		6.36		
Wholesalers	Labour Charges (Loading & Unloading)			0.15
	Packaging Material Cost			0.15
	Wastage during Sorting, Cleaning & Transportation and Weight loss		13.5%	0.86
	Margin (Average 12%)			0.90
	Selling Price at Commission Agent Point (Rs./kg)	8.42		
Local Retailer	Transportation Cost			0.34
	Loading & Unloading Cost			0.12
	Loss due to Transportation & Sorting		8.67%	0.73
	Margin (20%)			1.92
	Selling Price to the consumer (Rs./kg)	11.53		

From the above table number 12, it is clear that the price gap in tomato value chain from producer to end consumer is Rs. 658/q.

Table 13: Price Gap of Tomato

Price gap of tomato Rs./q between producer and end consumer	
Price payable to farmer (Rs./q)	495
Price payable by end consumer (Rs./q)	1153
Price Gap (Rs./q)	658



Out of the total cost difference between producer and consumer there is a certain amount of expenditure that occurred at various level of the value chain. In the present case, 48% of the total cost wasthe expense at various stakeholders' levels and maximum expense occurred at the retailer's level because of various losses at each stage.

Table 14: Price Breakup of Tomato

Price breakup	Rs./q	Percentage
Total expense at stakeholders' level	318	48%
Total margin at stakeholders' level	340	52%

Out of the total margin, retailer's share is highest *i.e.* 56% and wholesaler's share is 26% of his total cost. Trader gets 17% of the total cost incurred by him. So, it can be stated that out of the various stakeholders, retailer earns the maximum. There is also maximum risk involved at his level because he is the ultimate source who balances the whole supply and demand of the commodity in the consumer market. The wastages and time involved is also high at retailer's level.



Figure 9: Margin Percentage Distribution among Different Stakeholders

As far as tomato crop is concerned, wastages are very high at each level. Simple grading and sorting becomes an important task whenever commodity travels from one place to another, and losses due to wastes are the highest because of its perishability. During the survey, the price ranged from Rs. 100-1200/qand it also fluctuates intra-day. When a farmer takes his produce to the mandi his solo mission is to sell it, many a times he does not get better price for his commodity at mandi because of less demand. In such situation, he sometimes sells his produce at below the cost price because taking back the produce would add further cost.

6 ADDITIONAL FINDINGS FROM THE SURVEY

6.1 At Production Level

As per the survey conducted, respondent farmers are involved in tomato farming for 11 years on an average. When asked about reason for doing tomato farming, 49% of the respondents replied that resource availability is the main reason for doing tomato farming whereas 18% of the respondents told that tomato has high demand and that is the reason for cultivating tomato. Also, 15% of the respondents told that lower cost of production is the reason behind cultivating tomato.

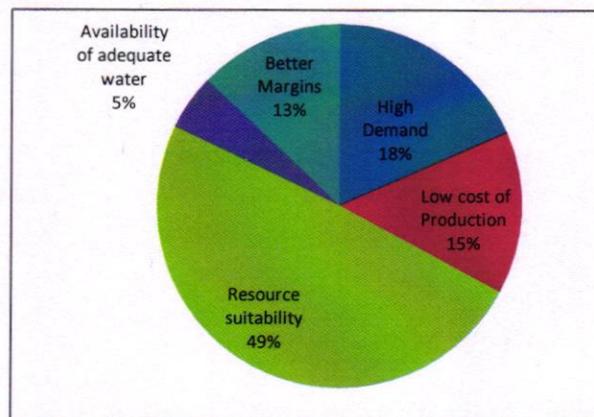


Figure 10: Reason for Engaging in Tomato Farming

Major varieties grown in the area surveyed: Major varieties grown in the area are HimSona (50%) from Syngenta, 524 (21%) from Namdhari Seeds Pvt Ltd. and Abhilash (6%) from Seminis (Monsanto). Reasons behind choosing these varieties are mentioned as higher yield and easy availability. None of the ICAR varieties have been used by the respondent farmers ever.

In Karnal district, only 0.60% of the total tomato area is under protected cultivation which produces only 2.3% of the total tomato in the district. Out of the total surveyed farmers, none reported about tomato cultivation under protected cultivation. As per the National Horticulture Board (NHB), recommended tomato varieties¹ for the protected cultivation in Haryana are:

- Tomato: By Syngenta – HimSona, Him Shekhalsona, 34774, etc.
- Cherry tomato – By Monsanto -Olleh, Raisy, etc.

Besides, the varieties developed by HAU and IARI are also available for protected cultivation.

¹ Model Bankable Project on Protected Cultivation in Haryana, Ministry of Agriculture, Government of India



Major pests and diseases in the area surveyed: As per the respondents, Blight (58%), Armyworm (33%) and Marodia*i.e.* Leaf curl (18%) are the most widely spread pests and diseases prevalent in the area which have affected tomato production.

Table 15: Practices followed for Control of Various Pests

Stages of Crop	Control Measures
During Nursery	Fungicide and pesticide spray
Before Transplanting	Fungicide and pesticide spray
Transplanting and during Crop Growth	Pesticide spray

Out of the total respondents, 57% replied that they do not use any kind of organic manure during tomato farming and when asked for the reasons, 44% of the respondents told that usage of organic manures decreases the yield of potato whereas 21% told that organic manure is costly and 16% of them are unaware about organic farming and its benefit.

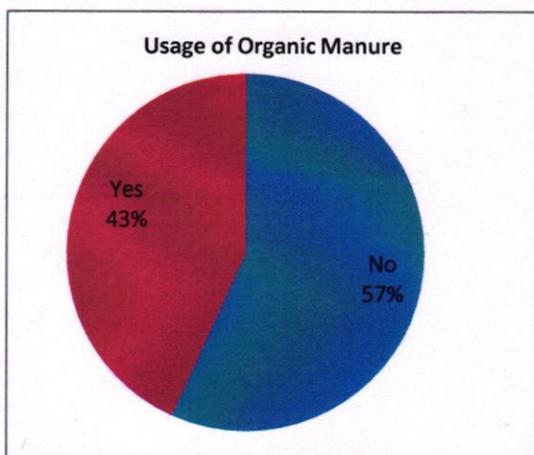


Figure 12: Percent of Farmers using Organic Manure

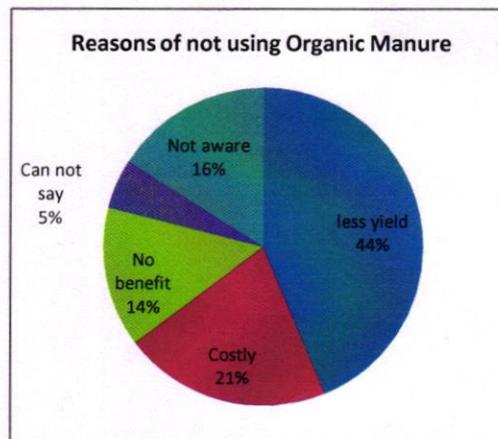


Figure 11: Reason for not using Organic Manure

About 43% of the total respondents reported that they use organic manure for tomato cultivation. When asked about the benefits, “good yield” and “less disease” were the answers received.



6.1.1 Awareness Level among the Farmers

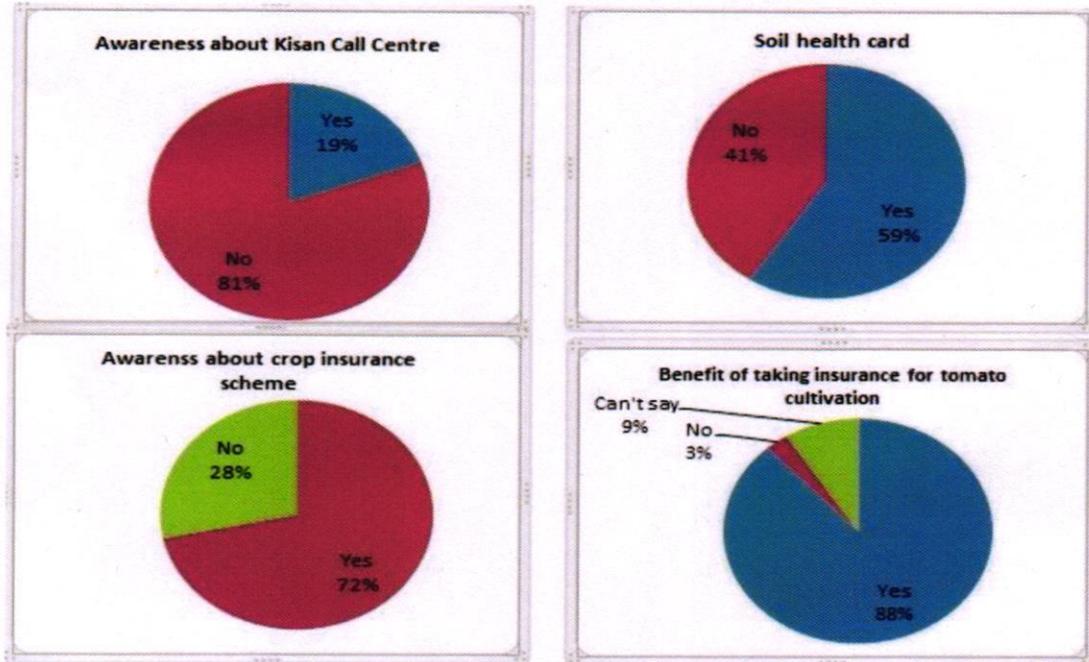


Figure 13: Awareness Level among the Farmers

- When the respondents were asked about Kisan Call Center (KCC), 81% of them replied that they have never talked to any KCC while 19% of the respondents replied that they had called KCC.
- When asked about Soil Health Card, 59% of the respondents answered that they know about Soil Health Card and its benefit and they regularly get soil testing done for their field.
- When asked about crop insurance, 72% of the respondents answered "Yes".
- When asked about training for best practices of tomato cultivation, 94% of the respondent replied with a "No", and rest 6% who took the training at Gharaunda as the location of training place.
- Out of the total respondents, 57% visited agriculture department for some guidance or to understand the various schemes available to support tomato farming, whereas 43% never visited agriculture department for any kind of support.
- Out of the total respondents, 73% were aware about the Center for Excellence of Horticulture in Gharaunda block whereas the remaining 27% were not aware of it.
- Awareness about IPM and INM is only 8% and 13% respectively, which is shown in the figure number 14 below.

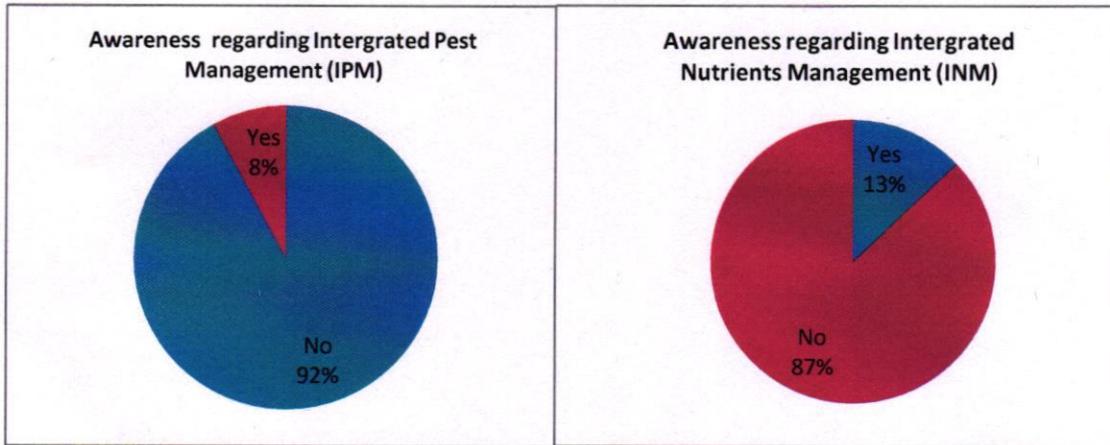


Figure 14: Awareness regarding IPM and INM

6.2 At Post-harvestLevel

6.2.1 Sorting and Grading

During the survey, almost all the farmers reported that they undertake all types of post-harvest practices like cleaning, sorting, grading, weighing & packaging in tomato before taking it to the market. All of them also grade their produce by themselves before selling it in the market. During grading, size, shape, disease & damaged fruits, ripened and deformed/blemished fruits are the main factors considered important by most of the surveyed farmers. About 3% of surveyed farmers also reported that they do preliminary treatment of tomato by Indo Jill, Redomill, Vitamins, 0.34.52, 0.0.50 etc. at maturity/ harvest time to enhance the quality.

Out of the total respondents, no farmer undertakes any primary processing when there is bumper production or prices are lower in the market. All the surveyed farmers also reported about non-availability of processing unit in their area where they could sell their produce at the time of bumper production. Even, there are no storage facilities in their area to store their produce during peak production season. All the respondents urged that setting of processing industry and storage space would reduce their losses and would help them in realizing better prices of their crop.

6.2.2 Post-Harvest Losses

Losses are a measurable reduction in foodstuffs and may affect either quantity or quality or both. They arise from the fact that freshly harvested agricultural produce is a living thing that breathes and undergoes changes during post-harvest handling. Post-harvest losses are caused by both external and internal factors like mechanical injuries, damage due to insects & pests attacks and physiological deterioration. Losses may occur anywhere from the point where the food has been harvested or



gathered up to the point of consumption. Poor handling, unsuitable packaging and improper packing during transportation are the main reasons for injury totomato.

The study reveals that there are about 13.34% losses in tomato value chain at the farmers' level. Maximum losses occur at the cleaning, grading, weighing and packaging stage (6.21%) followed by harvesting (4.80%). During transportation, losses in tomato are about 2.33%. There is no storage losses observed at farmer's level because it is highly perishable and due to non-availability of storage facilities, farmers directly sell their produce to the market just after harvesting.

Table 16: Various Losses at Post-harvest Level

S.N	Post-harvest stages	Percentage loss
1	Harvesting loss	4.80
2	Transportation losses	2.33
3	Cleaning, Grading, Weighing&Packaging losses	6.21
	Total	13.34

At trader's level, average loss reported was 3.4% which is mainly due to handling, weighing, loading and delay in marketing.

At the wholesaler 's and retailer's level, average losses are about 6.89and 8.63%respectively, and the main reasons of the losses are sorting, grading, weighing and delay in marketing. Most of the retailers throw all of their poor quality tomato but few of them also reported that they sell 20 to 30 % of their partially damaged tomato at lower price.

6.3 At marketing Level

6.3.1 Seasonal Availability

In Karnal, Padhana in Nilokheri block, Gularpur in Nissing block and Dhanora in Indri block are the major tomato growing belts. Area under tomato in Padhana, Gularpur and Dhanora is 400, 400 and 600 ha, respectively and average productivity of tomato up to 50 to 54 t/ha. In the district, tomato crop is generally cultivated during June to September (*kharif*) and October to February (*rabi*). Few farmers in the region also reported about summer crops but area under *kharif*/rainyseason tomato is highest in the region. We can infer from the below data in the table number 17 that there is significant variation in Karnal's production share in the state. Production share for the year 2016-17 is nearly 6.80% against 11% during 2014-15 with same area under cultivation. It implies that yield has gone down drastically which is a cause of concern. The years 2013-14 and 2014-15 look to be abnormal because of sudden jump in yield.



Table 17: Year-wise Area, Production and Share of Tomato Production in Karnal

Particulars		Years						
		2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Haryana	Area (ha)	27225	27070	27605	29415	27245	29085	31820.7
	Production (t)	392362	417443	400811	627282	666564	679419	643592
Karnal	Area (ha)	4280	4250	4250.0	4332	2520	2410	2515
	Production (t)	65440	67960	66505.0	6450	72965	38500	43587
Share of Karnal in Tomato Production (%)		16.68	16.28	16.59	15.38	10.95	5.67	6.77

Source: Horticulture Department, Government of Haryana, 2016-17

6.3.2 Tomato Price Seasonality

In India, tomato is mainly grown during two seasons across the country – June to September (*khariif*) and October to February (*rabi*) whereas in few regions it is produced throughout the year except 1 or 2 months based on the climatic conditions. In Karnal too, tomato is grown in the same two season. Few farmers also reported about summer crops in the region. The following figure number 15 below shows the monthly all-India average wholesale prices of tomato. During the months June to September, prices are normally on higher side because of the off season and lesser supply of tomato from producing regions.

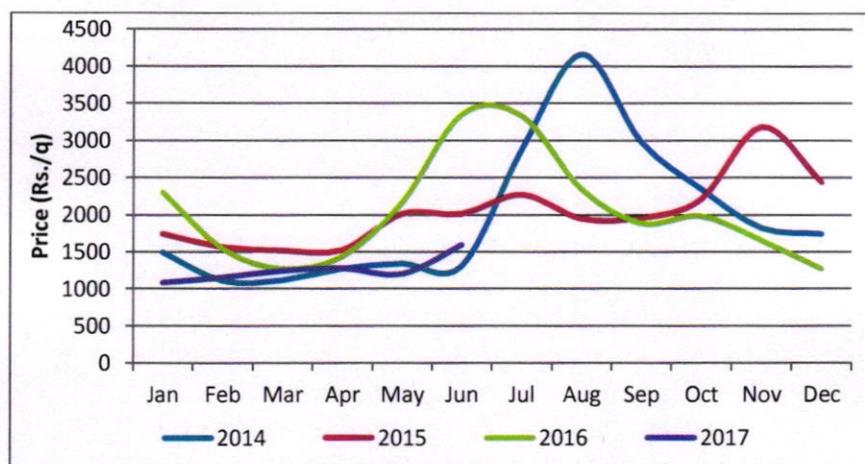


Figure 15: Tomato Wholesale Price Seasonality

Source: Government of Consumer Affair, GOI (Price Monitoring Cell), 2017-18

6.3.3 Most Prevalent Markets for Tomato

Among all the surveyed farmers, about 40% reported that they sell their produce to Delhi Markets like Ghazipurmandi, Azadpurmandi, Okhlamandi and Keshopurmandi to get higher price and early payment of their produce in cash. About 15 to 20% of the farmers also sell their produce in markets of other districts. Only 40 to 45% of the farmers sell their produce within the district because they are



located very close to the district market and it is also very convenient and transportation facilities are easily available for them.

Among all the markets mentioned in the table number 18 below, Ghazipurmandi, Azadpurmandi, Karnalmandi, Panipatmandi, Gharaundamandi and Graminmandi in Padhanaare the most preferable markets for tomato growers where they get better price of their produce. .

Table 18: Mandis where Karnal farmers sell Tomato

S.No.	Mandi name	Approx. Mandi distance (km)	Qty. Sold (q)	Average Sale price (Rs./ q)	Percentage of respondents going to the mandi
1	GhazipurMandi Delhi	159	8400	553	16
2	OkhlaMandi Delhi	154	7890	504	6
3	AjadpurMandi Delhi	155	7000	491	14
4	KarnalMandi	11	6495	483	13
5	PanipatMandi	49	4910	495	10
6	Gharaunda	4	4535	436	10
7	GraminMandiPadhana	3	4380	432	9
8	Primary market (Padhana)	1	1880	440	2
9	KeshopurMandi Delhi	168	1530	492	3
10	KurukshetraMandi	24	970	450	4
11	JindMandi	68	705	783	1
12	Other mandis	87	2255	468	12

6.3.4 FPOs/Cooperative Societies

Karnal Vegetable Producer Company Limited is a FPO having 39 FIGs in the 25 different villages of district Karnal. The strength of one FIG is 15 to 20 members. In group, farmers purchase all inputs for the vegetable cultivation that reduce cost of inputs. But for the marketing point of view, at present no farmer sells the produce through FPO. They directly sell their produce to the traders in the mandi or at the field. Many big traders from Delhi or Karnal market send their agents at farmer's fields and directly purchase tomato from the farmers. Karnal Vegetable Producer Company Limited has planned to establish an integrated Pack House at Padhanavillage under subsidized scheme of Horticulture Department. This Integrated pack house would provide facilities like collection centre, cleaning, washing, sorting, packaging, cold storage, repackaging and marketing. In the integrated pack house, there is also a provision for the establishment of tomato processing unit that will help farmers to get better price for their produce. These facilities will also help farmers to tackle with glut situation that occurs during bumper tomato production.

During survey, about 28% of the respondents replied that they are part of a farmers' group and out of these 28% respondents, 92% were members of cooperative group and the remaining 8% were member of groups like MahranaSabziUtpadakSamuh (2), Tata KisaanSansar / BehaterJindgi (1),

BrahmanandKishanSamuh(1), ManojGraminSamiti (1). 72% of the respondents told that they are not member of any group because it has no benefit. About 62% of the member farmers have told that being a part of a farmers' group helps in access of credit to them, whereas 26% of the member farmers have told that access to agri-inputs is the benefit they get being in a group of farmers, while marketing of the produce there are few standards which a farmer needs to comply with. Farmer grades his tomato mainly as per size and then it is sold grade-wise namely A, B & C.

As per the survey, all of the respondents were selling their crop at their own and there was no selling through FPOs.

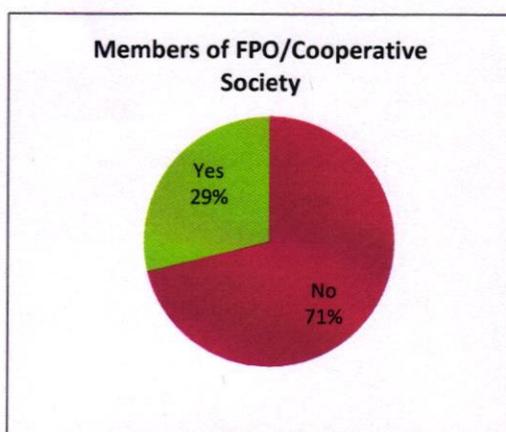


Figure 17: Member of FPO/Cooperatives

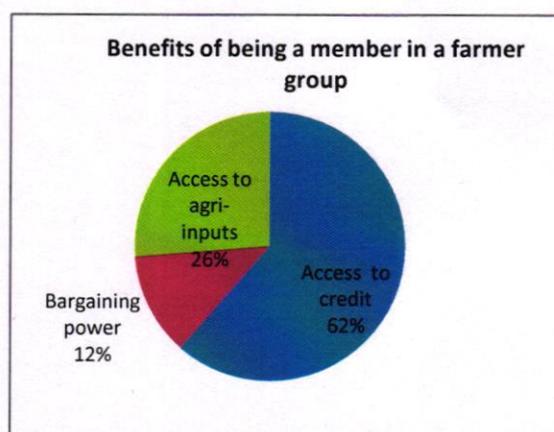


Figure 16: Benefit of Farmers Group

6.3.5 Availability of Infrastructure

A. Tomato Processing Unit

Though, India is the second largest producer of tomato with 11% global share, it processes less than 1% of its produce compared to 26% in other major producing countries. This results in a loss of value to the farmer, consumer and the economy. In 2015, about 41 million tons of tomato was processed globally out of which only 130,000 tons were processed in India which comprises 0.3% of the global tomato processing market. Thus, India could potentially process much more of the crop. An annual growth rate of over 12% in India's tomato production over the past 5 years also indicates strong interest amongst farmers to grow tomato as a major commercial crop.

In India, the demand of processed tomato products is expanding by 30% annually, driven by massive consumer demand for established products like pasta sauce and ketchup as well as new ready-to-eat products, gravies and bulk supplies to food retail chains including fast-food restaurants and hotel chains.



There is also a significant increase in export of processed tomato-based food products fueled in part by a burgeoning Indian diaspora. A recent survey by Assocham (the Associated Chambers of Commerce of India) conducted in leading Indian cities indicates that the demand for tomato puree and ketchup has surged by 40% in the month of June 2016 due to high prices of fresh tomato and a trend towards easier-to-cook meals.

In the surveyed area also, all the farmers reported that there is no processing unit in their area and therefore, they sell their entire produce to the traders in fresh form for table purpose. Even, nobody comes from outside to procure their tomato for processing.

Therefore, the Government should focus to establish more processing units in the tomato growing area so that farmers could get permanent market to supply their produce and it will also help farmers to get better price in the glut situation during bumper production or peak production time.

From processing point of view, a key constraint to production is the lack of improved cultivars particularly those suited for processing. Tomato varieties in India have been bred mainly for the fresh market. Therefore, to address this issue, the introduction of high-yielding varieties including open pollinated varieties suitable for processing is required. Reductions in the cost of production would also be necessary if more farmers are to produce tomato profitably and sustainably, particularly for the processing industry.

Additionally, processors seek consistent supplies of fresh tomato and a planned production scheduling synchronized with plant process requirements. Processors would need to negotiate staggered planning dates with farmers within clusters to ensure steady tomato supplies delivered to the factory at the right time. Cold storage systems are also required to maintain tomato fruits for longer periods than a few days because few processors seek to maintain a stockpile of tomato for subsequent processing requirements.

B. Storage Facilities, Collection Centre with Sorting and Grading line

During the survey, all the farmers reported about non-availability of storage and value addition like grading and packaging facilities in their area. They sell all their produce just after harvesting in fresh form to the mandi. Due to non-availability of the above facilities, farmers are compelled to sell their tomato crop at lower price or sometimes throw it to the road side or leave in the field during glut situation and peak production period because traders offer very little price to the farmers when production is very high. Therefore, for better price realization of tomato crops to the farmers,

Government should establish collection centres, cold storages, and shorting grading and packaging facilities in the tomato growing belt.

As per the Department of Horticulture, Karnal, Padhana in Nilokheri block, Gularpur in Nissing block and Dhanora in Indri block have the largest area under tomato cultivation and average yield of tomato in these areas is also very high and going up to 50 to 54 t/ha which is highest in the district. Therefore, these areas are very suitable for the establishment of collection centres, cold storages and sorting grading lines.

6.4 Expectations of the Farmers

Farmers have lot of expectation from Government and the agencies involved in the marketing of tomato. During the field survey, most of the farmers felt that the intermediaries in the marketing channel should be removed so that they can get better price. Few farmers also have expectation that Government should establish market place in the nearby area of their village. About 39% of the farmers in the surveyed area wished that Government should make policy to fix MSP for tomato and 21% wanted establishment of tomato processing unit in their area. Few farmers even desired export facilities in their area so that in case of bumper production, tomato farmers could get at least minimum price which they spent during production season.

At farm level, farmers need grading machines (4%) and storage facilities (39%) in their area. About 19% of the farmers also need on-the-spot selling of their produce at good price by the Government.

The following table number 19 represents the various supports and infrastructural development required by the farmers for the tomato cultivation:-

Table 19: Supports and Infrastructure Required by the Farmers

Support Required at Farm Level	
Provide agri input at low cost	4%
Provide grading machine facility	4%
Provide spot selling facility	19%
Provide storage facility at village	39%
Cannot say	35%
Support Required at Market Level	
Remove intermediary	33%
Good price realization	15%
Provide market nearby	3%
Cannot say	49%
Support Required at Govt. Level	
Establish processing unit	21%
Fix MSP	39%
Increase export of tomato	11%



Cannot say

29%

7 CONSTRAINTS IN TOMATO VALUE CHAIN

7.1 Constraints Identified at Producer Level

7.1.1 Production/Farm level

- In Karnal district there were 98% of the sample respondents who were buying all the seed material from agri-input dealers, only 2% of the respondents had gone to Agriculture Office for any kind of seed purchase. Reason stated was good quality seeds received from agri-input dealers. Also more than 90% of the respondents consulted input dealers or fellow farmers for any kind of information regarding farming or marketing.
- Major diseases occurring in the tomato plant in Karnal district are Blight, Armyworm and Leaf Curl, etc. and when asked about assistance sought for the diseases from the government department, 97% of the respondents answered that they did not get any solution for their queries, only 3% of the sample respondents had some benefit after consulting regarding their problems.
- Most of the respondents are using conventional method of tomato farming and source of irrigation was tubewell for all of them. When asked about micro-irrigation drips they replied that the technique is costlier one.
- Respondent farmers were asked about the contract farming agreement, but none of them agreed to any kind of contract farming agreement.

7.1.2 Constraints at Post-harvest Level

The following table number 20, represents the farmer responses to the various post-harvest problems.



Table 20: Farmers' Responses to the Various Post-harvest Problems

Post-Harvest Practices	Problems	Farmers' Response
Grading & Packing	Shortage of labour / Higher labour charges	38%
	Higher labour charges & Non-availability of infrastructure	36%
	Non availability of infrastructure	2%
	No problem	25%
Storage Facility	No storage facility	81%
	No storage facility & Inadequate cold storage facility in the village	19%
Transportation	Lack of vehicles	6%
	Vehicles not available in time	4%
	Non-availability of reefer transport	1%
	Lack of better connectivity to mandi	6%
	No problem	79%
	Vehicles not available in time & lack of better connectivity to mandi	2%
	Lack of vehicles & lack of better connectivity to mandi	2%
Market Intelligence	Information available for limited markets only, inadequate information	10%
	Information available for limited markets only, inadequate information & misleading information	1%
	Misleading information	31%
	No problem	58%
Mandi Infrastructure	Inadequate space available in mandi	10%
	Inadequate space available in mandi & non-availability of auction platforms	8%
	Non-availability of auction platforms	23%
	Non-availability of adequate staff for auction	2%
	Non-availability of storage facility in mandi	4%
	Non-availability of adequate staff for auction & non-availability of storage facility in mandi	2%
	No problem	51%
Malpractices in the market	Deduct higher charges	7%
	Deduct higher charges & higher commissions	1%
	Deduct higher charges, higher commissions & quote lower price than actual	4%
	Higher commissions	4%
	Quote lower price than actual	52%
	No problem	32%

Grading and packaging: In Karnal, respondents had a problem regarding labour availability and the wages. In grading and packing it is difficult to deploy labours because of their high wage demands reported by 38% of the farmers. About 36% of the respondents also reported about non-availability of infrastructure, shortage of labour and availability of labour at higher wages is one of the major problems faced by them.

Storage facility: Tomato is a crop that cannot be kept for long time in storage. At Karnal, there is no facility for the storage, the matured crop is picked and sold immediately and if it is not sold, then loss



percentage to the producers increase. There are few mandis in the district, and out of those in Karnal there is a newly constructed mandi with deep freezer especially for the storage of tomato, but it could not be made functional.

Transportation: When asked about transportation, 79% of the respondents reported that transportation is not an issue for them if the produce is sold in first time. Sometimes, crop is not sold in first time because of some other issues and then farmer takes his crop back which further adds to the cost.

7.1.3 Constraints in Marketing

- Tomato farmers sell their produce usually through a local aggregator or a trader at the local or regional mandi. Farmers realize an estimated 30-50% of total value through the supply chain with the remainder being distributed among multiple traders and commission agents.
- When asked about the understanding of tomato prices before going to the market, all of the respondents replied that they understood the price before going to the mandi but price fluctuates every hour depending on the arrivals in the market, so many a times they end up selling at lower prices than expected.
- In Karnal, farmers and middlemen prefer to sell the produce to urban markets like Delhi rather than to processors. Prime reason behind this was reported to be the non-availability of any processor (primary/secondary) in the area surveyed and also for better price realization. When the produce is sold in the bigger markets they receive better price. For Karnal area, Delhi is the bigger market, thus they prefer to sell their produce in Delhi markets or to Delhi traders/wholesalers.
- In Karnal, tomato farmers sell their produce usually through a local aggregator or a trader at the local or regional mandi as APMC is far away from the city and there is a local market at a place which connects Karnal to Delhi and that makes city traders to approach this place rather than going to APMC markets.

7.1.4 Alternate Marketing System

As per the survey, 82% of the respondents had no awareness about alternate marketing system and the rest 18% who knew about alternate marketing system made clear that except mandi they sold their tomato in private mandis or sometimes they did direct marketing.

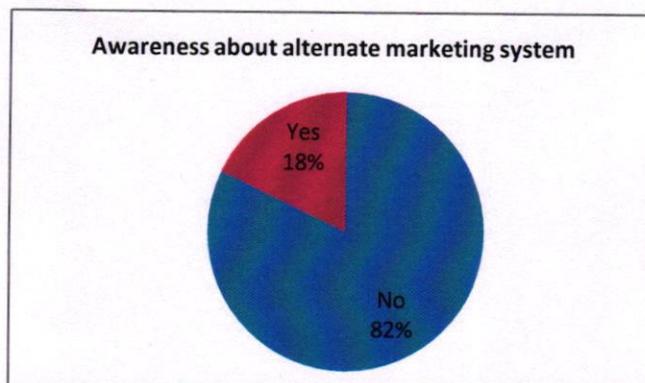


Figure 18: Awareness about Alternate Marketing System

7.1.5 Infrastructural Gaps

7.1.5.1 Gaps at Mandi Level

At Karnalmandi there are needful structures but still other interventions like grading & packing center and storage area (freezers) etc. are also required. Farmers bring their produce to the mandi but selling does not take place from that mandi. There is a local wholesaler market on the way to Delhi and all the city traders and retailers visit that place rather than mandi and that is a loss to the local traders and other stakeholders.

7.1.5.2 Gaps at Storage Level

In Karnal there is no facility for the storage of tomato. As we all know tomato cannot be stored for long time, lack of freezers in the area is a gap at operational level.

7.1.5.3 Gaps at Processing Level

Tomato processing is the best way to protect the crop otherwise loss percentage would always be at high due to its perishability. When enquired about processing industries nearby the villages of the respondents, we came to know that the state does not have any processing centers for tomato.

7.1.5.4 Collection Centre

During the survey, it was observed that there was no collection centre in the tomato production belt. Since areas like Padhana in Nilokheri block, Gularpur in Nissing block and Dhanora in Indri block have the highest area under tomato cultivation and average yield of tomato is also very high, these areas require collection centre with sorting, grading and packaging facilities.

8 RECOMMENDATIONS

As per the survey, more than 70% of the farmers' population falls under small and medium farmers' category and there are lots of constraints especially to these sections. Because only farming is the profession for them. Most of these farmers are also not very educated and hence could not use various technologies to plan their farming schedule.

Therefore, after the study we have come up with few recommendations that could help farmers and improve the existing value chain. These are:

A. Infrastructural development (Processing Units): There is need of primary (Sorting & Grading) and secondary processing industry in adjoining areas of the tomato producing districts. Tomato can survive for long duration only if it is processed, as its membrane is very thin and can be spoiled very easily. It is also a fact that processing is only an option for better price realization of tomato during glut situation. Therefore, it becomes very necessary for the government to promote processing industry, to minimize the losses.

B. Introduction of varieties suitable for processing: For processing point of view, the main constraint in India is the lack of improved cultivars suitable for processing. Tomato varieties in India have been bred mainly for the fresh market. Therefore, to address this issue, the introduction of high-yielding varieties including open pollinated varieties suitable for processing is required. Government should encourage seed companies and facilitate to develop locally adapted varieties that meet the quality requirements of the processing industry in India.

C. Reduction in cost of production: Reduction in the cost of production would also be necessary if more farmers are to profitably and sustainably produce tomato particularly for the processing industry, because processors require continuous supply of tomato at reasonable price. Processors cannot pay Rs. 30 to 40/kg in off season. Therefore, Government should introduce low cost technology for tomato cultivation. It will also help farmers to get reasonable price in glut situation.

D. Cold storage and collection centre with sorting grading line: Tomato is highly perishable commodity and its shelf life is very short. Therefore, there is a requirement of cold storage systems to preserve tomato for periods longer than a few days, so that farmers can negotiate to get better price. It will also help farmers to fight with glut situation which occurs during bumper crop production. To minimize the losses and to improve quality of tomato some value addition facilities like collection centre with sorting, grading and packaging units are also required in production belt like Padhana in Nilokheri block, Gularpur in Nissing block and Dhanora in Indri block so that farmer can earn maximum from their produce.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes the need for transparency and accountability in financial reporting.

2. The second part of the document outlines the various methods and techniques used to collect and analyze data. It includes a detailed description of the experimental procedures and the statistical analysis performed.

3. The third part of the document presents the results of the study, including a comparison of the different methods and techniques used. It also discusses the implications of the findings and the potential for future research.

4. The fourth part of the document provides a summary of the key findings and conclusions. It highlights the strengths and weaknesses of the different methods and techniques used, and offers recommendations for future research.

5. The fifth part of the document discusses the broader context of the study, including the impact of the findings on the field of research. It also addresses the ethical considerations and the limitations of the study.

6. The final part of the document provides a concluding statement and a list of references. It also includes a list of figures and tables that are used throughout the document.



E.Promotion of farmers' groups: Small and medium farmers do not have enough amount of produce so as to directly sell to processors and retail chains because they buy tomato in large quantities. Therefore, smallholder farmers should unite and make a farmers' group which could do the business together. It would not only help in reduction of total cost but also would increase total price realization by individual farmers.

F. Infrastructural support at farmers' group level: - For last few years promotion of FPOs is taking place and Govt. has been successful in making it too. Now there is a question of its sustainability and small interventions at each FPO level can bring a significant change in Indian farming techniques. In case of tomato growing areas, small pulping machines can be established at selected FPOs which would lead to reduced post-harvest losses and better price realization, and the farmers will be encouraged to increase tomato yield and area.

G. Awareness of best agricultural practices to improve yield: Tomato yield in Haryana is lower as compared to other states. It is because of the agro-climatic conditions of the area and also the seed varieties used by them. Marketing system in the state is also not that good. That is why farmers never try to increase their tomato yield and it's a secondary crop in the state. As per the survey, majority of the farmers do not follow standard practices like IPM and INM of ICAR in their farming. Therefore, awareness about these practices should be increased along with better marketing platform to increase the production.

H. Price determination: The price of tomato fluctuates not only from year to year but also from month to month, day to day and even on the same day. The change in prices may be upward or downward. These prices are generally determined by agents and traders. Sometimes, the price received by farmers is not in accordance with the production cost. Therefore, it is recommended that Government should fix MSP for tomato so that farmers receive price at least equal to the cost of production.

I. Market information: As per the survey, about 31% of farmers reported that they are misled by traders and 11% reported about limited information about market. Therefore, Government should start mobile based SMS facilities to spread real time market information for the tomato growers.

J. Ending the malpractices from the market: Many malpractices such as quoting lower price than actual, deducting higher market charges and commission charges and taking away part of the produce as a sample or loss etc. are common in the marketing of tomato and other vegetables in the market. Malpractices become more frequent when the farmers have low economic status, little or no education and weak bargaining power. As a result, the producer's share in the consumer's rupee is

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very low. Therefore, it is recommended that open auction of the vegetables should be strongly promoted under the supervision of marketing board/APMC officials in the market.

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