Title

Impact Assessment Report on IFCCO Kisans' Kagome Project- (Tomato farming in Maharashtra.

1. ABSTRACT:

The conventional agricultural extension system in India is not fully efficient to deliver advice to all the farming community which translates into farmers dealing with multitude of problems to increase crop productivity. Integrating information technology and latest technological assistance can aid in better cultivation of diverse crops grown in the country. The information technology brings huge potential and opportunity to revolutionise the whole agriculture.

Information communication technology (ICT) has been one of the most aspired fields in today's world. The farmers require real time and effective information for improved cultivation of tomato, and the information supplied by the various means to the farmers may not be sufficient for better cultivation of Tomato. Tomato farmers be provided the location and language specific real time information and advisory along with latest technological assistance about tomato cultivation in the country. Information Communication Technology has much opportunity and role with the exemplary success in many programs. With the advent of new and timely dissemination method of Information Technology, the productivity of tomato crop can be increased by providing the scientific knowledge of tomato in Integrated management.

This report provides a detailed impact report of integrating ICT interventions in comparison to traditional practices in tomato high tech farm in Nashik, Kopargaon and Shirpur in Maharashtra.

INTRODUCTION:

- **Common Name** : Tomato
- **Scientific Name** : *Solanum lycopersicum*
- **Type of Crop** : **Kharif crop**
- **Nutrition Management:** Apply 20-25 t/ha of well-rotted farmyard manure / compost during field preparation and thoroughly mix with the soil. It is possible to apply a fertiliser dosage of 75:40:25 kg N:P2O5:K2O / hectare. Before transplanting, apply half the nitrogen, full phosphorus, and half the potash as a basal. 20-30 days after planting, a fourth of nitrogen and half of potash can be administered. The remainder of the fertiliser can be used two months after planting.
- **Type of Soil** : Tomatoes grow in a wide range of soils, from light sandy to deep clay. Early crops thrive in light soils, whereas heavier harvests thrive in clay loam and silt-loam soils. Tomatoes grow best in soil that has a pH range of 6.0 to 7.0. Liming is necessary if the soil is acidic.

❖ **Field Preparation** :

- The land is ploughed or dug twice or three times to get a beautiful tilth. Organic manure and 10 kg carbofuran granules or 200 kg neem cake must be applied at the end of ploughing.
- **Method of Planting** :
- Transplanting
- Dibbling

❖ **<u>Total Production of Tomato in India:</u>**

- Highest area

Andhra Pradesh : 49790 Hectare

- Highest Production

Andhra Pradesh : 4481010 MT

- Highest Productivity

Andhra Pradesh : 90 MT/Hectare

STATE-WISE TOMATO PRODUCTION IN THE COUNTRY

(Production in '000 Tonnes)

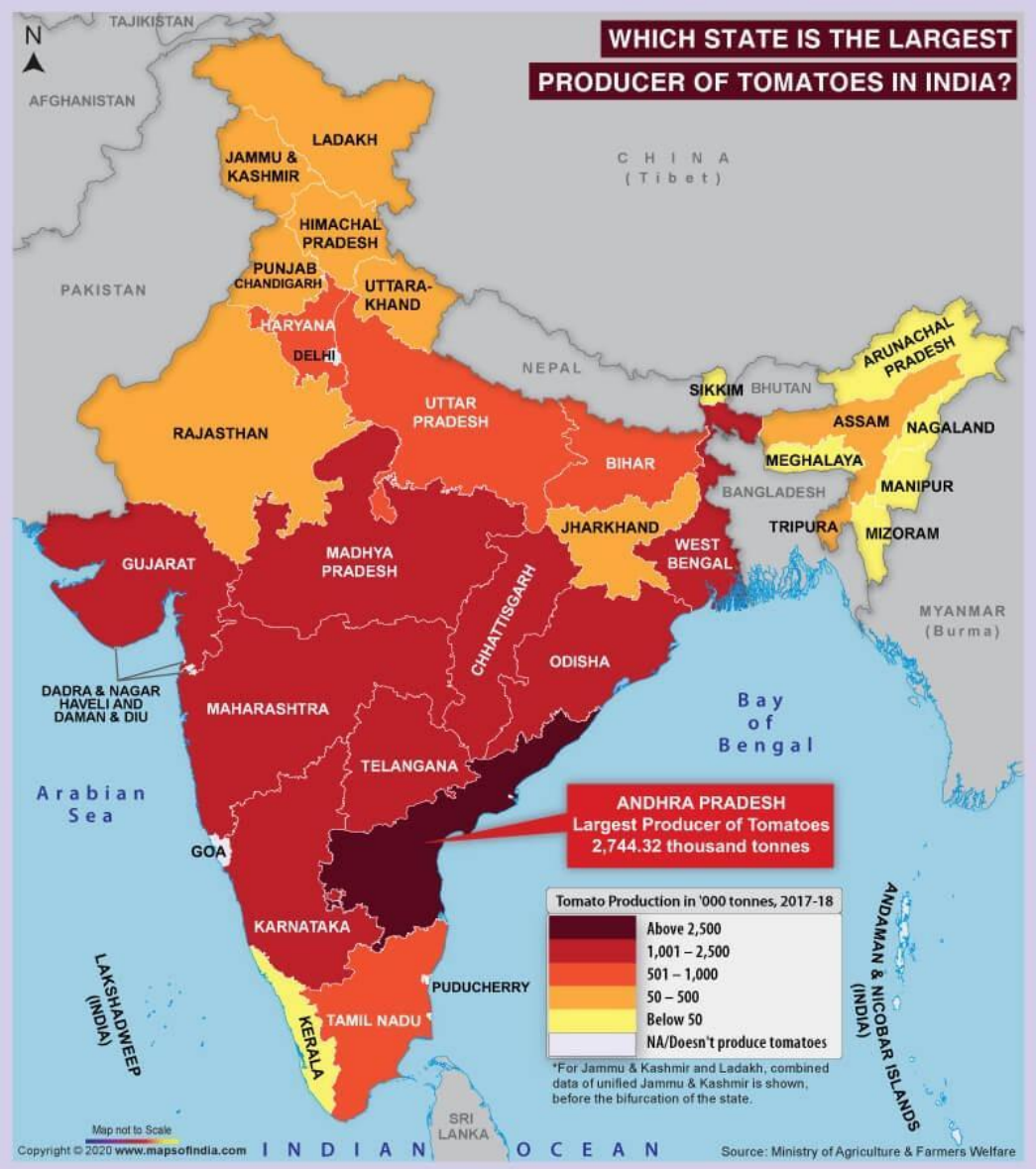
STATE/Uts	Five-year Average (2014-15 to 2018-19)		2018-19		2019-20 (Expected)	
	Production	% Share	Production	% Share	Production	% Share
Andhra Pradesh	2687.78	14.27	2503.00	13.72	2169.00	11.66
Madhya Pradesh	2423.56	12.87	2516.00	13.79	2588.00	13.91
Karnataka	1935.80	10.28	1600.00	8.77	1419.00	7.63
Odisha	1318.68	7.00	1304.00	7.15	1306.00	7.02
Gujarat	1342.81	7.13	1366.00	7.49	1567.00	8.42
West Bengal	1224.08	6.50	1268.00	6.95	1271.00	6.83
Bihar	992.62	5.27	964.00	5.28	964.00	5.18
Maharashtra	962.19	5.11	861.00	4.72	1040.00	5.59
Telangana	1027.86	5.46	892.00	4.89	623.00	3.35
Haryana	677.98	3.60	651.00	3.57	566.00	3.04
Uttar Pradesh	750.07	3.98	510.00	2.80	529.00	2.84
Tamil Nadu	660.91	3.51	814.00	4.46	1352.00	7.27
Total of Above States	16090.34	84.98	15249.00	83.59	15393.00	82.72
Other States	2828.05	15.02	2994.00	16.41	3215.00	17.28
All India	18832.39	100.00	18243.00	100.00	18608.00	100

Source - State Directorate of Horticulture

3. LOCATION:

Nashik is the fourth largest city in Maharashtra in terms of population after Mumbai, Pune and Nagpur. The city's tropical location and high altitude combine to give it a relatively mild version of a tropical wet and dry climate.

Geography: Nashik district is located between 18.33 degree & 20.53-degree north latitude & between 73.16 degree & 75.16-degree east longitude at northwest part of Maharashtra state, at 565 meters above mean sea level. Recently two tehsils are created in the district making the total tehsils to 15 Though average rainfall of the district is between 2600 to 3000mm, there is wide variation in the rainfall received at various blocks. Most of the rainfall is received from June to September. The maximum temperature in summer is 42.5-degree centigrade & minimum temperature in winter is less than 5.00 degree centigrade. Relative humidity ranges from 43% to 62%.



Nashik district is located between 18.33 degree & 20.53-degree north latitude & between 73.16 degree & 75.16-degree east longitude at northwest part of Maharashtra state, at 565 meters above mean sea level.

Demographics:

Nashik District population in 2021 is 6,534,981 (estimates as per Aadhar uidai.gov.in Dec 2020 data). As per 2011 census of India, Nashik District has a population of 6,107,187 in 2011 out of which 3,157,186 are male and 2,950,001 are female. Literate people are 4,345,366 out of 2,397,538 are male and 1,947,828 are female. People living in Nashik District depend on multiple skills, total workers are 2,763,328 out of which men are 1,746,286 and women are 1,017,042. Total 900,810 Cultivators are depended on agriculture farming out of 527,133 are cultivated by men and 373,677 are women. 644,052 people works in agricultural land as labor, men are 317,542 and 326,510 are women. Nashik District sex ratio is 934 females per 1000 of males. Next Nashik District Census will be in 2021. Nashik city had an average literacy rate of 89.85%: male literacy was 93.40%, and female literacy was 85.92%.

The sex ratio is 894 per 1,000 males for Nashik city. Child sex ratio is 865 girls per 1,000 boys

Major Farming Systems/Enterprises:

- ❖ Agriculture + Horticulture
- ❖ Horticulture + High tech Floriculture
- ❖ Agriculture + Horticulture + Dairy
- ❖ Agriculture + Poultry
- ❖ Agriculture + Dairy

Soil Types:

S. No	Soil type	Characteristics	Area in ha
1	Laterite and non laterite soils	Well drain, deficient in lime, PH 5-6, Low in nutrient, high leaching	70400
2	Reddish brown soils	Porous soils, absence in N,P,K,lime and organic matter, PH 7-7.5, low fertility status, high leaching	496645
3	Medium black soils	Heavy clay texture, PH 7.5-8.5, deficient in N and P, rich in K, poor aeration.	321760
4	Coarse shallow soils	Light texture, low clay content, PH 6-7.5, deficient in N,P,K.	647255

Rainfall and Temperature:

Nashik's climate is classified as tropical. The summers are much rainier than the winters in Nashik. In Nashik, the average annual temperature is 24.1 °C | 75.3 °F. About 1134 mm | 44.6 inch of precipitation falls annually. At an average temperature of 28.5 °C | 83.3 °F, April is the hottest month of the year. The lowest average temperatures in the year occur in January, when it is around 20.5 °C | 68.8 °F.

The month with the highest relative humidity is August (90.36 %). The month with the lowest relative humidity is March (34.05 %).The month with the highest number of rainy days is July (28.67 days). The month with the lowest number of rainy days is February (0.20 days).

Agro Climatic Zones of Nasik:

S. No.	Agroclimatic zones	Characteristics
1	Ghat Zone	Annual rainfall 3000 to 5000 mm., Laterite and non laterite soils with forest cover, Undulating topography
2	Transitional Zone I	Annual rainfall 1250 to 3000 mm., Reddish brown soils of hilly slopes
3	Transitional Zone II	Annual rainfall 700 to 1240 mm., medium black soils, plain zone.
4	Scarcity Zone	Annual rainfall 500 to 700 mm., coarse shallow soils, calcareous soils.

Area, Production and Productivity of Major Crops cultivated in the district:

Sr. No.	Crop	Area (ha.)	Production (Qtl)	Productivity (Qtl/ha)
1	Cereals	533900	5467000	10.24
2	Pulses	90000	609000	6.77
3	Fodder Grain	623900	6076000	9.74
4	Sugarcane	12100	6729000	560
5	Cotton	14100	200000	24.13
6	Groundnut	35800	305000	8.53
7	Safflower	100	1000	5.09
8	Soybean	20300	374000	18.44
9	Oilseeds	77800	773000	9.93
10	Kharif Rice	50800	702000	13.82

Farming Pattern

Geographical area	15,63,000
Cultivable_area	8,64,000
Average kharif Crop area	6,63,200
Average Rabi Crop area	1,36,500
Actual sown area	6,58,763
Forest	3,40,000
Uncultivable area	23,000

Irrigation

Area under irrigation	4,19,000
Major Project	13
Medium Project	08
Small Project	44
Rivers	Godawari, Girna, Darna, Mosam, Aaram, Vaitarna, Manyad, Kadwa

Land holdings

Particulars	Numbers
Geographical area	15548 square kilometers
Total Talukas	15
Total villages	1960
Total population	61,09,052
Number of account holders	6,42,662
Small Land holders	3,50,956 (54%)
Marginal Land holders	2,88,496 (44%)
Others	3,210 (02%)
Kharif Village	1577
Rabi Village	383

Selection of land site/ project site :

- IFFCO Kisan and Kagome Co. Ltd. entered into a Service Agreement / MoU in July 2019 to jointly develop, conduct and implement the best practices and customized management tool for a traceable cultivation of tomato crop, starting with 110 farmers and 260 Acres from 24 villages of Nashik, Kopargaon and Shirpur Maharashtra. The project was successfully completed with 5,000 MT of high-quality tomato produced and procured from member farmers, who have benefitted with better realization (by about 15% with average productivity of 28 MT / Acre) while Kagome benefitted with consistent supply of quality produce with lesser cost by 8-10 %. IFFCO Kisan provided cultivation practices control, pest and disease management and recording and monitoring of the farm activities through its digital platform and dedicated field staff, controlled and executed with timely advisories to all farmers.

Objectives of IFFCO Kisan's Smart farm:

Farm efficiency enhancement: Increase the farm efficiency in terms of input cost reduction and output enhancement with better quality production.

Farmers sensitizing and capacity building: Motivating the farmers to grow chemical free tomato crops and then later adopt jaggery production.

AgTech democratization: Mobilizing the farmers across the smart farm and educating them about various technologies that are used in the smart and their benefits.

Better forward linking facilitation: Market linkage facilitation for better realization.

Features of IFFCO Kisan's Smart Farm:

Climate – Smart Farming

Integrated Pest Management (IPM)

Good Agriculture Practices (GAP)

Internet of Things (IoT)

Automated Irrigation System

Automated Wireless Weather Station (AWWS)

Natural Produce

- Quality Food Production
- Safe Jaggery
- Satellite Imagery System
- Precision Agriculture
- Site-Specific Farming
- Drone Based on Crop Surveillance



Challenges faced by landlord/farmer:

- Cope with climate change, soil erosion and biodiversity loss.
- **tomato weed, tomato frost and transportation related problems**
- postharvest challenges
- **high input cost**
- There is no certain, stable and regular marketing structure in tomatoes growing in real world due to the characteristics of agricultural products
- The major groups of pests and abiotic factors impeding tomato production were insects (34%), fungi (23%), bacteria (13%), nutrient deficiencies (12%), mites (8%), viruses (3%), nematodes (2%), and water moulds (2%)

Work Done in Season 2:

This season, a total of 375 acres have been targeted for tomato transplanting, as well as around 8500 MT of fruit. With the measures taken in the aftermath of the COVID 19 epidemic, a total of 375 acres were transplanted, thanks to a field visit and monthly meetings with farmers. Geo-fencing is also available for areas up to 375 acres. Nasik, Shirpur, Nampur, and Latur have all been successfully transplanted this season.

Sr.no	District/Tehsil	Total Number Of Farmers	Total targeted area in acre	Transplanted area in acre	Geofencing area in acre
1	Nasik	145	315	315	315
2	Shirpur	8	50	50	50
3	Latur	1	5	5	5
4	Nampur	1	5	5	5
Total		155	375	375	375

Other details

Ø Cumulative Tomato harvested till Date - 5350 MT

Ø Average Tomato arrival per day for processing – 30 to 35 MT

Ø Cumulative Tomato processed till Date - 5100 MT

Ø Targeted MT of Tomato to be harvested till the end of this month (April'2021) - 1200 MT.

Challenges faced

Climate issues

unexpected heavy rainfall

decrease temp (below 10^0c)

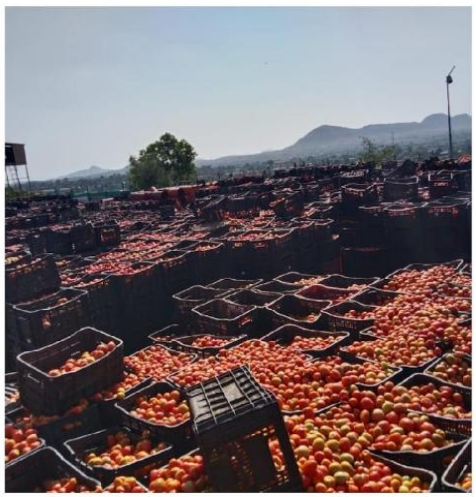
higher Market rates.

Season 2 KAGOME Project:









Tentative Projection of Current Season:

Months	Location	Transplanting area	Tentative Harvesting period				Total	Total Month wise
			FIRST	SECOND	THIRD	FOURTH		
			Second week of january	First week of february	FOURTH week of february	Second week of March		
September	Nasik	30	240	240	120	60	660	660
	Jalgaon & Shirpur	0	0	0	0	0	0	
	MP	0	0	0	0	0	0	
October	Nasik	80	640	640	320	160	1760	4290
	Jalgaon & Shirpur	75	600	600	300	150	1650	
	MP	40	320	320	160	80	880	
15th November	Nasik	40	320	320	160	80	880	2970
	Jalgaon & Shirpur	75	600	600	300	150	1650	
	MP	20	160	160	80	40	440	
		Total	2880	2880	1440	720	7920	

Tentative Projection 21-22						
Area	Sowing		Transplanting	Harvesting		TOTAL (MT)
Location	Sowing Month	Area Cover Acre	Transplanting Month	Harvesting Month	Harvesting Yield (MT)	
JALGAON/SHIRPUR (150 acre)	Sep-21	40	Oct-21	Jan-22	800	3000
	Sep-21	40	Oct-21	Feb-22	800	
	Oct-21	45	Nov-21	Mar-22	900	
	Oct-21	25	Nov-21	Mar-22	500	
NASHIK (100 acre)	Sep-21	25	Oct-21	Jan-22	500	2000
	Oct-21	30	Nov-21	Feb-22	600	
	Oct-21	25	Nov-21	Mar-22	500	
	Oct-21	20	Nov-21	Apr-22	400	
KHARGAON (105 acre)	Aug-21	10	Sep-21	Jan-22	200	2100
	Sep-21	40	Oct-21	Feb-22	800	
	Oct-21	40	Nov-21	Mar-22	800	
	Nov-21	15	Dec-21	Apr-22	300	
Total		355			7100	7100

4. Why ICT intervention- Researched Benefits of the tools in Tomato

a. Use of Drip Irrigation in Tomato

i) Impact study between traditional vis a vis with drip irrigation

- Average water requirement for tomato is 400 - 600mm.

S.No.	Crops	Duration in days	Water requirement (mm)	No. of irrigations
1.	Tomato	90-120	400-600mm	24

- **Irrigation interval approach**

For 12 months tomato crop water requirement at each growth phase

Development Stage	Stage length, days
Establishment	25- 35 days
Vegetative	20 -25 days
Flowering	20-30 days
Yield formation	20-30 days
Ripening	15-20 days

Traditionally farmers are using the following irrigation method to irrigate tomato

Irrigation in tomato

- The crop has a fairly deep root system and in deep soils roots penetrate up to some 1. 5 m. The maximum rooting depth is reached about 60 days after transplanting. Over 80 percent of the total water uptake occurs in the first 0.5 to 0.7 m and 100 per-cent of the water uptake of a full-grown crop occurs from the first 0.7 to 1.5 m
- Each tomato plant needs different water requirement as per its height, climate, and soil type. On an average, tomatoes require 1-1.2 inches of water in a week. For proper watering, farms are equipped with sprinklers, drip and flooding techniques that satisfy the plant's need
- Flooding and Sprinkler are widely used methods for watering the plants, but the risk is of attracting diseases because plants get water from top to bottom. An efficient method of watering is drip irrigation that provides complete moisture to plants, but material and labor cost in drip irrigation increases considerably. During rains, it is important to cover the tomato plants to avoid the plants to rot and die.

Drip irrigation:

- The depth of irrigation is directly associated with the depth of the tomato root system. Out of all the roots, 80% of the feeding roots remain in the 20cm-30cm depth. Precision irrigation prevents leaching of fertilizers beyond the feeding root zone. Fertilizer use efficiency results in increased tomato yield.
- Maintaining the balance between vegetative growth and productiveness is imperative while growing tomatoes. Precision irrigation acts as a solution to this requirement as it offers both control and flexibility, thus ensuring that the crops receive appropriate amounts of water and fertilizers.

Table 1: Effect of different types of irrigation and growing methods on growth, and water use efficiency of Tomato.

Treatments	Plant height (cm)	Fruit weight (g)	Plant dry matter (g)	Weed growth (gm^{-2})	Water applied (cm depth)	Water use efficiency($t\ ha^{-1}cm^{-1}$)
T1:furrow method	72.32	74.23	32.40	59.32	70.0	0.46
T2: Furrow +mulch	75.66	75.62	36.34	30.36	69.2	0.50
T3:furrow+mulch+ trellising	83.32	83.33	41.32	30.23	69.2	0.70
T4:drip	80.40	83.21	41.22	57.12	43.1	1.09
T5:drip+mulch	83.42	84.32	42.43	6.30	43.1	1.26
T6:drip+mulch+trellising	91.22	88.33	49.32	6.12	43.1	1.44
T7:control	67.52	67.20	28.12	62.76	70.0	0.41

Table 2: Effect of different types of irrigation and growing methods on yield and economics of Tomato

Treatments	Yield t/ha	Cost of production Rs./ha	Gross returns Rs./ha	Net returns Rs./ha	B/C ratio
T1:Furrow method	30.30	62532	121200	58668	1.93
T2: Furrow +mulch	35.23	67560	140920	73360	2.08
T3:Furrow+mulch+ trellising	43.82	72572	175280	102708	2.41
T4:Drip	46.20	74250	184800	110550	2.48
T5:Drip+mulch	54.32	78354	217280	138926	2.77
T6:Drip+mulch+trellising	62.21	87706	248840	161134	2.83
T7:Control	26.23	57456	104920	47464	1.82

Water Requirements of Tomatoes

Weather Conditions	Litres per Day	Pints per Day
Very dull, cloudy or dull for most of the day	0.14 -0.28	0.25 – 0.50
Fairly dull, overcast for most of the day	0.28 -0.42	0.50 -0.75
Fairly sunny, cloudy at points with bright periods	0.71 – 0.85	1.25 – 1.50
Sunny, just occasional cloud cover	1.10 -1.20	2.00 -2.25
Very sunny, clear blue skies all day.	1.50 -1.80	2.75 -3.25

Water Requirement in Tomato Plantation

Tomatoes are sensitive to both excess water as well as very little water. A major challenge in tomato cultivation is maintain an even moisture supply. During summer it is necessary to irrigate the crop once a week while irrigating it once in every two weeks is sufficient. Care should be taken to prevent any drought period after a heavy watering dose. It may affect the crop produce. In addition, drought followed by an abrupt watering during the fruiting phase would cause cracking in tomatoes.

Among the three methods of irrigation, Drip irrigation provides

- Less water application
- Higher cane yield (mt/ha)
- Higher Water use efficiency
- High commercial cane sugar

Major benefits of drip irrigation

- Saving irrigation water 40 - 70 % compared to traditional method
- Low labour cost for irrigation
- Increased water use efficiency (60-200%),
- Uniformity in water distribution (90%)
- Suitable for inferior quality irrigation water
- Use of saline water is possible
- Suitable for any type of soil
- Reduces fertilization requirement (20-33%) through fertigation, produces better quality crop and increases yield (7-25%) as compared with conventional irrigation
- Low tillage requirement

Transplanting

- The transplanting is done in small flat beds or in shallow furrow depending upon the availability of irrigation.
- In heavy soil it is usually transplanted on ridges and during the rains also it is advantageous to plant the seedlings on ridges.
- For indeterminate varieties/hybrids, the seedlings have to be staked using bamboo sticks of two-meter length or planted in broad ridge of 90 cm width and 15 cm height. The seedlings are planted in the furrows at a spacing of 30 cm and the plant is allowed to spread on the broad ridge.

- **Propagation**
- **Nursery Bed Preparation**
- Tomato seeds are sown on nursery beds to raise seedlings for transplanting in the field. Raised beds of size 3 x 0.6 m and 10-15 cm in height are prepared. About 70 cm distance is kept between two beds to carry out operations of watering, weeding, etc. The surface of beds should be smooth and well levelled. Add sieved FYM and fine sand on the seedbed. Raised beds are necessary to avoid problem of water logging in heavy soils. In sandy soils, however, sowing can be taken up in flat beds. To avoid mortality of seedlings due to damping off, drench the seed bed first with water and then with Bavistin (15-20 g/10 litres of water).

- **Season of Planting**
- Seeds are sown in June July for autumn winter crop and for spring summer crop seeds are sown in November. In the hills seed is sown in March April.

- **Raising of Seedlings**
- About 250-300 g of seed are sufficient for raising seedlings for one hectare of land. Prior to sowing seeds are treated with fungal culture of *Trichoderma viride* (4 g/ kg of seed) or Thiram (2g/kg of seed) to avoid damage from damping-off disease. Sowing should be done thinly in lines spaced at 10-15 cm distance. Seeds are sown at a depth of 2-3 cm and covered with a fine layer of soil followed by light watering by water can. The beds should then be covered with dry straw or grass, or sugarcane leaves to maintain required temperature and moisture. The watering should be done by water can as per the need till germination is completed. The cover of dry straw or grass is removed immediately after germination is complete. During the last week in nursery, the seedlings may be hardened by slightly withholding water.
- The seedlings with 5-6 true leaves are ready for transplanting within 4 of sowing.

Figure 3.1 : ALL INDIA MONTHLY ARRIVALS FOR TOMATO

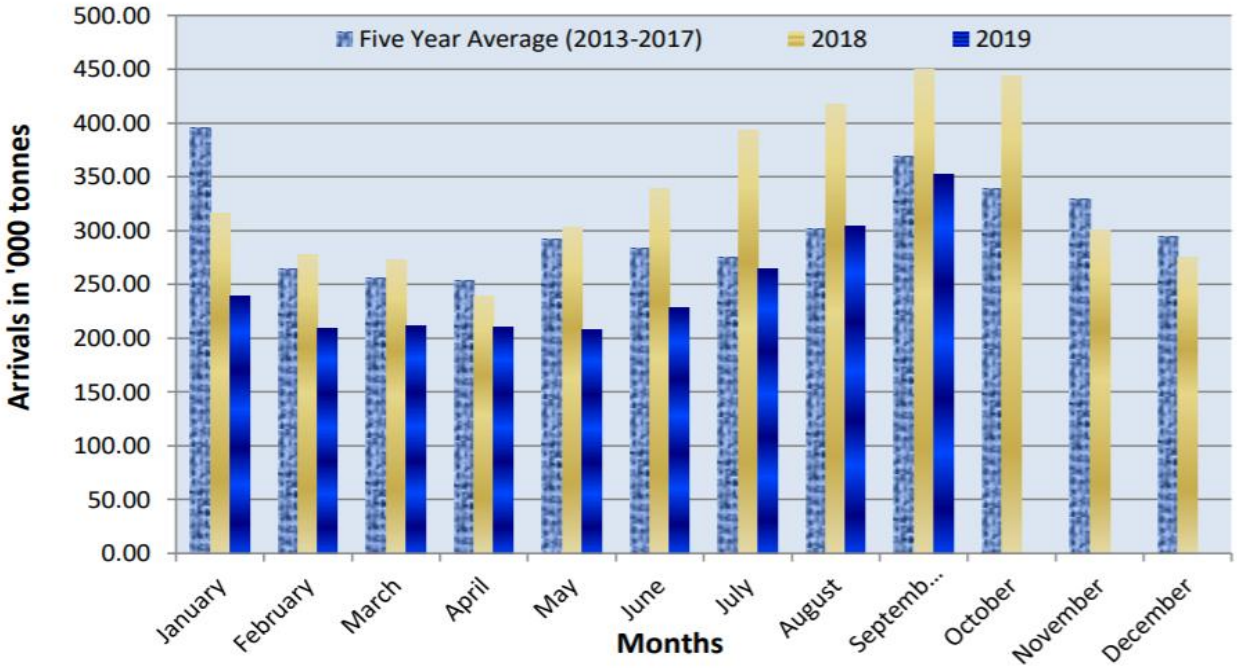
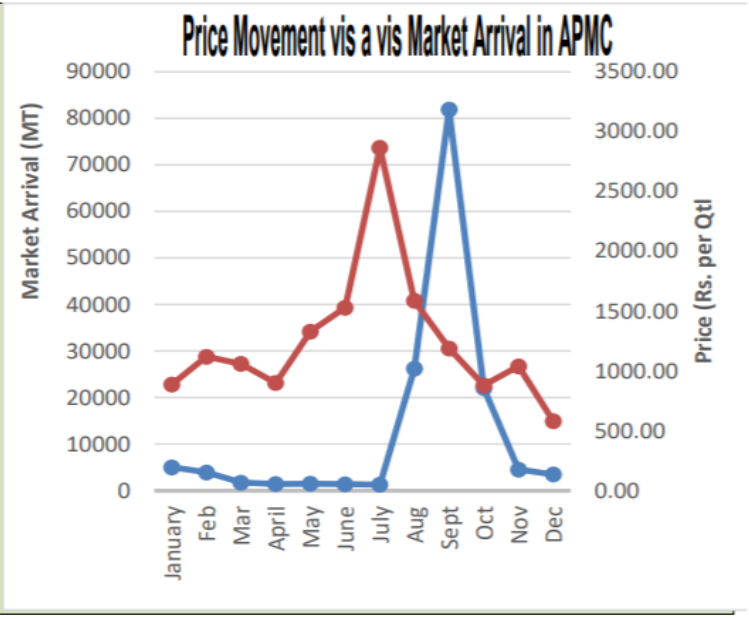


Table 8: Month wise Price Variation in Tomato in Nashik (Average of six years period 2012-2017)Quantity -MT; Price ₹/Qtl

Month	Market Arrival Qnty	Avg Model Price
January	5048.20	886.67
Feb	3919.80	1120.00
March	1740.90	1060.00
April	1429.40	900.00
May	1501.80	1330.00
June	1389.30	1530.00
July	1306.70	2865.00
August	26239.80	1587.00
Sept	81898.20	1188.60
October	22061.40	880.20
Nov	4567.90	1039.80
Dec	3488.40	582.00



Source: National Horticulture Board (NHB)

Remote sensing is a management tool that captures colour, shape or other characteristics to identify spatial variability. A series of images collected over time can show changes in plant growth, soils, erosion or other physical processes.

Some agricultural uses of remote sensing include

- Estimating crop yields
- Detecting diseases
- Identifying pest and weed coverage
- Evaluating uniformity of irrigation
- Observing changes in plant growth over time
- Assessing the impact of severe weather
- Determining the location and extent of crop stress.

To decrease the expense and dangers associated with pesticide spraying, large-scale tomato cultivation would benefit from a timely and location-specific detection and monitoring system. One of the most significant uses of remote sensing in agriculture is the detection of crop disease stress.

Use of remote sensing in Tomato

Remote sensing has been used for many different purposes in tomato growing and harvesting. Some potential uses of imagery may include:

- Forecasting regional yield
- Producing farm-level and block-level yield maps
- Evaluating the effectiveness of irrigation
- Screening research and breeding trials
- Identifying and managing cane grubs
- Measuring canopy nitrogen status
- Monitoring Yellow Canopy Syndrome (YCS)

Conclusion: Crop monitoring, growth performance, and yield estimation are critical for ensuring food security and maximizing financial returns. The financial feasibility of doing such an analysis is increasing at the current rate of technical advancement. As more free or inexpensive satellite imagery becomes accessible, the prospect of producing these solutions in a more cost-effective manner increases. These approaches help to ensure food security while also minimizing negative economic consequences caused by inefficient agricultural and processing processes in areas where human populations are rising, and arable farming land is dwindling.