



## From Farms to Markets: Climate Change's Influence on Tomato Prices in India

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Punjab Governor put off tomatoes from the menu of Rajbhavan and even urges the public to substitute it for the time being" a headline covered in national newspapers. The volatility in tomato prices has garnered attention due to its widespread use in culinary practices and its economic significance. The tangy-sweet profile of tomatoes enriches gravies, curries, and sauces, while their vibrant red hue enhances the visual appeal of traditional Indian dishes. "No Tomato, No Cooking" is a very popular phrase that holds in the case of Indian households. The year 2023 is witnessing soaring price hikes in many vegetables such as tomato, cauliflower, ginger, garlic, bean, etc. Tomato is undisputedly the worst-hit vegetable. The vegetable was available at ₹ 20-40 per kg in June and soared 2 to 3 times in July, hovering between ₹100 and 200 per kg. If McDonald's can feel the pinch, it is almost inevitable for common households to skip tomatoes from the recipes. August however witnessed some fall in the prices, bringing the kitchen king back to the households.

### Introduction

Tomato (*Solanum lycopersicon*) is a widely consumed vegetable all over the world. Its production value is more than 90 billion USD annually (FAOSTAT, 2019). It holds the 2nd or 3rd position among vegetables in almost every country. India is a major producer as well as consumer of tomatoes, producing about 16,089.32(000 Tonnes) annually (NHB, 2021-22). A nutritionally rich vegetable containing many essential nutrients and antioxidants, contains a carotenoid Lycopene which has been reported to protect against cancer and cardiovascular diseases, B-Carotene is converted into vitamin-A, good for eye health, healthy skin, and the immune system, and is a source of dietary fiber, vitamin C, vitamin K, potassium, etc. Tomato production is concentrated in states such as Madhya Pradesh (14.63%), Andhra Pradesh (10.92%), Karnataka (10.23%), and Tamil Nadu (7.34%) (NHB, 2021-22). There are two crops of tomato in a year. The first is a rabi crop grown in parts of Maharashtra and Karnataka, and the other is a kharif crop grown in UP and Nashik. Rabi crop comes to market from March onwards, extending up to August. Rabi crop is seen during the rest of the year. Climate Change is one of the greatest threats to all the existing biological diversity in the 21st century. The global mean surface temperature has increased approximately by 1.1°C compared to pre-industrial levels and is all set to surpass 1.5°C within the next few decades (IPCC, 2021). The very impact of it is becoming more pronounced in recent years. Agriculture is the main livelihood of the rural population in India, engaging around half the workforce of the country. India too has been witnessing the adverse impacts of climate change on its farming sector. Rain-fed agriculture is more vulnerable to uncertain events. Among the various crops, tomatoes stand out as one of the most affected crops due to the changing climate patterns such as rising temperatures, unpredictable rainfall, and extreme

weather. Most of the tomatoes produced in the country are used for fresh production and a very small portion of it (less than 1%) is utilized for value addition. This when combined with the seasonal and highly perishable nature of crops negatively affects the supply and demand dynamics, leading to fluctuations in tomato production and subsequently, tomato prices in the Indian market. There has been a trend in the past few years, the price hike is mainly witnessed in July, as it is the dearth period, the Rabi crop starts declining and the Kharif season crop is yet to reach the market (Table 1)

**Table-1: All India monthly average wholesale prices of tomato (Prices in ₹ /Quintal)**

| Month     | 2016   | 2017   | 2018   | 2019   | 2020   |
|-----------|--------|--------|--------|--------|--------|
| January   | 1742.0 | 1294.4 | 1705.9 | 1811.5 | 1522.2 |
| February  | 1331.5 | 1177.5 | 1293.1 | 1552.2 | 1306.3 |
| March     | 979.1  | 1279.0 | 1160.0 | 1986.2 | 1207.6 |
| April     | 1246.9 | 1440.5 | 1140.5 | 2112.1 | 1291.9 |
| May       | 2297.3 | 1427.5 | 1266.1 | 2747.6 | 1099.9 |
| June      | 2995.3 | 2026.1 | 1764.2 | 2812.9 |        |
| July      | 2658.4 | 3983.7 | 2044.5 | 3074.8 |        |
| August    | 1876.0 | 3927.0 | 1750.6 | 2718.8 |        |
| September | 1797.8 | 2543.5 | 1588.6 | 2236.7 |        |
| October   | 1839.8 | 2712.1 | 1568.5 | 2861.6 |        |
| November  | 1682.2 | 3537.1 | 1639.5 | 2647.1 |        |
| December  | 1181.1 | 2147.8 | 1399.2 | 1557.7 |        |

Source: AGMARKNET

## Impact of Climate Change on Tomato Production

### Temperature Extremes

- The abnormal increase in temperatures for a sufficiently long period and this negatively affects the physiological processes of a plant such as photosynthesis, transpiration, etc. is referred to as Heat Stress.
- It has a negative correlation with the reproductive health of a plant, it particularly reduces the pollen, and seed viability thus impacting the reproductive health of a plant which in turn means reduced yields. Extreme heat can also reduce fruit quality by causing sunscald, uneven ripening, and flavor loss.
- Lycopene content has been reported to be the highest at 21-24°C it reduces substantially above 27°C
- The state of Karnataka witnessed the best waves in March itself while other states such as Andhra Pradesh, West Bengal, Bihar, Haryana, etc. experienced it a month later in April, affecting the rabi crop.
- There are very few heat-tolerant varieties that present severe restrictions when grown in areas where the temperature may rise as high as 40°C even for a short period.

### Pests and diseases

- With the indiscriminate use of pesticides many pathogens and insects have developed resistance to these, this when combined with increased temperatures and humidity causes unprecedented losses to crops such as aphids, whiteflies, and fungal pathogens.
- Viral infections are the most difficult to manage as there are no established remedies against these.
- Cucumber Mosaic Virus (CMV) and Tomato Mosaic Virus (ToMV) are the two viruses that have been blamed the most for crop losses in Maharashtra, Karnataka, and other Southern States.

- The viruses cause similar damage which includes mottled yellow, light green, and dark green patches resulting in loss of photosynthetic area in addition to uneven ripening of fruits.

### **Unpredictable Rainfall**

- The monsoon this year marked an early arrival in most parts of the country, around 15-20 days earlier than the normal dates.
- The Cyclonic storm Bijarpoy made landfall in Western India in June, then came the floods in the state of Assam, Monsoon and western disturbances cumulatively led to heavy rainfalls over Northern States such as Himachal Pradesh, Uttarakhand, Punjab, and Haryana, which aggravated extreme weather events as cloud bursts, landslides, flash floods, damage to infrastructure. This led to a near wipeout of the crop from these regions.
- The Transportation Sector is severely hit, as noticed in the case of Himachal Pradesh which is one of the important kharif season growing areas, there were frequent roadblocks, and products had to be sent through alternate routes widening the gap between farms and markets.
- Heavy rainfall often causes swelling of fruits, which ultimately break, aggravating the attack of diseases such as buck eye rot (*Phytophthora nicotianae* var. *parasitica*)

### **Pollination Disruption**

- Although tomato is a self-pollinated crop with the extent of cross-pollination of less than 5% bees, particularly the bumble bees substantially increase the crop yields in terms of quality as well as quantity.
- Bees are adapted to specific patterns of availability of pollen and nectar. Thus even a small rise in temperatures results in a bloom that is a few days to weeks earlier resulting in a temporal mismatch between flora and bees.
- Heavy rains discourage the flights of bees and also predispose them to pests and diseases making them lethargic and weaker.

### **Market Implications**

#### **Price Volatility:**

- With climate-induced fluctuations in tomato production, the market experiences price volatility. During years with reduced yields, tomato prices soar due to supply shortages. Conversely, during years of abundant production, prices may drop, leading to reduced income for farmers.
- Frequent cases are seen when the farmers prefer to throw away the produce, compelled by poor market prices as happened in some parts of Maharashtra this year in May.

### **Storage and Supply Chain Management**

- Tonnes of the produce is wasted until it finally reaches the consumers because it is highly perishable.
- The cold storage facilities are minimal in the country and they too available at not-so-affordable prices, this combined with poor transportation facilities, long distances to mandis, and unfair practices by the middlemen leads to price variations.
- Climate-induced fluctuations require better storage and supply chain management to ensure a steady supply of tomatoes throughout the year.

### **Regional Disparities**

- India consists of 15 agro-climatic zones.
- There is more than one crop cycle and that too of different situations resulting in multiple price hikes within the same year.

- One region might experience higher productivity due to changing climate conditions, while others may face severe challenges. This disparity can create regional imbalances in tomato prices and availability.

### **Impact on Food Inflation**

- Tomatoes are a staple ingredient in Indian cuisine, and fluctuations in their prices can have a significant impact on food inflation.
- Tomato, Potato, and Onion are chief contributors to headline inflation. June's retail inflation rose to 4.87% (a three-month high) from 4.31% in May, while July witnessed a much higher retail inflation of 7.44% owing to increased costs of household commodities like pulses, milk, tomato, etc.
- There was a 28% and 11% surge in the prices of Veg and Non- Veg Thali respectively in July on month to month basis as per the reports of CRISIL.

### **Mitigation Strategies**

#### **Climate resilient practices**

- Implementing agroforestry practices to provide shade and reduce heat stress.
- Growing varieties that are more resistant to heat, drought, etc.
- mulching to reduce soil evaporation and maintain soil temperature, adopting water-efficient irrigation systems such as drip irrigation to reduce water usage and minimize water stress on plants.
- improving soil status through practices like cover cropping and adding organic matter.
- Farmers need to work closely with agricultural extension services, research institutions, and local communities to design and implement the most suitable climate-resilient strategies for their specific contexts

#### **Integrated Pest Management**

- It is an integrated approach that takes into consideration the life cycle of a pest and the possible interaction and impact on the surrounding environment by utilizing all the possible methods in the best compatible manner incorporating practices ranging from pest surveillance and variety to sown to chemical measures.
- Trap crops such as sorghum, pearl millet, and sunflower reduce the incidence of tomato leaf curl virus in tomatoes.
- encouraging populations of *Coccinellids* a primary predator of a no of aphids by providing supplementary food sources, and avoiding chemical sprays.
- On the larger picture, IPM promotes natural protection and sustainable agriculture in the long run.

#### **Crop Rotation and Diversification**

- Rotate tomato crops with other non-host plants to prevent the build-up of pests.
- Marigold when grown in between the rows of tomato crops exudates alpha terthienyl from roots which inhibits the population of root-knot nematodes.
- crop rotation with cereals or legumes effectively reduces the populations of soil-borne pathogens such as *Verticillium*, *Fusarium*, and *Phytophthora*, in addition to nitrogen fixation by legumes.

#### **Agri-Intelligent Platforms and Precision Agriculture**

- It utilizes technology such as GPS, Satellite Images, Sensors, Drones, etc. to perform need-based agriculture diversifying the management decisions of a field, and the ability to manage a field in separate blocs instead of a single block.
- VRT (Variable Rate Technology) locates precise locations in the field for differential rates of input application, this when combined with collected data directs VRT-enabled equipment such as a sprayer to exactly apply the required amounts at the respective



location. \* A more comprehensive evaluation of a farm would be available to a farmer including soil status, weather conditions, site history, etc.

- Further new potential growing pockets can also be identified by integrating the Temperature, Rainfall, and Soil data.

### **Protected Cultivation**

- Greenhouses offer precise control over the microclimatic condition of a plant. Soil-less agriculture as hydroponics and aeroponics is gaining momentum, offering an end number of benefits such as no soil-borne pathogens, and more controlled nutrient status of media.
- Tomato is one of the major crops grown in the greenhouse along with eggplant and cucumber.
- It is expected that the world population will exceed 9 billion by 2050, out of every 3 persons 2 will be residing in cities, practices such as vertical farming which focuses on the vertical expansion of agriculture against the conventional horizontal, will help produce food spaces in urban spaces more sustainably.

### **Value Addition**

- The tomato can be transformed into products such as sauces, ketchup, canned tomatoes, dried tomatoes, paste, etc. Value addition offers benefits such as year-round availability, 2-3 times higher prices, variety, and smaller storage space. These units should preferably be set up in rural or suburban areas which will offer reduced transportation costs and easy availability of raw material

### **Community Engagement and Education**

- Raise awareness about the impacts of climate change on tomato production within the community.
- Educate farmers about sustainable and climate-resilient practices through workshops and training programs.
- Strengthening the ICAR Lab to Land Programme, 1979, focussing on activities of KVKs (Krishi Vigyan Kendras), agricultural research stations.
- Provide incentives or subsidies for adopting climate-smart technologies and practices.

### **Summary**

The impact of climate change is real, be it tomato production or any other crop and it encompasses a range of challenges, including altered temperature and precipitation patterns, increased pest and disease pressure, and changing nutritional content. The increased pest incidence has prompted the farmers to intensify the pesticide application, which has degraded the soil quality substantially, there are more frequent drought periods that leave rain-fed farming in trouble, rains have become more intense and concentrated over a shorter period inviting numerous pathogens and insects. The rabi season crop was affected mainly due to heat stress and viral attack, while the Kharif season crop was hit by unpredictable rainfalls. This cumulatively led to a shoot-up in the prices mainly in July. The prices are expected to come down post-mid-August, as more of the kharif season crop will reach the market. There should be a gradual shift in adopting climate-resilient practices such as organic farming, protected cultivation, integrated pest management, etc. More focus should be made on the post-harvest handling of produce such as cold store facilities, value-addition into ketchup, purees, sauces, etc. Any sudden shift can invite disasters as happened in Sri Lanka owing to the overnight ban import of synthetic fertilizers and pesticides forcing millions of farmers to go organic, a major reason for the collapse of the Sri Lankan economy in the year 2022. As the effects of climate change begin to intensify, it becomes imperative for the agricultural sector to implement adaptive measures to ensure food security, stabilize prices, and sustainably meet the needs of both producers and consumers.