ISSN – 2277-7911
Impact Factor – 5.958
YOUNG RESEARCHER
A Multidisciplinary Peer-Reviewed Refereed Research Journal
January - 2025
Vol. 14
Special Issue
No. 1

# Projections for Onion Consumption in India

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**DOI - 10.5281/zenodo.14857003**

***Abstract:***

*This study explores the consumption demand in India, focusing on future projections and their implications for the agricultural sector. Using historical data on production, area harvested, exports, imports, and population, the paper applies a linear regression model to project per capita onion consumption up to 2030. The findings indicate a consistent growth trajectory, with per capita consumption expected to increase from 211 Mt/10,000 people in 2023 to 266 Mt/10,000 people by 2030, driven by population growth, dietary shifts, and urbanization.*

***Keywords: Onion, availability, consumption demand Projection, Linear Regression Model***

**Introduction and Literature Review:**

In India Onion (Allium Cepa) is produced in different seasons: Kharif, Late-Kharif and Rabi. The marketing season for Kharif is during November – January, the crop in the Late-Kharif season reaches the market during January – February and that grown during the Rabi season arrives during the March – June season. While the onion grown in Kharif and late Kharif seasons cannot be stored for a very long time and offer short seasonal supply, the Rabi onion Contributing approximately 60% of total production and storable year-round, making them critical for both domestic supply and exports. Onions play a pivotal role in the livelihoods of millions of Indian farmers and contribute significantly to the agricultural GDP. As a cash crop, they generate higher net returns compared to other vegetables, making them a lucrative option for farmers in states like Maharashtra, Karnataka, and Madhya Pradesh. Additionally, onions are a politically sensitive commodity; fluctuations in their prices often trigger public and governmental responses due to their impact on consumer affordability and food security. The Rabi crop, being storable, ensures year-round availability and acts as a buffer against seasonal price volatility. It also dominates India's onion exports, which contribute to foreign exchange earnings and strengthen the agricultural economy. However, high dependency on Rabi onions for storage and export makes the supply chain vulnerable to climatic disruptions, such as unseasonal rains.

India's culinary scene shows notable regional variations in onion consumption, which are impacted by different agriculture methods, cultural tastes, and financial considerations. For example, onions have a strong use in

traditional cuisines like Punjabi and Kashmiri, and are frequently used in northern regions to make spicy dishes and rich gravies. On the other hand, southern states emphasize the use of onions in lighter dishes, such as sambar and curries, demonstrating a varied taste of food. Furthermore, regional supply and demand determine how much onions cost, which has a direct impact on consumption trends. In addition to influencing shifting culinary applications, seasonal fluctuations and regional harvest conditions can have a significant impact on onion pricing across states.

In the end, these regional variations highlight the complex connection between the availability of local produce and culinary customs, demonstrating how cultural identity and economic considerations influence how people consume food.

Onions are consumed in various forms—raw, cooked, or processed—and their versatility extends to value-added products like onion powder, flakes, and pickles. This adaptability drives their importance in households, commercial kitchens, and food processing industries. In 2022–23, India exported 2,527,000 metric tons of onions of values Rs.4,525.91 crore, reflecting their significance in international trade and consumed 19361 '000MT fresh form. Onion market is also highly segmented. The segmentation is based on the consumer preferences and suitability of different varieties for export, processing, etc. It is believed that the prices are also influenced by this segmentation. Prices play a central role in guiding production and consumption.

The behaviour of commodity prices is typically the result of a complex mixture of changes associated with seasonal, cyclical, trend, and random factors. Moreover, the most common regularity observed in an agricultural price series is a seasonal pattern. The commodities also exhibit cyclical behaviour i.e., a tendency exists for production and prices to vary systematically (cyclically) over a period of years. (Tomek et al.)

Understanding the dynamics affecting onion prices in India requires a multifaceted analysis, particularly during periods of sharp price fluctuations. A notable spike occurred between December 2019 and January 2020, where increased prices led to reduced consumption among consumers, demonstrating the direct correlation between price and demand. The variations in supply and demand in the agricultural market contribute significantly to these price shifts, often influenced by factors such as seasonal harvests, transportation issues, and market speculation. Furthermore, the economic context in which onion prices exist is pivotal; for instance, the real wages of casual labourers are often tethered to essential commodities like onions. As reported, unskilled labourer's wages have lagged behind the cost of living, thereby diminishing their purchasing power and altering consumption expenditure patterns. Such economic pressures highlight the need for effective government intervention in managing onion price volatility to ensure stability in the market (Dey et al.)(Lyngskor et al.).

The fluctuations in onion prices and consumption patterns in India are significantly influenced by seasonal variations and the complexities of supply chain dynamics. As the demand for onions typically increases during festivals and wedding seasons, producers often grapple with the challenge of timing their harvests

to coincide with peak market demand, thereby maximizing profitability. This requires meticulous harvest date planning as discussed in (Everaarts et al.), which emphasizes the importance of aligning production cycles with urban consumption needs.

The consumption patterns of onion in India reflect a significant shift driven by economic changes and dietary preferences over the last two decades. This transition aligns with a broader trend away from staple cereals towards high-value agricultural commodities, including vegetables like onions, in both rural and urban settings (Jain et al.).The demand for onions is not merely a function of their culinary versatility but is also influenced by their economic viability for farmers. For instance, studies in Punjab show that the net returns from onion cultivation surpass those of other vegetables, such as cauliflower, emphasizing its profitability (Kumar et al.).This profitability encourages farmers to adjust their production strategies, thereby meeting the growing consumer demand. Consequently, onions have become a staple in Indian households, further reinforcing their prominence in domestic markets and contributing to a dynamic agricultural sector that adapts to market signals while addressing the nutritional needs of the population.

As a staple in Indian cuisine, onions remain integral to dietary practices, yet their price volatility can lead to substantial variations in consumption patterns. As very little literature available with reference to the projection of onion consumption demand, author uses linear regression modelling approach. This paper analyses the consumption, trade and project the consumption demand of Onion in India up to year 2030.

**Data, Methodology and Analytical Procedure:**

The study is used all the available information on the subject. The secondary data and prices of onion at Lasalgaon market is selected as a representative market in India. The data of area, production, yield, prices, consumption, export, import, population were collected from government publish reports like National Sample Survey organization (NSSO), Economic Survey, Agmarknet and FAOSTATS. This raw data collected from the years 2004 to 2023.

These provide disaggregate data of Area Harvested (Ha), Production (tonnes), Export (tonnes), Import (tonnes) for onion in India. For the further procedure data of area harvested converted in '000 Ha while Production, Export and import data has been converted in '000 MT. The Consumption demand for onion is projected by considering area, productions, export, import, availability of onion and populations etc.

**Availability of onion in India = Production – Export + Import**

**Table 1: Data of Onion on various parameters**

| Year | Area harvested (000 Ha) | Production (000 mt) | Export quantity (000 mt) | Import quantity (000 mt) | Availability (000 mt) | Population (Million) | Per capita consumption (Mt per ten thousand) |
|---|---|---|---|---|---|---|---|
| 2004 | 613.80 | 8554.59 | 918.48 | 0.00 | 7636.11 | 1125.636 | 68 |
| 2005 | 703.60 | 10397.54 | 1060.21 | 7.24 | 9344.57 | 1144.326 | 82 |
| 2006 | 768.00 | 11956.76 | 1522.86 | 0.00 | 10433.90 | 1161.148 | 90 |
| 2007 | 821.00 | 15322.11 | 1112.59 | 0.11 | 14209.64 | 1178.217 | 121 |
| 2008 | 834.00 | 14952.84 | 1841.65 | 0.10 | 13111.28 | 1195.537 | **110** ↓ |
| 2009 | 756.20 | 13402.77 | 1848.76 | 0.69 | 11554.70 | 1213.111 | **95** ↓ |
| 2010 | 1064.00 | 16664.72 | 1503.92 | 5.96 | 15166.76 | 1230.985 | 123 |
| 2011 | 1087.23 | 19302.65 | 1223.72 | 7.84 | 18086.77 | 1246.618 | 145 |
| 2012 | 1052.00 | 18533.14 | 1684.11 | 0.00 | 16849.03 | 1262.45 | **133** ↓ |
| 2013 | 1217.00 | 21273.48 | 1627.64 | 19.67 | 19665.51 | 1278.483 | 154 |
| 2014 | 1203.57 | 21386.67 | 1396.92 | 0.90 | 19990.65 | 1294.72 | 154 |
| 2015 | 1173.00 | 20863.42 | 1154.64 | 96.26 | 19805.04 | 1311.163 | **151** ↓ |
| 2016 | 1320.00 | 23072.45 | 2025.22 | 0.10 | 21047.33 | 1327.815 | 159 |
| 2017 | 1306.00 | 24721.51 | 1787.67 | 7.27 | 22941.11 | 1344.678 | 171 |
| 2018 | 1285.00 | 25641.94 | 1861.16 | 7.81 | 23788.58 | 1361.755 | 175 |
| 2019 | 1220.00 | 25153.61 | 1609.98 | 83.97 | 23627.61 | 1379.05 | **171** ↓ |
| 2020 | 1431.00 | 28760.37 | 1596.94 | 144.49 | 27307.93 | 1396.563 | 196 |
| 2021 | 1624.00 | 29366.64 | 1581.71 | 30.63 | 27815.56 | 1414.3 | 197 |
| 2022 | 1941.00 | 34928.90 | 2341.95 | 1.81 | 32588.76 | 1432.261 | 228 |
| 2023 | 1740.00 | 33298.58 | 2787.27 | 22.62 | 30533.92 | 1450.451 | 211 ↓ |

*Souce: https://www.fao.org/faostat/; http://censusindia.gov.in/; and Author's conversion (availability and per capita consumption)*

**Interpretation of Parameters in relation to consumptions:**

- **Area Harvested (000 Ha)-** Increased from **613.80** in 2004 to **1,740.00** in 2023 and growth is gradual, with spikes in 2010 and 2020.Shows that larger harvested onion area correlates positively with higher production and availability, boosting consumption.
- Production (000 MT)- Increased significantly from **8,554.59** in 2004 to **33,298.58** in 2023 and peaks in 2022 at **34,928.90**.Shows that higher onion production ensures greater availability, meeting rising onion consumption demand.
- Export Quantity (000 MT)- Fluctuates widely, from 918.48 in 2004 to 2,787.27 in 2023 and Peaks in 2022 (2,341.95).Shows that onion exports reduce domestic availability, potentially constraining consumption if supply is tight.
- Import Quantity (000 MT)- Minimal before 2015 and increases after 2015 due to supply shortfalls (highest: 144.49 in 2020).Shows that onion imports compensate for shortfalls in domestic production, stabilizing consumption.

- Availability (000 MT)- Gradual increase from 7,636.11 in 2004 to 30,533.92 in 2023, reflecting production minus exports plus imports. Shows that onion availability is directly proportional to consumption. Higher availability allows steady consumption growth.
- Population (Million) - Population rises steadily from 1,125.64 in 2004 to 1,450.45 in 2023 shows that population growth in India drives aggregate demand for onions, necessitating higher production and availability.
- Per Capita Consumption- Grows consistently from 68 MT/10,000 people in 2004 to 211 MT/10,000 people in 2023, a 210% increase. Shows that lifestyle changes and rising incomes result in higher per capita onion consumption.

**Why per capita Onion consumption (measured in Mt per 10,000 people) showed a decline in the years (2008, 2009, 2015, 2019, and 2023) despite overall trends of increasing population and production?**

**Key Factors Influencing Onion Per Capita Consumption Decrease is as follows:**

1. **Year 2008 and 2009**: Per capita consumption dropped from 121 Mt (2007) to 110 Mt (2008) and further to 95 Mt (2009). Because Onion availability (production minus exports plus imports) decreased from 14,209 MT in 2007 to 13,111 MT in 2008 and 11,554 MT in 2009 due to higher exports. Exports rose significantly in 2008
2. (1,841.65 '000 MT) and 2009 (1,848.76 '000 MT), reducing the domestic supply. As population steadily increased, reduced availability of onions per capita led to a decline in consumption.
3. **Year 2015:** Per capita consumption dropped slightly from 154 Mt (2014) to 151 Mt (2015). Because Inconsistent rainfall during 2014–15 led to lower yields, especially in major onion-producing states like Maharashtra and Karnataka. While exports remained high (1,154.64 '000 MT), imports increased (96.26 '000 MT) but were insufficient to counter the production shortfall. Weather-induced supply constraints caused price volatility, leading to reduced affordability for consumers.
4. **Year 2019:** Per capita consumption decreased from 175 Mt (2018) to 171 Mt (2019).
5. Because onion production dropped from 25,641.94 '000 MT (2018) to 25,153.61 '000 MT (2019) due to unseasonal rainfall affecting major growing regions. High onion prices in late 2019 reduced demand, especially among low-income households. Despite domestic challenges, exports remained significant (1,609.98 '000 MT), limiting domestic supply further.
6. **Year 2023:** Per capita consumption fell slightly from 228 Mt (2022) to 211 Mt (2023). Because export quantity increased significantly to 2,787.27 '000 MT, reducing domestic availability despite good production (33,298.58 '000 MT). High export-

driven prices might have deterred domestic consumers, particularly those in rural or lower-income groups. A lack of effective measures to balance export and domestic needs contributed to supply constraints.

In general, per capita consumption decreases due to **(a) Availability-** Lower onion availability due to reduced production or higher exports directly impacted per capita consumption. **(b) Price Volatility**: Spikes in prices often lead to reduced onion demand, especially among price-sensitive consumers. **(c) Population Growth:** Even slight reductions in availability are magnified by increasing population, leading to noticeable drops in per capita metrics. **(d) Weather and Supply Chain Issues**: Unpredictable weather and inadequate storage exacerbate supply disruptions, reducing consumption.

**Consumption Demand Projection model:**

The consumption demand projections for onion are done by using following Linear Regression model:

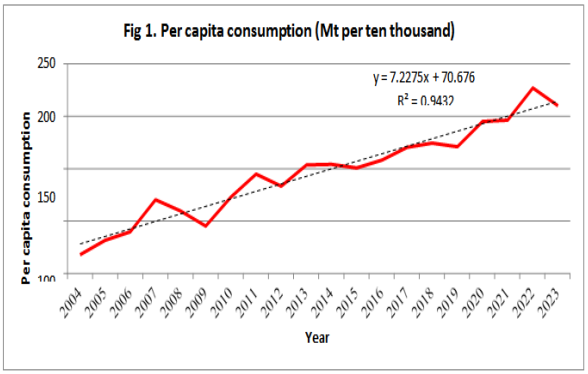
Where,

- y is the projected per capita consumption (Mt/10,000 people) (dependent variable).
- Intercept: The starting point or base level of per capita consumption when x=0
- Slope: The rate of change in per capita consumption for each unit increase in x (independent variable, representing time or trend). The annual growth rate of per capita consumption.
- x is trend Trend variable in the regression model, typically representing the year or time progression (independent variable)

The above formulation given is highly significant and requires less information and Parameters at the aggregate level.

**Results and Discussion:**

1. **Consumption of Onions:**




*Source: Author's Calculations*

The above figure 1 shows per capita consumption of onion has been increases continuously after the year 2004, while aggregate demand has been simultaneously increasing due to rapid population growth. Overtime per capita consumption of onion has been uniform and increases across all household categories and across all region of the country. Per capita consumption of onions across all of India has been increasing due to many reasons including lifestyle changes. From 2004 to 2023 duration of 20 years per capita consumption of onions boosted to 210% in India. While the production and availability also increase in India to same degree.

Linear regression fitted to per capita consumption and trend data. $R^2$ for this regression model is 94% which is highly significant. An R Square value of 94 % indicates that 94 % of variability in the dependent variable can be explained by

independent variables in the given model. The regression line aligns closely with actual data points, confirming that per capita onion consumption growth is primarily driven by predictable, linear factors. Therefore the model fits the data very well.

**Consumption Demand Projections for Onions:**

Consumption demand projection scenario for onions in India in given in Table 2.

**Table 2: Consumption Demand Projection**

| Year | Per Capita demand/ consumption (Mt per ten thousand) |
|---|---|
| 2024 | 222 |
| 2025 | 230 |
| 2026 | 237 |
| 2027 | 244 |
| 2028 | 251 |
| 2029 | 259 |
| 2030 | 266 |

*Source: Author's projection*

The **steady increase** in per capita consumption reflects a growing demand for onions driven by lifestyle changes, dietary shifts, and population growth. The model predicts an **annual growth** in per capita demand of approximately 7.23 MT per 10,000 people.

**Conclusions:**

This study highlights the critical relationship between onion consumption demand With per capita onion consumption projected to rise steadily from 211 Mt/10,000 people in 2023 to 266 Mt/10,000 people by 2030, the demand for onions is expected to surpass current supply levels. This growth is fuelled by population expansion, changing dietary patterns, and increasing urbanization, underscoring the need for strategic interventions to ensure food security and market stability.

As onion consumption continues to grow, fostering innovation in agricultural practices and strengthening policy frameworks will be essential for bridging the demand- supply gap. These efforts will not only stabilize the onion market but also contribute to the broader goals of enhancing farmer livelihoods and ensuring food security for India's growing population.

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