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# THE INDIAN MAIZE SECTOR

*Trends, Challenges & Imperatives for Sustainable Growth*



2024

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| TITLE | The Indian Maize Sector: Trends, Challenges & Imperatives for Sustainable Growth | |
| YEAR | September, 2024 | |
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# Message



Maize, a versatile cereal often referred to as the "queen of cereals,' occupies a unique position in Indian agriculture ranking third in production after rice and wheat. The strategic importance of this crop in the country is further accentuated as it is being promoted as a viable alternative for making bioethanol.

India's maize production has witnessed significant growth over the years, while the acreage, production and yield of maize have grown at a CAGR of 2.16%, 5.52% and 3.28%, respectively, those of food grains have grown at 0.91%, 2.52% and 1.59%, respectively. Notably, only 29% of this crop is cultivated under irrigated conditions, compared to 95% of wheat and 68% of rice, respectively. This indicates that maize has the potential to generate better farmer income considering the vagaries of monsoon. This performance in maize crop has been driven by key factors like strong support from the Government for crop diversification, strong growth in demand from poultry feed and starch industry and significant improvement in adoption of high yielding seeds resulting in increased productivity.

By leveraging innovative practices and fostering partnerships, we can unlock the full potential of maize as a cornerstone of agricultural prosperity in India. The report reviews the global as well as domestic production, consumption, and trade trends. It identifies select drivers that are shaping the future of the maize industry in India and also delves into the key challenges faced across maize supply chain. The report puts forth select interventions that could boost sustainable long-term growth of India's maize ecosystem. It is our strong belief that this report would be helpful in focusing India's potential in the maize sector and immensely useful to various stakeholders in the maize value chain.

**Jyoti Vij**
Director General
FICCI



# Message - Industry



Maize is a crucial crop in India's agriculture. Popularly known as "queen of cereals'' it has great potential in climate-resilient farming due to its adaptability and diverse uses. It plays a key role in food security, livestock feed, energy security and various industrial applications. It touches our lives in multiple ways daily.

A study by NITI Aayog suggests that domestic maize demand is projected to reach 86 million MT by 2047-48. The year 2047 holds significant importance for India as it also aligns with the vision of Viksit Bharat with a broader goal of transforming India into a developed nation. Sustainable Maize production will certainly play a vital role in realizing this vision and achieving long-term feed and energy security for the country.

As maize becomes critical for balancing the demand from the feed and fuel sector, there is an imminent need to adopt strategies for productivity led growth aimed at sustainably increasing maize production in the country. Meeting this challenge will require a significant increase in investment in new technologies and innovations, accelerated adoption of hybrid seeds and seed treatment solutions, improved agronomic practices, integrated pest management, and collaboration among all stakeholders for value chain integration.

Climate change poses significant challenges to crop production, bringing unpredictable weather patterns, increased incidence of pests, and deteriorating soil health. It is important to work alongside farmers and provide them tools like biologicals which serve as complementary, sustainably advantaged solutions for them. Training farmers on silage making not only empowers them to diversify their income but also contributes to the livestock feed market and fodder scarcity challenges. By transitioning to innovative technologies and products, Indian maize farmers could be better equipped to meet future challenges, ensuring both environmental sustainability and economic viability.

Corteva Agriscience has worked side-by-side with farmers around the world to provide high yielding seeds, crop protection solutions, and agronomic recommendations to enable them to be more sustainable and productive. Our focus on innovation goes together with our dedication to sustainability. Through training and education programs we aim to improve both productivity and environmental stewardship.

Our collaborations with government organizations and agricultural universities also ensure that farmers have access to the best resources and knowledge available to maximize their potential. Sustainability remains at the core of our mission. Corteva is committed to ensuring that maize farmers can thrive in a changing world. By continuing to support their journey towards greater productivity and sustainability, we look forward to creating a brighter, more secure future for India's Maize sector.

**Anuja Kadian**
Government & Industry Affairs Director -Asia Pacific
Corteva Agriscience



# Foreword



Maize continues to play a pivotal role in India's agricultural landscape. Ranked as the third most important cereal crop (after rice and wheat), maize has witnessed remarkable growth in demand and supply. This growth-spurt is driven by the crop's intrinsic ability to adapt to diverse agro-climatic conditions, innate high yielding potential and versatile end usage - not just for food but also for animal feed, starch, bio-ethanol, and other industrial purposes.

The growing importance of maize in Indian agriculture may be judged by the fact that it is the fastest growing cereal crop in terms of area, production, and productivity. For instance, domestic maize production has increased from 22.3 million MT (in 2012-13) to 38.1 million MT (in 2022-23), growing at a decadal CAGR of 5.5%. During this period, average national productivity of maize grew at a CAGR of 3.3% (from 2.6 MT/Ha to 3.5 MT/Ha). In comparison, production and productivity of rice grew at a CAGR of 2.6% and 1.4% while that of wheat grew at 1.7% and 1.2% respectively. This growth is in spite of the fact that just 29% of maize is cultivated under irrigated conditions, compared to 68% for rice and 95% for wheat.

Despite this remarkable surge in production, India's maize sector is at a critical crossroads, as growth in domestic demand is rapidly outpacing that of indigenous production. A recent report published by NITI Aayog indicates that the demand for maize is estimated to reach 60 million MT in 2035-36, and 86 million MT in 2047-48. Domestic production during these years is projected to be about 51 million MT and 80 million MT respectively, resulting a demand-supply gap of 6 to 9 million MT in the coming decades.

Bridging this growing demand-supply gap, through improvement of productivity and supply chain efficiencies, has become an urgent priority for our nation. However, India's maize ecosystem faces critical challenges across the value chain that hamper holistic growth and development of the sector. While factors such as high dependency on rainfed farming, limited adoption of modern hybrids, inadequate plant health management and low farm mechanization are adversely impacting productivity at the farm level; factors such as poor post-harvest management, lack of adequate infrastructure (especially for bulk storage and transportation) and lack of integration and scale in operations are affecting market-linkage efficiencies.

Keenly aware of the existing challenges, the Government of India has taken up numerous proactive initiatives to safeguard the interest of farmers, build efficiencies from farm to fork and create a conducive policy environment for private sector participation across the maize supply chain. Through investments in research, technology, infrastructure, and sustainable practices, many forward looking private enterprises are not just contributing to sectoral growth but also aligning their strategies with changing demand. However, to actualize a transformative jump in growth, there is a need for a diverse set of stakeholders to come together and co-create a holistic strategy that addresses the multifaceted demand-supply challenges faced by this sector.

YES BANK is sincerely committed to playing a catalytic role in the development of India's agricultural sector, not just by serving as a trusted banking partner but also by working alongside private sector, multilateral institutions, government and industry associations for assimilation and propagation of knowledge that contributes to sustainable growth of this ecosystem. Towards this endeavour, YES BANK

is pleased to partner with FICCI to release this Knowledge Report titled "The Indian Maize Sector -Trends, Challenges & Imperatives for Sustainable Growth'.'

This report reviews the global as well as domestic production, consumption, and trade trends, delves into the key challenges faced across various legs of the supply chain and identifies select interventions that could boost sustainable long-term growth of India's maize ecosystem. I sincerely hope that this report will serve as a reference document to inspire actions and pave the way for transformative changes required to build a more resilient and prosperous maize sector in India.

Sincerely,

**Prashant Kumar**
Managing Director & CEO
YES BANK



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# Executive Summary

This report provides an analysis of the maize sector, focusing on global and domestic production trends, trade dynamics, and consumption patterns. It highlights maize's pivotal role in contributing to food security, feed for livestock, and industrial applications. The report delves on the challenges faced across the maize supply chain and identifies select interventions across the supply chain that could facilitate in driving sustainable growth of the sector.

Maize is a crop of immense versatility and adaptability. It can be cultivated across diverse agro-climatic conditions and is used extensively across industries, including food processing, animal feed, starch manufacturing and bioethanol production. Globally, maize production has seen significant growth over the past decade, driven by advances in hybrid seeds, improved agricultural practices, and the rising demand for maize-based products. In 2022, global maize production reached 1.17 billion metric tons (MT)[1], making it the highest produced cereal crop, surpassing both rice and wheat. While maize is cultivated in about 170[2] countries across the world, the top five producing countries, namely the USA, China, Brazil, Argentina, and India collectively account for approximately 70% of global maize production. A review of global trade data for the year 2023 indicates that about 202.12 million MT of maize was traded across countries with top exporters being Brazil, USA, Ukraine, and Argentina. Collectively, these top maize exporting nations contributed to about 75% (in volume terms) of total global maize exports.[3]

In India, maize is the third most important cereal crop after rice and wheat. In 2022-23, maize was cultivated across 10.74 million hectares (Ha) with production touching 38.09 million MT[4]. Globally, India ranks 4$^{th}$ in terms of acreage and 5$^{th}$ in terms of annual production, contributing to about 4.9% and 2.9% to world acreage and production respectively. India exported 2.31 million MT of maize valued at USD 0.70 billion in 2023. In terms of value, Vietnam (48%), Bangladesh (24%) and Nepal (14%) were the top countries to which India exported approximately 86% of its maize[5]. India's domestic market is reasonably protected from imports as entry of genetically modified maize (GM Maize) is restricted and only maize with non-GM origin cum GM free certification is allowed for imports.

Maize is a key source of food and nutritional security, especially in traditional growing areas, but only about 22%[6] of domestic production is used for direct food consumption and remaining crop is utilized for industrial purposes. Over the last two decades, India's growing economy and expanding middle income consumers have been fueling demand for animal protein, starch and other industrial products that utilize maize as a key raw material. This, in turn, has been driving demand for maize in India.

[1] FAOSTAT
[2] FAOSTAT
[3] ITC Trade Map
[4] Department of Agriculture and Farmers' Welfare, GOI
[5] ITC Trade Map
[6] International Grain Council

This report identifies select drivers that are shaping the future of the maize industry in India. These include availability of varied agro-climatic conditions to grow different maize varieties, increasing investment and private sector participation across maize supply chain, increasing demand for maize in the poultry and livestock sectors, growing use of maize in the production of bioethanol, and rising consumption of maize-based products. However, the sector also faces significant challenges, such as inadequate irrigation infrastructure, limited access to quality seeds and inputs, and inefficiencies in post-harvest handling and logistics that are hindering the sector's growth. Climate change poses an additional threat, with its potential to disrupt maize production through extreme weather events, changing rainfall patterns, and increased incidence of pests and diseases.

The maize industry in India has significant potential for growth and transformation. This growth would be driven by innovative technologies, strategic collaborations, supply chain efficiencies and effective policy initiatives. Government of India has rolled out several policy initiatives, schemes and programs that benefit the maize ecosystem, including initiatives by Indian Institute of Maize Research for crop improvement, protection and management; Sub mission on feed and fodder development under NLM; Sub mission on agriculture mechanization; National agriculture market and Agriculture infrastructure fund scheme among others. It is imperative for private sector to collaborate with the government to formulate relevant strategies and implement initiatives that co-create value for farmers and other stakeholders across the maize supply chain. Many forward-looking private companies are focusing intensively on yield enhancements, resource conservation, waste reduction and better quality of maize. Private sector could partner with the government to enhance the impact of their efforts on development of industry specific maize varieties, crop intensification and diversification, introduction of innovative technology solutions, scaling up partnerships with FPOs and establishment of post-harvest infrastructure.

However, to unlock the next level of growth, it is imperative for public sector as well as private sector to come together and co-create a holistic strategy that effectively responds to the intricate demand-supply challenges faced by this sector. Key imperatives identified in this regard include:

- **Develop a roadmap to scale up maize production and acreage** by introduction and widespread adoption of high-yielding and stress-tolerant hybrid seeds. This also requires a concerted effort to map agro-climatic zones and promote specific maize varieties tailored to different end-use sectors such as feed, starch, and food processing. An enhanced varietal and seed replacement rate could lead to improved use of quality seeds resulting in increased productivity and better farmer income. Strong PVP&FRA regulation and prevention of illegal copy of patents will help retain the progress made by R&D focused companies and provide confidence to private sector for introduction of best hybrid varieties into India.

- **Ensure faster and broader adoption of new technologies**: Emphasize the use of digital platforms, precision farming techniques, and advanced storage solutions to enhance productivity and sustainability in the sector. Developing digital platforms that facilitate equipment rental and sharing services will make advanced machinery and tools accessible to smallholder farmers. Financial incentives and subsidies could be provided for deployment of remote/in-situ sensors, drones for crop monitoring, and automatic weather stations. It is also important to ensure adoption of these technologies at farm level through PPP initiatives.

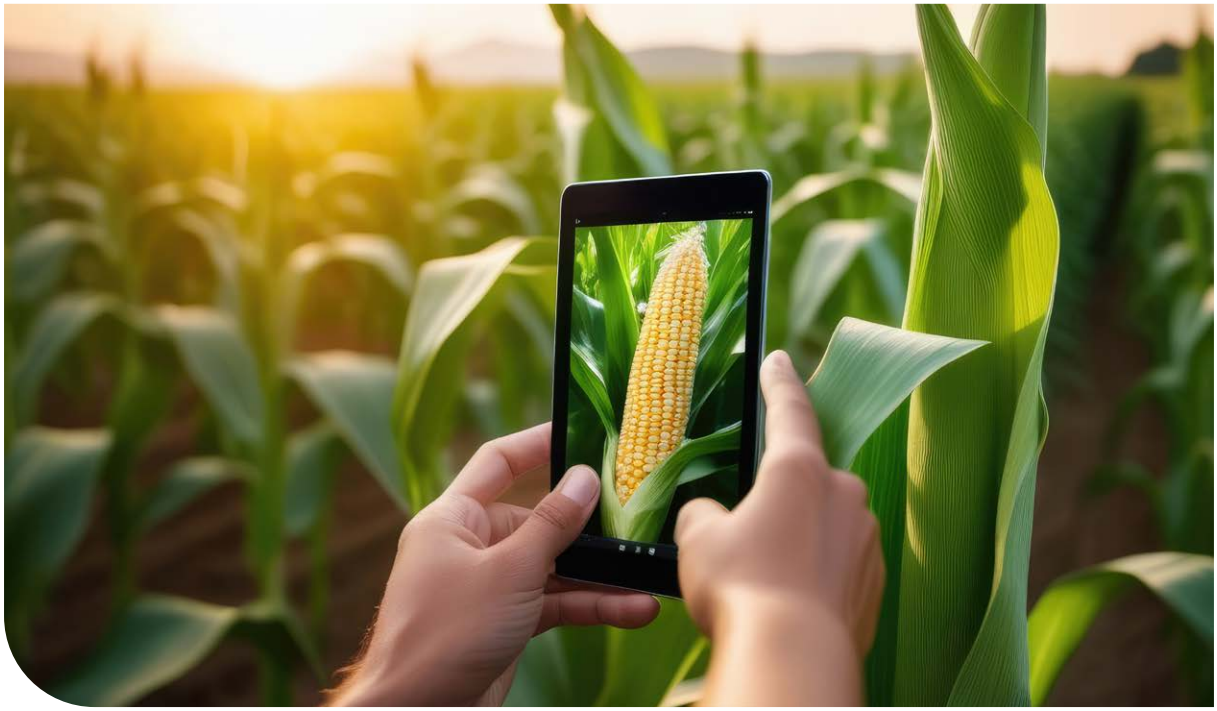
- **Devise effective extension programs to promote adoption of good agricultural practices**. Combining traditional extension methods, such as on-field demonstrations, farmer field days, and training sessions, with digital platforms will help in reaching a larger audience. Digital platforms can deliver information through mobile apps, SMS, and online portals. Creating applications that provide real time information on key parameters such as weather and pest alerts while also providing required support through helpline would ensure faster adoption of new technologies and practices.

- **Strengthen post-harvest infrastructure for building a robust maize supply chain**: Improve farmers' access to markets, reduce post-harvest losses, and ensure a consistent supply of quality maize to industries. This necessitates investing in scientific bulk storage facilities, enhancing farm-level drying and storage infrastructure, and promoting the formation of maize clusters and Farmer Producer Organizations (FPOs). Digital platforms and cooperatives could enable farmers to access markets directly, bypassing intermediaries and ensuring fair prices. E-marketplaces will help in providing transparency and competitive pricing. Creating efficient supply chains and logistics networks will ensure timely market access.

- **Facilitate maize supply security for diverse industries**: Rationalize import duty and regulations to facilitate maize import by industry during shortage of domestic supply. Review requirement of TRQ quota for industries and use scientific models to arrive at the level of quota required. Review of export obligation period, quarantine norms and source of origin regulations to be done. More focus to be given towards development of industry specific maize varieties.

- **Promote private sector investment across the maize value chain** through various incentives and schemes to establish processing and storage infrastructure across the maize value chain.

Implementing these interventions has the potential to drive sustainable growth across the maize ecosystem, enhancing the livelihoods of millions of farmers and strengthening India's position in the global maize market. This will not only contribute to the nation's food security but also drive broader economic development and rural prosperity.







01

# Introduction

Maize is one of the most widely cultivated and consumed crops globally. Its adaptability to diverse environments, high yield potential and versatility in usage makes maize a crop of paramount importance. Maize originated in Central America over 9,000 years ago[7] and has since spread to become a staple crop in many parts of the world. Today, maize is a multifaceted crop with a wide range of uses, including for food, feed, industrial applications, energy, and pharmaceuticals. As a food source, maize is consumed in various forms such as cornmeal, flour, and sweet corn. In addition to its food value, maize is an essential ingredient in animal feed, particularly for poultry and livestock. Its industrial applications are diverse, with maize starch, oil and other derivatives used in the production of food, biodegradable plastics, textiles, paper, and pharmaceuticals. Maize is also used to produce ethanol, a biofuel that is blended with petrol. Key uses of maize are captured in Exhibit 1.

**Exhibit 1: Multifaceted usage of maize**

| | |
|---|---|
| Direct Food Consumption | Cornmeal, Corn flour, Sweet corn, Masa |
| Food Processing Industry | Cornstarch, Corn syrup, High-fructose corn syrup, Corn oil, Breakfast cereals, Snack foods (e.g., chips, crackers), Corn bread, Baking powder, Corn-based vegan meat alternatives, Corn-based prebiotic fibers/probiotics |
| Animal Feed | Aquaculture feed (fish feed), Pet treats, Livestock feed (cattle, pigs, poultry), Corn-based animal probiotics |
| Industrial Applications | Bioplastics, Biodegradable packaging material, Textile production (corn fiber), Adhesives, Detergents, Cosmetics (skincare products), Pharmaceuticals (tablet coatings, capsules), Excipients (e.g., starch, cellulose) |
| Beverages | Specialty alcohols (e.g., butanol, isobutanol), Corn-based coffee creamers, Corn-based plant-based milk alternatives |
| Energy | Ethanol blends, Biodiesel, Biogas, Corn-based biojet fuel |
| Other Uses | Biorefinery products (e.g., biogas, bio-oil), Building materials (e.g., biodegradable insulation), Personal care products (e.g., toothpaste, shampoo), Tobacco products (filter tips, cigarette paper), Biodegradable agricultural films |

Source: YES BANK Analysis

[7] Singh, A. K. (2023). Early history of crop presence/introduction into India: VII. American cereal, maize (Zea mays L.). Indian Journal of Genetics and Plant Breeding, 83(01), 1-7.

Owing to its multiple uses, global maize production as well as consumption has been the highest among cereals in the recent past. In 2022, for instance, about 1.17 billion metric tons (MT) of maize was produced, which was 30.9% higher than that of wheat (0.81 billion MT) and 33.8% higher than that of rice (0.78 billion MT)[8]. In the same year, global consumption of maize stood at 1.19 billion MT, which was 34.4% higher than wheat (0.78 billion MT) and 56.0% higher than rice (0.52 billion MT). Consumption of top three cereals (maize, wheat, and rice) stood at 2.50 billion MT of which maize held about a 47.72% share[9]. During 2012-2022, global production of maize increased at a compounded annual growth rate (CAGR) of about 2.9%, while the area under maize cultivation globally increased at a CAGR of 1.2%.

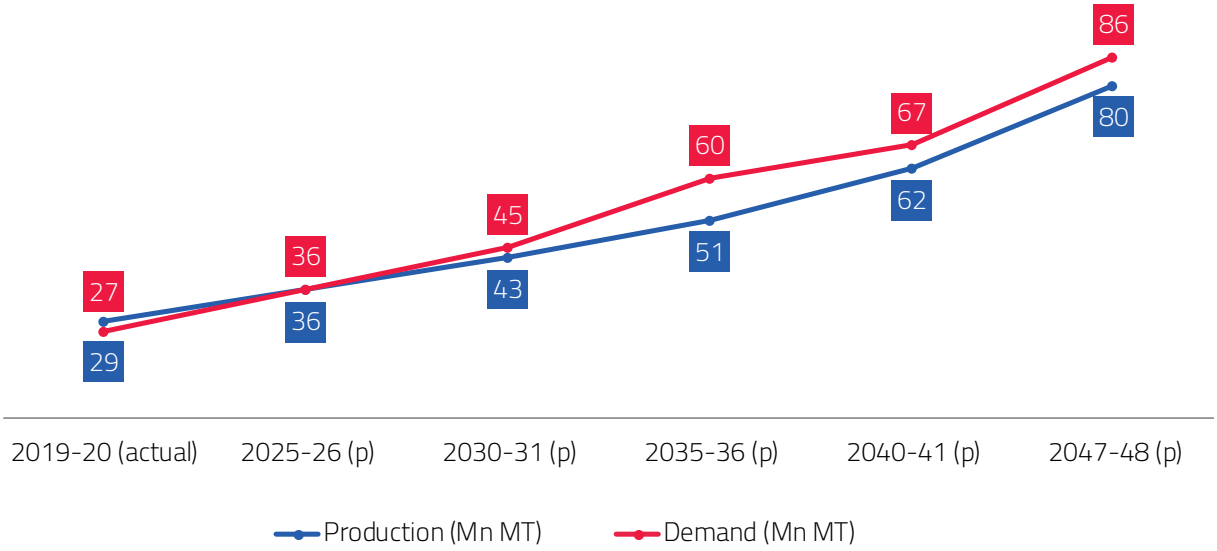
In India, maize is a key source of food and nutritional security, especially in traditional growing areas. However, only about 22%[10] of maize is consumed directly as food while a major share of production is consumed for industrial usage, mainly for animal feed and starch. The strategic importance of this crop in the country is further accentuated as it is being promoted as a viable alternative for making bioethanol, used for blending petrol.

Though India is currently able to meet most of its domestic demand through indigenous production, studies indicate that the demand for maize is growing faster than production. A recent report released by NITI Aayog[11] indicates that domestic maize demand is projected to touch 86 million MT by 2047-48, growing at a CAGR of about 4.2% (from base year of 2019-20). During the same period, maize production is projected to increase to 80 million MT growing at a CAGR of 3.7%. Thus, the consumption-production gap is expected to increase to about 6 million MT by 2047-48 (refer Exhibit 2).



[8] FAOSTAT and YES BANK Analysis
[9] OECD-FAO Agricultural Outlook 2024-2033
[10] International Grain Council
[11] NITI Aayog Report on Working Group Report on Crop Husbandry, Agriculture Inputs, Demand & Supply, 2024

**Exhibit 2: Maize production v/s consumption trend in India**




Source: NITI Aayog Report on Working Group Report on Crop Husbandry, Agriculture Inputs, Demand & Supply, 2024, YES BANK Analysis

Presently, Government of India's strong focus to diversify raw-material for bio-ethanol production, away from sugarcane and towards maize (by increasing the procurement price of ethanol made from maize), has further driven the consumption of maize in ethanol industry. This has led to higher domestic prices, impacting the availability and procurement price of other maize dependent industries (mainly animal feed and starch industry).

With domestic demand for maize growing faster than production, there is an imminent need to identify and address key barriers hindering growth of the Indian maize ecosystem. Multiple challenges across the value chain are impacting farm productivity and prices on one hand, while constraining the availability of good quality produce to the end users at a reasonable price on the other. This necessitates efforts towards boosting efficiencies across the maize supply chain to ensure food security and to effectively meet end-user industry demand, by closely studying the consumption and production trends, identifying key challenges in the sector, and determining the steps required to tackle these challenges.

This report reviews the global as well as domestic production, consumption, and trade trends, delves into the key challenges faced across various legs of the maize supply chain and identifies select interventions that could boost sustainable long-term growth of India's maize ecosystem.



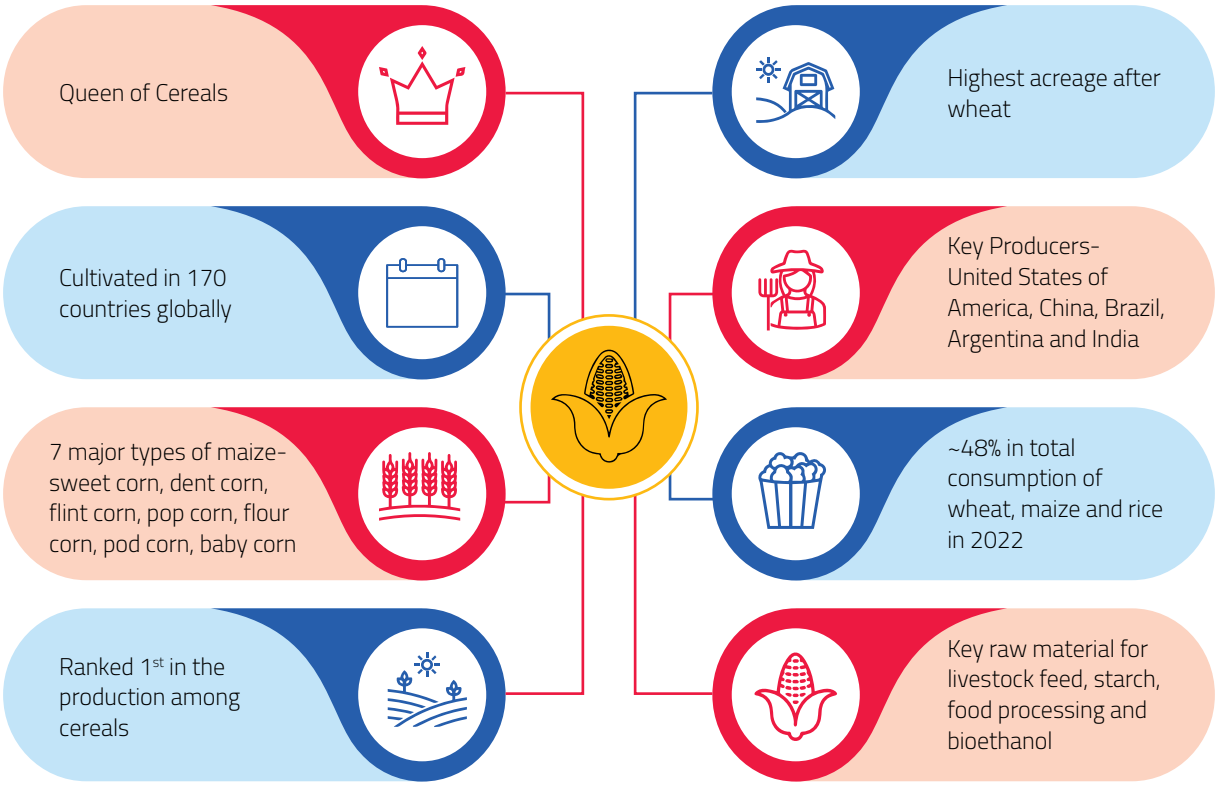


02

# Global scenario

Globally, maize is grown across diverse seasons and ecologies, indicating its exceptional geographic adaptability. Maize cultivation is distributed across the Americas, Asia, Europe, and Africa covering 170 countries[12]. It contributes to food security in most developing countries. In regions such as Latin America and Sub-Saharan Africa, which depend on maize as a key staple crop, it serves as an important source of carbohydrate, protein, iron, vitamin B, and minerals. In the year 2020, a third of the global farms were estimated to have cultivated maize (i.e., 216 million maize farms), with small farms (< 2 ha) predominately located in Asia, Africa, and South America[13]. In these regions, farmers often depend on maize for their food security and livelihoods. On the other hand, countries like the USA and Brazil, with large commercial mechanized maize producers, combine highly productive new maize genetics with intensive crop management. A snapshot of the global standing of maize is captured in Exhibit 3.

**Exhibit 3: Maize at a glance**




Source: FAOSTAT, YES BANK Analysis

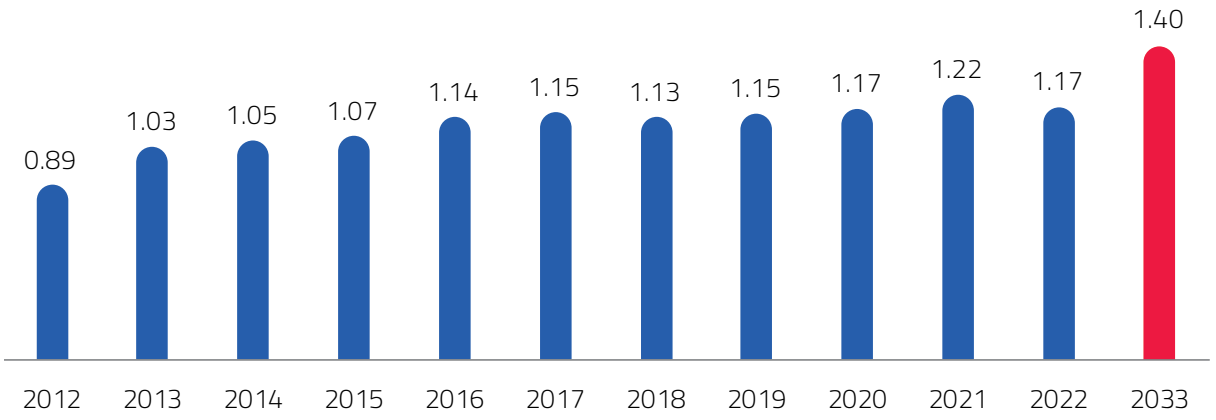
[12] FAOSTAT

[13] Erenstein, O., Jaleta, M., Sonder, K. et al. Global maize production, consumption and trade: trends and R&D implications. Food Sec. 14, 1295–1319 (2022)

## 2.1 Area, production & productivity

Global maize production has increased from 0.89 billion MT in 2012 to 1.17 billion MT in 2022 growing at a decadal CAGR of 2.9%. In the coming decade, a higher share of global maize production is expected to originate mainly from yield improvements owing to use of improved and more widely accessible high yielding seed varieties, enhanced input use efficiency and better agricultural practices. However, factors such as the impact of climate change on yields, constraint in area expansion for maize cultivation and a lack of investment on new technologies could constraint maize output growth. Considering these factors maize production is expected to grow at a CAGR of 1.63% during 2022-2033 to reach 1.40 billion MT by 2033[14] (refer Exhibit 4).

**Exhibit 4: Global maize production trends (in billion MT)**



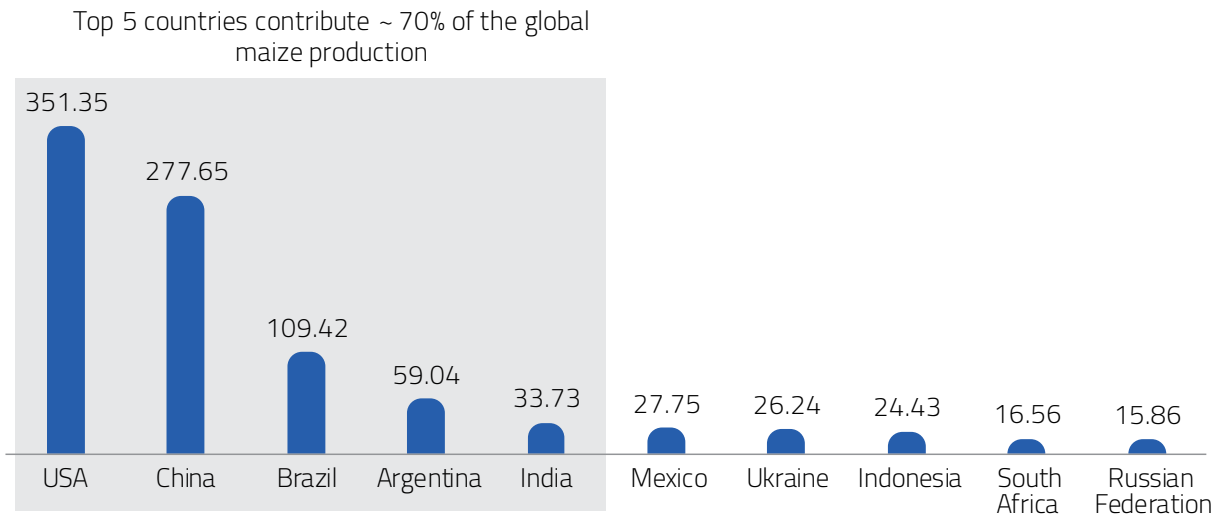

Source: FAOSTAT, OECD-FAO Agricultural Outlook 2024-2033, YES BANK Analysis

In 2022, USA was the largest producer of maize, contributing about 30% of global production, followed by China (24%), Brazil (9%), Argentina (5%), and India (3%). Together, these countries contributed nearly 70% of global maize production (refer Exhibit 5)[15]. Over the next decade, the top countries will continue to retain their position in global maize production with the largest increases in the United States and China, followed by Brazil, Argentina, and India.[16] Together, USA, China and Brazil are expected to account for more than half of the production increase over the next decade. Increased production in Brazil is projected to be largely driven by higher second-cropped maize following the soybean harvest. Production growth in the United States is projected to be below the global average of 1.2% p.a., at 0.6% p.a. over the next ten years. In Sub-Saharan Africa, total maize output is projected to increase by 28 MT, of which white maize is projected to account for the largest share[17].



[14] OECD-FAO Agricultural Outlook 2024-2033, YES BANK Analysis
[15] FAOSTAT, YES BANK Analysis
[16] OECD-FAO Agricultural Outlook 2024-2033, YES BANK Analysis
[17] FAOSTAT, OECD-FAO Agricultural Outlook 2024-2033

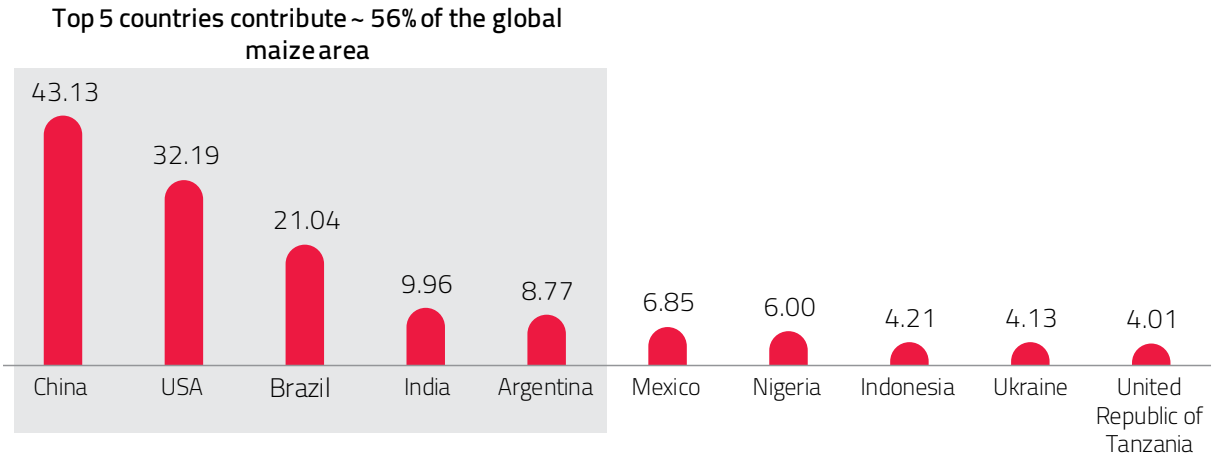
## Exhibit 5: Top 10 maize producers (in million MT) – 2022




Source: FAOSTAT, YES BANK Analysis

In terms of area, maize cultivation has increased from 181.5 million Ha in 2012 to 204.6 million Ha in 2022[18], growing at a decadal CAGR of 1.20%[19]. Five countries, namely, China (21%), USA (16%), Brazil (10%), India (4%), and Argentina (4%) account for approximately 56% of global maize acreage (refer Exhibit 6). Globally, more than two-thirds of the maize area is planted with conventional improved maize (i.e., not genetically modified). Since the mid-1990s, there has been an increased use of maize seed with biotechnological traits (e.g., insect resistance and herbicide tolerance) and associated agronomic practices to both increase maize yield potential and reduce yield loss to pest and environmental stress. Maize is now the second most widely grown GM crop globally (after soybean), with about 31% of cultivated area under GM.[20]

## Exhibit 6: Area under maize cultivation in million Ha (top 10 countries) - 2022




Source: FAOSTAT, YES BANK Analysis

[18] FAOSTAT, YES BANK Analysis
[19] FAOSTAT, YES BANK Analysis
[20] Erenstein, O., Jaleta, M., Sonder, K. et al. Global maize production, consumption and trade: trends and R&D implications. Food Sec. 14, 1295–1319 (2022))

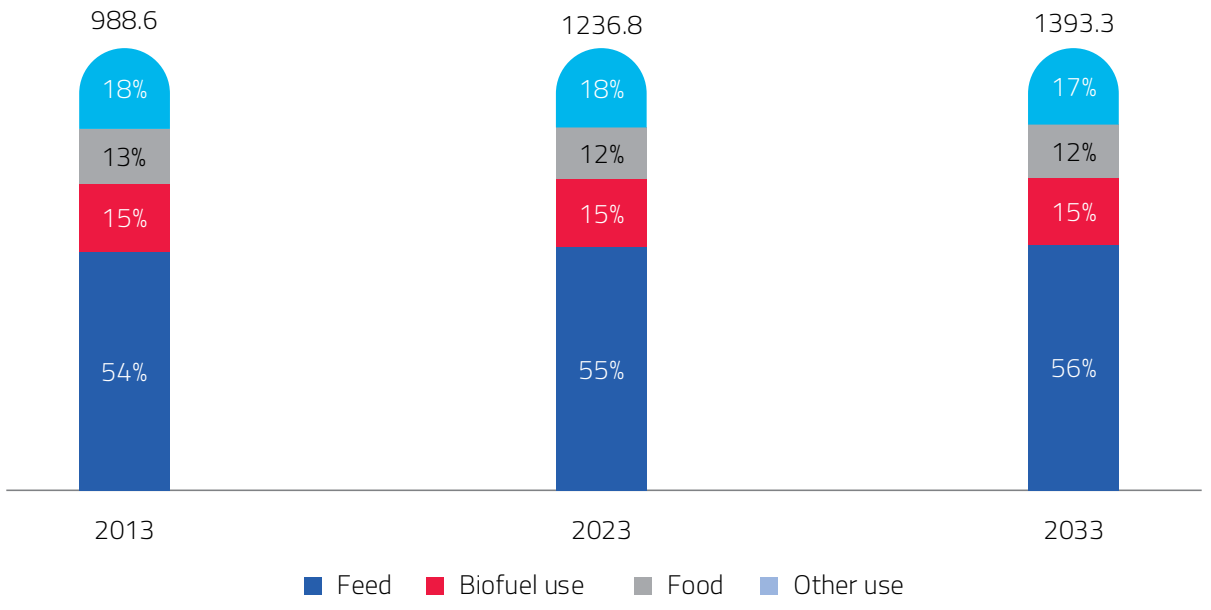
Over the last decade, global average productivity has grown from 4.9 MT/Ha (2012) to 5.7 MT/Ha (2022) at a CAGR of 1.6%. In 2022, among the top ten maize producing countries, the highest yields were recorded in the USA, with average productivity of 10.9 MT/Ha followed by Argentina at 6.7 MT/Ha. In 2022, India's maize productivity stood at 3.4 MT/Ha.[21]

## 2.2 Consumption

Global consumption of maize has grown at a CAGR of 2.3% over a period of 10 years, increasing from 988.6 million MT in 2013 to 1,236.8 million MT in 2023. Of total maize consumption, about 55% was used as animal feed, 15% for biofuel, 12% for food consumption and remaining 18% for other industrial uses (refer Exhibit 7).

Maize is consumed in over 180 countries and is the third most consumed cereal as human food after rice and wheat (both direct and processed or unprocessed). Global human food consumption of maize stood at 17.1 kg per capita per year, contributing to about 10% of the global average annual cereal consumption (of 177.4 kg/capita/year)[22]. The use of maize as food is markedly more common in low and lower-middle income countries (43% of production), touching 54% of production in Africa and 66% of production in eastern and southern Africa (66%)[23].

**Exhibit 7: Global trends in offtake of maize (in million MT)**




Source: OECD-FAO Agricultural Outlook 2024-2033, YES BANK Analysis

Global consumption of maize is projected to increase by 1.2% p.a. to 1.39 billion MT in 2033, driven mainly by higher demand for animal feed (refer Exhibit 7). Feed demand globally is expected to rise mainly in China, the United States, Brazil, Argentina, Mexico, India, Viet Nam, Indonesia, and Egypt. Asian countries are projected to account for 56% of the increase in feed consumption (nearly half of this in China) due to their rapidly expanding livestock sectors. The use of maize as food is expected to increase

[21] FAOSTAT
[22] FAOSTAT, for 2022, excluding beer.
[23] Erenstein, O., Jaleta, M., Sonder, K. et al. Global maize production, consumption and trade: trends and R&D implications. Food Sec. 14, 1295–1319 (2022)

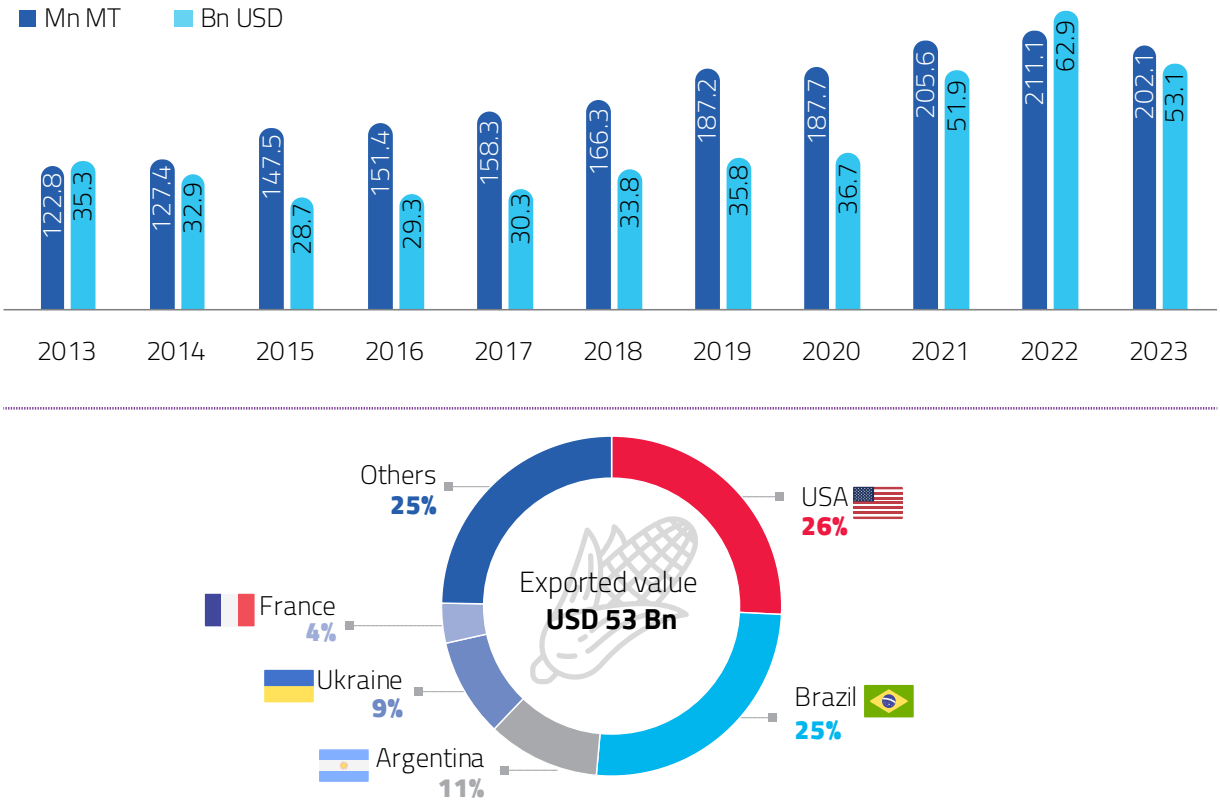
primarily in Sub-Saharan Africa where population growth is strong. Maize consumption as food in African countries is projected to grow at about 2.5% per annum[24]. Growth of maize for biofuel production is expected to be limited, as current biofuel related policies may not support further expansion from major producers.

## 2.3 Trade scenario

Maize is the most widely traded cereal in volume terms, with 16.2% of global maize production being exported (in 2023), up from 11.7% a decade earlier[25]. Global exports grew at a decadal CAGR (2013-2023) of 5.1%, increasing from 122.8 million MT in 2013 to 202.1 million MT in 2023 (refer Exhibit 8). In 2023, in volume terms, Brazil was the largest maize exporter, followed by the USA, Ukraine and Argentina. Collectively, these top maize exporting countries contributed to about 75% of total global maize exports.

In terms of value, maize export increased from USD 35.3 billion in 2013 to USD 53.1 billion in 2023, at a CAGR of 4.2% over the last decade. Major share of exports was contributed by the USA (USD 13.7 billion), followed by Brazil (USD 13.6 billion), Argentina (USD 5.7 billion), Ukraine (USD 5.0 billion) and France (USD 2.0 billion). Together, these countries accounted for approximately 75% of the global maize export basket (refer Exhibit 8).

**Exhibit 8: Global maize export trend and key exporters**

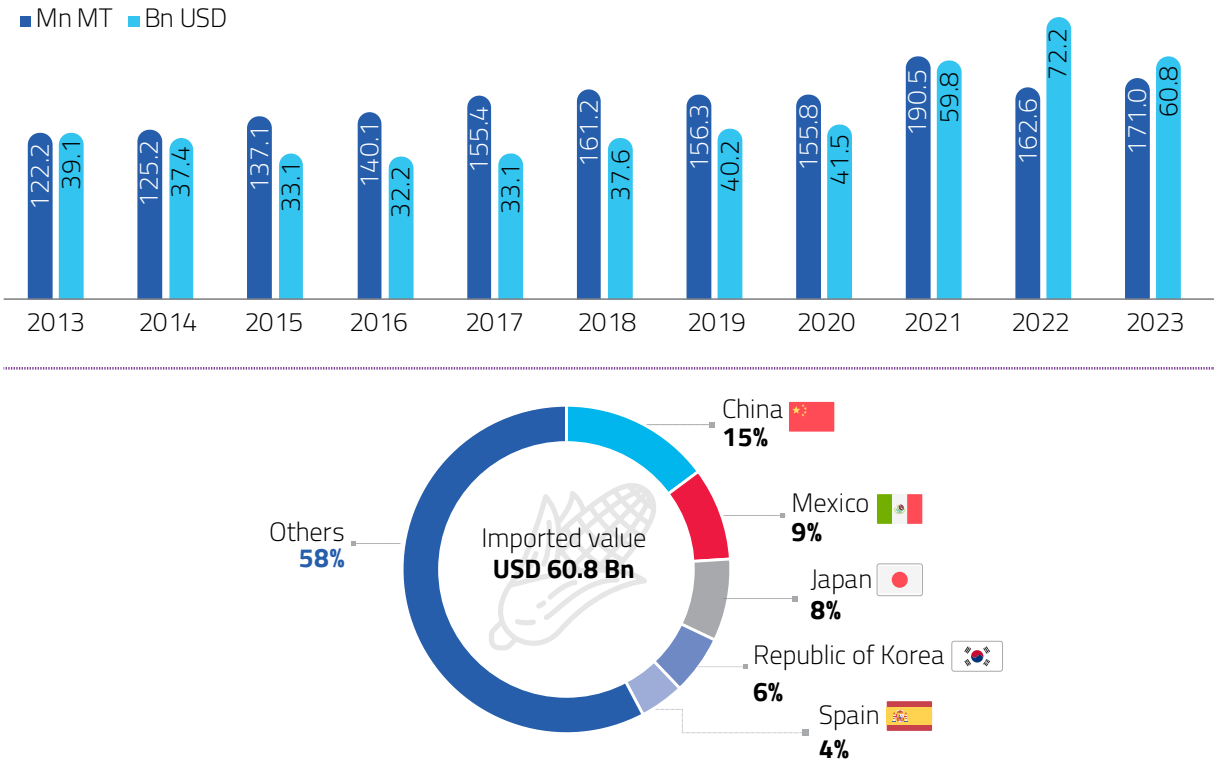



Source: ITC Trade Map (Maize or corn, HS Code:1005), YES BANK Analysis

[24] OECD-FAO Agricultural Outlook 2024-2033
[25] OECD-FAO Agricultural Outlook 2024-2033, ITC Trade Map and YES BANK Analysis

The global imported volume of maize increased to 171.0 million MT in 2023 from 122.2 million MT in 2013, growing at a CAGR of 3% over the years. The imported value of maize grew at a CAGR of 5% during 2013-2023, increasing from USD 39.1 billion in 2013 to USD 60.8 billion in 2023. The top 5 importers by value in 2023 were China, followed by Mexico, Japan, the Republic of Korea (South Korea) and Spain (refer Exhibit 9). These countries accounted for about 42% of global maize imports.

**Exhibit 9: Global maize import trend and key importers**




Source: ITC Trade Map (Maize or corn, HS Code:1005), YES BANK Analysis

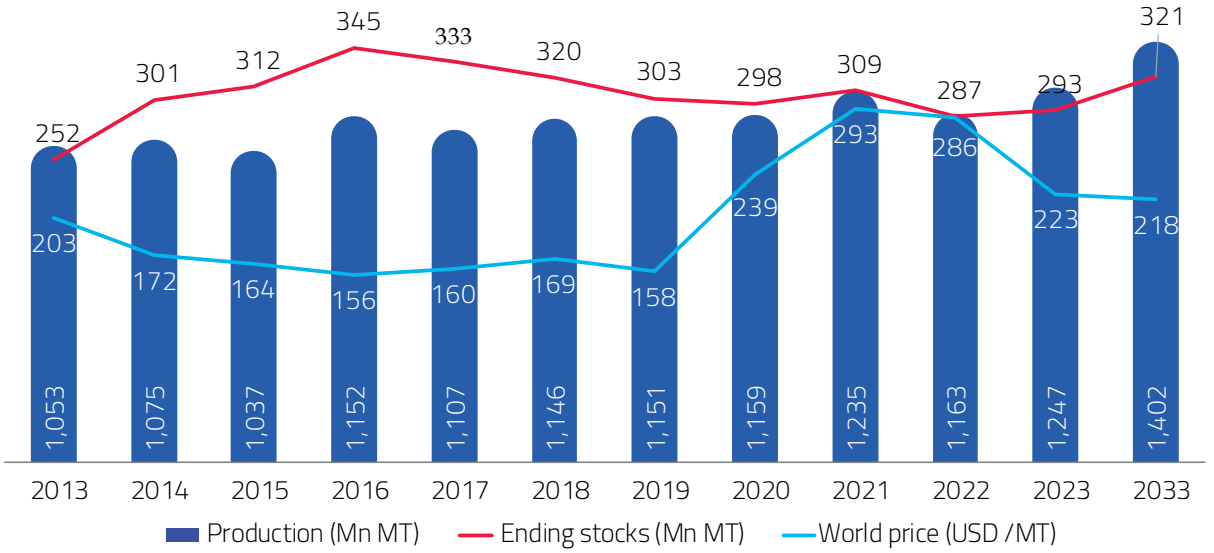
## 2.4 Stock and price trends

In 2023, maize prices reached their lowest values since 2021 to USD 223 per MT. Ample supplies of maize from Brazil and strong competition among exporters underpinned the downward trend in world maize prices. Reduced uncertainty as a result of continued shipments from Ukraine by alternative routes, along with lower energy and input prices also contributed to the overall softer market sentiment[26]. In the coming decade, maize is expected to return to its medium-term path with global maize price expected to reach USD 218 per MT in 2033[27] (refer Exhibit 10).

Global maize stock move in tandem with production i.e., with increase in production ending stock also increases. With higher production estimates for the EU and India global maize ending stock is projected to increase from 293 million MT in 2023 to about 321 million MT in 2033[28] (refer Exhibit 10).

[26] OECD-FAO Agricultural Outlook 2024-2033
[27] OECD-FAO Agricultural Outlook 2024-2033
[28] OECD-FAO Agricultural Outlook 2024-2033

## Exhibit 10: Movement of global maize stock and price vis-à-vis production




Source: OECD-FAO Agricultural Outlook 2024-2033; World price for US Maize, No.2 Yellow variety





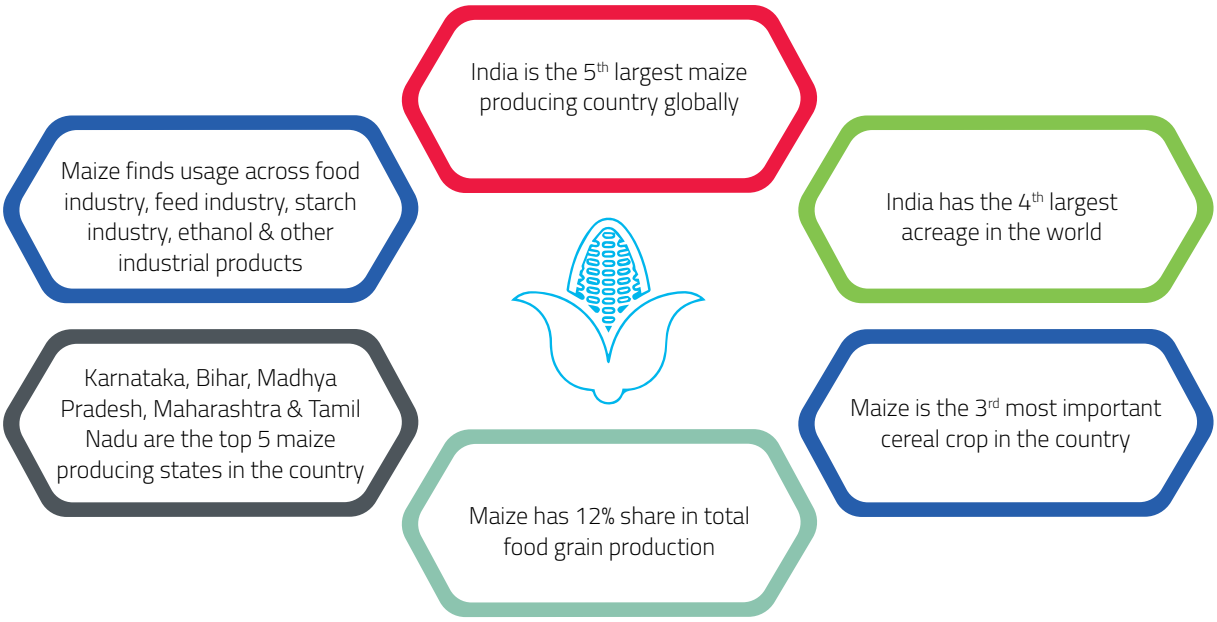


03

# Maize scenario in India

India's ranking in global maize production has improved significantly over the past 5 years, driven by strategic efforts of key stakeholders to meet the increasing demand. In 2022, India ranked 4th in global maize acreage and 5th in global production, contributing to about 4.9% of acreage and 2.9% of production respectively[29]. Maize is the 3rd most important food grain in our country (after rice and wheat). Domestic maize production has nearly quadrupled from less than 10 million MT in the mid-1990s to about 38 million MT in 2022-23. Notably, only 29% of this crop is cultivated under irrigated conditions, compared to 95% of wheat and 68% of rice respectively[30]. This indicates that maize has the potential to generate better farmer income mainly for resource poor farmers who are vulnerable to vagaries of monsoon. It also reflects the crop's intrinsic ability to adapt to varied agro-climatic conditions. Some key facts about maize in India are presented in the Exhibit 11.

**Exhibit 11: Key facts about maize in India (reference year 2022)**




Source: FAOSTAT, Department of Agriculture and Farmers Welfare, GOI, YES BANK Analysis

Maize is also the fastest growing cereal crop in India in terms of area, production, and productivity. Between 2012-13 and 2022-23, while the acreage, production and yield of maize have grown at a CAGR of 2.16%, 5.52% and 3.28%, respectively, those of food grains have grown at 0.91%, 2.52% and 1.59% respectively (refer Exhibit 12). This performance in maize crop has been driven by three key

[29] FAOSTAT, YES BANK Analysis
[30] https://desagri.gov.in/, YES BANK Analysis

factors namely (a) Strong support from the Government for crop diversification and Minimum Support Price for farmers (b) Strong growth in demand from Poultry Feed and Starch Industry and (c) Significant improvement in adoption of HYV seeds resulting in increased productivity.

**Exhibit 12: Comparative assessment of area, production, and productivity trends**

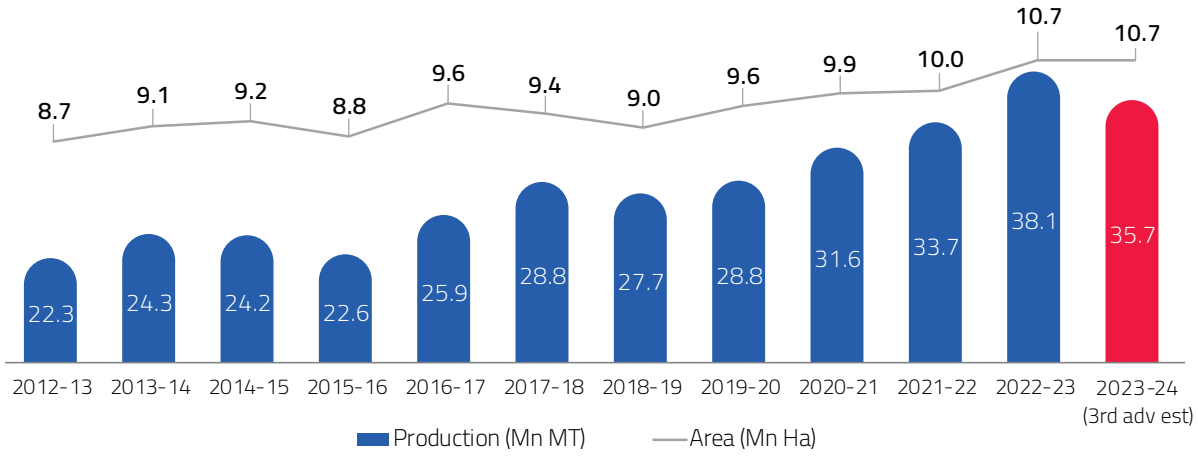
| Crop | 2022-23 | | | 10 year CAGR (%) | | |
|---|---|---|---|---|---|---|
| | Area (Mn Ha) | Production (Mn MT) | Yield (MT/ Ha) | Area (Mn Ha) | Production (Mn MT) | Yield (MT/ Ha) |
| Rice | 47.83 | 135.76 | 2.84 | 1.1% | 2.6% | 1.4% |
| Wheat | 31.40 | 110.55 | 3.52 | 0.5% | 1.7% | 1.2% |
| **Maize** | **10.74** | **38.09** | **3.54** | **2.2%** | **5.5%** | **3.3%** |
| Barley | 0.63 | 1.91 | 3.05 | -1.0% | 0.9% | 1.9% |
| Jowar | 3.54 | 3.81 | 1.08 | -5.5% | -3.2% | 2.4% |
| Bajra | 7.57 | 11.43 | 1.51 | 0.4% | 2.7% | 2.3% |
| Ragi | 1.16 | 1.69 | 1.45 | 0.3% | 0.7% | 0.4% |
| All cereals | 103.30 | 303.63 | 2.94 | 0.6% | 2.4% | 1.8% |
| All Pulses | 28.90 | 26.06 | 0.90 | 2.2% | 3.6% | 1.3% |
| **All food grains** | **132.20** | **329.69** | **2.49** | **0.9%** | **2.5%** | **1.6%** |

Source: Directorate of Economics & Statistics, Ministry of Agriculture & Farmers Welfare, YES BANK Analysis

## 3.1 Area, production & productivity

In the year 2022-23, maize was cultivated across 10.74 million Ha in India, with national production reaching 38.1 million MT. Over the period from 2012-13 to 2022-23, production increased from 22.3 million MT to 38.1 million MT at a CAGR of 5.5%, while acreage under cultivation grew by only 2.2%. This indicates that the increase in production has primarily resulted from better productivity rather than acreage expansion. Exhibit 13 highlights trends in the area and production of maize in India from 2012-13 to 2023-24.

**Exhibit 13: Decadal trends in area and production of maize in India**




Source: Department of Agriculture and Farmers' Welfare, GOI (https://agriwelfare.gov.in/en/AgricultureEstimates)

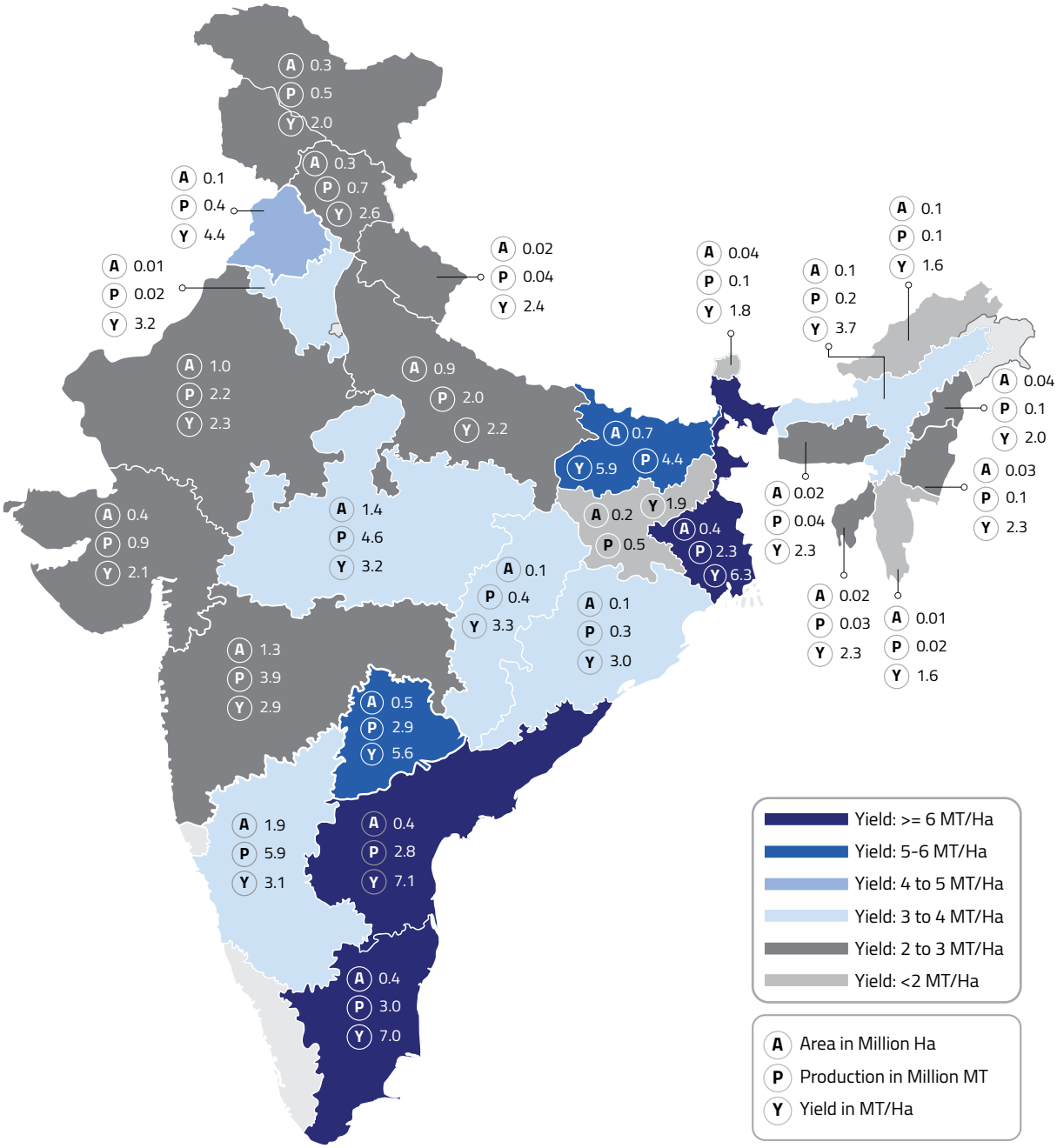
The final estimates for area, production, and productivity of maize for 2023-24 is yet to be released by the Department of Agriculture and Farmers' Welfare, GOI. As per the third advance estimates, maize production in 2023-24 was estimated at 35.7 million MT which is 6% lower than the production in 2022-23. Maize production was impacted adversely due to weaker monsoons in India owing to El Nino effect. However, in current year (2024-25), encouraged by the increased maize price (due to diversion of maize for ethanol production) farmers have expanded the maize acreage during the kharif season. As of 30th August 2024, maize acreage had increased by 5.3% compared to the same period last year[31].



Maize is currently grown across 27 states in India, with the top five maize producing states being Karnataka (16%), Bihar (12%), Madhya Pradesh (12%), Maharashtra (10%), and Tamil Nadu (8%). Together, these states contribute to more than half of the total country's total maize production. According to maize production and area statistics for the year 2022-23 released by Department of Agriculture and Farmers' Welfare, GOI, maize productivity across various states ranged from 1.6 MT/Ha to 7.1 MT/Ha, with the lowest productivity in Arunachal Pradesh and highest in Andhra Pradesh. Out of the 27 maize growing states of India, 22% have productivity more than 4.0 MT/Ha; 19% have productivity between 3.0 to 4.0 MT/Ha and 59% have productivity below 3.0 MT/Ha (refer Exhibit 14).

[31] https://www.deccanherald.com/opinion/for-india-is-there-light-at-the-end-of-this-maize-3187433

## Exhibit 14 : State wise overview of maize acreage, production & productivity in India (2022-23)

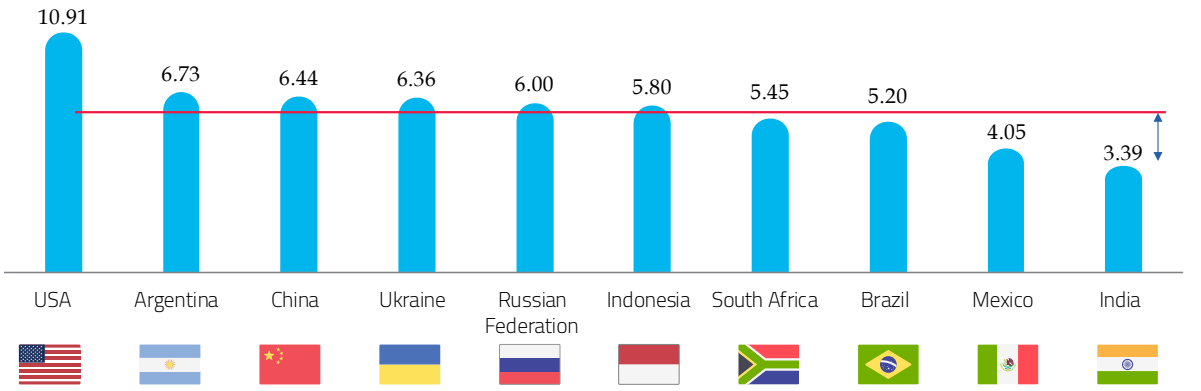



Source: https://upag.gov.in/, YES BANK Analysis

Average productivity in India has increased from 2.6 MT/Ha to 3.5 MT/Ha[32] growing at a decadal CAGR of 3.3% (2012-13 to 2022-23). Use of high yielding variety seeds has played a significant role in boosting productivity. Since the early 1990s, many private seed companies have been focusing on developing High Yield Varieties (HYVs), primarily single cross hybrids that could replace traditional varieties and old hybrids. According to industry sources, hybrid maize, which is mostly feed and industrial grade corn, accounts for 60% or more of the planted area in India[33].

Although productivity is growing steadily, there is scope for further increase in maize yield to meet the rising demand. In 2022, the average global productivity of maize was 5.7 MT/Ha with highest productivity of 10.9 MT/Ha in the USA, followed by 6.7 MT/Ha in Argentina. The productivity of maize in India reached 3.4 MT/Ha during the same year (refer Exhibit 15).

**Exhibit 15: Productivity of maize across major producing countries (in 2022, MT/Ha)**




Source: FAOSTAT, YES BANK Analysis

In India, maize is principally grown in two seasons: rainy (kharif) and winter (rabi) with a minor production in summer season. Kharif accounted for 75% of the maize area followed by rabi with 20% area and summer with 5% area[34]. The average productivity of maize cultivated in kharif is 2.94 MT/ha while it is 5.36 MT/ha in rabi.[35]

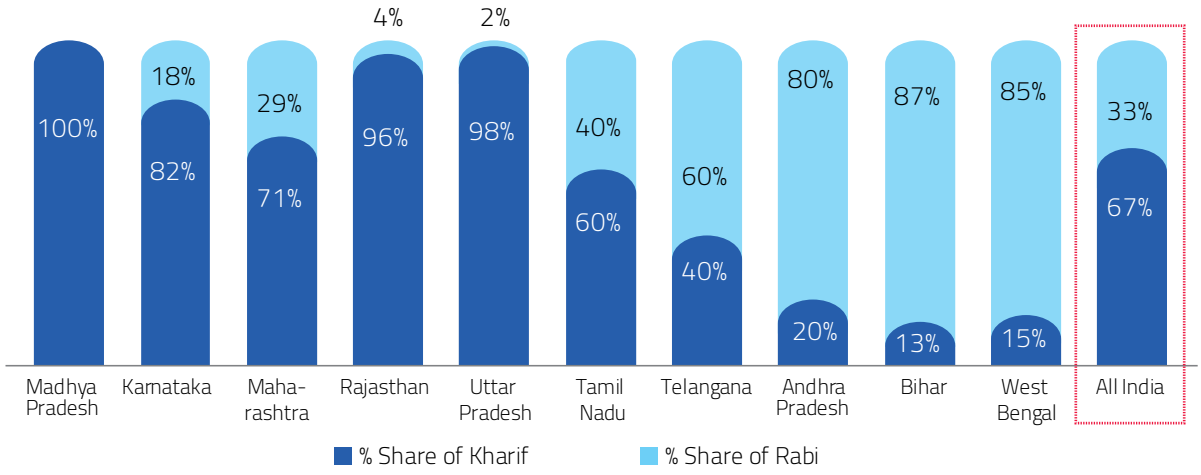
Kharif maize faces higher biotic and abiotic stress compared to rabi maize. The incidence of biotic stresses, such as insect-pest attack and diseases infections are also quite low in rabi compared to the kharif season.[36] In addition, other major contributing factors to high yield in rabi maize include better water management, mild and favorable temperatures, better response to macronutrients, lower incidence of diseases and insects/pests, and better weed management[37].

Maize cultivation is primarily taken during the kharif season in most states in India – including Madhya Pradesh, Rajasthan, Karnataka, and Maharashtra, among others. In contrast, the states of Bihar, Andhra Pradesh, Tamil Nadu, and Telangana contribute significantly to rabi production. Together, these four states contribute to about 68% of the rabi maize production in India. Individually, more than 85% of

[32] India's productivity in 2022 as per FAO is 3.4 MT/Ha. The difference is due to reporting done as per calendar year by FAO.
[33] Industry sources
[34] https://upag.gov.in/
[35] Ministry of Agriculture & Farmers Welfare
[36] Bhavya, & Dayal, Parmeswar & Anuragi, Kuldeep & Bharti, Shyama. (2023). Why does Rabi Maize Highest Productivity in Bihar?. 5. 374-376.
[37] Nirupma Singh, R.Ambika Rajendran, Meena Shekhar, S.L. Jat, Ramesh Kumar & R.Sai Kumar. Rabi Maize Opportunities Challenges, Directorate of Maize Research, Pusa Campus, New Delhi -110 012, Technical Bulletin, No. 9: 32 p

Bihar's maize production and approximately 80% of Andhra Pradesh's maize production occur in the rabi season (refer Exhibit 16).

**Exhibit 16: State wise % share of kharif vs rabi crop production in India (2022-23)**

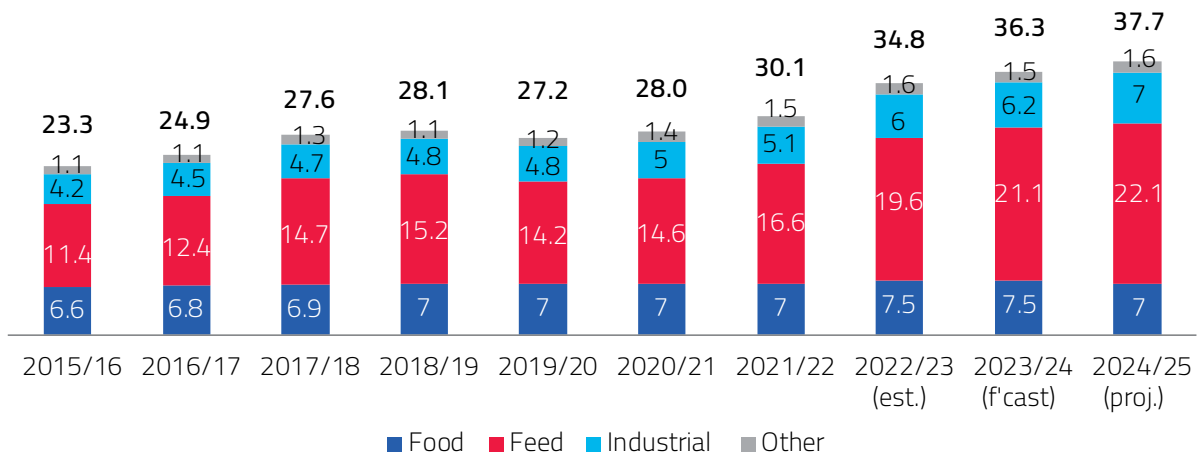



Source: International Grain Council (https://www.igc.int/en/markets/marketinfo-sd.aspx), YES BANK Analysis
Year - Nov/Oct

## 3.2 Consumption

International Grain Council (IGC) report reveals that about 34.8 million MT of maize was consumed in India in the year 2022/23. This is forecasted to reach 37.7 million MT in the year 2024/25. Over the last two decades, India's growing economy and expanding middle income consumers have been fueling demand for meat / animal protein (poultry and livestock sector) and clothing (starch sector). This, in turn, has been driving demand for maize crop in India. Exhibit 17 depicts the decadal trend of maize consumption in India.

**Exhibit 17: Decadal representation of maize consumption in India- All figures in million MT**

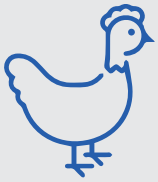
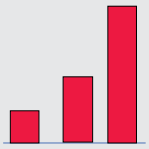
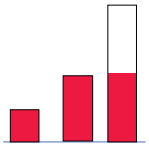


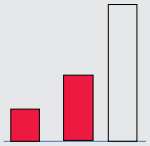
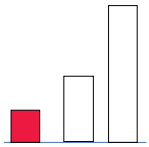
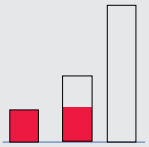

Source: International Grain Council (https://www.igc.int/en/markets/marketinfo-sd.aspx), YES BANK Analysis
Year - Nov/Oct

During 2015/16 to 2022/23, maize consumption grew at a CAGR of 5.9%, increasing from 23.3 million MT in 2015/16 to 34.8 million MT in 2022/23. Maize off-take by the feed industry grew fastest, at a CAGR of 8.8% followed by industrial segment (primarily starch), which grew at a CAGR of 6.2%. Off-take for food grew at a CAGR of 0.8%.

In the year 2022/23, around 56% of the total maize was consumed by the feed industry as compared to 22% for food. By 2024/25, the share of maize used in animal feed is expected to further increase to 59% chiefly due to increased meat consumption with increase in disposable incomes. The projected usage of maize for bio-fuel in India is still very insignificant as compared to feed and food but it might increase in tandem with positive government policy changes with respect to ethanol blending. An overview of the key trends in each of these sectors and their impact on maize demand is captured herewith.

**Exhibit 18: Overview of key trends in various sectors**

| Sector | Key characteristics and trends | Impact on maize demand |
|---|---|---|
|  **Feed Industry** | ◎ In animal feed formulations, maize leads to the highest conversion of dry matter to meat, milk, and eggs compared to other cereal grains.<br>◎ Due to its low protein and crude fiber content, maize is ideal for poultry.<br>◎ Maize constitutes about 63% of animal feed component.<br>◎ Feed production in India witnessed a growth rate of 13.4% from 2022 to 2023 reaching 52.8 million MT.<br>◎ The growing Indian economy and expanding middle income consumer base are driving demand for meat and animal protein derived from the poultry and livestock sector. |  High impact on maize demand |
|  **Starch** | ◎ Maize has about 60-65% starch content, making it a suitable raw material for starch processing.<br>◎ Maize starch and its derivatives have wide utility across various industries, including food, paper, pharmaceutical, textiles, cosmetics, adhesives, and bio-plastics.<br>◎ High value derivatives include corn glucose, corn oil, dextrose and sorbitol.<br>◎ The starch industry in India has a crushing capacity of approximately 6.5 million MT. It is expected to reach a volume of 8.5 million MT by 2026, with a CAGR of 9% from 2021 to 2026. |  Medium to high impact on maize demand |

| Sector | Key characteristics and trends | Impact on maize demand |
|---|---|---|
| **Processed Food** | ◎ Maize is a key ingredient for snacks which are baked or roasted. Demand for these snacks is increasing due to growing consumer health consciousness.<br>◎ The demand for food-grade maize for processed foods is estimated to be growing at double-digit rates due to its use in products such as cornflakes (as breakfast cereal and ready to eat savories), extruded snacks, traditional namkeen, popcorn and frozen sweetcorn.<br>◎ Frozen sweet corn and baby corn, which are niche varieties of corn, are also showing double digit growth due to their health benefits and exotic appeal. | <br>Medium impact on maize demand |
| **Food** | ◎ Maize is traditionally used for the preparation of maize flour which is used to prepare traditional dishes like "makki roti".<br>◎ The availability of rice and wheat through the public distribution system at low prices is leading to higher consumption of these cereals in place of maize. However, maize continues to hold a prominent position in the kitchens of traditional maize growing areas.<br>◎ The growing demand for coarse grain fortified or multigrain flour is expected to drive demand in urban areas. | <br>Low impact on maize demand |
| **Ethanol** | ◎ India's ethanol production capacity reached 13.8 billion liters per year as of November 2023.<br>◎ Due to the Ethanol Blended Petrol (EBP) Program, ethanol production may increase three to fivefold in the near future. The Government of India has set a target of achieving 20% ethanol blending by 2025-26.<br>◎ In 2020, the Government of India allowed the use of grains such as rice and maize for producing ethanol for fuel. Recently, the Government has announced an extension of subsidized credit to grain based distilleries to boost ethanol production for bio-fuel. | <br>Low to medium impact on maize demand |

| Sector | Key characteristics and trends | Impact on maize demand |
|---|---|---|
| **Fodder & Silage** | ◎ Stalks and shanks of maize can be used as fodder and feed. They can also be used in the preparation of silage for the lean season.<br>◎ The quality of maize fodder is considered better than that of sorghum and pearl millet, as the latter crops contain anti-nutritional components such as prussic acid (HCN) and oxalate, respectively.<br>◎ Silage maize (with a crop duration of 80 days) is considered a good option for addressing fodder shortages. The current market size for silage maize is estimated to be about 5 million MT (with approximately 1 million Ha under fodder cultivation).<br>◎ With the dairy sector growing at about 6%, and the increasing shortage of fodder, the demand for silage maize is expected to rise. | Medium impact on maize demand |

Source: Alltech Agri-Food Outlook, 2024; Report on Boosting Growth of India's Maize Ecosystem: Key Imperatives, 2021; USDA Gain-Biofuels Annual Report 2024 (for India); Indian Petroleum & Natural Gas Statistics 2021-22; https://krishi.icar.gov.in; https://pib.gov.in; YES BANK Analysis

## Maize requirement characteristics for key end use sectors



Maize has a great processing potential and can be used as input for various food and non-food processing industries. Maize requirement of key end use sectors including feed, starch, food, and ethanol depend on multiple characteristics such as grain size, moisture content, hardness of grain, fungal or aflatoxin presence. Procurement of right quality of maize meeting the industry requirement is critical for a good quality product.

Maize requirement characteristics and their importance for key end use sectors is provided in the Exhibit 19. All listed characteristics are most important for food sector and least important for ethanol production. Moisture content of 12-13% is required for feed/starch production as higher moisture content will lead to fungal and aflatoxin contamination on storage.

**Exhibit 19: Maize requirement characteristics for key end use sectors**

| Key Characteristics / Importance | Feed | Starch | Food | Ethanol |
|---|---|---|---|---|
| Large grain size |  |  |  |  |
| Low moisture content |  |  |  |  |
| Low to no Aflatoxin content |  |  |  |  |
| Hardness of corn |  |  |  |  |

Source: Industry sources, YES BANK Analysis

## 3.3 Trade scenario

India's maize exports have remained inconsistent over the years due to changing production and consumption patterns, high domestic prices, low crop yields and fluctuations in international demand. In the last decade (2013-2023), maize exports fluctuated from 4.75 million MT in 2013 to 2.31 million MT in 2023 with dips and peaks of exports in between.

Maize exports drastically declined after 2013 until 2019 as improved supplies from other competing countries, such as North and South America, led to lower export prices in the global market, weakening demand for Indian maize. Additionally, higher domestic prices (due to changes in the Minimum Support Price (MSP)) -with Indian maize priced about 20%[38] higher than the international maize - and increasing domestic demand from the poultry industry were significant factors contributing to the sharp decline in maize exports from India during 2014-2019.

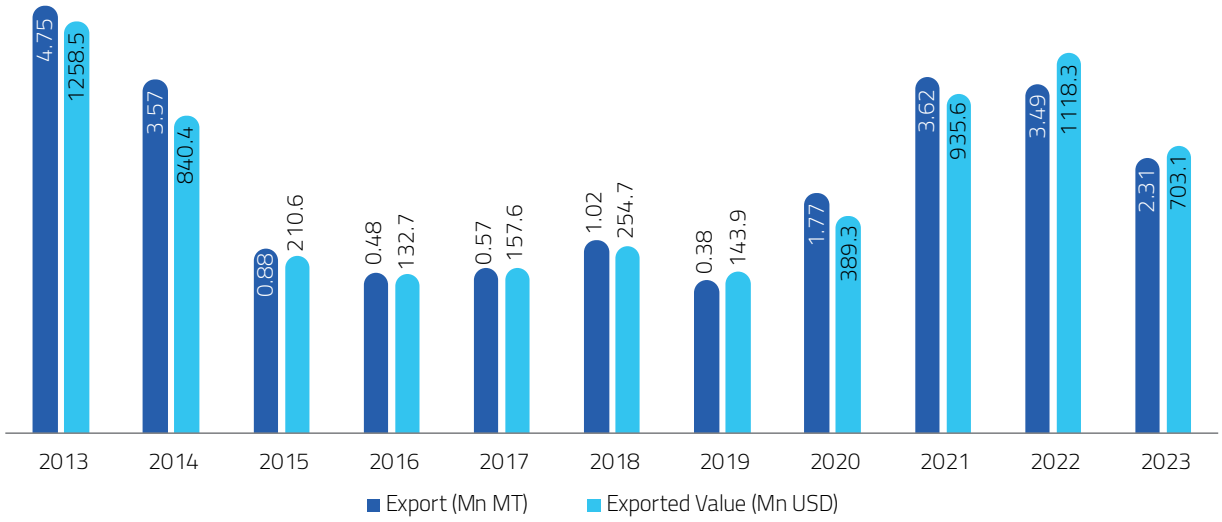
From 2019 to 2022, there was a significant increase in maize exports. This rise was driven by increased domestic production, exploration of new markets, and improved export competitiveness of Indian maize (sourcing non-GMO) in neighboring countries. Maize export volumes to countries like Thailand and Bhutan increased in 2020. Exports to destinations such as Vietnam (which emerged as a major destination for maize), and Bangladesh also picked up in 2020. Additionally, supply disruptions from Ukraine and Russia due to the ongoing turmoil in the Black Sea region positively impacted Indian maize exports.

In 2023, the maize exports dropped to 2.31 million MT valued at USD 703.1 million due to rising domestic prices and strong demand from the poultry and ethanol industry. Domestic demand for maize surged after the government increased the procurement price of ethanol made from maize by 8.8% to INR 71.86 per liter[39].

Vietnam (48%), Bangladesh (24%), Nepal (4%), Malaysia (4%), and Thailand (1%) were the top 5 countries to which India exported approximately 93% of its maize in 2023 (refer Exhibit 20).

[38] FICCI-NCDEX report – India Maize Summit'15
[39] https://www.reuters.com/markets/commodities/indias-corn-exports-plunge-local-prices-rally-strong-demand-2024-01-18/

## Exhibit 20: India's maize exports scenario




| Importers | Value in Mn USD (2023) | % of Export |
|---|---|---|
| Viet Nam | 339 | 48 |
| Bangladesh | 171 | 24 |
| Nepal | 102 | 4 |
| Malaysia | 31 | 4 |
| Thailand | 10 | 1 |

Source: ITC Trade Map, YES BANK Analysis

India imported USD 11.8 million worth of maize in 2013, which has fluctuated over the years reaching a peak value of USD 76.5 million in 2019 and then subsequently decreasing to USD 8.0 million in 2023. The top 5 supplying markets for maize imported by India in 2023 were South Africa (74%), the United States of America (15%), Argentina (6%) and Brazil (3%). Together, these countries accounted for approximately 98% of the total maize imported by India in 2023.

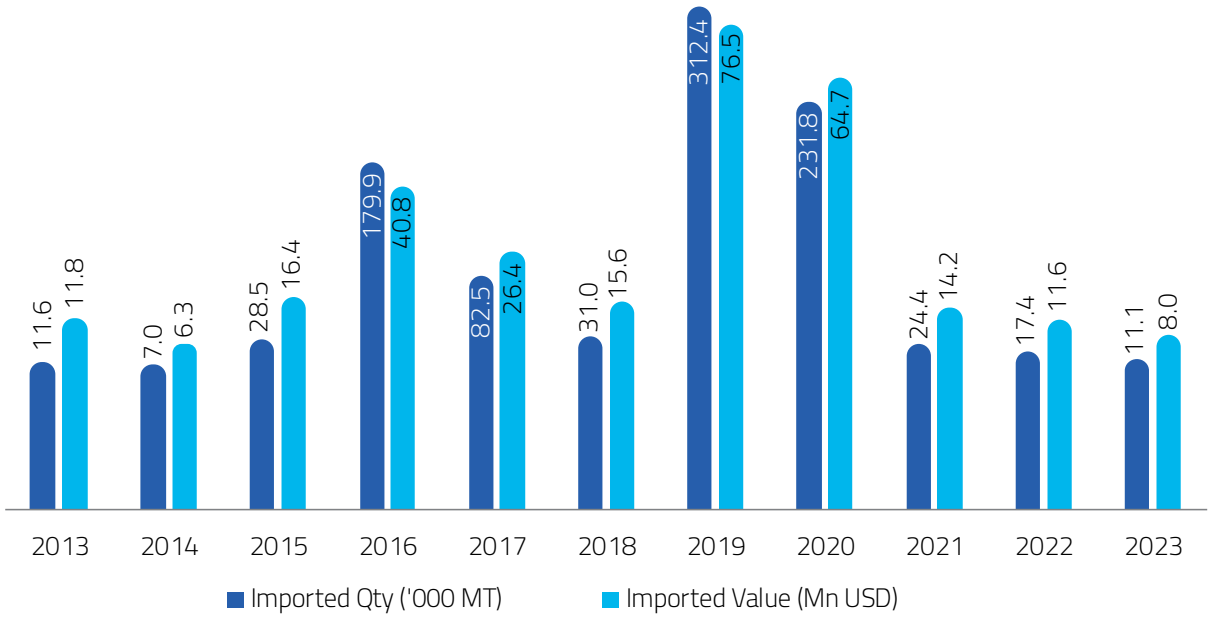
From an import perspective, the source of origin of maize imported into India is restricted to prevent the entry of genetically modified produce[40]. Maize imports also attract a 15% import duty under the Tariff Rate Quota (TRQ) and a 50% duty outside of the TRQ[41]. These factors restricted the entry of major maize producers which are using GM maize for cultivation.

[40] As per the notification released by the Food Safety and Standards Authority of India (FSSAI) dated 21 August 2020, every consignment of imported food products must be accompanied by a non-GM origin cum GM free certificate to ensure that only non-GM food crops are imported into India.

[41] https://apeda.gov.in/apedawebsite/DGFT_Tradenotice/Trade_notice_no._25_dated_09.07.2019.pdf

However, due to increasing industrial demand and the fact that there are long periods of non-availability during a year due to seasonality, the Government provides import quota for select industries (such as poultry and starch) on an ad hoc basis. Industry specific imports of maize are done under the advance license system which allows industries to import maize duty-free but requires them to export about 1.8 times[42] the value of imports post-value addition.

**Exhibit 21: India's maize imports scenario**




| Exporters | Value in Mn USD (2023) | % of Import |
|---|---|---|
| South Africa | 5.9 | 74 |
| USA | 1.2 | 15 |
| Argentina | 0.5 | 6 |
| Brazil | 0.2 | 3 |

Source: ITC Trade Map, YES BANK Analysis

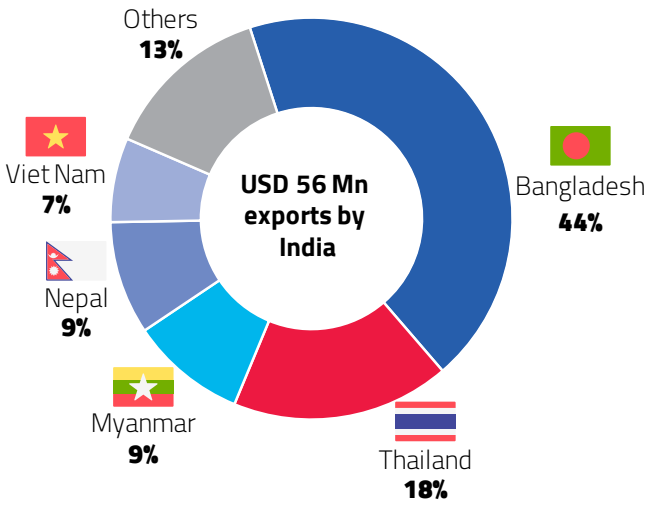
### 3.3.1 Maize seed trade

In 2023, India exported USD 56.5 million worth of maize seed. Exports of maize seed have been steadily increasing since 2013 (USD 29.2 million), growing at a CAGR of 7%. The top 5 importing countries of Indian maize seed in 2023 were Bangladesh (44%), Thailand (18%), Myanmar (9%), Nepal (9%), and Vietnam (7%). These countries collectively accounted for 86% of India's maize seed exports (refer Exhibit 22). India also imports maize seeds, but the value is very insignificant as compared exports.

[42] FICCI-YES BANK Report on Boosting Growth of India's Maize Ecosystem: Key Imperatives, 2021

As the maize seed trade is growing across the globe, there is ample opportunity for India to tap this market to increase its share in the global maize seed trade.

**Exhibit 22: Maize seed exports by India in 2023 (in terms of value)**

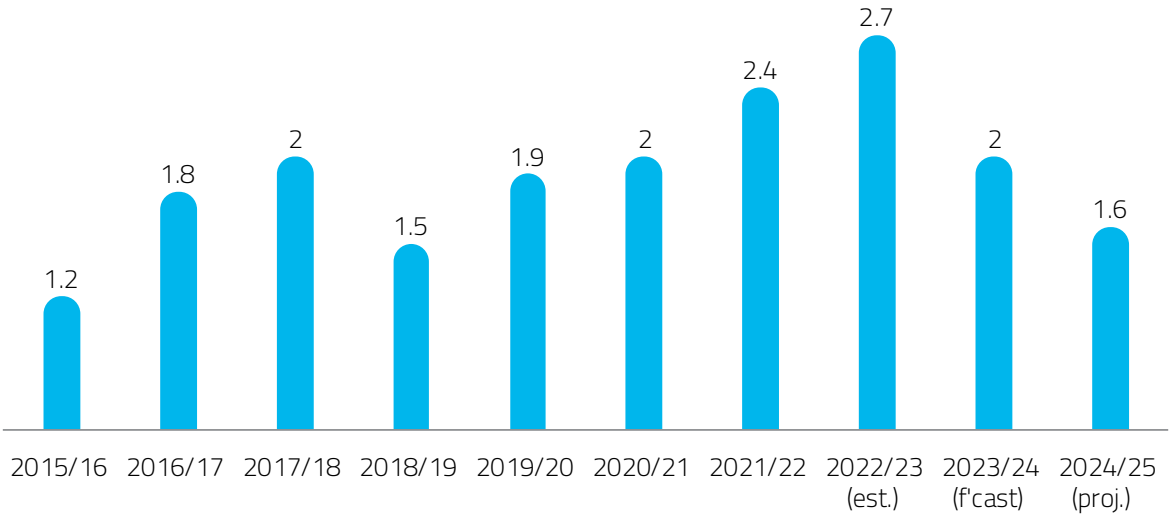



Source: ITC Trade Map, YES BANK Analysis

## 3.4 Stock and price trends

In India, the expected ending stocks of maize for 2023/24 is forecasted to be about 2 million MT, a decrease of 26% from the previous year. This decrease is largely attributed to higher domestic consumption and a dip in production as well as imports. It is projected to further reduce to 1.6 million MT in 2024/25.

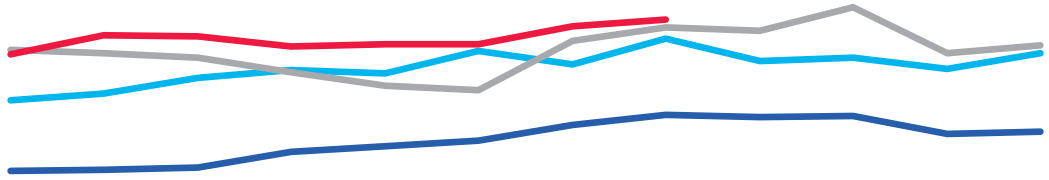
**Exhibit 23: Maize ending stocks movement in India (in million MT)**




Source: https://www.igc.int/en/markets/marketinfo-sd.aspx
Year – Nov/Oct

Over the past three years, maize prices in the country have experienced considerable growth, rising by 35% from INR 17,755 per MT in August 2021 to INR 23,908 per MT in August 2023. Maize prices have further grown by 3% to touch INR 24,513 per MT in August 2024 (refer Exhibit 24 below). The domestic price movement is influenced by various factors including demand, production, available stocks, weather conditions, input prices and international trade.

**Exhibit 24: Overview of maize commodity price movement in India from 2021 to August, 2024 (in INR/MT)**



| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2021 | 13,780 | 13,822 | 13,986 | 15,097 | 15,546 | 15,886 | 17,050 | 17,755 | 17,575 | 17,633 | 16,405 | 16,537 |
| 2022 | 18,795 | 19,223 | 20,361 | 20,950 | 20,655 | 22,306 | 21,296 | 23,107 | 21,532 | 21,771 | 20,989 | 22,142 |
| 2023 | 22,314 | 22,105 | 21,799 | 20,731 | 19,845 | 19,526 | 22,982 | 23,908 | 23,667 | 25,368 | 22,081 | 22,653 |
| 2024 | 22,059 | 23,373 | 23,343 | 22,567 | 22,773 | 22,771 | 24,018 | 24,513 | | | | |

2021 2022 2023 2024

Source: Agmarknet, YES BANK Analysis



04

# Growth drivers and challenges

## 4.1 Factors driving growth of maize ecosystem

As India's economy continues to grow, the demand for maize is expected to rise, driven by increasing demand from the poultry and livestock sectors as well as growing industrial uses such as ethanol production, which is expected to reach 6.35 billion liters by 2024[43]. The key factors that are driving growth of the maize ecosystem are provided in the Exhibit 25 below.

**Exhibit 25: Key factors driving growth of Indian maize ecosystem**

**Intrinsic characteristics of Maize**

- Adaptable to varied agro-climatic conditions
- Generates higher farmer income than other coarse grains
- Requires less water than rice and wheat – hence good for crop diversification
- Suitable for genetic and molecular engineering to meet human needs
- Diverse end-use of applications (such as feed, starch, food processing, bio-fuel)

**Production and supply strengths**

- Availability of varied agro-climatic conditions to grow different varieties
- Improved productivity due to the introduction and better adoption of high-yielding varieties
- Better farmer access to factors of production (credit, quality plant protection chemicals)

**Evolving post -harvest supply chain**

- More efficient aggregation through the formation of cooperatives and FPOs
- Increased investment in bulk storage and trading infrastructure (including e-trading and e-marketing platforms)
- Enhanced adoption of modern storage techniques and monitoring systems

**Increasing consumption**

- Population growth resulting in higher food consumption
- Dietary shifts toward higher animal protein consumption, such as poultry and meat
- Increased demand for starch and it's derivatives for food processing, textiles, paper industry etc.
- Health consciousness driving demand for healthy snacks and breakfast cereals such as corn flakes and extruded snacks
- Energy security driving the use of maize for bio-fuel production

[43] USDA Biofuel Annual 2024

**Favorable policy environment**

- Numerous schemes aimed at doubling farmer income
- Promotion of maize as an alternative for crop diversification
- "Make in India'' focus promoting investment in the development of storage and processing infrastructure
- Aim to achieve 20% ethanol blending in petrol by 2025, which will also drive production of grain-based ethanol including maize

**Growing private sector participation across the supply chain**

- Farm inputs
- Contract farming
- Storage and logistics infrastructure
- E-markets and e-commerce platforms
- Growing agritech startups ecosystem to address specific challenges
- Growing investment in feed, starch and food processing

Source: Industry sources, YES BANK Analysis

## 4.2 Key challenges across the maize supply chain

With domestic demand projected to outpace production by 2030, Indian maize sector is under pressure to enhance productivity, efficiency, and sustainability. However, several key challenges, including inadequate irrigation facilities, limited access to quality farm inputs, vulnerability to climate change, farm price volatility and inefficient post-harvest supply chains continue to plague the sector. Addressing these challenges is crucial to unlock the full potential of India's maize sector and ensure a food-secure and prosperous future. An overview of key challenges identified in discussion with the industry across the maize supply chain is provided below.

### Challenges at farm level

- Low adoption of hybrid seeds, especially single cross hybrids

  While the area under hybrid seeds has increased over the years, only about 30% of the cultivated area is under Single Cross hybrids, compared to 100% in the USA and Argentina. In Madhya Pradesh, Rajasthan, Chhattisgarh, and Gujarat, where maize is primarily grown for food consumption, composite seeds, that have low genetic yield potential, are the most commonly used varieties. In 2022-23, productivity in Madhya Pradesh and Uttar Pradesh was 3.2 MT/Ha and 2.2 MT/Ha, respectively, compared to 7.0 MT/Ha in Tamil Nadu[44]. Moreover, the focus on developing HYV and providing extension services for maize grown for food purposes in traditional geographies is low.

- High dependency on rainfed cultivation

  About 70% of the maize crop is sown during the kharif season and is prone to the vagaries of the monsoon, which impact productivity. Technological advances, such as drought tolerant

[44] Department of Agriculture and Farmers Welfare, GOI (UPAJ Portal)

varieties and modern irrigation techniques, are yet to be widely popularized and adopted on large scale to significantly mitigate crop loss. Only about 29% of Indian maize acreage is irrigated, compared to 66.15% for total cereals & millets and 57.27% for total food grains[45].

- Inadequate plant health care and pest management

  Kharif crops are susceptible to infestation by weeds and insect pests. Recently, infestation of Fall Army Worm has caused significant damage in maize growing regions across the country. Poor pest management practices, including lack of seed treatment, are resulting in substantial losses due to pest attacks.

- Access to credit

  Un-availability of timely, adequate, and cost-effective credit to farmers is one of the most critical challenges for maize production. While the Government has implemented several initiatives to improve farmers' access to credit, the inability of small farmers to obtain credit for purchasing high quality seeds, fertilizers, and pesticides affects both the yield and quality of maize produced in the country.

- Low farm mechanization

  Currently, India's level of farm mechanization stands at 40% which is lower as compared to developed nations such as China (59.5%), Brazil (75%) and the USA (95%)[46]. Adoption of mechanization varies widely across states, with higher usage of combined harvester and planters in Bihar, Gujarat and Tamil Nadu compared to states such as Madhya Pradesh, Chhattisgarh and Odisha which largely depends on manual labor for these activities.

## Challenges in post-harvest handling and logistics

- Low farmer price realization due to poor quality management

  Poor post-harvest handling by farmers results in poor quality, such as high moisture content, high levels of foreign matter, impurities of animal origin, damaged grains, and pest infested or weevilled grains. After the harvesting process, maize requires drying for 10-15 days to reduce moisture levels to 13%-14%[47]. Most farmers practice sun drying, and improper drying results in higher moisture content as high as 18%, making the produce susceptible to fungal infection and high aflatoxin levels. For every 1.5% increase in moisture content above the required level, grain deterioration doubles[48]. These factors led to poor farm price realization and high wastage.

- Fragmentation resulting in poor aggregation and inefficient farmers' access to markets

  In India, maize farmers are predominantly small and marginal, with an average landholding of less than one hectare. As the maize quantity produced per farmer is low, small & marginal

[45] https://desagri.gov.in/
[46] Vemireddy, V., & Choudhary, A. (2021). A systematic review of labor-saving technologies: Implications for women in agriculture. Global Food Security, 29, 100541.
[47] Vitázek, Ivan & Vereš, Peter. (2013). Drying Rate of Grain Maize. Acta Technologica Agriculturae. 16. 10.2478/ata-2013-0008.
[48] https://www.fao.org/4/x0530e/X0530E05.htm

farmers depend on village level agents for aggregation and market access. The low scale of operations and thinly spread agricultural markets in certain states result in high intermediation and lower than potential price realization for farmers. While the Government is focused on developing FPOs to address this issue, their reach and effectiveness are still at a nascent stage. FPOs have yet to mature sufficiently to significantly address the challenges of efficient post-harvest aggregation.

- Limited use of technology

  During storage, both biotic factors (such as insects, pests, and micro-organisms) and abiotic factors (such as relative humidity, temperature, and time) can cause grain damage and trigger mold growth or aflatoxin contamination, making the produce unsafe for human and livestock consumption. Reports on post-harvest losses indicate that approximately 3% to 4%[49] of maize produced in India is lost due to improper post-harvest management (PHM) techniques and inadequate storage. This loss can be reduced to as low as 1-2%[50] by using scientific storage methods and efficient PHM techniques.

## Challenges faced by processing industry

The aforementioned farm-level and supply chain challenges impact the efficiency of all industries that are dependent on maize as a raw material. Ensuring the availability of the right quantity and quality of raw material at the right price and right time is crucial for building a competitive advantage. However, varietal and quality mismatches, high costs of raw material due to involvement of a large number of intermediaries, fluctuating prices, seasonal availability and import restrictions strongly impact the cost efficiencies of these industries.

On the import front, several factors such as high customs duty (up to 50%), restrictions on origin of produce (GMO free) under FSSAI notification, zero tolerance guidelines – with no Low-level Presence (LLP) set and expectation of a declaration on GMO from source nations hinder industries' efforts to secure a steady supply of maize even during domestic shortages. Each of these constraints has varying degree of impact for each industry. An overview of select critical challenges affecting various industries that use maize as raw material is captured herewith.

- Feed Industry
  - The average grain count for Indian maize is approximately 450 grains per 100 grams, whereas grain count for US number 2 maize grade typically ranges from of 295 to 300 grains per 100 grams, making the latter more suitable for feed industry.
  - Maize with high moisture content cannot be used for poultry feed due to its impact on quality, increased risk of aflatoxin contamination, and reduced storability.
  - The lack of raw material availability for 4 - 5 months and skewed rabi production lead to high storage and transportation costs.

[49] NABCONS (2022). Study to determine post-harvest losses of agri produces in India
[50] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5296677/

- When maize prices are too high, industries turn to alternative grains such as bajra and barley for cattle feed, and sorghum, wheat, and rice for poultry feed.
- Lack of bulk logistics infrastructure and need for multiple handling result in significant cost escalation.

- Starch Industry
  - Variability in maize quality, moisture content and protein levels affect starch yield, quality and consistency. The starch content in Indian maize is relatively low, ranging from 63% to 67%, compared to 73% in US number 2 maize.
  - High domestic maize prices result in starch derivatives being uncompetitive in the international market.
  - High import duties and lack of import quota allocation during shortages result in poor capacity utilization and increased costs.
- Food Processing Sector
  - There is a lack of focused research and development for high-yielding flour maize varieties suitable for food consumption, resulting in low productivity.
  - Non-availability of right quality maize required for processing – specially for extruded snacks and popcorn. Significant quantity of maize is imported for this purpose.







05

# Imperatives for sustainable growth of India's maize sector



The maize industry in India has significant potential for growth and transformation. This growth would be driven by innovative technologies, strategic collaborations, and effective policy initiatives. It offers unmatched flexibility in cultivation, product diversification, processing, and value creation for participants across the supply chain. This flexibility, coupled with growing demand, can be harnessed to accelerate farmer income and natural resource conservation by addressing key challenges faced by stakeholders across the value chain.

Maize is already an important raw material for poultry, dairy and food processing, in addition to its traditional uses. The demand for livestock-based products and other industries driving maize demand (food processing, starch, bio-fuel) is expected to grow at a faster pace than maize production. Policy changes to divert maize for ethanol production may further drive demand of maize to levels higher than currently forecasted. To meet the ever-increasing domestic demand for maize while addressing environmental concerns, interventions are needed at various levels of the value chain, with cumulative efforts from all stakeholders involved.

Government of India has rolled out several policy initiatives, schemes and programs that benefit the maize ecosystem. A snapshot of select government initiative aims towards improving the growth of maize ecosystem is provided below.

**For improving crop productivity and farmer income**

- Initiatives by IIMR for crop improvement, protection, management
- Sub mission on feed and fodder development under NLM
- Sub mission on agriculture mechanization
- Soil Health component of Rashtriya Krishi Vikas Yojana (RKVY) Scheme

**For processing of maize**

- Pradhan Mantri Kisan Sampada Yojana (PMKSY) under MoFPI
- Promoting Maize dryers
- Pradhan Mantri Formalisation of Micro Food Processing Enterprises (PMFME) Scheme
- Animal Husbandry Infrastructure Development Fund

**For infrastructure development and credit facilitation**

- National Agriculture Market (e-NAM)
- Agriculture Infrastructure Fund (AIF)
- National e-Governance Plan in Agriculture (NeGP-A)

**For extension**

- Promotion of agritech start-ups
- Promotion of digital extension services and apps
- National Interactive Digital Platform
- Kisan Suvidha mobile application
- Krishi Yantra

It is imperative for private sector to collaborate with the government to formulate relevant strategies and implement initiatives that co-create value for farmers and other stakeholders across the maize supply chain. Many forward-looking private companies are focusing intensively on yield enhancements,

resource conservation, waste reduction and better quality of maize. Select initiatives that private sector could focus on to further enhance the growth of maize sector include:

- **Invest in research & development** - Private sector has a visible presence in maize breeding research and seed production R&D in India. To further enhance the existing efforts, more focus could be given towards development of climate resilient, pest resistant seeds which have high yields especially in Kharif growing areas. The industry may also focus on development of maize varieties for industrial usage such as varieties which have higher recovery for ethanol or high starch content.

- **Introduce innovative technology solutions** such as drip irrigation, drone use for inputs application, rapid soil testing and real time data monitoring at farm level.

- **Develop a robust farmer extension and advisory services network** to educate farmers about new technologies and adoption of good agricultural practices. Develop farmer friendly apps for training them in their vernacular language.

- **Foster partnerships with farmer cooperatives and FPOs** to provide the required handholding to scale FPOs operations through adoption of new technologies and connecting them to the market through various e-platforms for better price discovery. This can lead to economies of scale and benefit both farmers and the industry.

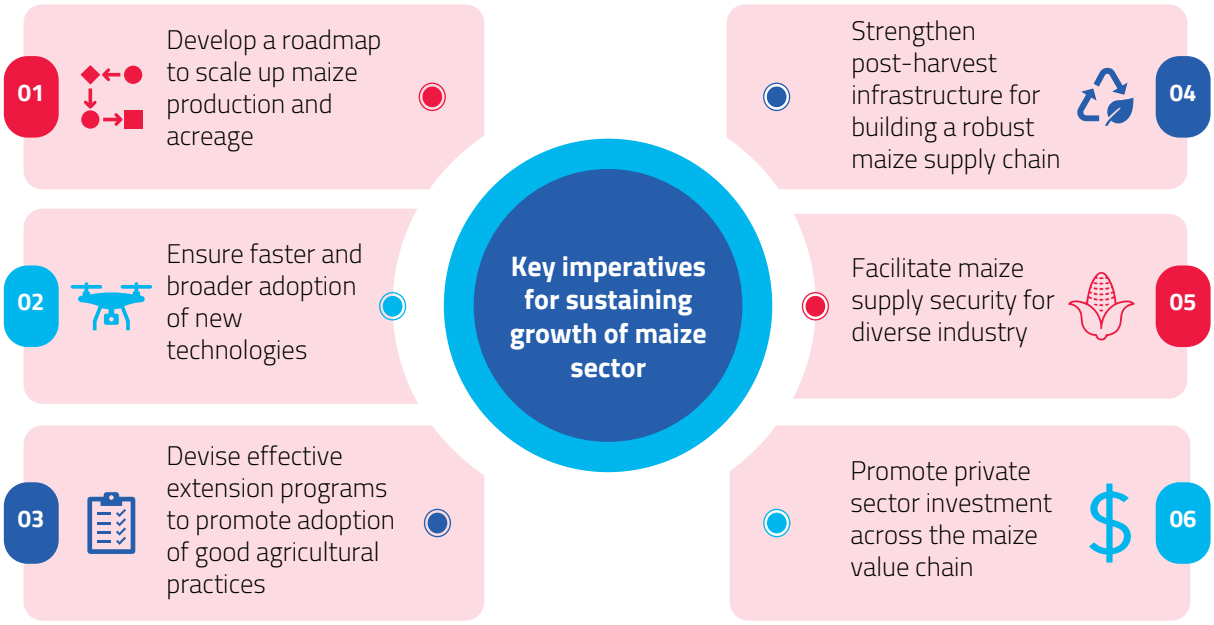
- **Promote crop diversification** from traditional wheat, rice-based cultivation practice to maize cultivation which will result in natural resource conservation (soil & water conservation) and better farmer incomes.

- **Establish post-harvest handling and processing infrastructure** such as bailing technology for silage, creation of modern bulk silo capacity duly equipped with facilities like dryer and chiller for safe and efficient preservation of maize.



Discussion with the industry players indicate that policy makers could further accentuate sustainable growth, resilience, and development of the maize ecosystem by focusing on six key imperatives as captured in Exhibit 26.

**Exhibit 26: Key imperatives for sustaining growth of maize sector**




Source: Industry sources, YES BANK Analysis

## 1. Develop a roadmap to scale up maize production and acreage

Maize is a crucial crop for food security, livestock feed and industrial applications, with immense potential to contribute to India's agricultural growth and rural development. However, maize cultivation in India faces several challenges, including low productivity, limited acreage specially in rabi, high dependency on rain-fed crop and inadequate adoption of modern technology. To address these gaps and unlock the full potential of maize, it is essential to develop a comprehensive roadmap outlining strategic interventions necessary to scale up maize production and acreage. Key actions to improve maize productivity and expand area include:

- **Strongly focus on introduction and widescale adoption of high yielding and stress tolerant hybrid seeds–** with focus on Single Cross Hybrid Introduction. A targeted effort is needed to deliver high yielding varieties for cultivation in traditional areas for food purposes and stress tolerant maize for rainfed kharif cultivation. In this regard, while private seed companies could play a critical role in introducing globally best quality hybrids, the government needs to review procedures for hybrid seed introduction (such as the need for a three-year confirmatory trial for any hybrid seed being introduced into the state, despite it having been tested and approved elsewhere in the country). The hybrid seed development involves long breeding process and usually takes 9-10 years to develop a new commercial hybrid. This also include rigorous testing of hybrids for 5 years to develop high quality data on G X E (Stability & region fit). A further 2-to-3-year confirmatory trial requirement increases cost of seed as well as carries the risk of obsoleteness for private companies – as hybrid maize development has stiff competition. Two to three years of university

testing required by states for commercialization across states increased overall time period to 12-13 years. Common and standard set of procedures/guidelines for faster approval would ensure predictability to the seed industry and help in bringing new germplasm faster to the market that will further help farmers in realizing the benefits of improved yields and better returns.

- **Encourage seed companies to identify and develop climate-resilient maize varieties** that are pest-resistant and suitable for different agro-climatic conditions, including waterlogged conditions and low temperatures.

- **Map agro-climatic as well as industry specific raw material quality requirements to identify specific focus geographies for promotion of specific varieties of maize** that would cater to the requirement of each end use sector such as feed, starch, food processing. For instance, maize for feed requires high energy content, while maize for starch focuses on starch content, and maize for food processing emphasizes malleability and popability. Industry also faces acute shortage of maize during many months of the year requiring area expansion under the right varieties across geographies and more so in rabi season.

- **Devise, monitor, and target time-bound, district level plans to boost seed and varietal adoption.** An enhanced varietal replacement rate, coupled with improved seed replacement rate, could lead to improved use of quality seeds of high-yielding hybrids and varieties resulting in increased productivity and better farmer income.

- **Review and approve registration applications for seed treatment solution on priority for effective control against Fall Army Worm (FAW).** Seed treatment solutions provide effective control against FAW right from germination stage till early establishment of the crop, providing less chemical exposure to the environment, beneficial insects, and farmers. Experimental trials suggest that seed treatment solutions when applied as first line of defense followed by foliar application as an integrated pest management solution at the right time can protect the yield by 25-30% in case of moderate to severe FAW infestations[51]. Regulators have proactively approved foliar applications against FAW, however, there are very limited options available for seed treatment solutions. Proactive steps are also required for a smooth and fast registration process to provide more options for seed treatment solutions so as to mitigate the risk of FAW in India.

- **Strengthen enforcement mechanism under The Protection of Plant Variety and Farmers Right Act (PPVFR Act)** to protect against illegal copying of patents: The Protection of PPVFR Act plays a prominent role in seed regulation in terms of introduction of intellectual property rights in India. Strong PVP&FRA regulation and prevention of illegal copy of patents will help retain the progress made by the R&D in maize and provide confidence to private sector for introduction of best hybrid varieties into India.

- **Review benefits versus concerns with regard to Genetically Modified maize:** There is a large gap in productivity as well as stress tolerance between GM maize and non-GM maize. A socioeconomic viability study needs to be done and a policy level stakeholder dialogue needs to be reinitiated to re-evaluate the impact of introducing GM maize in India on farmer income versus the general concerns associated with its introduction.

[51] FICCI-YES BANK knowledge report "Indian Maize Sector: Securing Supply Sustainably', May 2022

- **Integrate Geographical Information System (GIS), Geographical Positioning System (GPS) and meteorological data** for estimation of area, production, productivity and for forecasting of disease and pest incidence.

- **Incentivize seed production to make it remunerative for farmers** as they are getting better income per acre in alternate crops as well as bonus support from local government for cultivation of different crops. This will ensure availability of good quality seeds.

## 2. Ensure faster and broader adoption of new technologies

- **Enable equipment sharing:** Developing digital platforms that facilitate equipment rental and sharing services which will make advanced machinery and tools accessible to smallholders who cannot afford to purchase them outright.

- **Build trust for data sharing:** Streamlining data collection processes and ensuring transparency in data usage will build farmers' trust. Secure and transparent data-sharing mechanisms can lead to better decision-making and personalized agricultural advisory services.

- **Develop IT Infrastructure:** Government and private players should collaborate to expand internet and mobile network coverage in rural areas, making connectivity affordable and reliable for farmers.

- **Incentivize technology deployment:** Financial incentives and subsidies should be provided for the deployment of remote/in-situ sensors, drones for crop monitoring, and automatic weather stations. This will enable farmers to make data-driven decisions.

- **Digital agriculture tools:** Encouraging innovation in digital agriculture tools including AI, blockchain, remote sensing, GIS technology, and drones to enhance productivity and sustainability.

- **Promote Public-Private Partnerships (PPP) for mobilizing resources, expertise, and innovations across the maize value chain.** Effective PPPs can drive significant improvements in productivity, leading to enhancement of farmer income, better adoption of modern practices and effective infrastructure development. With the advent of innovative technologies like drones, satellite mapping, IoT and blockchain, PPPs have become increasingly important for ensuring the adoption of these technologies at farm level. PPP initiatives will facilitate private investment in the maize sector, leverage public investment and align all stakeholders with a shared vision of dynamic and value-added growth in the sector.

## 3. Devise effective extension programs to promote adoption of good agricultural practices

- **Utilize traditional and digital methods:** Combining traditional extension methods, such as on-field demonstrations, farmer field days, and training sessions, with digital platforms can reach a larger audience. Digital platforms can deliver information through mobile apps, SMS, and online portals.

- **Develop farmer-friendly apps:** Creating mobile applications that provide real-time information on weather, pest alerts, and best farming practices in regional languages will enhance accessibility and usability for farmers.

- **Provide continuous support:** Ongoing support and education through helplines, farmer networks, and advisory services will ensure farmers can effectively use new technologies and practices

- **Institute suitable measures to combat the proliferation of spurious and counterfeit agricultural inputs-** Awareness generation needs to be done at farmers' level to educate them on the risks associated with counterfeit products and to promote the use of genuine inputs to ensure optimal crop yields and quality.

- **Move towards mechanization:** Address labor shortages by adopting mechanization to enhance farm management efficiency. Some measures in this direction include large scale adoption of micro-irrigation, leveraging solar energy in maize production and establishment of farm machinery banks in PPP model which could help in augmenting productivity and cost efficiency. There persists a need to closely study the requirement of small farmers and develop cost effective machines that are best suited to small farm conditions.

## 4. Strengthen post-harvest infrastructure for building a robust maize supply chain

Maize, as a commodity, is prone to significant price fluctuations, as its price depends on key end-use sectors such as poultry, which themselves experience fluctuating demand. This volatility leaves farmers vulnerable to economic losses. Additionally, inconsistent maize quality, stemming from poor post-harvest practices and inadequate storage infrastructure, exacerbates the issue, leading to lower prices for farmers. To address these challenges, it is essential to strengthen market linkages and infrastructure, enabling farmers to access market price information, adopt risk management strategies, and produce high-quality maize that meets industry standards. Leveraging technology and innovation (such as digital platforms and modern drying and storage solutions) can play a vital role in improving post-harvest management, reducing supply chain inefficiencies, and creating a more efficient, sustainable, and farmer-friendly maize supply chain. Key interventions suggested include:

- **Establish maize clusters and FPOs:** Establishing specialized maize clusters and Farmer Producer Organizations (FPOs) will enhance collective bargaining power and resource utilization. These clusters can focus on specific aspects such as seed production, post-harvest management, and value addition.

- **Develop farm level drying and storage infrastructure:** Investing in farm-level infrastructure such as maize drying and storage facilities is essential to reduce post-harvest losses and improve product quality.

- **Facilitate direct market access:** Digital platforms and cooperatives could enable farmers to access markets directly, bypassing intermediaries and ensuring fair prices. E-marketplaces will help in providing transparency and competitive pricing. Creating efficient supply chains and logistics networks will ensure timely market access.

- **Develop price discovery mechanisms:** Implementing mechanisms for transparent price discovery such as electronic trading platforms and commodity exchanges will ensure farmers receive fair compensation for their produce.

- **Develop scientific bulk storage Infrastructure:**

  - Promote private sector investment in developing scientific bulk storage infrastructure. The initiative taken up by FCI for wheat and rice could be extended to maize. Investing in market facilities such as warehouses and transportation networks will reduce post-harvest losses and improve the quality of maize reaching the market.

  - Specialized large scale integrated bulk handling projects, including collection centers and material handling infrastructure for handling bulk quality of maize like silos and wagons could be developed on a PPP model – as in the case of rice and wheat.

## 5. Facilitate maize supply security for diverse industries

Availability of sufficient quantity of the right quality maize at the right time is critical for efficient industry operations. However, in addition to challenges related to non-availability of maize during most parts of the year, there are strong restrictions on import of maize as well. Key interventions suggested for improving the industry's access to sufficient raw material include:

- **Invest in development of industry specific maize varieties.** For instance, development of waxy corn or glutinous corn variety for use in food, adhesives and textiles.

- **Rationalize import duties and regulations such that industry can import during shortage.** Suggested action steps include:

  - Review and rationalize the high import duty on maize (currently 50%).

  - While providing for TRQ quota for imports, develop a scientific mechanism based on statistical models to arrive at the level of quota to be provided and how much to import. In addition to poultry sector, TRQ quotas need to be considered for starch and other industries.

  - Review import quarantine norms to align with international standards. For instance, Aluminum Phosphide as fumigant is used in many parts of the world, but such produce is restricted from being imported into India as only methyl bromide fumigated material is allowed.

  - Review import source of origin regulations. Indian regulations mandate that only non-GM maize can be imported. However, unlike in Europe (which defines that 99.1% non-GMO is acceptable), India does not have a LLP for maize. Also, Indian regulation requires a declaration from the source country that the produce is non-GMO and the location from where it is sources does not cultivate GM crop. This requirement needs to be reviewed as it is difficult to get such declaration from source countries.

- **Review export obligation period for maize:** Export obligation period for maize is currently 6 months from the date of clearance of each consignment by the Customs Authority. This period may be extended to 9 months (with option of additional extensions, post approval) instead of 6 months. This extension would allow industries to better manage the handling and transportation of maize from port to plant, effectively plan production and export marketing, stabilize output pricing, and enter long-term contracts with buyers.

## 6. Promote private sector investment across the maize value chain

The Government of India has launched several schemes to promote private sector investment in post-harvest storage and processing of agricultural produce. Given the socio-economic importance of maize, investments in this crop value chain could be considered eligible for various incentives. For instance:

- **Focused promotion of Pradhan Mantri Formalisation of Micro Food Processing Enterprises (PMFME) Scheme** for setting up collection centers for maize – which have modern dryers, storage facility, testing facility etc.

- **Incentives for maize processors to establish storage infrastructure**, including warehouses near processing facilities or within plant premises.

- **Include starch-based derivatives as eligible products for various MOFPI schemes.**

Transforming India's maize sector requires a comprehensive and integrated approach that leverages modern technology, fosters public-private partnerships, and creates a supportive regulatory environment. By implementing these detailed recommendations, India can achieve sustainable growth and development in its maize sector, ensuring improved livelihoods for farmers and enhanced food security for the nation.

# List of Abbreviations

| | |
|---|---|
| Bn | Billion |
| CAGR | Compounded Annual Growth Rate |
| DOA&FW | Department of Agriculture and Farmers Welfare |
| EBP | Ethanol Blended Petrol |
| FAO | Food and Agriculture Organisation |
| FAW | Fall Armyworm |
| FCI | Food Corporation of India |
| FPOs | Farmer Producer Organizations |
| FSSAI | Food Safety and Standards Authority of India |
| GIS | Geographical Information System |
| GM | Genetically Modified |
| GMO | Genetically Modified Organisms |
| GoI | Government of India |
| GPS | Geographical Positioning System |
| Ha | Hectares |
| HCN | Prussic acid |
| HYV | High Yield Variety |
| IGC | International Grain Council |
| LLP | Low Level Presence |
| Mn | Million |
| MOFPI | Ministry of Food Processing Industries |
| MSP | Minimum Support Price |
| MT | Metric Tonnes |
| NAFCC | National Adaptation Fund for Climate Change |
| OECD | Organization for Economic Cooperation and Development |
| P.A. | Per Annum |
| PHM | Post-Harvest Management |
| PMFME | Pradhan Mantri Formalisation of Micro Food Processing Enterprises |
| PPP | Public Private Partnership |
| PPVFR | Protection of Plant Variety and Farmers Right |
| R&D | Research and Development |
| RCTs | Resource Conservation Technologies |
| RTE | Ready To Eat |
| TRQ | Tariff Rate Quota |
| USA | United States of America |

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# Acknowledgment

FICCI and YES BANK would like to acknowledge the support of the industrial experts and thought leaders for their valuable inputs and suggestions on the report. We would like to express our sincere gratitude to Mr. Siraj Hussain, Advisor Food Processing, FICCI and Former Secretary, Ministry of Agriculture & Farmers Welfare and Ministry of Food Processing Industries, Government of India; Mr. Pravesh Sharma, Chairman, FICCI Task Force on FPOs and Director Samunnati; Dr B.M. Prasanna, Director, Global Maize Program, CIMMYT; Dr PH Zaidi, Principal Scientist, CIMMYT; Dr HS Jat, Director, ICAR-Indian Institute of Maize Research (IIMR); Dr S. L. Jat, Senior Scientist, ICAR-Indian Institute of Maize Research (IIMR); Mr Yougesh Kumar, Crop Marketing Lead - Spring & Post Rainy Corn Seed, South Asia, Corteva Agriscience; Ms Ruchira, Head, Advocacy & Industry Affairs, India & South Asia, Corteva Agriscience; Mr. Amit Sachdev, India Representative, U.S. Grains Council; Mr. Reece Cannady, Director, US Grains Council; Mr. Rajvir Rathi, Director- Public Affairs, Science & Sustainability, Bayer CropScience Ltd.; Mr. Dhirtliman Biswas- Director Government Relations- South Asia, Cargill; Mr. Vijay Tiwari, Crop Lead-Corn and Millets, Mahindra Agri Solutions Ltd; Mr. Ombeer Tyagi, Vice President Corporate Affairs, UPL ltd.; Ms. Mallika Verma, Director- Government Affairs, Syngenta India Pvt Ltd.; Mr. B Yogesh, Business Head, Rallis India Ltd.; Mr. M Venkatachalam, Head-Regulatory and Public Affairs, Rasi seeds Pvt Ltd; Mr. Naveen Pasuparthy, VP, CLFMA; Mr. Nishith Tiwari, Head of Procurement & Supply Chain, Grobest Feeds; Mr. Suresh Chitturi R, MD, Srinivasa Farms; Mr. Harinder Singh, Fodder Researcher Specialist, Excellent Enterprises; Mr. Ravi Palanisamy, VP, Waterbase Ltd.; Mr. Anish Arora, Head Logistics, IGL; Mr. SK Shukla, President, UPDA and Poultry Federation of India.

**We would like to thank all our Partners:** Ministry of Agriculture and Farmers Welfare, GOI; ICAR-Indian Institute of Maize Research (IIMR); CIMMYT; Corteva Agriscience; U.S. Grains Council; Bayer CropScience Ltd.; Cargill; Godrej Industries; Roquette India Pvt. Ltd.; Syngenta India Pvt Ltd.; TAFE and LDC for their support in making this initiative a success.

# NOTES

# N O T E S

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