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INDIAN MAIZE SECTOR

Securing Supply Sustainably



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MESSAGE



Maize is considered to be one of the most important cereal grains globally. In India also it has emerged as the 3rd most important crop after rice and wheat. The significant importance of the crop lies in the fact that it not only accounts for usage as human food and animal feed but at the same time it is also widely used as an important raw material in food processing, poultry, dairy, meat and ethanol industry making it the fastest growing cash crop. Maize is being considered as the best alternative for crop diversification for traditional rice, wheat-based farming. States like Punjab, Haryana have initiated Crop diversification schemes and are promoting maize.

In India, Maize yields have increased over the last decade, but average productivity of maize still remains low. Low adoption of hybrid seeds is one of the main reason for lesser productivity. Stronger focus on introduction and wide-scale adoption of High yielding and stress tolerant hybrid seeds would help raise productivity levels. Towards this, private seed companies along with public sector could play a critical role in introducing good quality hybrids. There is a need to strengthen the mechanism for intellectual property rights in the country to provide adequate protection to new technology or products. This will certainly boost innovation and competitiveness in the sector. Maize crop being tropical, is susceptible to infestation by weeds and insect pests. Since last few years infestation of Fall Army Worm has been causing havoc in maize growing belts across the country. In 2020-21, total FAW affected area in maize was estimated to be over 7.07 lakh hectare. Poor pest management practices, including lack of seed treatment options is resulting in high loss due to pest attack. Therefore conscious attention towards pest management is equally important. Given the growing demand for maize and the diverse end-uses, it is critical that coordinated efforts be taken for development of this sector.

Vedika Kapoor
Head of Government & Industry Affairs – South Asia
Corteva Agriscience India Pvt. Ltd

MESSAGE



The U.S. Grains Council's (USGC) mission is to develop markets, enable trade, and improve lives, and to fulfill that mission, USGC works closely with local feed manufacturers and other end users to build capacity for more and higher-quality feed and grain demand. The goal of these programs is to accelerate the sustainable growth of local industries using coarse grains and products. This in turn increases overall demand for grain and meets rising demand from consumers for better food. The Council supports free trade while understanding there are critical constraints and challenges confronting end-user industries.

USGC is pleased to be a partner in the 8th edition of the FICCI Maize Summit and contribute to the Maize Vision report, which identifies opportunities and challenges within the Indian maize industry and offers recommendations to grow this sector.

In these challenging times, it is critical to develop and implement new approaches and technologies that not only provide a growing global population access to adequate nutritious, safe, and affordable food but, creates value added products, preserves natural resources, and minimizes negative environmental impacts.

The U.S. is the largest corn producer in the world, with over 90 million acres dedicated to corn production. Although corn (or maize, as it's known throughout much of the world) is grown in nearly all 50 states, production is primarily concentrated in the northern and Midwestern states —collectively known as the U.S. corn belt. Yet. Corn is much more than just a crop - it represents a source of income for the hundreds of thousands of farmers in the country. Its diverse uses create value added products like dried distillers' grains with solubles (DDGS), and ethanol which helped to revitalize the U.S. farming industry and economy.

Nearly 50% of U.S. corn is utilized in animal feed (grain and DDGS) and food and beverages. Nearly 20% is exported (primarily for animal feed), and less than 30% is used in fuel. When taking into account domestic and export demand combined, approximately 70% of corn's demand comes from animal feed, food and/or beverages.

Today's seed and precision farming technology has allowed farmers to increase production on each acre of land, and corn productivity is projected to continue to rise. Increased corn productivity enables growers to outpace demand with a higher supply, meeting the demand for food, feed, fuel and exports.

We look forward to growing the U.S.-India trade relationship and USGC and industries are ready to support Indian livestock producers and other end user sectors.

Ryan LeGrand
President and CEO
US grain council

FOREWORD



The Covid-19 pandemic has impacted all aspects of the economy across regions and countries. However, one sector that withstood this wave was agriculture, it was a cushion that absorbed the shock and provided much-needed succor to approx. 50% of the households continue to depend on it as a primary livelihood option.

Agriculture has made considerable advances in making our country self-reliant in food production and a net exporter as well. However, stagnating yields, continuous mining of nutrients and groundwater, and excessive use of natural resources have put pressure on the production system that needs to become sustainable. To surmount these challenges, the country needs to focus on low water consumption and more beneficial high-yielding crops. In the present agricultural and climatic scenario, maize is going to be an important crop for a bright future in Indian Agriculture.

Maize is an important crop that has its wider utilization as poultry & animal feed, industrial raw material, and food. Maize is very water efficient and lower quantum of water is required to irrigate maize as compared to many other crops. Worldwide it is the top-ranking crop utilized for food, feed, and industrial raw material. India is presently producing around 28.8 Mn MT of maize which is primarily consumed as animal and poultry feed. Globally, maize is cultivated in 170 countries on over 192.8 million Ha with average productivity of about 6 MT/ha. USA and China contribute around 31% and 23% of total global production, respectively. India ranks fourth in area and sixth in production.

The importance of maize in Asia's cropping systems has grown rapidly in recent years, with several countries showing impressive growth in their production and productivity. Driven by structural changes in agriculture and food consumption patterns, maize is bound to hold its share as an important cereal crop in the future. In the current scenario, there is a scope for further expansion of maize area in the country with innovations in crop improvement, management, and diversification. The study on maize is an effort to bring to the fore the global and domestic scenario of maize and issues confronting the maize supply chain.

FICCI has always thrived in providing thought leadership. It is our strong belief that this report would be helpful in focusing on India's potential in the maize sector and immensely useful to redraw our strategies to make significant enhancements toward large scale maize cultivation in the country.

T R Kesavan
Chairman, FICCI National Agriculture Committee &
Group President, TAFE Ltd.

FOREWORD



Maize has a prominent role to play in the Indian economy owing to its diverse usage, not just as food but also for feed, fuel, and other industrial purposes. Importance of maize in India can also be judged by the fact that it is the fastest growing cereal crop in terms of area, production, and productivity. Domestic maize production has nearly tripled from less than 10 million tonnes in the mid-1990s to more than 29 million tonnes in 2019-20. However, Maize ecosystem like other agricultural commodities is at risk from climate change, unsustainable water use and inefficient fertilizer usage practices. In addition, increasing demand for animal feed and industrial usage is leading to a demand-supply mismatch that could lead to shortage of supply in the near future.

India's maize consumption is projected to increase to 33.8 million tonnes in 2030. To meet this demand, concerted efforts need to be put in towards augmenting sustainable production and supply of maize. This will entail focus on enhancing yield, adapting to climate change, and minimizing environmental impact on crop thus leading to availability of better quality and required quantity of maize for all end users including processed food players, starch manufacturers and feed industry.

Both private and government stakeholders have taken numerous proactive initiatives towards enhancing maize production, but growth in consumption of maize is still outpacing the growth in production. This warrants a collaborative public-private action that creates pathways for bridging the demand-supply gap sustainably.

YES BANK is pleased to collaborate with FICCI for the 8th edition of India Maize Summit, wherein this knowledge report on "Indian Maize Sector: Securing Supply Sustainably", is being released. The report provides an extensive review of the maize sector and puts forth key recommendations that, if implemented, could lead to sustainable supply of maize to all end use sectors. I sincerely hope that this publication will be a useful reference for shaping strategic interventions oriented towards securing supply of maize sustainably.

Prashant Kumar
Managing Director & CEO
YES BANK Ltd.

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Executive Summary

Maize is the third most important food grain in India (after rice and wheat) and the fastest growing cereal crop in terms of area, production, and productivity. There have been significant efforts from both government and private sector to boost maize production, nevertheless the growth rate of maize consumption has outpaced the production growth over last decade. Maize supply is also at risk from climate change, unsustainable water use and inefficient fertilizer usage practices thus making it imperative for all key stakeholders to deliberate interventions required for ensuring long term sustainable supply of maize for the country.

Changing global dynamics due to ongoing conflict in the black sea region, covid outbreak and low production of key producers due to unfavorable weather conditions has impacted the global maize trade leading to higher prices and issues in availability. This has created an opportunity of maize exports from India to nearby markets like Vietnam, Bangladesh as Indian maize has become competitive in world market. From an export's realization of USD 142.8 Mn in 2019-20, the export of maize increased nearly sevenfold, with maize exports increasing to USD 930.2 Mn (April-February) in 2021-22. This increased focus on exports might have an impact on availability of maize for domestic use.

Maize is amongst the world's most widely produced and consumed cereal crops. In 2020, about 1.16 Bn MT of maize was produced globally, covering an acreage of about 192.8 Mn Ha. Global production of maize increased at a decadal CAGR of 2.9% from year 2010 to 2020. Top 5 producers of maize contribute to about 70% of global maize production with USA, China and Brazil as key producers. USA and China are also top consumers of maize with contribution of 26% and 25% in global maize consumption. In terms of trade about 184 Mn MT of maize was traded across countries with top exporters being USA, Argentina, Brazil, Ukraine and Russia. Russia and Ukraine both handle a total export quantum of nearly 28 Mn

MT maize annually and due to ongoing conflict, both their trading ports are blocked leading to disruption in trade. This has further put pressure on the biggest global supplier of maize i.e. USA to supply for the deficit leading to higher prices.

Maize is the third most important food grain crop in India and accounts for about 10% of total cereal production after rice and wheat which accounts for 40% and 35% respectively. In the year 2019-20, maize was cultivated across about 9.6 Mn Ha across India with national production touching 28.8 Mn MT. Globally, India ranks 4th in terms of acreage and 6th in terms of annual production, contributing to about 4.9% and 2.6% to world acreage and production respectively. India's domestic market is reasonably protected from imports as entry of genetically modified maize is restricted and only corn with Non-GM origin cum GM free certificate is allowed for imports.

From the demand side, while maize is a key source of food and nutritional security, especially in traditional growing areas, only about 15-20% of domestic production is used for direct food consumption, while about 80-85% is utilized for industrial purposes – including 50% for animal feed industry, 25% for starch industry, 5% food processing and a small portion for bio-ethanol production. 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 good quality product. The sourcing of maize by end use sectors is being impacted by low productivity, seasonality, inefficient post-harvest handling and storage, high logistics cost, volatile pricing and import restrictions. Government of India has rolled our several policy incentives like promoting maize as an alternative crop for diversification, National Food Security Mission, promoting collectivization to address some of these challenges.

To meet the ever-increasing domestic demand of maize while addressing the environmental concerns, interventions need to be done at various levels of the value chain with cumulative efforts made by all the stakeholders involved. Five key action areas which have been identified post discussion with industry to ensure sustainable supply of maize for all end users are

1. Enhancing maize production ecosystem
2. Making post-harvest interventions more robust
3. Transformation of storage and logistics infrastructure
4. Facilitation of domestic supply and international trade of maize
5. Upgradation of processing infrastructure

These actions steps if implemented in a co-creation mode with strong inter institutional partnership as well as public-private partnership will ensure sustainable supply of maize to meet the future demand.



NEED FOR SUSTAINABLE SUPPLY OF MAIZE IN INDIA

Maize is an important staple crop in India as well as globally, considering its usage in food, animal feed and manufacturing of processed food and non-food materials. The versatile contribution of maize to India's socio-economic equilibrium is significant as maize is the third most important food grain in India (after rice and wheat) and the fastest growing cereal crop in terms of area, production, and productivity. Domestic maize production has grown from less than 10 Mn MT in the mid-1990s to more than 28 Mn MT in the last couple of years. More importantly, only 27% of this crop is cultivated under irrigated conditions, compared to 94% of wheat and 60% of rice respectively[1]. This indicates that maize has the ability 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.

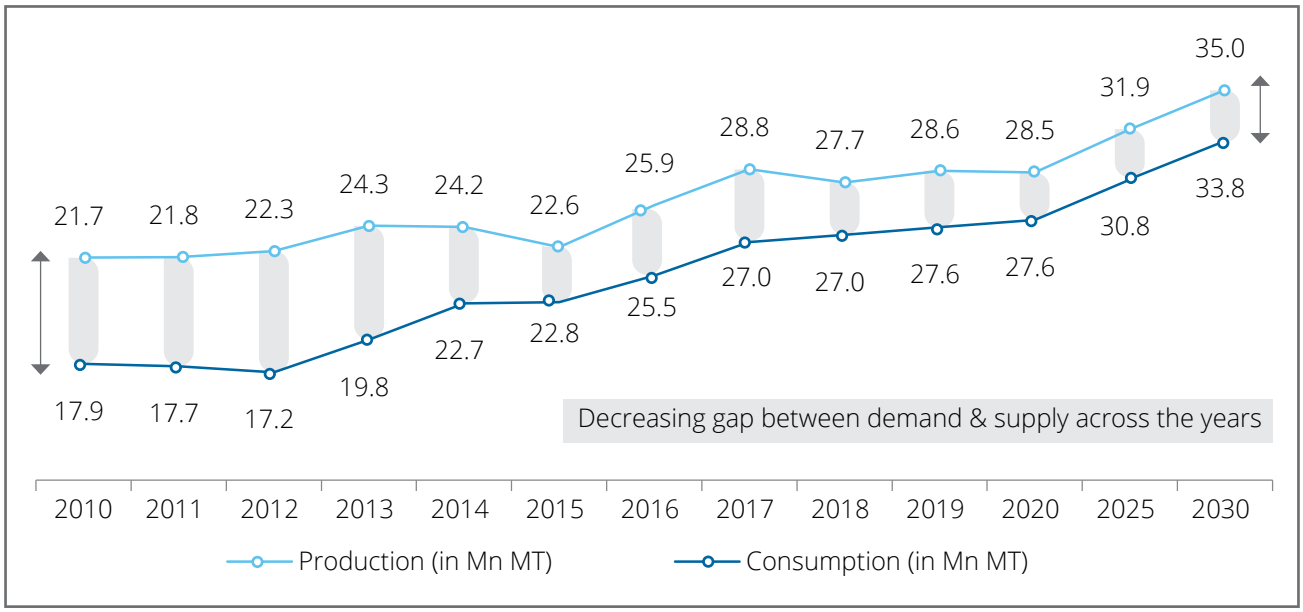
However, maize ecosystem like other agricultural commodities is at risk from climate change, unsustainable water use and inefficient fertilizer usage practices. In addition, changing patterns of food consumption (especially related to increased intake of animal protein) are burdening the production resources to meet the ever-increasing demand. India's maize consumption is projected to increase to 33.8 Mn MT in 2030 with major contribution of industrial usage[2]. This further necessitates effort towards intensifying maize production sustainably for ensuring food security and to meet end user industry demand. With growing end user demand and its mounting pressure on natural systems, improving the sustainability of maize ecosystem means not only continuing to increase maize production but also enhancing nutrition, adapting to climate change, minimizing environmental impacts, shorter supply chains and improved quality. All these supply related requirements will also need to be tailormade to suite quality and quantity requirements of diverse off-takers – including processed food player, starch manufacturers and feed industry.

[1] *Ministry of Agriculture & Farmers Welfare*
[2] *OECD-FAO Agricultural Outlook 2021-2030*

Increasing Demand-Supply Gap of Maize

From the demand side, while maize is a key source of food and nutritional security, especially in traditional growing areas, only about 15-20% of domestic production is used for direct food consumption, while about 80-85% is utilized for industrial purposes – including 50% for animal feed industry, 25% for starch industry, 5% food processing and a small portion for bio-ethanol production.[3] During last decade (2010-2020), maize consumption grew at a CAGR of 4.4%, which was higher than the growth rate of domestic production (which grew at 2.8% during this period). Domestic production exceeded domestic consumption by about 3.8 Mn MT in 2010, which has decreased to 0.90 Mn MT in 2020 indicating the tightening situation of supply vis-à-vis demand (refer Exhibit 1).

Exhibit 1: Maize production v/s consumption trend in India



Source: OECD-FAO Agricultural Outlook 2021-2030, YES BANK Analysis

Volatile Prices of Maize

Despite being reasonably protected from imports (as most global trade in corn is GM), farm gate prices of Maize have been volatile, ranging between INR 1,300-2,900 per quintal during last 5 years[4], indicating that these price variations have been primarily due to inconsistent supply. Due to price volatility, end users like feed industry are enforced to replace maize with other alternatives like rice, wheat, bajra and starch industry which is primarily dependent on maize runs at lower capacity utilization due supply constraint or high prices. Bio-ethanol industry still uses very minor maize production (<1%) as procuring maize at economically viable price point (of about INR 16-17 per kg) is a challenge for the industry[5]. Changing global dynamics due to ongoing conflict in black

[3] *OECD-FAO Agricultural Outlook 2021-2030*
[4] *India average wholesale monthly prices during Jan 2017- Apr 2022*
[5] *OECD-FAO Agricultural Outlook 2021-2030, Industry Sources*

sea region and covid outbreak have further impacted the maize trade leading to increase in prices.

High import duty on maize and increasing opportunity-based export is also impacting maize availability for the domestic use.

Thus, with increasing domestic demand, volatile pricing, opportunity-based exports, changing global dynamics and stress on natural resources it is becoming crucial to **Secure Supply of Maize Sustainably at right quantity, right quality, and right prices**.





GLOBAL SUPPLY - DEMAND SCENARIO OF MAIZE

Maize is amongst the world's most widely produced and consumed cereal crops. Maize is an annual plant with high productivity and exceptional geographic adaptability owing to its photo-thermal insensitivity and its genetic amenability to reconstruction. It contributes to food security in most of the developing countries. In regions such as Latin America and Sub-Saharan Africa, that are dependent on maize as a key staple crop, it serves as an important source of carbohydrate, protein, iron, vitamin B, and minerals. Maize also serves as a key raw material across various sectors – including livestock feed, starch, food processing and bioethanol. Additionally, derivatives of corn starch are actively used in diverse industries including pharmaceuticals, cosmetics, food processing, textiles, and paper among others.

2.1 Global Maize Production

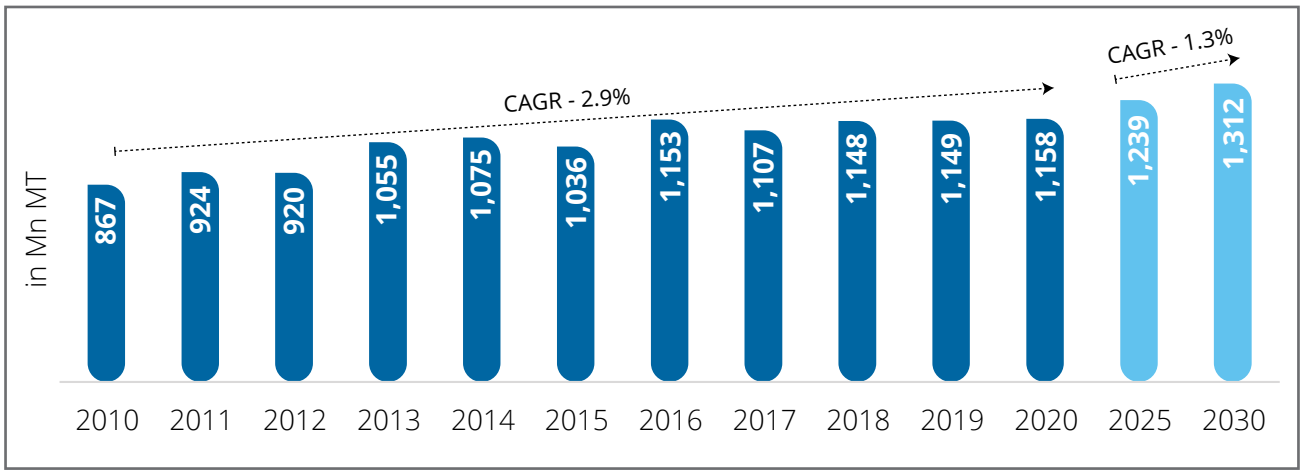
In 2020, about 1.16 Bn MT of maize was produced globally, covering an acreage of about 192.8 Mn Ha. Global production of maize increased at a decadal CAGR of 2.9% from year 2010 to 2020. In coming decade, a higher share of global maize production is expected to originate mainly from yield improvements 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 due to limited land availability 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 1.3% in the coming decade to reach 1.31 Bn MT by 2030 (refer Exhibit 2).[6]

USA is the largest producer of maize in the world contributing to 31% of global maize production followed by China (23%), Brazil (9%), Argentina (5%) and Ukraine (3%). Exhibit 3 below highlights top 5 maize producing countries in 2020. Over the next decade, China is projected to contribute the most (22%) to increases in global maize output, mainly by expected increases in yields and from increased cultivation of maize.[7] Together, China,

[6] *OECD-FAO Agricultural Outlook 2021-2030*

[7] *OECD-FAO Agricultural Outlook 2021-2030, YES BANK Analysis*

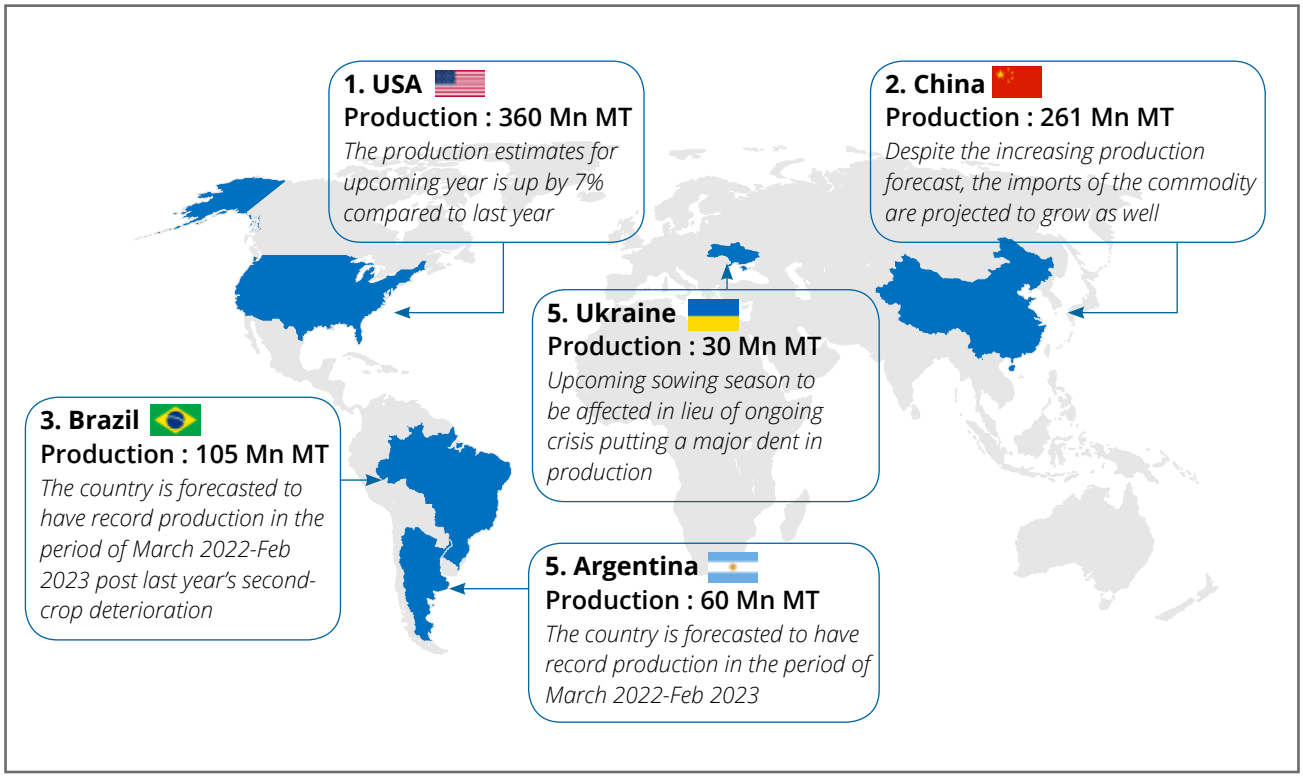
Exhibit 2: Global maize production trend



Source: OECD-FAO Agricultural Outlook 2021-2030

USA and Brazil are expected to account for more than half of the production increase over the next decade. Production of maize in United States is expected to increase at a slower pace in coming decade due to slower growth in domestic demand, particularly for ethanol.

Exhibit 3: Top 5 maize producing countries in 2020



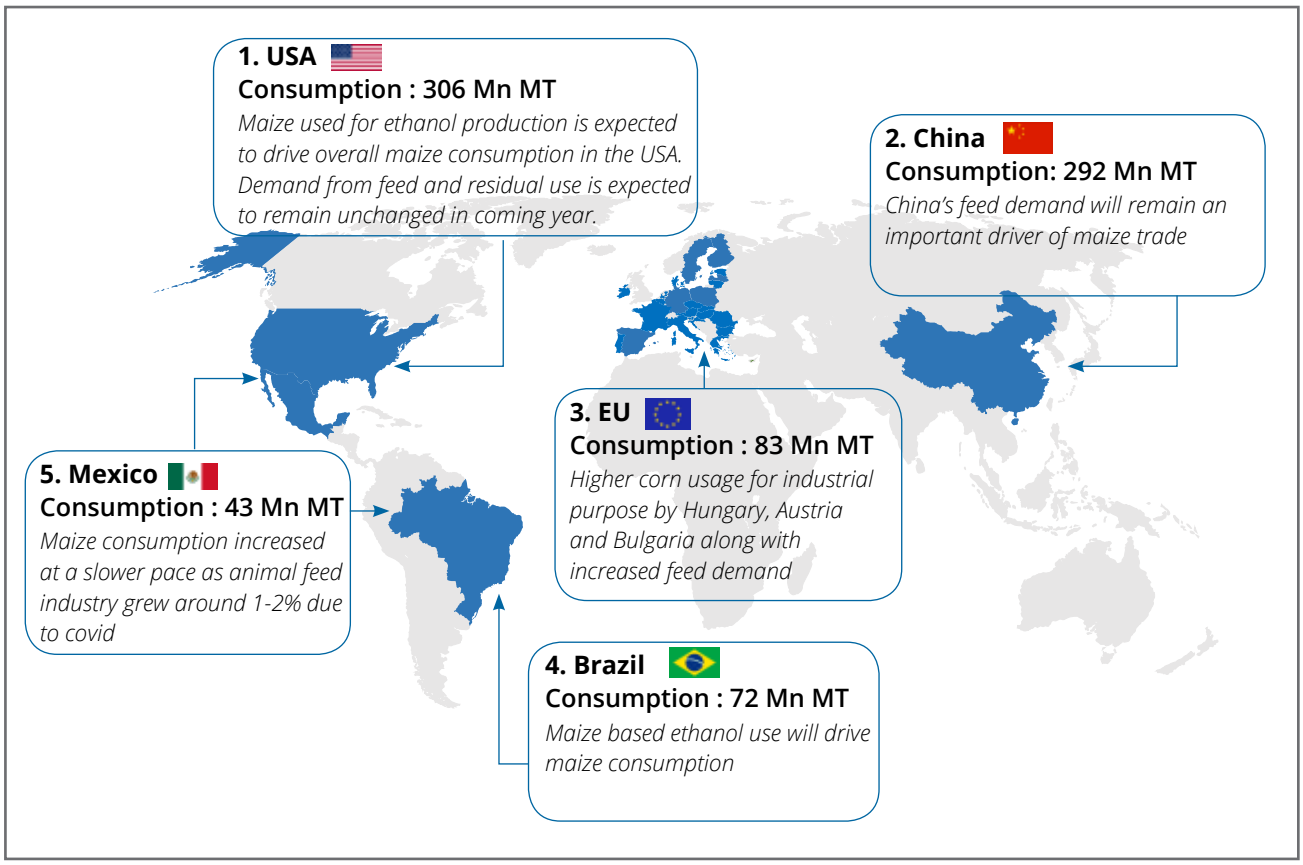
Source: OECD-FAO Agricultural Outlook 2021-2030, , WASDE (March 9, 2022 edition), USDA Grain (March 2022 edition)

2.2 Global Maize Consumption

In the year 2020, the global consumption of top three cereals (maize, wheat, and rice) stood at 2.5 Bn MT of which maize contributed to about 48% share[8]. Over the last decade, global maize consumption has increased from about 879 Mn MT (2010) to 1,186 Mn MT (2020) growing at a CAGR of 3.0% (refer Exhibit 5). Maize has attained a position of an industrial crop as about 85% of its production in the world is used in feed, starch, biofuel, and other industrial uses[9]. The emerging ethanol industry is expected to absorb a larger share of the maize produce which could further intensify demand competition.

Exhibit 4 below highlights the top 5 maize consuming nations in 2020 which included USA (26%), China (25%), EU (7%), Brazil (6%) and Mexico (4%). China is one of the largest animal feed producers in the world. Around 60% of the total maize production in China is utilized for animal feed production and only 10% is utilized for human food and seeds whereas in the USA approximately 45% of the maize produced is utilized for feed production. Global consumption of maize is less concentrated than production. Nonetheless, 67% of global consumption occurs in the top 5 maize producing countries.

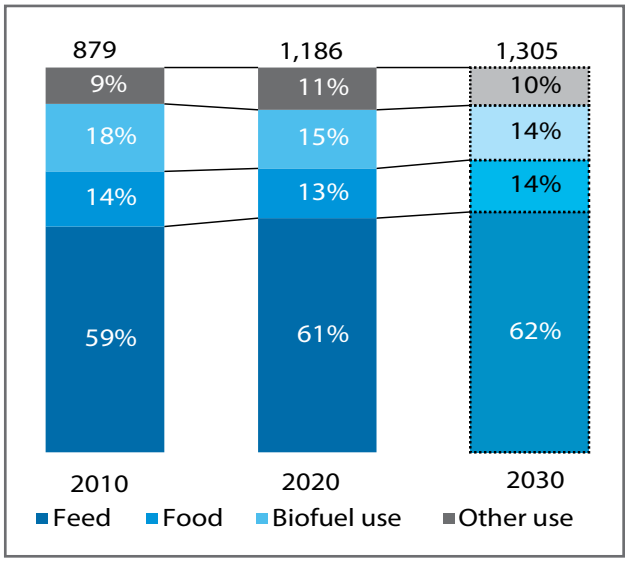
Exhibit 4: Top 5 global consumers of maize in 2020



Source: OECD-FAO Agricultural Outlook 2021-2030, OECDSTAT, WASDE (March 9, 2022 edition), USDA Grain (March 2022 edition)

Global consumption of maize is projected to increase to 1.3 Bn MT in 2030, driven mainly by higher incomes that translates into higher feed demand (refer Exhibit 5). Developing countries are expected to account for almost 3/4th of the increase in feed consumption due to fast expanding livestock and poultry sectors. In the year 2020, around 61% of the total maize was consumed by the feed industry as compared to 15% and 13% for biofuel and food respectively (refer Exhibit 5). By 2030, the share of maize used in animal feed is expected to further increase to about 62% chiefly due to fast expanding livestock sectors in developing countries. Growth in maize consumption as food is strongest in African countries amongst all developing countries at about 2.5% per year supported by strong population growth.[10] Growth of maize for biofuel production is expected to be limited, as current biofuel related policies may not support further expansion from major producers.

Exhibit 5: Global trends in sectoral off take of maize



Source: OECD-FAO Agricultural Outlook 2021-2030, YES BANK Analysis

2.3 Global Maize Trade Trends

In the year 2020, about 184 Mn MT of maize was traded across countries and is expected to grow to 207 Mn MT by 2030.[11] Top 5 maize exporters contributed to about 88% of the global exports, led by USA (35%), Argentina (20%), Brazil (18%), Ukraine (13%) and Russia (2%) (refer Exhibit 6). USA has retained its position as top exporter over the years but there has been a declining trend in maize exports from the USA. The reason for decrease in exports from USA is due to maize being consumed locally for production of ethanol. The rising demand for maize and decrease in exports from USA has led to an increase in prices globally.

Top 5 maize importers contributed only about 44% of global share led by China (11%), EU (10%), Mexico (8%), Japan (8%) and S. Korea (6%) (refer Exhibit 6) indicating less concentration of imports. China has become a maize deficit country over the past few years due to high demand growth from feed industry and the data shows that its imports rose by about 62% to 20 Mn MT during 2019-2020 making China the leading importer of maize during 2020. Every year China consumes about 175 Mn MT of maize in animal feed.[12]



[10] *OECD-FAO Agricultural Outlook 2021-2030*
[11] *OECD-FAO Agricultural Outlook 2021-2030*
[12] *OECD-FAO Agricultural Outlook 2021-2030*

Exhibit 6: Top exporters and importers of maize in 2020 (Mn MT)

Country	Volume exported (in Mn MT)	% Share
USA	65	35%
Argentina	37	20%
Brazil	33	18%
Ukraine	24	13%
Russia	4	2%

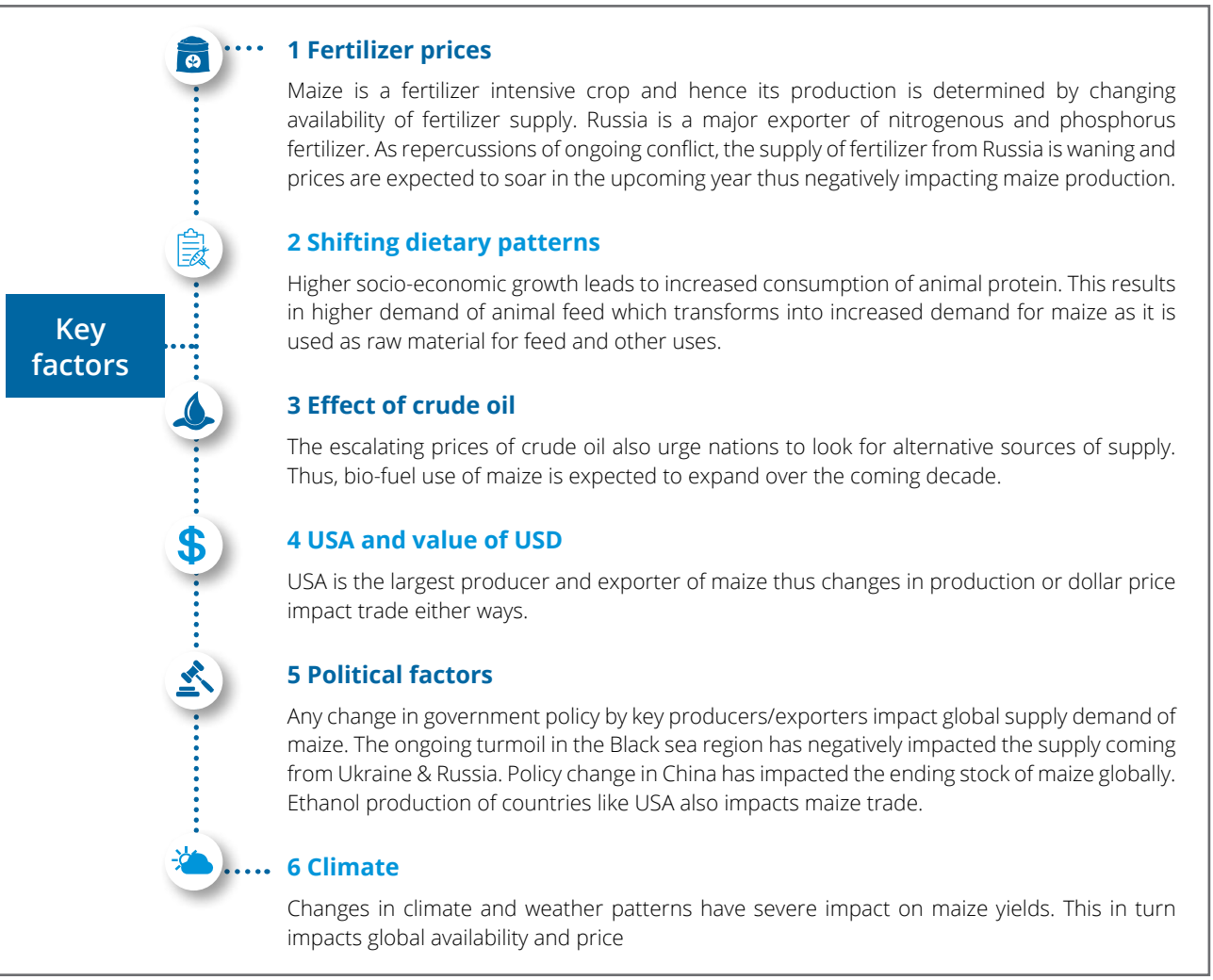
Country	Volume imported (in Mn MT)	% Share
China	20	11%
EU	19	10%
Mexico	16	8%
Japan	16	8%
Korea	12	6%

Source: OECD-FAO Agricultural Outlook 2021-2030, YES BANK Analysis



Key factors influencing global supply-demand of maize are captured in the Exhibit 7 below.

Exhibit 7: Key Factors Impacting Global Supply-Demand of Maize



Source: Industry Sources, YES BANK Analysis

Impact of Russia-Ukraine conflict on world maize supply & demand is captured in the Exhibit 8 below.

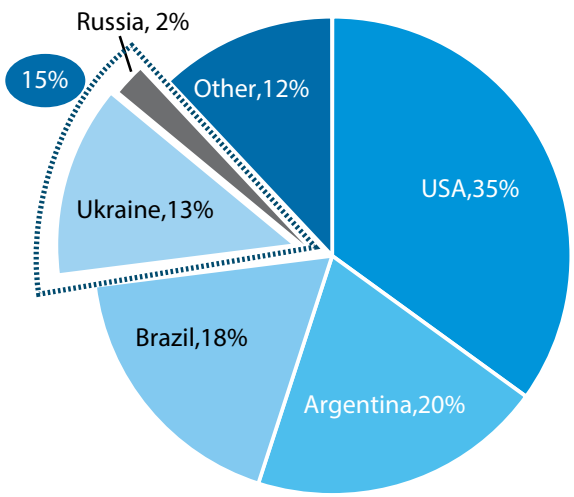
Exhibit 8: Effect of the Black- sea conflicted region on world maize supply & demand

Ukraine is known as the grain basket of the world. With respect to maize the country is a key supplier of non-GMO maize to the world. In the year 2020, Ukraine alone exported 24 Mn MT of maize which accounted for about 13% of the global exports in volume terms. The ongoing military unrest in the black sea region has disrupted the commercial activity and trade operations.

Russia & Ukraine both handle a total export quantum of nearly 28 Mn MT maize annually and in lieu of the ongoing conflict, both their trading ports are blocked leading to disruption

in trade. This further increases the pressure on the biggest global supplier of maize i.e. USA to supply for the deficit as well. As per USDA, the country has ample supplies and could fill the gap until South American exports (supply of second crop from Argentina & Brazil) are fully available in market. However, the soaring maize prices may urge some importers capable of substitution to look for alternative sources of supply. According to International Grains Council (IGC), the maize price has reached USD 350 per MT for the first time for a major exporter (USA), highest in over 20 years. Bids for all major exporters touched record highs in early March of 2022.

Share of Ukraine & Russia in global trade of maize in 2020



Source: OECD-FAO Agricultural Outlook 2021-2030, USDA Grain: World Markets & Trade (2022 edition)

2.4 Global Maize Stock and Price Trends

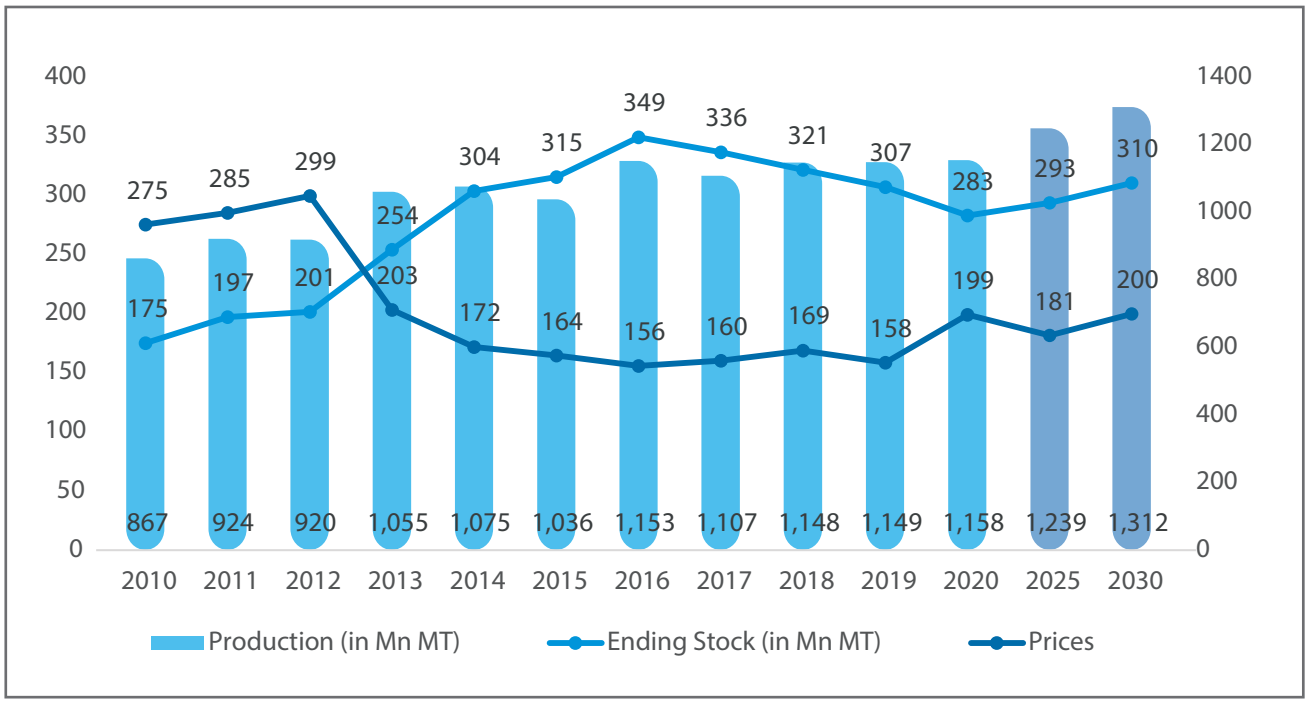
The world maize price averaged USD 199/MT in 2020[13], the highest level in last six years. In coming decade, declining stocks combined with strong global feed demand is expected to support maize prices to reach nearly USD 200/MT by 2030 in nominal terms (refer Exhibit 8). USA being the largest producer as well as exporter of maize drives the maize prices globally. Last year US maize export prices annual change was nearly 25% year leading to high trading price of maize globally.[14]

Maize is a fertilizer intensive crop and a rise in fertilizer prices leads directly to higher input costs for the farmers. Fertilizer prices saw an unprecedented rally in last year following a surge in prices of key feedstocks including maize and certain export restrictions put in place by supplying countries. Global maize prices are also being impacted by high ocean freights which were already at 7-8 year high due to covid outbreak and got further impacted by the ongoing Russia-Ukraine conflict further leading to high global maize prices.

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 expected to increase from 283 Mn MT in 2020 to about 295 Mn MT in 2025[15] (refer Exhibit 9).

[13] *as measured by the benchmark US maize No. 2 Yellow (fob)*
[14] *https://www.igc.int/en/markets/marketinfo-prices.aspx*
[15] *OECD-FAO Agricultural Outlook 2021-2030*

Exhibit 9: Movement of global maize stock and price vis-à-vis production



Source: OECD-FAO Agricultural Outlook 2021-2030





Maize in India: Supply - Demand Scenario

With an annual production of about 28.8 Mn MT (2019-20),[16] maize is ranked the 3rd most important food grain crop in India after rice and wheat. Globally, India ranks 4th in terms of acreage and 6th in terms of annual production, contributing to about 4.9% and 2.6% to world acreage and production respectively.[17] Over the last few decades, maize cultivation has shifted from being grown only during the kharif in traditional areas (such as Rajasthan, Uttar Pradesh and Bihar), primarily to be used as food, to being grown across non-traditional areas (such as Andhra Pradesh, Madhya Pradesh and Karnataka), across seasons and primarily for industrial use. However, the production system continues to be largely rain-fed, with most of the cultivation primarily being carried out by small and marginal farmers. The average land holding of maize in India is estimated to be about one Ha[18].

Maize is also the fastest growing cereal crop in India in terms of area, production as well as productivity. Between the year 2010-11 and 2019-20, while acreage, production and yield of maize have grown at a CAGR of 1.1%, 2.8% and 1.7% respectively, that of food grains has grown at -0.2%, 2.0% and 2.2% respectively[19]. This performance in maize crop has been driven by three key factors namely

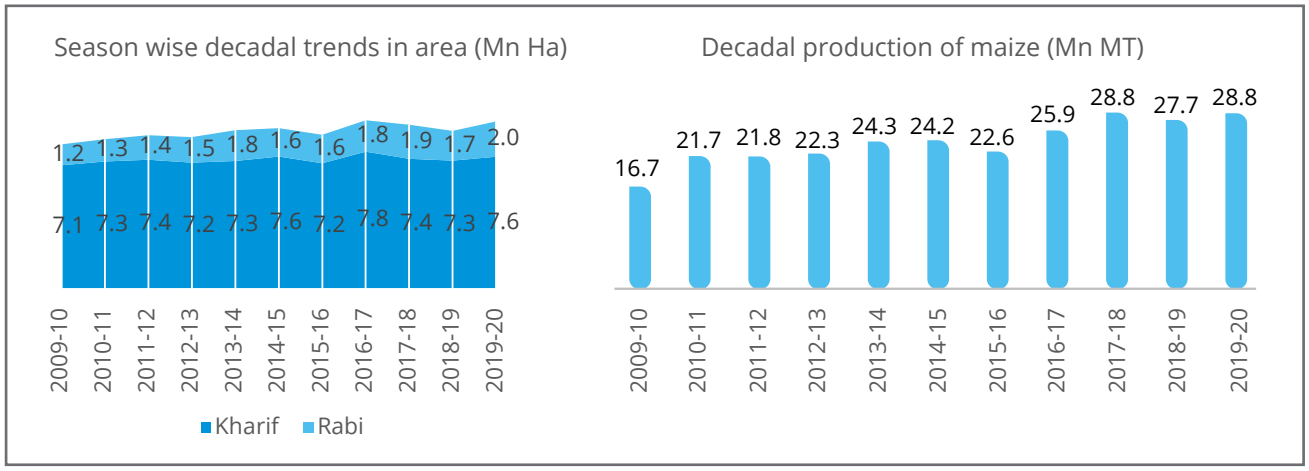
1. **Strong support from government for crop diversification and Minimum Support Price for farmers**
2. **Strong growth in demand from Poultry Feed and Starch Industry**
3. **Significant improvement in adoption of HYV seeds resulting in increased productivity**

[16] *Ministry of Agriculture & Farmers Welfare*
[17] *FAOSTAT*
[18] *Source: : https://iimr.icar.gov.in/maize-statistics-india/, average land holding for the year 2015-16*
[19] *Ministry of Agriculture & Farmers Welfare*

3.1 India Maize Production

In the year 2019-20, maize was cultivated across about 9.6 Mn Ha across India with national production touching 28.8 Mn MT[20]. Over the period (2010-11 to 2019-20), production increased at a CAGR of 2.8% while acreage under cultivation has grown by just about 1.1%. Clearly, increase in production has primarily been driven by improved yields, which enhanced from 2.5 MT/ha to 3.0 MT/ha over the period - principally due to use of high yielding variety seeds. Exhibit 10 highlights trends in area and production of maize crop in India from year 2010-11 to year 2019-20. Kharif remains the main season for cultivation of this crop, contributing to around 80% of acreage and about 70% production[21]. However, in past few decades, rabi maize has gained significant prominence in total maize production in India.

Exhibit 10: Season wise decadal trends in area (Mn Ha) and production of maize (Mn MT) in India



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

Maize farmers, mostly in non-tradition areas, have expanded the usage of improved hybrid seeds. Since the early 1990s, many private seed companies have been focusing on developing HYVs, primarily single cross hybrids that could replace traditional varieties and old hybrids. Hybrid maize, which is mostly feed and industrial grade maize, accounts for around 75% of the planted area in India, while food grade maize is produced using traditional cultivars in traditional maize consuming states in the northern parts of India.[22]

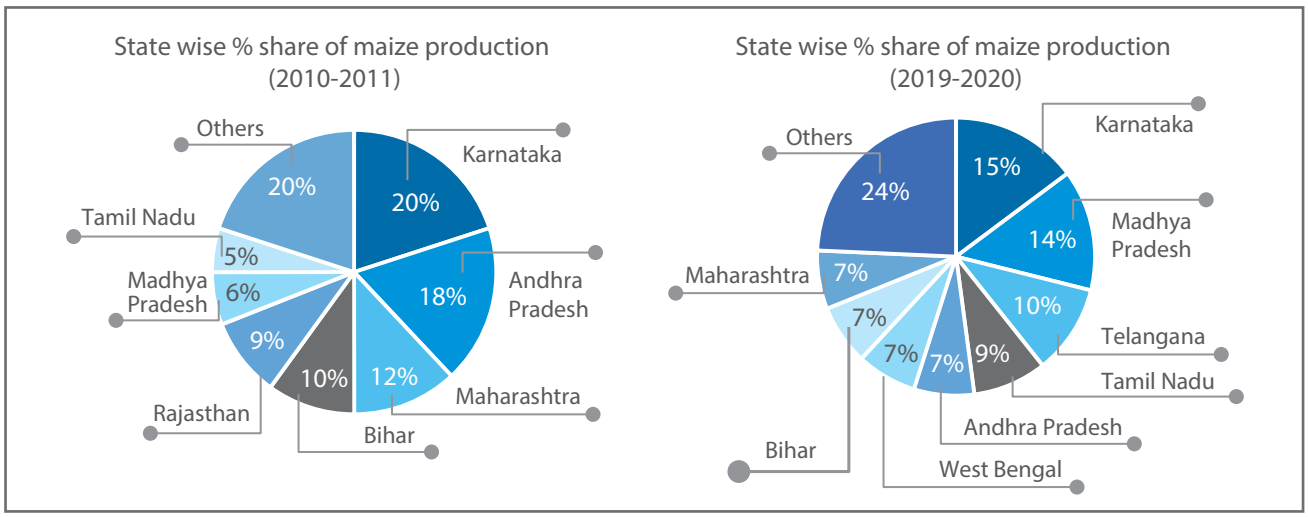
Maize is cultivated throughout the year in all states of the country. In terms of regional distribution, top 5 states contributed close to 55% of India's total maize production in 2019-20, with Karnataka (15%), Madhya Pradesh (14%), Telangana (10%), Tamil Nadu (9%) and Andhra Pradesh (7%) topping the list (refer Exhibit 11). Over the period 2010-11 to 2019-20, West Bengal contributed the most to growth in production, growing at a CAGR of 21%, followed by Madhya Pradesh (16.2%), and Tamil Nadu (10.3%).

[20] *Indiastat*

[21] *https://iimr.icar.gov.in/wp-content/uploads/2020/03/Maize-production-system-book.pdf*

[22] *Grain and Feed Annual – 2021, USDA*

Exhibit 11: State wise trends in maize production, 2010-11 to 2019-2020

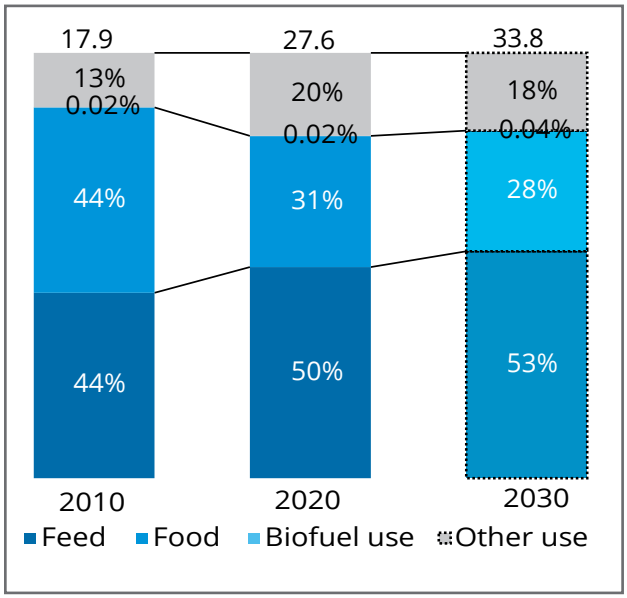


Source: Ministry of Agriculture and Farmers' Welfare, GoI, YES BANK Analysis
*Note: * CAGR Data for Andhra Pradesh and Telangana taken together as base year data not available*

3.2 India Maize Consumption

India's maize consumption was estimated at 27.6 Mn MT during 2020 and is forecasted to reach 33.8 Mn MT in the year 2030 (refer Exhibit 12). 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 12 depicts the trend of maize consumption in India. In the year 2020, around 50% of the total maize was consumed by the feed industry as compared to 31% for food. Usage of maize for bio-fuel is still at nascent stages in India and less than 1% maize is currently being utilized for the same. By 2030, the share of maize used in animal feed is expected to further increase to ~53% 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.

Exhibit 12: Trends in sectoral off take of maize in India



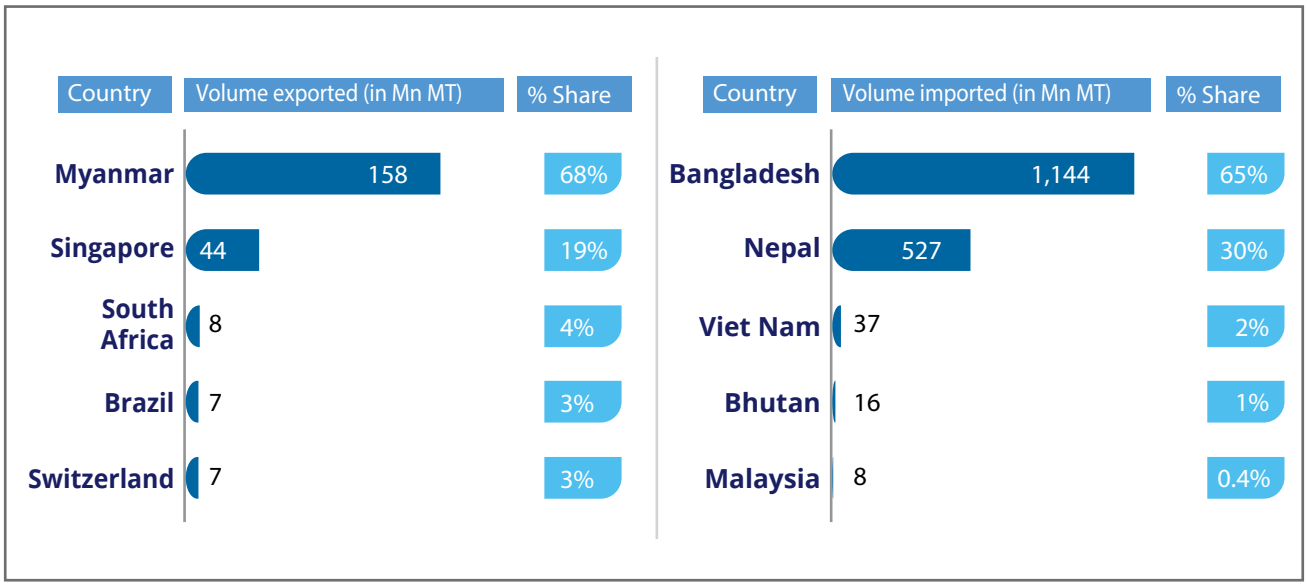
Source: OECD-FAO Agricultural Outlook 2021-2030

3.3 India Maize Trade Trends

India imported 231.8 Mn MT of maize in the year 2020 and Myanmar was the major exporting nations to India contributing to 68% of total maize

imports. In 2019, India imported around 80% maize from Ukraine, but no imports were done in 2020[23]. India exported 1.8 Mn MT of maize in 2020 and top countries who imported maize from India were neighboring countries of Bangladesh, Nepal, Vietnam, Bhutan, and Malaysia. India exported maize based on competitive pricing, proximity to markets, and the possibility of shipping smaller consignments overland. Exhibit 13 highlights the top 5 maize exporters to India and top 5 importers from India.

Exhibit 13: Top 5 Maize trade partners for India- Quantities in Mn MT, 2020

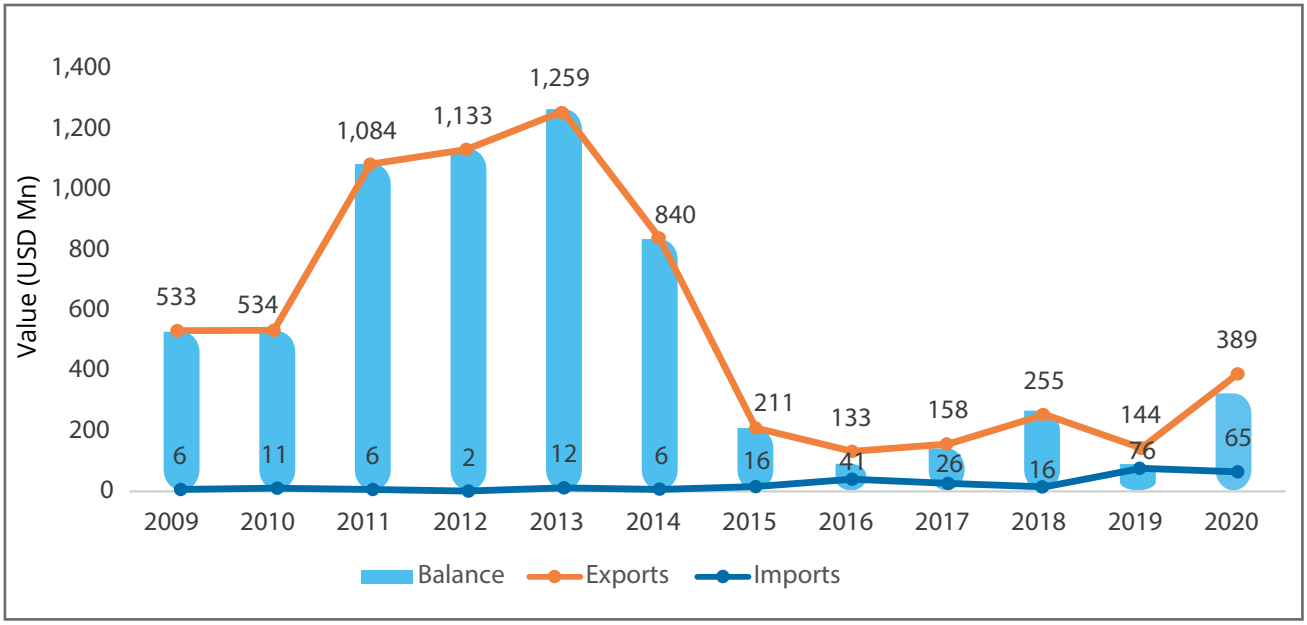


Source: ITC Trade Map (for HS Code 1005), YES BANK Analysis

Maize used to contribute significantly to India's agri export basket in the past. In the year 2011, Indian maize exports crossed the USD 1 Bn mark and touched a peak of USD 1.26 Bn in 2013 (refer Exhibit 14). However, strong domestic demand, inconsistent supplies due to pest attacks/dry weather and the fact that MSP was higher than global prices, has resulted in drastic reduction in exports in following years till 2019. The scenario changed in 2020 with maize export increasing by three times (as compared to 2019) to USD 389 Mn supported by bumper crop harvest and export to newer destinations like Vietnam. As per APEDA, maize exports from India further touched USD 930.2 Mn in 2021-22 (April - February)

[23] *ITC Trade Map & YES BANK Analysis*

Exhibit 14: Maize – Import and Export Trends



Source: ITC Trade Map (for HS Code 1005)

From an import's perspective, the source of origin of maize imported into India is restricted- to prevent entry of genetically modified produce. FSSAI issued a notification in August 2020 to ensure only non-GM food crops are imported in India accompanied with Non-GM origin cum GM free certificate. Moreover, maize imports attract an import duty of 15% under Tariff Rate Quota (TRQ) of 500,000 MT and 50% duty out of the TRQ[24]. However, given that consumption is growing faster than production in the country, and the fact that there are long periods of non-availability during a year due to seasonality, the Government provides for Import quota for select industries (such as poultry) on an adhoc basis. During such periods of shortage, certain industries, such as the starch industry, suffer significant shortage of raw material as they cannot substitute maize with any alternative crop for starch. Starch industry import corn under advance license system (industry can import without any duty but have to necessarily export about 1.8 times the value of imports post value addition).

Maize emerging as one of the significant foreign exchange earners among commodities covered under APEDA

The export of maize has touched USD 930.2 Mn in 2021-22 (April-February), exceeding the USD 634.85 Mn achieved during the last financial year. From an export's realization of USD 142.8 Mn in 2019-20, the export of maize increased sevenfold in 2021-22 despite logistical challenges posed by the COVID19 pandemic outbreak. Neighboring countries like Bangladesh and Nepal are the major importers of maize from India.

[24] *Industry sources*

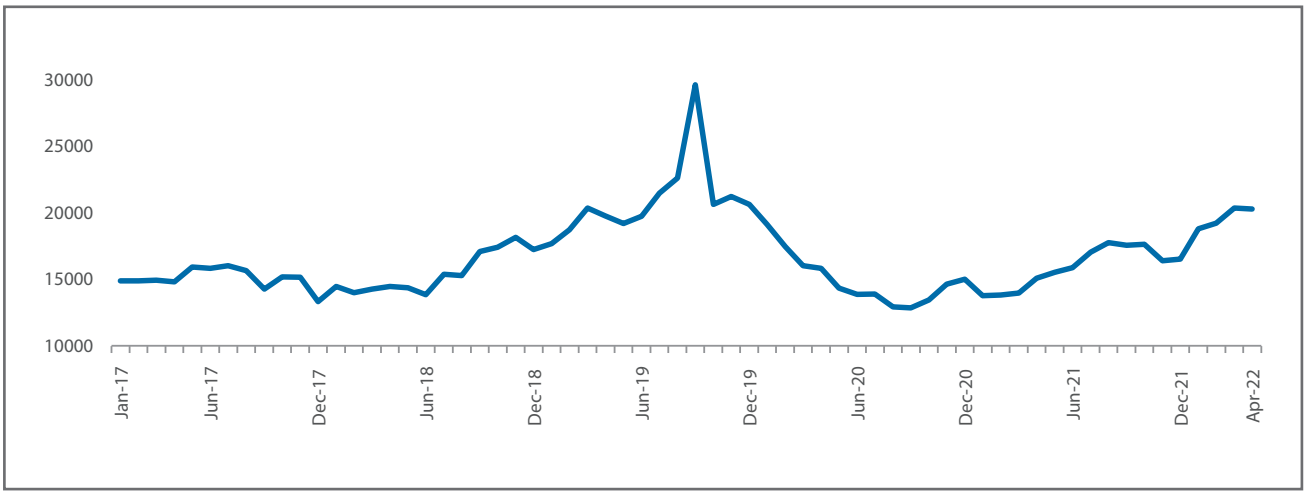
With initiatives of the Ministry of Commerce & Industry to explore and diversify new markets, Vietnam has emerged as a major destination for export of maize. India exported maize worth USD 289.1 Mn to Vietnam during 2021-22 (April-February). Other prominent importing countries are Malaysia, Myanmar, Sri Lanka, Bhutan, Taiwan and Oman.

Source: APEDA

3.4 India Maize Price Trends

An overview of the maize wholesale price in India since 2017 is depicted in Exhibit 15 below. There has been a wide variation in maize wholesale prices, ranging from INR 12,867/MT to INR 29,642/MT. From its peak of INR 29,642/MT in September 2019, maize prices started dipping in 2020 reaching to about INR 12,867/MT in September 2020, lowest in last 5 years. Since then, there has been a gradual, yet tentative recovery with prices touching INR 20,306/MT in April 2022 close to last 5 years peak. Industry interactions suggest that prices are further expected to increase by 5-7% over next 6 months.

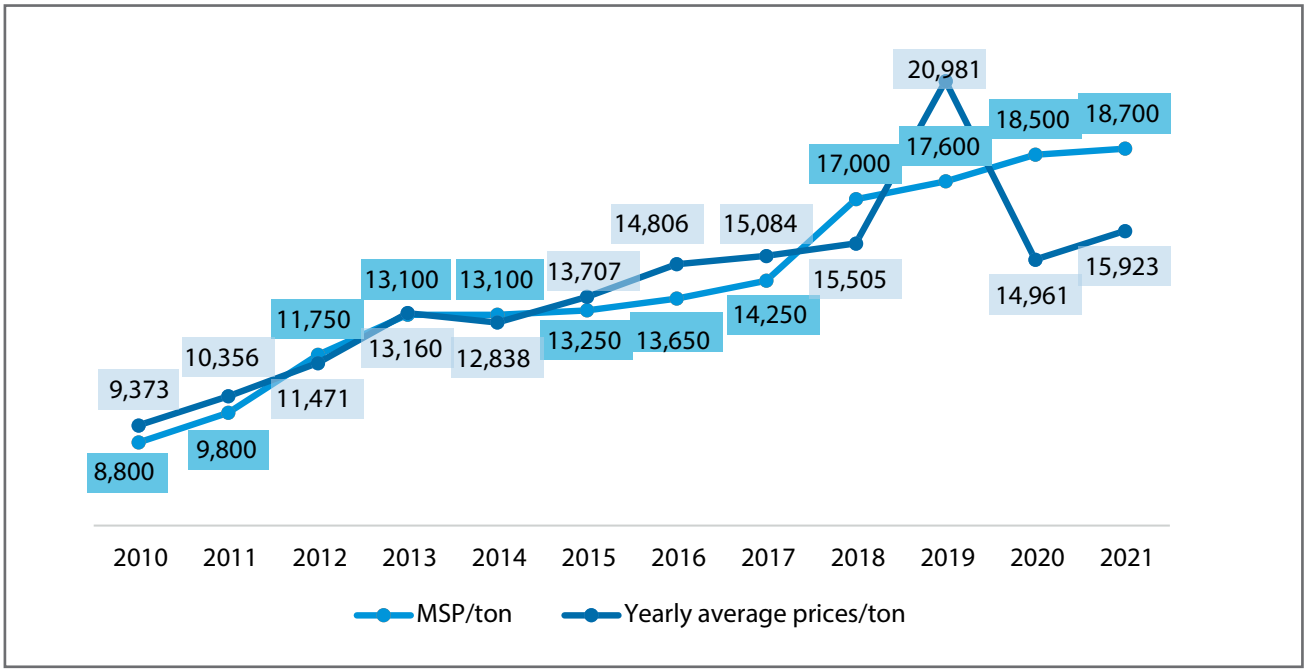
Exhibit 15: India National Average Maize price



Source: Agmarknet

Exhibit 16 below indicates the average wholesale price of maize and its MSP during last 5 years. While for the most part, market price tends to be lower than MSP, it was significantly higher than MSP during 2019 as India's maize output during that year was impacted due to dry weather and infestation by fall armyworm.

Exhibit 16: Comparative assessment of MSP vs APMC Market Price of Maize (2010-2021)



Source: Agmarknet, https://farmer.gov.in/mspstatements.aspx





Overview of Sector wise Demand and Sourcing Requirement of Maize

4.1 Feed Industry

India is one of the largest and fastest growing compound feed markets in the world with total feed production of 44.06 Mn MT in 2021[25]. Poultry, aqua and dairy industry occupy the major share in overall feed demand. The feed industry requirements that are met with compound feed are 72-75% for poultry feed, 12-15% for aqua feed and 10-12% for cattle feed[26]. In general, raw materials that are used as ingredients for preparing animal feeds include maize, wheat, bajra, soybean, oil cakes, sugarcane, and rice bran among others.

Maize is used extensively as the main source of calories in animal feed formulations as it leads to the highest conversion of dry substance to meat, milk, and eggs as compared to other cereal grains. With its low protein and crude fiber content, it is ideal for poultry. In the poultry feed industry maize constitutes on an average 60% of the feed and therefore is a critical raw material. Region wise composition of poultry feed is captured in Exhibit 17.

Exhibit 17: Regional trends in crop wise contribution to poultry feed

North	East
Corn (60%) + soybean (25%) and rest of farm gate wastages e.g rice/ wheat/ meat meal	Corn (60%) and mix of rice/ sorghum
West	**South**
mix of corn + soybean	Corn (65%) + soybean (30%) and rest of it is oil, groundnut, sunflower residues and fish meal

Source: Industry sources

[25] *Alltech Agri-Food Outlook 2022*
[26] *Grain and Feed Annual 2021, USDA*

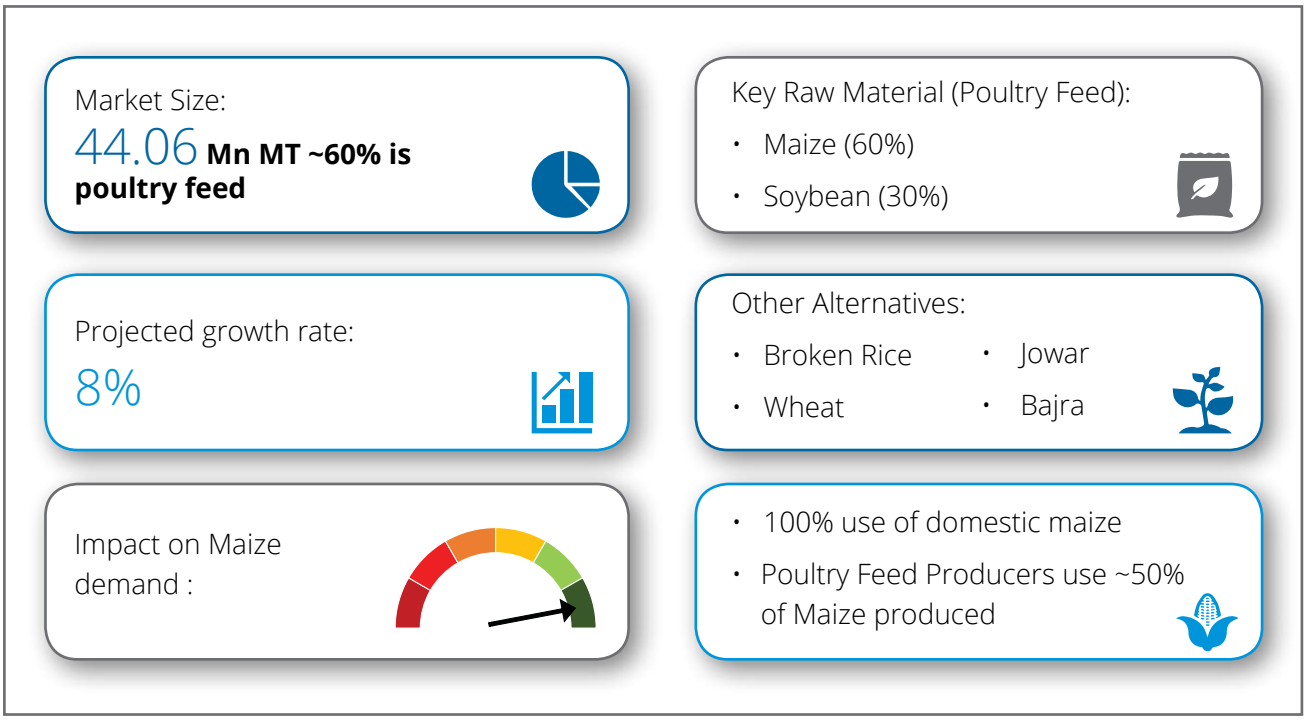
India has grown to be the 5th largest egg producer globally and 18th largest producer of broiler chicken.[27] Growing Indian economy and expanding middle income consumers is driving demand for animal protein derived from the poultry and livestock sector. Annual growth in demand is expected to range from 8-10% for egg and broiler industry, implying a rising demand for maize as feed.[28] Since maize is the key raw material for poultry feed across regions, rising poultry consumption would lead to a spurt in maize demand.

Apart from poultry feed, maize is also used as one of the ingredients in cattle feed (about 15%)[29]. With increased focus on improving cattle productivity dairy farmers are replacing homemade feed mixes of oil cake, household food waste, and lower quality wheat & grains to compound feed. This is leading to increased demand for commercial dairy feed, which is growing by 10-12% annually[30].



[27] *https://apeda.gov.in/*
[28] *www.apeda.gov.in*
[29] *Industry sources*
[30] *Grain and Feed Annual 2021, USDA*

Exhibit 18: Overview of feed industry and maize usage in the industry



Source: Industry Sources, Alltech Agri-Food Outlook 2022 OECD-FAO Agricultural Outlook 2021-2030, YES Bank Analysis

4.2 Starch Industry

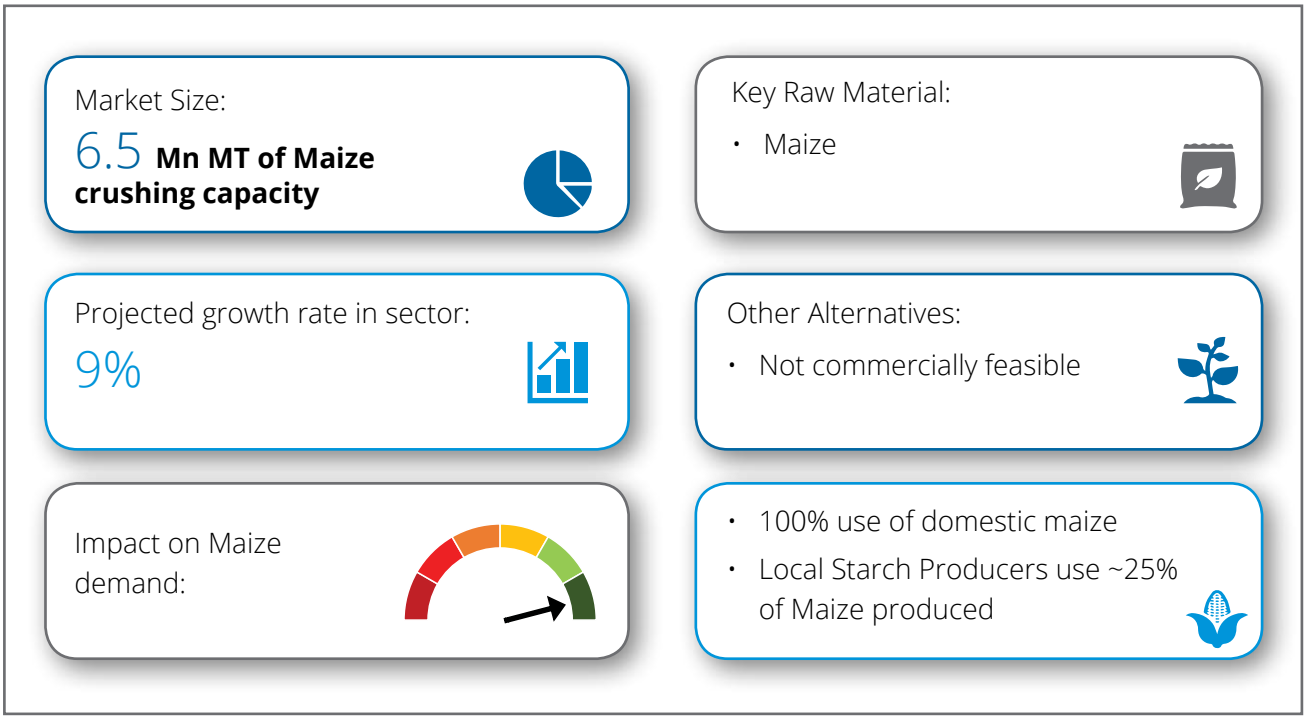
Maize has about 60-65% per cent starch content, which makes it suitable raw material for starch processing. The starch industry in India has a crushing capacity of approximately 6.5 Mn MT and majorly depends on maize for production of starch for multiple industrial and food uses. India's starch production is expected to reach a volume of 8.5 Mn MT by 2026, with a CAGR of 9% (2021-2026)[31]. Maize starch and its derivatives have wide utility across food, paper, pharmaceutical, textile industry, cosmetics, adhesives, and bioplastic. High value derivatives from maize include corn glucose, corn oil, dextrose, and sorbitol are mainly used by food processing industry.

In the food sector, maize starch and derivatives are used as sweetener, flavor & colour enhancer, thickening agent and stabilizer, inducer of crispiness, bulkiness/carriers, anti-crystallization, texture, humectant, dusting, and extrusion. The sweeteners derived from maize starch is becoming a replacer of sugar in industrial use especially when sugar prices are high.

The Indian starch industry is at nacent stage and derives about 40 products from Maize, whereas more than 800 products of starch and starch derivatives can be derived. The per-capita starch consumption in India is estimated to about 1.5 kg / annum, compared to 64 kg in US and 6 kg globally indicating huge potential of usage. Rising health consciousness among consumers is driving preference for products using maize starch and derivatives due to their nutritional superiority.

[31] *https://www.imarcgroup.com/native-starch-market-india*

Exhibit 19: Overview of starch industry and maize usage in the industry



Source: Industry Sources, OECD-FAO Agricultural Outlook 2021-2030, YES Bank Analysis

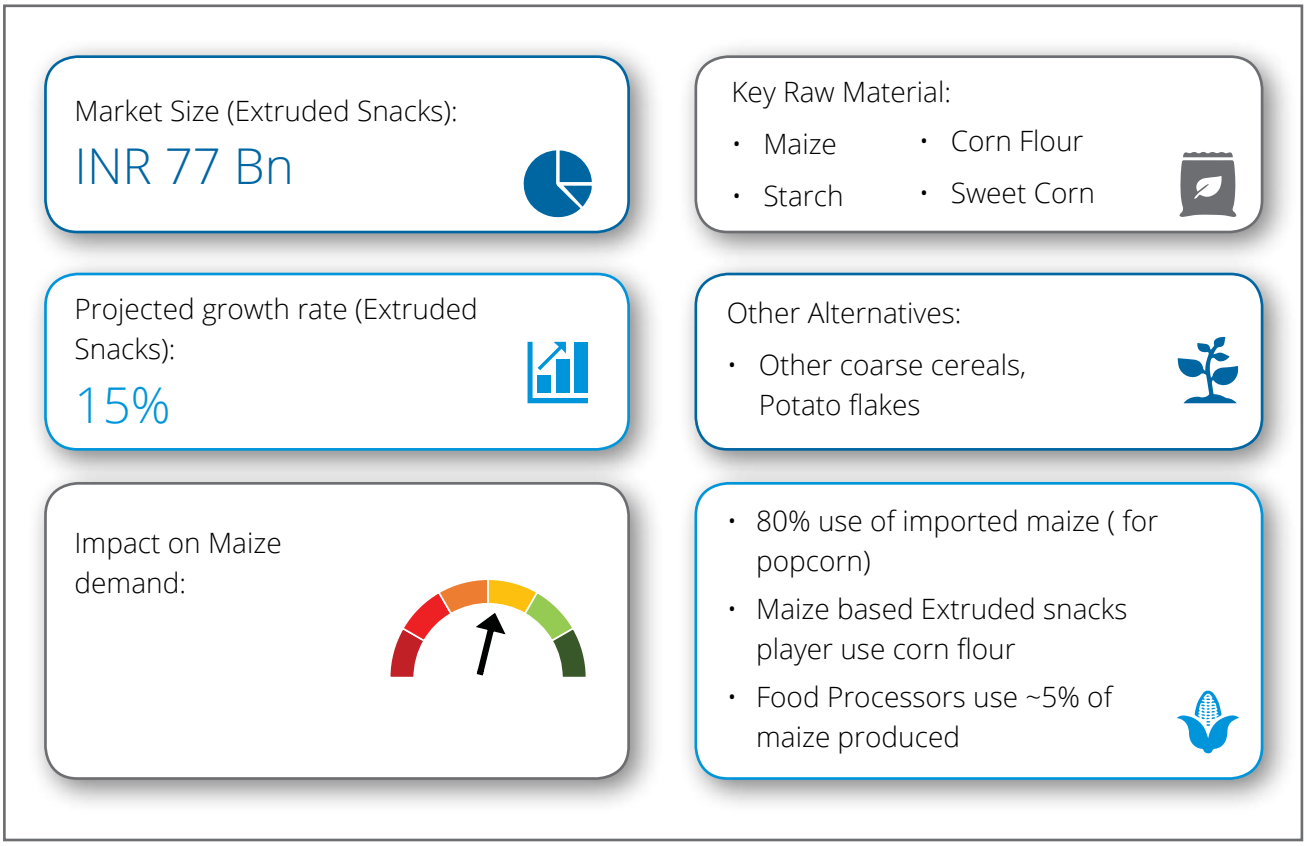
4.3 Food Industry

Due to product innovation and consumer health consciousness, the focus is shifting towards snacks that are mostly baked or roasted. Ingredients such as maize, are used for these processed snacks and savories. Maize based snacks are comparatively low in bulk density and are popularized as high-fiber and comparatively low-calorie healthy snacks. Demand of food grade corn for processed food is estimated to be growing in double digits due to its use for cornflakes (as breakfast cereal and RTE savories), extruded snacks, traditional namkeen and popcorn. Popcorn comprises only 0.3% of the snacking industry in India indicating huge potential for growth[32]. Frozen sweet corn and baby corn, which are the niche varieties of corn, are the other two categories that are showing double digit growth owing to their health benefits and exotic nature.

Availability of rice and wheat through the public distribution system at low prices is resulting in 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. In traditional areas such as Rajasthan, maize is primarily grown for preparation of maize flour – which in turn is used for preparation of traditional food such as "makki roti". Growing demand for coarse grain fortified or multigrain flour is expected to drive maize demand in urban areas.

[32] *Industry sources*

Exhibit 20: Overview of food industry and maize usage in the industry



Source: Industry Sources, OECD-FAO Agricultural Outlook 2021-2030, YES Bank Analysis

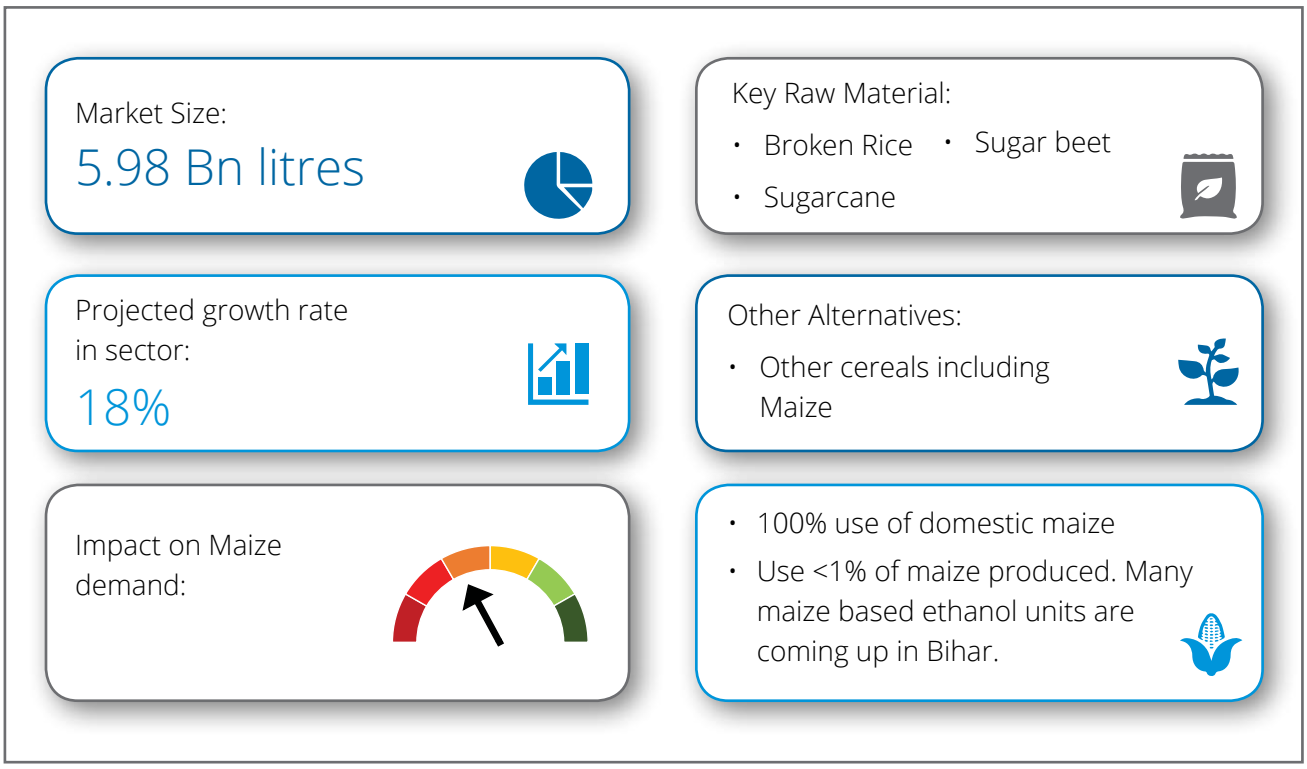
4.4 Ethanol

The ethanol production in India is projected to grow from 5.98 billion liters (ESY 21)[33] to 13.50 billion liters (ESY 26), exhibiting a CAGR of 18%, on the back of increasing ethanol use in applications such as fuel additives and alcoholic beverages.

India's domestic ethanol program uses molasses (a sugar industry byproduct) as feedstock. In year 2020, GoI allowed use of grain such as rice and corn for producing ethanol for fuel. Recently, government has announced extension of subsidized credit to grain-based distilleries as well to boost ethanol production for bio-fuel. Due to Fuel Blending Program (BFP), ethanol production is expected to increase by three to five folds in the coming future. The government has set a target of achieving 10% bio-ethanol blending of petrol by 2022 which is further targeted to reach 20% by 2025.

[33] *Ethanol Supply Year (December – November)*

Exhibit 21: Overview of ethanol industry and maize usage in the industry



Source: Industry Sources, OECD-FAO Agricultural Outlook 2021-2030, YES Bank Analysis



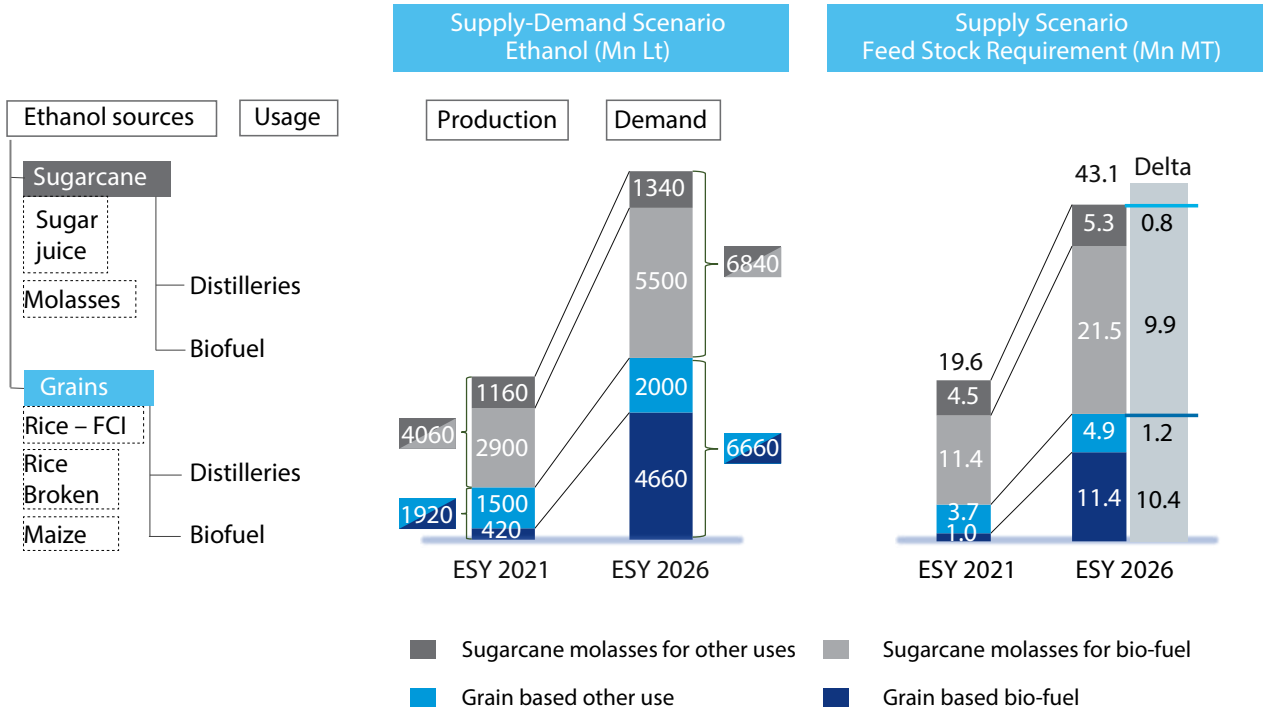
Overview of demand-supply scenario for bio-ethanol in India and usage of grain for its production is provided in Exhibit 22 below.

Exhibit 22: Grain Usage in Bio-ethanol

India's National Biofuel Policy (NBP-2018)

- Targets 20% (E20 program) blending of ethanol in petrol by 2025 under the Ethanol Blended Petrol (EBP) Program.
- Oil Marketing Companies (OMCs) assure offtake tie-ups: Through annual contracting mechanism
- Govt announces incentive of 6%interest subvention for 5 years
- The Cabinet Committee on Economic Affairs (CCEA) approved a modified scheme for extending 6% interest subvention for 5 years for those setting up grain-based along with molasses-based ethanol distilleries. The total outlay of the scheme is INR 84.6 billion for increasing India's ethanol production capacity, with the scheme extended to those setting up distilleries using grain, molasses, dual feed, sugar beet, sweet sorghum, and cereals as a feedstock.

Demand & Supply Scenario for Bio-ethanol



In 2021, majorly sugarcane juice and molasses were used to produce ethanol for both distilleries and to be used as bio-fuel. Only 7% of ethanol production was done by using grains which primarily included rice supplied by FCI and broken rice. Maize contribution in grain usage of ethanol production is still very miniscule. In 2026, the demand for ethanol is expected to reach to 13,500 Mn litres, more than double of existing demand and contribution of ethanol production from grains is expected to increase to 50% (equivalent to that from sugarcane). Around 11.4 Mn MT of grains will be required to meet the demand for bio-ethanol production.

Sourcing of raw material is a critical success factor for ethanol industry. Sugarcane based ethanol is likely to face less shortage / supply challenges compared to grain based (if the proposed capacity comes up). Presently, FCI has surplus stock of rice/broken rice which can be diverted to ethanol production but being a staple grain its availability to meet future demand of bio-ethanol industry is still debatable.

Presently, availability of maize for bio-ethanol production is not sufficient due to high demand and its production from maize is not economically viable due to volatile prices. Few ethanol units are coming up in Bihar, which is one of the key maize producing state, for better raw material availability at lower prices.

With rise in petrol prices, government might further push the production of bio-ethanol through various incentives which might lead to diversion of maize to bio-ethanol industry and making availability of maize a challenge for other end users.

Source: Roadmap for Ethanol Blending in India 2020-25, Niti Aayog, June 2021, Industry Sources, 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 good quality product.

Maize requirement characteristics and their importance for key end use sectors is provided in the Exhibit 23 below. All listed characteristics are most important for food sector[34] 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.

[34] *Hardness and low moisture content relevant for popcorn only*

Exhibit 23: Maize Requirement Characteristics for Key End Use Sectors

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

Source: Industry sources, YES Bank Analaysis

4.5 Value Chain Leg-wise Hurdles to Supply Security

With domestic demand for maize growing faster than production and the fact that maize provides the right avenue for crop diversification and increasing farmer income, 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 prices on one hand, while constraining the availability of good quality produce to the end users at reasonable price on the other. Some of the key challenges to secure supply across the maize value chain are highlighted below.



Level	Key Challenges	Description and details
Farm level	• Low productivity • Relative unattractiveness co nstraining wider crop adoption • Skewed production due to seasonality	• Yield is at 3.0 MT/ha compared to global average of 5.8MT/ha. 70% rainfed. • Just 75% usage of hybrid seeds compared to 100% in USA, Brazil and upto 86% in Bangladesh, SCH yet to be adopted in large scale • Poor pest management (Weeds, Fall Army Worm). No seed treatment • Low mechanization (for sowing & harvest just about 5-7%) • Cost of Cultivation higher than Sorghum, Bajra & even Rice & Wheat • Limited area under production in rabi
Post-harvest handling / Marketing	• Low farmer price realization due to poor quality management • Inefficient access to markets due to fragmentation	• Quality loss due to unscientific harvesting, shelling, drying and farm level storage techniques • High moisture content at the time of sale • High intermediation as land holdings are fragmented and produce quantity per farmer is low making it uneconomical to transport to market • Inefficient price discovery as produced sold at village level
Storage & Transport	• Multiple handling points and high cost of logistics due to poor bulk storage and logistics infrastructure	• Poor storage conditions result in rodent & pest attack and aflatoxin build-up • Lack of bulk storage and transportation infrastructure leading to multiple handling and high cost of transport
Processing	• Challenge of right quality & quantity at right time and price	• Varietal quality mismatch. Low starch content, high moisture content and low grain weight • High cost of raw material due to involvement of large number of intermediaries • Fluctuating prices, seasonal availability and import restrictions • End products not competitive in international market
International Trade	• Uncompetitive price of Indian maize at global level • Import restrictions	• Higher price due to strong domestic demand and rising MSPs resulted in slowing down of exports due to uncompetitive price • High import duty and lack of quota allocation to certain industries at the time of shortage. Source of origin issues.

Key sourcing challenges faced by processing industry

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

On the import front, factors such as high customs duty (upto 50%), restrictions on origin of produce (GMO free) under FSSAI notification, zero tolerance guidelines – with no LLP set and expectation of a declaration on GMO from source nations hinder industries' efforts to secure their raw material supply through import – even during situations when there is shortage of corn in the country.

That said, each constraint has varying degree of impact for each industry. An overview of select critical challenges that impact on various industries that use maize as raw material is captured herewith.

Feed Industry

- Quality: Average grain count for Indian maize stands at ~450 grains / 100 grams, whereas grain count for US number 2 maize grade is generally in the range of 295 – 300 grains/ 100 grams making it more suitable for feed industry
- Corn with high moisture cannot be used for poultry feed because it affects quality and reduces storability of feed
- Lack of availability of raw material for 4 - 5 months and skewed rabi production results in high storage and transportation costs
- Usage of competitive grains such as bajra & barley in cattle feed and sorghum, wheat and rice in poultry feed when prices of maize are too high
- Lack of bulk logistics infrastructure and need for multiple handling

Starch Industry

- Quality - Starch content in Indian maize is low close to 63 – 67% compared to 73% in US number 2 maize grade
- High domestic maize prices result in starch derivatives being uncompetitive in the international market
- High import duty and lack of import quota allocation during shortage resulting in poor capacity utilization and high costs
- Lack of clear guidelines on source of origin for imports impacting sourcing plans

Food Processing Sector

- Lack of focused R&D for development of high yielding flour maize varieties suitable for food consumption. Hence, productivity is low.
- Non-availability of right quality maize required for processing – specially for extruded snacks and popcorn. Significant quantity of maize is imported for this purpose.



Government Initiatives to Scale up Maize Supply in the Market

With a strong focus on doubling farmers' income while conserving natural resources by promoting sustainable agriculture, Government of India has rolled out several policy initiatives, schemes and programmes that benefit the entire agrultural ecosystem. Some of the key government initiatives aimed towards improving the maize supply are listed below.

Promoting maize as an alternative crop for diversification

With food grain production at a record high and the concerns of soil and water resource degradation looming large, policy makers are looking at sustainable options for increasing farmer income on one hand while balancing surplus management of rice and wheat on the other. Maize is considered a promising option for diversifying Indian agriculture, especially in rice dominated states which are stressed for water resources such as Punjab and Haryana (refer exhibit 24), given its low water requirement, growing demand in the domestic and international market as well as amenability to adapt to various agro-climatic conditions.

Exhibit 24: Mera Paani, Meri Virasat Yojana by Haryana Government

Mera Paani, Meri Virasat Yojana

Govt. of Haryana launched *"Mera Paani, Meri Virasat Yojana"* in the year 2020 to incentivize farmers for crop diversification. Under this scheme government provides financial assistance of upto INR 7000/- per acre to promote maize in place of paddy aimed at conservation of water. Farmers who produce alternative crops to paddy were also offered 80% subsidy on Micro & Drip irrigation system.[35]

[35] *https://www.nscsindia.org/mera-pani-meri-virasat-yojana/*

However, certain critical factors that are being closely reviewed as Government rolls out maize as a crop diversification alternative include- the crop's high waterlogging susceptibility, especially during the early stages of growth – making it unsuitable for black soils or regions with high water table and its comparatively high cost of cultivation vis-à-vis bajra, sorghum, rice and wheat.

To address these challenges, the Government as well as the private sector are focusing intensively on introduction of hybrid varieties that have high yield potential and are tolerant to waterlogging and other biotic and abiotic stresses - such that the cost of production comes down and net farmer revenue increase.

National Food Security Mission

National Food Security Mission (NFSM) was launched in 2007-08 to increase the production of rice, wheat, and pulses by 10 Mn MT, 8 Mn MT and 2 Mn MT, respectively by the end of XI Plan. With the success that followed post implementation, other crops such as coarse cereals and oilseeds were also included in the mission. The objectives of the scheme are: expansion of area under cultivation, enhancing production & productivity in a sustainable manner; enhancement of soil fertility, farm level economics, post-harvest value through market linkages. This scheme involves stakeholders at all levels to ensure the wider reach and increased efficiency. Currently, NFSM-Coarse cereals is being implemented in 265 districts of 28 states. The interventions covered under NFSM-Coarse Cereals include Cluster Demonstrations on Improved package of practices, Seed distribution of hybrid and HYVs, Local initiatives and other initiatives like demonstration by NGOs in remote areas, assistance for custom hiring.

Promoting collectivization and the formation of FPO

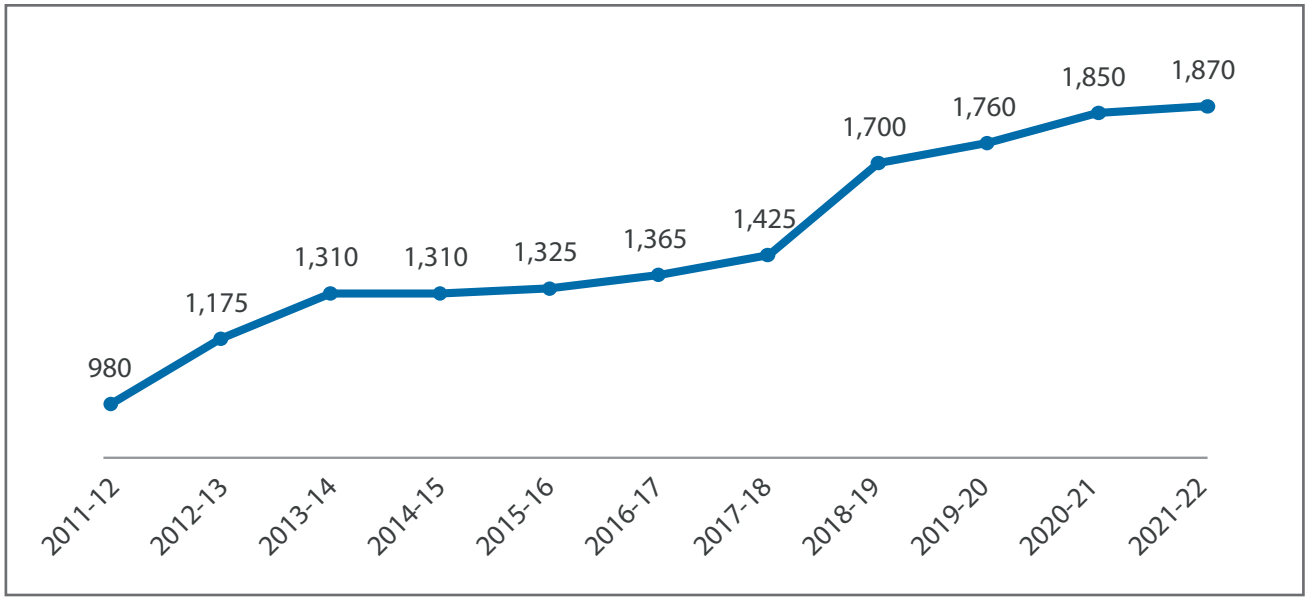
Collectivization is an effective facilitator towards achieving economics of scale. It is being promoted intensively by Government of India. One of the schemes dedicated towards this cause is "Formation and Promotion of 10,000 FPOs" for implementation across the country. The scheme provides for a cluster-based approach to FPO formation and has instituted "Cluster Based Business Organizations" to handhold and professionally run these FPOs for a period of five years from the time of creation. To bring in crop focus, specialized FPO produce clusters are being allocated for formation of FPOs.

Industry discussions reveal that development of maize clusters for specific Industries (such as for feed & starch) and development of maize FPOs could significantly catalyze the process of crop planning, extension, quality control and traceability for maize, facilitating strategic direction for contract farming and large-scale integration of small farms in supply chains for generating optimal value both for the farmers and the industry.

Minimum Support Price for maize

The Government of India provides for a Minimum Support Price for maize cultivators to protect farmer income and promote cultivation of maize. Over the last decade, the minimum support price for maize has been increased from INR 980/ Quintal (in 2011-12) to INR 1,870/ Quintal (in 2021-22) at a CAGR of 6.7% (refer Exhibit 25).

Exhibit 25: Decadal trends in Minimum Support Price provided for maize (INR/Quintal)



Source: https://farmer.gov.in/mspstatements.aspx

e-NAM & e-Kisan Mandis

Digitisation of the agri-value chain has been a key focus area for the central government. One of the key initiatives that could have a significant impact on farmers' price discovery and markets is the e-NAM initiative – an electronic trading portal which intends to integrate all APMCs across the country through a common online marketing platform – to facilitate a transparent online auction process. Industry discussions reveal that this initiative, along with the promotion of e-kisan mandis, could transform the way maize is traded in India, if implemented widely and efficiently.

Other select initiatives

In addition, the Government has introduced several schemes for the agricultural sector that have significant impact on the production, distribution, and off-take of maize. Exhibit 26 depicts some of these interventions.



Exhibit 26: Illustrative list of government initiatives impacting the maize ecosystem

Towards augmenting crop productivity and farmer income

- R&D activities undertaken by ICAR & SAUs\
- Soil health card & fertilizer subsidy
- PMKSY towards improving irrigation infrastructure
- PM-Kusum towards installation of pumps powered by renewable energy
- PMFBY towards improving access to crop insurance & KCC for credit
- NMSA towards improving productivity in rainfed areas

Towards infrastructure development

- Gramin Bhandaran Yojana towards building adequate post harvest storage facilities
- Agriculture Infrastructure Fund towards building common infrastructure
- Schemes towards supporting infratructure development by FPOs
- e-Kisan mandis and e-NAM towards improving price discovery & access to market
- AHIDF incentives for setting up animal feed processing facilities
- MoFPI's SAMPADA Yojana towards incentivizing investments in food processing infrastructure
- Pradhan Mantri Matsya Sampada Yojana incentivizing fish feed processing units

Source: GoI websites, Industry, YES Bank Analysis



Securing Supply Sustainably – Action Points

Driven by structural changes in agriculture and food consumption patterns, maize is bound to increase its share as an important cereal crop in future. Maize is already an important raw material for poultry, dairy and food processing along with its traditional use. It also lends unmatched flexibility in cultivation, product diversification, processing, marketing, distribution, and value creation for participants across the supply chain. This flexibility coupled with growing demand can be better harnessed for accelerating farmer income and natural resource conservation by addressing key challenges that stakeholders across the value chain face.

Demand of 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. Any policy changes to divert maize for fuel production or substituting sugar with maize derived fructose in beverages may drive the demand of maize to much higher level than currently forecasted. To meet the ever-increasing domestic demand of maize while addressing the environmental concerns, interventions need to be done at various levels of the value chain with cumulative efforts made by all the stakeholders involved. Five key action areas listed below have been identified post discussion with industry to ensure sustainable supply of maize for all end users.

Exhibit 27: Five Action Areas for securing sustainable supply of maize



Source: Industry Sources, YES Bank analysis

6.1 Enhancing maize production ecosystem

Productivity improvement coupled with strong knowledge transfer on good agricultural practices is critical for securing sustainable increase of maize supply. The key actionable towards improving maize productivity include:

- **Strong focus on introduction and wide-scale adoption of high yielding and stress tolerant hybrid seeds– with focus on Single Cross Hybrid Introduction.** Focused drive is needed to deliver high yielding varieties for crops cultivated in traditional areas for food purposes and high yielding stress tolerant crops cultivated in rainfed kharif. Towards this, while private seed companies could play a critical role in introducing globally best quality hybrids, governments need to review repetitive procedures (such as the need for a three-year confirmatory trial for any hybrid seed being introduced into the state, in spite of it having been tested and approved elsewhere in the country). Hybrid seed development involves long breeding process and usually takes 9-10 years to develop 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 for identification and development of climate-resilient crop varieties** with high sustainability index.
- **Devise, monitor, and target time-bound, district level plans to boost seed and varietal adoption rates in an integrated manner.** Enhanced varietal replacement rate coupled with seed replacement rate could lead to improved access to quality seeds of high yielding hybrids and varieties resulting in increased productivity and returns.
- **Review and approval of registration applications for seed treatment solution on priority** for effective control against Fall Armyworm (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[36]. 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 at the grower's hands to mitigate the risk of FAW in India.
- **Strengthening 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 to retain the progress made by the R&D in maize and provide confidence to private sector for introduction of best hybrid varieties into India. There is an urgent need to establish harmony among the PPV&FR Act, the Seed Bill and the Biodiversity Act.
- **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 reinitiated to re-evaluate the impact of introducing GM maize into India on farmer income versus the general concerns associated with its introduction.
- **Moving towards mechanization:** Due to paucity of labour, mechanization can aid in easing farm management processes and increasing their efficiency. Some measures in the direction include large scale adoption of micro-irrigation, leveraging solar energy in maize production and establishment of farm machinery banks in PPP model can help augment 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.

[36] *Industry sources*

- **Better access to credit:** Access to credit will help facilitate timely operations of farm related activities, the Industry could play a significant role by anchoring such initiatives and tying up with banks to provide access to credit. They could support in popularization of Kisan Credit Card (KCC), use of digital banking and fin-tech solutions to ensure credit availability for maize cultivation. Promoting the use of innovative blended finance instruments to mobilize public, private and philanthropic investments towards sustainable agriculture. Developing a formal blended finance scheme which ensures public investment in sustainable agriculture will play a key role in unlocking long-term developmental finance for high-risk projects which would otherwise go unfinanced through traditional routes.
- **Certification programs:** Establishing an equivalent of Fairtrade certification at par with global standards but acclimatized to the diverse Indian growing conditions will help the farmers in realizing higher incomes in both domestic and export markets thus encouraging increase in acreage & production. The inputs regarding the parameters towards formulation of the above said framework can be taken from the Industry to ensure overall alignment which translates into wider adoption of the same.

6.2 Making post-harvest interventions more robust

Quality is paramount in case of crops like maize as it directly (consumed by humans) or indirectly (as poultry/ fishery feed) enters the cycle of consumption. However, unscientific post-harvest practices such as sun drying lead to high moisture content, which when combined with poor post-harvest storage, leads to fungal growth and mycotoxin development. Following measures can be adopted to make post-harvest interventions more robust leading to better quality of maize for end users.

- **Identification of specialized maize clusters and development of "Maize FPOs".** These FPOs could further specialize for specific industries (for instance Starch maize FPOs or Poultry maize FPOs) and could be supported and promoted by the industry. This could help in improving quality & processes, increasing accessibility, achieving better unit cost economics and building resilience in the ecosystem.
- **Policy level discussion regarding allowance of private sector to take up stake in FPO companies.** This would help in building professional capacity of FPOs as well as provide them the wherewithal to access organized credit and markets.
- **Promotion of improved means of drying, threshing & shelling machinery through existing farm machinery subsidy schemes** with specialized focus on maize growing pockets.

6.3 Transformation of storage & logistics infrastructure

Of present, there is unscientific management of maize during bulk handling, storage & transportation. Development of afore-mentioned scientifically managed infrastructure is critical for improving quality and ensuring supply of good quality maize. Key measures suggested towards improving the storage & logistics infrastructure include:

- **Focused promotion of MOFPI's "Formulation of Micro Enterprises Scheme"** for setting up collection centers for maize – which have modern dryers, storage and testing facility.

- **Incentivizing the setting up of specialized large scale integrated bulk handling projects,** including collection centers, material handling infrastructure for handling bulk quality of maize like steel silos and wagons on PPP model. This can aid in improving future outlook of traded maize in a sustainable manner.
- **Incentives for setting up storage infrastructure for maize processors** to set up warehouses near processing facility/inside plant premises.
- **Replication of Kisan Rail Model for maize** will help in timely movement of maize from point of production to point of consumption. Having a well-developed maize logistics ecosystem will ultimately help in maintaining quality of maize by maintaining moisture requirement as per industry parameters.
- **Providing tax incentives to companies investing in or adopting sustainable systems** for transportation, storage, and quality protection.
- **Encouraging private sector to provide quality testing and certifying services**

6.4 Facilitation of domestic supply and international trade of maize

Trade encompasses both internal operations within the country & external operations with other countries. The steps towards making internal trade of maize within the country better are listed below:

- **Supply side:**

- Investing in development of more acreage under maize – specially for rabi season, trying to emulate Bihar's success in other maize producing pockets of the country.
- Promoting contract farming could facilitate private sector's entry into multi-season contracts thereby boosting farmer income.
- Advance data analytics and network mapping to monitor produce flow and identify gaps is necessary for collating information on risks in the supply chain.

- **Market operations & price stabilization:**

- Building a wide network of basic hardware infrastructure and popularising e-platforms such as e-kisan mandis and agri-tech e-procurement platforms such that farmer has transparent access to market price and markets
- Facilitating a more liquid hedging mechanism for maize by way of public sector also participating in NCDEX stock exchange market while procuring maize
- Popularizing the benefits of options among maize farmers and the Government coming forward to subsidize the premium that farmer would have to pay for purchase of options. This will help farmers hedge their price risk.
- Effort needs to be put in to assess involvement of private sector in public procurement programs to introduce efficiency and reduce the government's burden.

The external trade is composed of exports made to other countries and imports received from other countries. India has increasing internal demand of maize owing to increasing consumption, but with sustainable increase in acreage & production, the country can emerge as a major trading partner for the neighboring countries. With soaring maize commodity prices year after year, external trade should be encouraged thereby allowing higher net profit realization for the farmers cultivating the crop. Some steps in easing external trade include:

- **For imports:**

- Regular review and rationalization of the high levels of import duty being imposed on maize.

- TRQ need to be considered towards inclusion of other sectors such as starch (which do not use any alternatives apart from maize) and other industries.

- Adoption and implementation of import quarantine norms in tandem with the globally accepted standards. (example: Aluminum Phosphide is used as fumigant in many parts of the world, but for being imported into India only Methyl Bromide fumigated maize is allowed thus re-fumigation needs to be done at port which attracts an additional cost of about USD 15 per MT)[37]

- Review on source of origin regulations. Indian regulation requires a declaration from the source country that the produce is non-GMO and the location from where it is sourced does not cultivate GM crop. This requirement needs to be reviewed based on import needs as it is difficult to get such declaration from the major maize supplying countries.

- **On exports:**

- Reviewing the total addressable market for India in terms of maize export towards devising a holistic plan for phase-wise implementation. The international trade ecosystem for maize will act as a channel for increasing farmer income but also providing the pathway for off-take during periods of glut (if any).

6.5 Upgradation of processing infrastructure

At the outset, increase in supply of maize should be coupled with increased capacity building of the required processing infrastructure. For this, a better ecosystem is essential which incentivizes the setting up of such units. The strategy developed needs to be aligned with optimal monetization of manufactured maize goods, sustainable production technology and reduced cost of production. Also, considerable efforts need to be made towards increasing efficiencies of existing processes to improve the overall quantum of output. Actions in this direction could include:

- Inclusion of maize & maize-based derivatives as eligible products under various MOFPI schemes.

- Incentivization of maize processing units by providing tax breaks for initial years

- Evaluation of the option of incentivizing the development of an action strategy with quantifiable targets to promote and procure sustainable produce – specially for large food processing companies

- Providing a CAPEX incentive for innovative sustainable packaging companies (R&D/ manufacturing)

- Focused R&D efforts towards improving increased efficiencies of existing processes to reduce losses and increase the output

- Build maize as an important industrial raw material beyond feed and food. In USA, nearly 3,500 products are being made using maize directly or indirectly, while in India we limit around 1,000 products. Therefore, there is a vast scope for developing maize agro-based or allied industries. It can be processed into more than 3,000 industrial products/ input. Demand generated through Maize processing can improve industrial structure, increase products value, and solve the issues

[37] *Industry sources*

of profitability in agriculture. Processing units and industries around the corn growing geographies will sustain and grow maize crop acreages

Maize holds immense potential for food and nutritional security of the nation as it provides the right avenue for crop diversification, conservation of natural resources as well as increasing farmer income, especially for small and marginal farmers in the rainfed areas. Maize is amongst the important cereal which is utilized as food, feed, and fodder. Thus, ensuring its regular supply to all end users has become a key imperative. Ensuring supply of maize has become more critical considering enormous pressure to produce more from less land with shrinking water and other natural resources. The above mentioned 5 action steps if implemented in a co-creation mode with strong inter institutional partnership as well as public-private partnership will ensure supply of maize sustainably to meet future demand.



Abbreviations

Abbreviation	Extension
AHIDF	Animal Husbandry Infrastructure Development Fund
APEDA	Agricultural & Processed Food Products Exports Development Authority
APMC	Agricultural Produce & Livestock Market Committee
Bn	Billion
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CCEA	Cabinet Committee on Economic Affairs
ESY	Ethanol Supply Year
EU	European Union
FAW	Fall Army Worm
FCI	Food Corporation of India
FPO	Farmer Producer Organization
FSSAI	Food Safety and Standards Authority of India
GM	Genetically Modified
GMO	Genetically Modified Organism
HYVs	High Yielding Varieties
IGC	International Grains Council
KCC	Kisan Credit Card
Mn	Million
MoFPI	Ministry of Food Processing Industries
MSP	Minimum Support Price
MT	Metric Tonnes
NCDEX	National Commodity and Derivatives Exchange
NFSM	National Food Security Mission
NMSA	National Mission on Sustainable Agriculture
NGOs	Non-Governmental Organisations
PMFBY	Pradhan Mantri Fasal Bima Yojana
PMKSY	Pradhan Mantri Krishi Sinchai Yojana
R & D	Research & Development
RTE	Ready To Eat
TRQ	Tariff Rate Quota
USD	US Dollars
USDA	United States Department of Agriculture

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