



Green Revolution in Maize

For Prelims: [Green revolution](#), [Maize](#), [Cereal crop](#), [Ethanol](#), [Ethanol blending](#), [National Food Security Mission](#)

For Mains: Food Security, Agricultural Resources, Green revolution

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Why in News?

Recently, [India's maize industry](#) has undergone a remarkable transformation, evolving from a **basic feed crop to a crucial component in the fuel and industrial sectors.**

- This shift is indicative of a broader [green revolution](#), echoing the historic advances made in wheat and rice but with a modern twist driven largely by private-sector innovations.

What is the Current State of Maize Production in India?

- **Tripling Production:** Since 1999-2000, India's maize production has more than tripled, increasing from **11.5 million tonnes to over 35 million tonnes** annually, with average per-hectare yields also rising from 1.8 to 3.3 tonnes.
 - As per [APEDA](#), India is the **fifth largest maize producer**, accounting for 2.59% of global production in 2020.
 - Maize is the **third most important cereal crop in India** after [rice and wheat](#). It accounts for around 10% of total food grain production in the country.
- **Yield Improvements:** Average per-hectare yields have risen from 1.8 to 3.3 tonnes over the same period.
- **Major States:** Karnataka, Madhya Pradesh, Bihar, Tamil Nadu, Telangana, Maharashtra, and Andhra Pradesh are the primary maize-growing states.
- **Year-Round Cultivation:** Maize is grown throughout the year, predominantly as a Kharif crop (85% of the maize cultivation area is during this season).
- **Export Volume:** India exported 3,453,680.58 MT of maize worth Rs. 8,987.13 crores in 2022-23.
 - **Major Export Destinations:** Bangladesh, Vietnam, Nepal, Malaysia, and Sri Lanka are key markets for Indian maize.
- **Major Uses:** Approximately **60% of maize is used as feed for poultry** and livestock, while only about **20% is directly consumed by humans.**
 - Maize is a primary energy source in livestock feed, with 55-65% of broiler feed and 15-20% of cattle feed comprising maize.
 - **Starch and Ethanol:** Maize grains, containing 68-72% starch, are used in industries such as **textiles, paper, and pharmaceuticals.**
 - Recent developments have shifted focus to using maize for [ethanol production](#), particularly as a **substitute for rice in ethanol blending** due to food security concerns.
 - During the crushing season, distilleries run on sugarcane molasses and juice/syrup,

while in the off-season they use grains, with the recent shift towards maize.

How does Maize's Green Revolution Compare to Wheat and Rice?

- **Self-Pollinating vs. Cross-Pollinating:** Unlike **self-pollinating** wheat and rice, **maize's cross-pollinating** nature makes hybrid breeding commercially viable.
 - The Green Revolution in wheat and rice was driven by farmers cultivating high-yielding varieties being self-pollinating plants that are not amenable to hybridization.
 - The Green Revolution in maize has been, and continues to be, a private sector-led one. Private-sector hybrids dominate over **80% of maize cultivation, with high yields limited to the first generation.**
 - Farmers cannot harvest the same yields if they save the grains from these yields and reuse them as seeds (self termination nature of seeds).
- **Innovations in Maize Cultivation:** The Indian Agricultural Research Institute (IARI) has bred India's first "**waxy**" **maize hybrid** (AQWH-4) with high **amylopectin starch content**, making it better suited for ethanol production.
 - The starch in maize is a mixture of two polymers, comprising glucose molecules bonded together in a **straight chain (amylose) and in branched form (amylopectin)**.
 - Normal maize starch has 30% amylose and 70% amylopectin, while IARI's waxy maize hybrid has 93.9% amylopectin.
 - Amylose starch makes the grain hard, while amylopectin makes it soft, affecting starch recovery and fermentation rates.
 - Softness aids in better grain grinding for flour production. Granules with higher amylopectin are more easily broken down into glucose units. The glucose is then fermented into ethanol using yeast.
 - Normal maize grains have 68-72% starch, but only 58-62% is recoverable. The new Pusa Waxy Maize Hybrid-1 has 71-72% starch with 68-70% recovery.
 - This **hybrid offers an average yield of 7.3 tonnes per hectare** and has the potential to reach 8.8 tonnes.
- **Private Sector's Role:** The International Maize and Wheat Improvement Center (CIMMYT) has established a **maize doubled haploid (DH)** facility in Kunigal (Karnataka), producing high-yielding, genetically pure inbred lines.
 - This facility speeds up the development of maize hybrids and enhances breeding efficiency.
 - In the conventional process, inbred lines are formed by continuous **self-pollination for 6-8 generations**. DH technology enables the production of completely uniform lines after **just two cropping cycles**.
 - In 2022, the Kunigal facility produced and shared 29,622 maize DH lines. The lines are **high-yielding, tolerant to drought, heat, and water-logging, nutrient-use efficient, and resistant to pests** and diseases such as fall armyworm and maize lethal necrosis.
 - Companies like Mahyco, Shriram Bioseed, Advanta Seeds, and others play a significant role in developing and promoting high-yield maize hybrids.

What are the Initiatives to Promote Maize in India?

- National Food Security Mission (NFSM).
- **India Maize Summit:** Organized in 2022, with a focus on securing a sustainable maize supply to meet growing demand and increase farmer prosperity.
- Rashtriya Krishi Vikas Yojana (RKVY).

Green Revolution

- It was led by **Norman Borlaug in the 1960s**, resulted in the development of High Yielding Varieties (HYVs) of wheat and led to him winning the Nobel Peace Prize in 1970.
- In India, M.S. Swaminathan played a key role in the Green Revolution, which significantly increased food grain production, especially **wheat and rice**.
 - The revolution transformed India from a food-deficient country to one of the world's leading agricultural nations between 1967-68 and 1977-78.
- It included the incorporation of various irrigation methods to **reduce dependence on rainfall**.

Mechanisation of major agricultural practices to **reduce labour costs** and increase efficiency. Use of [chemical fertilizers and pesticides](#) to enhance soil fertility and protect crops.

- **Double cropping in existing farmland** to increase cropping intensity and yield.
- Expansion of farming area by bringing more land under cultivation, especially in semi-arid and arid regions, using irrigation and HYV seeds.
- The Green Revolution significantly led to a substantial increase in grain output, making **India one of the largest agricultural producers in the world**.
 - As a result, **India became a net exporter of wheat, rice, and other food grains**, with record-high exports in recent years.
- The higher productivity also contributed to [poverty alleviation](#) by lifting many small-scale farmers out of poverty through increased incomes.
- The Green Revolution brought several challenges, including **environmental degradation from synthetic fertilizers and pesticides, soil erosion, and water pollution**. It also led to **loss of biodiversity and genetic diversity of crops**, displacement of indigenous crops, and traditional farming practices.
 - Additionally, it increased vulnerability of crops to pests, diseases, and [climate change](#).

Drishti Mains Question:

Q. Discuss the recent transformation of India's maize industry from a basic feed crop to a crucial component in the fuel and industrial sectors.

UPSC Civil Services Examination, Previous Year Questions (PYQ)

Prelims

Q. Given below are the names of four energy crops. Which one of them can be cultivated for ethanol? (2010)

- (a) Jatropha
- (b) Maize
- (c) Pongamia
- (d) Sunflower

Ans: (b)