

INDEPENDENT MARKET REPORT ON AGROCHEMICALS & SEEDS INDUSTRY

Final Report

FROST & SULLIVAN

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Abbreviations

Abbreviations	Full Form
AI	Artificial intelligence
AICRP-PM	All India Coordinated Research Project on Pearl Millet
APAC	Asia Pacific
API	Active pharmaceutical ingredients
BLB	Bacterial Leaf Blight
Bn	Billion
BPH	Brown Plant Hopper
Bt	Bollgard
CAGR	Compounded annual growth rate
CAPEX	Capital expenditure
CDMO	Contract Development and Manufacturing Organization
CEPA	Comprehensive Economic Partnership Agreement
CRISPR	Clustered regularly interspaced short palindromic repeats
CY	Calendar year (CY)
DA&FW	Department of Agriculture and Family Welfare
DCPC	Department of Chemicals & Petrochemicals
DPPQS	Directorate of Plant Protection, Quarantine & Storage
DSR	Direct-seeded rice
DUS	Distinctness, Uniformity and Stability
EC	Emulsifiable Concentrates
EU	European Union
Evs	Electric vehicles
FDI	Foreign direct investment
FSSAI	Food Safety and Standards Authority of India
FTA	Free Trade Agreement
FY	Fiscal year
GDP	Global Gross Domestic Product
GEAC	Genetic Engineering Appraisal Committee
GM	Genetically Modified
GTM	Go To Market
GVA	Gross Value Added
Ha	Hectare
HDPS	High-Density Planting System
HHP	Highly Hazardous Pesticides
IIP	Index of Industrial Production
IMF	International Monetary Fund
INR	Indian Rupee
IPM	Integrated Pest Management
Kg	Kilogram
MFSM- OS	National Food Security Mission-Oilseeds
Mn	Million

MOSPI	Ministry of Statistics and Programme Implementation
MSME's	Micro, Small, and Medium Enterprises
MSP	Minimum Support Price
NARES	National Agricultural Research Education and Extension System
NMEO	National Mission on Edible Oils
NSC	National Seed Corporation
NSP	National Seeds Project
OD	Oil Dispersion
PGR	Plant Growth Regulators
PLI	Production-Linked Incentives
PMB	Pesticide Management Bill
PMI	Purchasing Manager's Index
PVP	Plant Variety Protection
QTL	Quantitative trait loci
RBI	Reserve Bank of India
SMSP	Sub Mission on Seed and Planting Material
SRR	Seed Replacement Rate
UAE	United Arab Emirates
UPOV	Union for the Protection of New Varieties of Plants
US	United States
USD	United States Dollar
VCUS	Value for Cultivation, Use, and Sustainability

1. Global Macroeconomic Overview

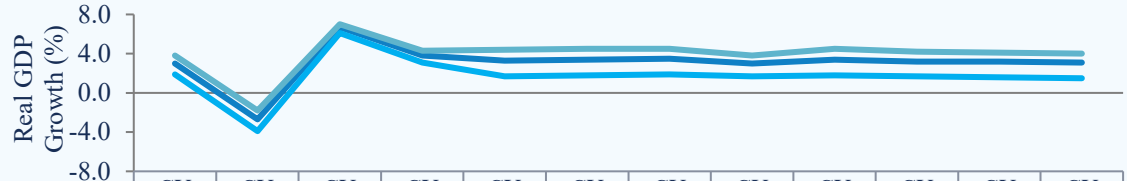
1.1 Gross Domestic Product (GDP) Growth Outlook, Global

World GDP is projected to grow in the range of 3.0% to 3.5% (in real terms) between calendar year (CY)2026 and CY2030, with nominal GDP rising from an estimated USD 126.3 trillion in CY2026 to USD 151.4 trillion by CY2030.[1] Over the past two decades, world GDP growth has generally remained steady, with periodic downturns during crises. Episodes such as the global financial crisis, the COVID-19 pandemic, the tariff wars, and the geopolitical tensions have temporarily disrupted growth, but the world economy has consistently demonstrated resilience. As a result, nominal GDP is projected to register a compounded annual growth rate (CAGR) of 5.8% between CY2020 and CY2030.[2]

After a strong rebound in CY2021, with real GDP growth of 6.7%, the global economy lost momentum, slowing down to 3.8% in CY2022 and 3.3% in CY2023. This slowdown was driven mainly by the Russia-Ukraine war, which raised inflation, disrupted supply chains, and led to coordinated worldwide monetary tightening. Growth improved marginally to 3.4% in CY2024 as inflation eased and interest rates were cut. In CY2025, despite heightened US tariff tensions and elevated trade policy uncertainty, sustained investments in artificial intelligence (AI), infrastructure, renewable energy, and cybersecurity, together with supportive fiscal and monetary policies, helped global growth improve to 3.5%.

However, global GDP growth is expected to moderate to 3.0% in CY2026, as supply chain disruptions, elevated energy prices, higher freight and insurance costs, and persistent inflationary pressures during H1 CY2026 arising from heightened US-Iran tensions weigh on economic activity. Nevertheless, expected easing of geopolitical tensions and improving supply chain conditions in H2 CY2026 are expected to support lower oil prices, gradual inflation stabilization, measured monetary easing, and stronger business confidence. Despite these short-term headwinds, long-term global growth will be supported by productivity gains from AI and digital transformation, continued infrastructure and clean energy investments, structural shifts in global trade patterns, and the rise of new manufacturing and industrial hubs.

Exhibit 1: Real GDP Growth (%), World, Advanced, and Emerging Economies, Calendar Year (CY)2019-CY2030F



	CY 2019	CY 2020	CY 2021	CY 2022	CY 2023	CY 2024	CY 2025	CY 2026E	CY 2027F	CY 2028F	CY 2029F	CY 2030F
World	3.0	-2.7	6.7	3.8	3.3	3.4	3.5	3.0	3.4	3.2	3.2	3.1
Advanced Economies	1.9	-3.9	6.1	3.1	1.7	1.8	1.9	1.7	1.8	1.7	1.6	1.5
Emerging Economies	3.8	-1.8	7.0	4.3	4.4	4.5	4.5	3.8	4.5	4.2	4.1	4.0

Note: E: Estimate, F: Forecast; Data is represented in calendar years (CY). For e.g. CY2019 refers to 1 January 2019 and 31 December 2019; Source: International Monetary Fund (IMF), Frost & Sullivan

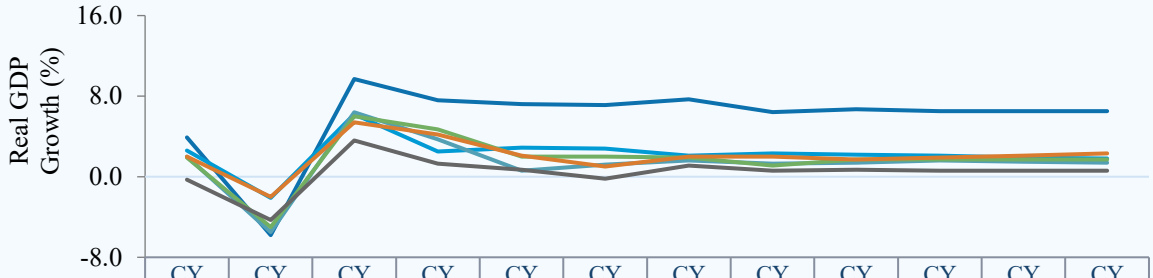
Advanced economies will see an average growth of 1.7% from CY2026 to CY2030, constrained by aging population, high debt, inefficient supply chains, and high costs of transitioning into new energy sources. Stable inflation and low interest rates will provide some assistance to consumption and investment, but maintaining growth will require targeted structural reforms, innovation, and long-term policy vision. In contrast, emerging markets will lead global growth, averaging 4.1% annually from CY2026 to CY2030, supported by favorable demographics, stronger manufacturing capabilities, and investments in digital and green sectors. However, trade tensions and geopolitical risks will require nations to diversify supply chains and pursue sustainable development strategies to build long-term resilience.

[1] International Monetary Fund (IMF)
[2] IMF

1.2 GDP Growth Outlook, Major Economies

India's economic growth will remain resilient and will grow at an average of 6.8% between FY2025-26 (CY2025 in chart) and FY2029-30 (CY2029 in chart), the fastest among major economies[3]. India's robust growth will be driven by elevated strong public capital expenditure (CAPEX), strong services exports, manufacturing thrust, and resilient domestic consumption. The US economy will experience a slight uptick to 2.3% in CY2026, supported by stronger consumption and investment following Federal Reserve (Fed) rate cuts in H2 CY2025; however, elevated global energy prices arising from the US-Iran conflict and continued trade policy uncertainty remain key risks. The EU's growth is expected to slow from 1.6% in CY2025 to 1.3% in CY2026 as disruptions to oil and gas supply routes, elevated energy prices, weak manufacturing, and sluggish consumption weigh on economic activity. Growth is projected to improve marginally to 1.4% in CY2027 as energy supply normalizes and inflationary pressures ease. In Canada, USMCA[4]-related trade frictions and persistent global geopolitical tensions will weigh on exports and business confidence in CY2026, despite interest rate cuts supporting consumption demand. Japan's growth is expected to slow in CY2026 as weaker external demand, elevated energy import costs, and global trade uncertainty outweigh support from wage growth and private consumption. Australia's growth is expected to remain stable, supported by resilient domestic demand and public investment, although global trade uncertainty and softer commodity demand will weigh on exports.

Exhibit 2: Real GDP Growth (%), India, United States (US), European Union (EU), Canada, Japan, Australia, CY2019-CY2030F



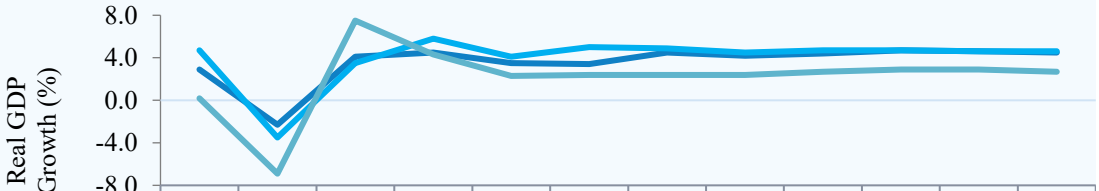
	CY 2019	CY 2020	CY 2021	CY 2022	CY 2023	CY 2024	CY 2025	CY 2026E	CY 2027F	CY 2028F	CY 2029F	CY 2030F
India	3.9	-5.8	9.7	7.6	7.2	7.1	7.7	6.4	6.7	6.5	6.5	6.5
US	2.6	-2.1	6.2	2.5	2.9	2.8	2.1	2.3	2.2	2.1	1.9	1.8
EU	2.0	-5.5	6.4	3.7	0.6	1.2	1.6	1.3	1.4	1.6	1.5	1.4
Canada	1.9	-5.0	6.0	4.7	2.0	2.0	1.9	1.1	1.7	1.7	1.7	1.7
Japan	-0.3	-4.3	3.6	1.3	0.7	-0.2	1.1	0.6	0.7	0.6	0.6	0.6
Australia	2.0	-2.0	5.4	4.2	2.1	1.0	2.0	2.0	1.7	1.9	2.1	2.3

Note: E: Estimate, F: Forecast; Data is represented in calendar years. For e.g. CY2019 refers to 1 January 2019 and 31 December 2019; India's data is represented in fiscal years. For e.g. FY2019-20 data refers to April 2019 to March 2020 and corresponds to CY2019;
Source: IMF, Frost & Sullivan

[3] The G20 (Group of Twenty) is the standard reference for "major economies" comprising the world's largest advanced and emerging economies in terms of nominal GDP, accounting for ~85% of global GDP and ~75% of global trade.
[4] United States–Mexico–Canada Agreement

1.3 GDP Growth Outlook, Emerging Market Economies

Exhibit 3: Real GDP Growth (%), Africa, South-East Asia, Latin America and Caribbean, CY2019-CY2030F



	CY 2019	CY 2020	CY 2021	CY 2022	CY 2023	CY 2024	CY 2025	CY 2026E	CY 2027F	CY 2028F	CY 2029F	CY 2030F
Africa	2.9	-2.3	4.1	4.5	3.5	3.4	4.5	4.2	4.4	4.7	4.6	4.5
South-East Asia	4.7	-3.5	3.5	5.8	4.1	5.0	4.9	4.5	4.7	4.7	4.6	4.6
Latin America and Caribbean	0.2	-6.9	7.5	4.3	2.3	2.4	2.4	2.4	2.7	2.9	2.9	2.7

Note: E: Estimate, F: Forecast; Data is represented in calendar years. For e.g. CY2019 refers to 1 January 2019 and 31 December 2019; Source: IMF, Frost & Sullivan

Africa's growth is projected to average 4.5% during CY2026-CY2030, up from an average of 2.9% between CY2019 and CY2025, as easing inflation, improving macroeconomic stability, and firmer consumption and investment support demand. However, with geopolitical tensions, trade fragmentation, and climate pressures, there will be need for structural reforms, stronger public services, and economic diversification. South-East Asia's (SEA) growth is expected to moderate to 4.5% in CY2026, before averaging 4.7% during CY2027-CY2030, supported by resilient domestic demand, a young workforce, and continued investment in infrastructure, digital connectivity, and green energy. However, tariff disputes, geopolitical tensions, and export-related uncertainty will continue to pose risks. Latin America and the Caribbean growth is forecast to average 2.8% during CY2027-CY2030, as resilient domestic demand will help offset weaker external demand amid softer commodity prices, trade uncertainty, and policy uncertainty. However, policy uncertainty, high debt servicing costs, tight credit conditions, and persistent structural bottlenecks will constrain long-term economic growth.

1.4 Key Predictions for the Global Economy, 2026-2027

Global Growth to Slow with Uneven Regional Recovery: Global GDP growth is forecast to moderate from 3.5% in CY2025 to 3.0% in CY2026, primarily reflecting supply chain disruptions, persistently elevated oil prices (USD 90-92 per barrel in H1 2026) following the US-Iran conflict, and a weak investor sentiment. Higher energy costs are expected to keep inflationary pressures elevated through Q3 CY2026. Nevertheless, the expected reopening of the Strait of Hormuz and continued US-Iran negotiations in H2 CY2026 are expected to support a gradual normalization in inflation and economic activity. Key downside risks include further geopolitical escalation, slower-than-expected AI-driven productivity gains, and renewed trade tensions. Oil-exporting economies are expected to remain relatively resilient, supported by stronger trade linkages and alternative export routes, whereas oil-importing countries are likely to experience more pronounced economic slowdowns.

Inflationary Pressures and Trade Disruptions to Weigh on Global Recovery: Continued disruptions across supply chains, shipping, and energy markets through Q2 CY2026 are expected to keep global inflation elevated at 4.4% in CY2026, up from 4.1% in CY2025, delaying further interest rate cuts until late CY2026. At the same time, disruptions in the Middle East, rising geopolitical tensions, evolving trade policies, and ongoing supply chain adjustments are expected to slow global goods trade growth.

New Emerging Markets to Gain from Mexico+1 and China+1 Strategies: As companies look to reduce risks in operations due to increasing geopolitical tensions, nearshoring and diversification strategies have become

crucial for supply chain realignment. The trend, often called "Mexico+1" and "China+1," shows efforts to reduce dependence on single country manufacturing and sourcing. SEA, India, and some Middle Eastern countries are becoming major beneficiaries of this shift. Attractive labor markets, government incentives, improved infrastructure, and projects that boost connectivity, like the India-Middle East-Europe Economic Corridor, are encouraging multinational companies to set up or grow operations in these areas. While Gulf Co-operation Council (GCC) countries have lost some of their investment attractiveness in light of the present US-Iran conflict, prospects will improve once a complete US-Iran deal is signed and the Straight of Hormuz full reopens.

India to Remain the World's Fastest-Growing Major Economy: India is set to outperform peers with GDP growth averaging 6.5% over FY2026-27 to FY2029-30, the highest among major economies. Growth will be driven by elevated public capital expenditure, budgeted at INR 12.2 trillion for FY2026-27, and strong momentum in the Production-Linked Incentive (PLI) schemes that are attracting investment into electronics, automotive, and pharmaceuticals, and resilient services exports. Rising domestic consumption, supported by tax reductions, a rising middle-class, and favorable demographics , is further strengthening demand.

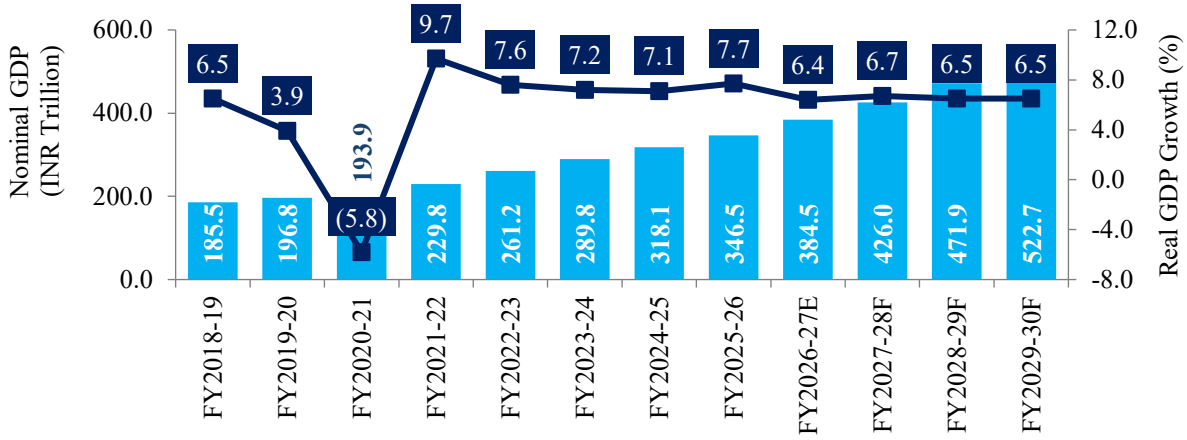
India's Policy Access + Market Access Edge: India's "plus-one" edge is now structural, driven by scale manufacturing, improving logistics, and a growing web of trade ties that reduce friction with the US, EU, and the Gulf. The India–Middle East–Europe Economic Corridor is being advanced as a long-haul connectivity bet, still funding-constrained but designed to shorten lanes linking India to Gulf/EU demand. As Europe's CBAM shifts carbon costs onto imports from 2026, India's producers that can prove lower-carbon processes gain a relative price edge into the EU versus higher-emission peers.

2. India Macroeconomic Overview

2.1 India GDP Outlook

India's economy expanded by 7.7% in FY2025-26 (from 7.1% in FY2024-25), supported by strong domestic demand, low inflation, and the GST and income tax reform-led consumption boost.. Real GDP growth is estimated to moderate to 6.4% in FY2026-27 as the one-off consumption boost from tax reforms fades and elevated global energy prices arising from Middle East oil supply disruptions exert inflationary pressures. Nevertheless, resilient domestic demand and continued government capital expenditure (budgeted at INR 12.2 trillion) are expected to support economic activity. Make in India, supported by the Production-Linked Incentive (PLI) scheme, continues to attract investments into priority manufacturing sectors such as electronics, pharmaceuticals, and automobiles. Supported by a large consumer market, cost-competitive labor, a growing middle class, and ongoing industrial and infrastructure reforms, India is well positioned to emerge as the world's third-largest economy by the end of the decade.

Exhibit 4: Nominal GDP (INR Trillion) and Real GDP Growth (%), India, Fiscal Year (FY)2018-19 to FY2029-30F



Note: E: Estimate, F: Forecast; India's data is represented in fiscal years. For e.g. FY2018-19 data refers to April 2018 to March 2019;
Source: Ministry of Statistics and Programme Implementation (MOSPI) – India, IMF, Frost & Sullivan

2.2 India Inflation Outlook

Exhibit 5: Inflation (%), India, FY2018-19 to FY2029-30F



Note: E: Estimate, F: Forecast; India's data is represented in fiscal years. For e.g. FY2018-19 data refers to April 2018 to March 2019;
Source: MOSPI – India, IMF, Frost & Sullivan

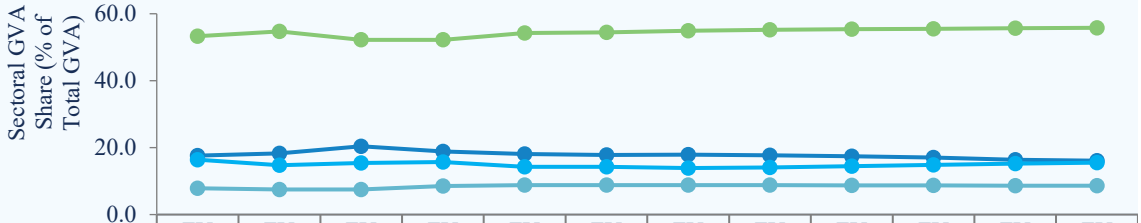
India's inflation moderated from a peak of 6.6% in FY2022-23 to 2.1% by FY2025-26 as food and energy prices stabilized, reflecting an improvement in overall price stability. Inflation is estimated to increase to 4.7% in FY2026-27, driven by energy supply disruptions associated with tensions around the Strait of Hormuz. Higher average crude oil prices, elevated freight costs, rupee depreciation, and weather-related food price pressures resulting from delayed monsoons are expected to raise fuel, transportation, and production costs, leading to broader inflationary pressures in H2 2026. Elevated inflation is likely to constrain the Reserve Bank of India's (RBI) near-term flexibility of cutting down interest rates. This will increase the likelihood of an extended pause in interest rate cuts until inflationary pressures from energy prices and exchange rate movements begin to ease. Thereafter, inflation is expected to stabilize at around 4.0% through FY2029-30, supported by stronger supply

chains, prudent macroeconomic management, and continued measures to contain food price volatility within the RBI's 2-6% target range.

2.3 Sectoral Gross Value Added (GVA)

India's economic structure is shifting steadily towards more high-value sectors. Agriculture, forestry, and fishing comprised 17.7% of GVA in FY2025-26, down from 20.4% in FY2020-21, with forecast decline to 16.1% by FY2029-30. Manufacturing GVA share in total GVA was at 13.9% in FY2024-25. Within this, chemicals accounted for an estimated 8.0% of manufacturing GVA. Moreover, manufacturing GVA showed a marginal improvement to 14.1% in FY2025-26 and is projected to further recover to 15.5% by FY2029-30, helped by domestic industrial demand, targeted investments, and incentives under Make in India and the PLI scheme. This recovery will further be supported by global supply chain diversification trends, with India emerging as a key beneficiary of 'China+1' strategies, particularly in electronics, electric vehicles (EVs), and semiconductors. Construction held firm at 8.8% in FY2025-26 and is projected to remain resilient and stabilize at 8.6%-8.7% through FY2029-30, driven by infrastructure and urban growth.

Exhibit 6: Sectoral GVA Share (% of Total GVA), India, FY2018-19 to FY2029-30F



	FY 2018-19	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23	FY 2023-24	FY 2024-25	FY 2025-26	FY 2026-27E	FY 2027-28F	FY 2028-29F	FY 2029-30F
Agriculture, forestry and fishing	17.6	18.3	20.4	18.9	18.1	17.8	17.9	17.7	17.4	17.0	16.4	16.1
Manufacturing	16.4	14.7	15.4	15.7	14.3	14.3	13.9	14.1	14.5	14.8	15.2	15.5
Construction	7.9	7.5	7.5	8.5	8.8	8.8	8.8	8.8	8.7	8.7	8.6	8.6
Services	53.3	54.7	52.2	52.2	54.2	54.4	54.9	55.2	55.4	55.5	55.7	55.8

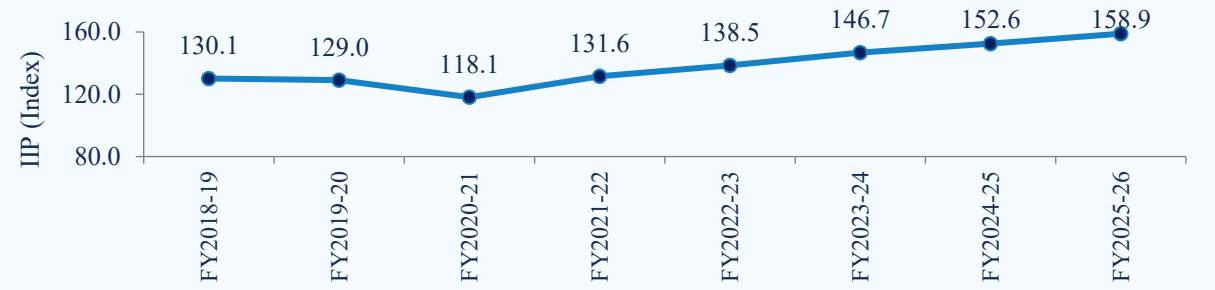
Note: E: Estimate, F: Forecast; India's data is represented in fiscal years. For e.g. FY2019 data refers to April 2018 to March 2019; Source: MOSPI – India, IMF, Frost & Sullivan

Services continue to anchor India's expansion, rising from 53.3% in FY2018-19 to 55.2% in FY2025-26, with a projection of 55.8% by FY2029-30. Growth is fueled by rapid digital adoption, a young and skilled workforce, and rising demand for finance, healthcare, education, and logistics. At the same time, India's strong global role in IT and business services is deepening, with expanding opportunities in AI, cloud computing, and fintech-driven exports. While external trade risks, like US tariffs, could weigh on export competitiveness, particularly for IT and manufacturing, India's domestic economic fundamentals remain resilient, underscoring a broad-based and technology-driven growth trajectory.

2.4 Industrial and Manufacturing Growth

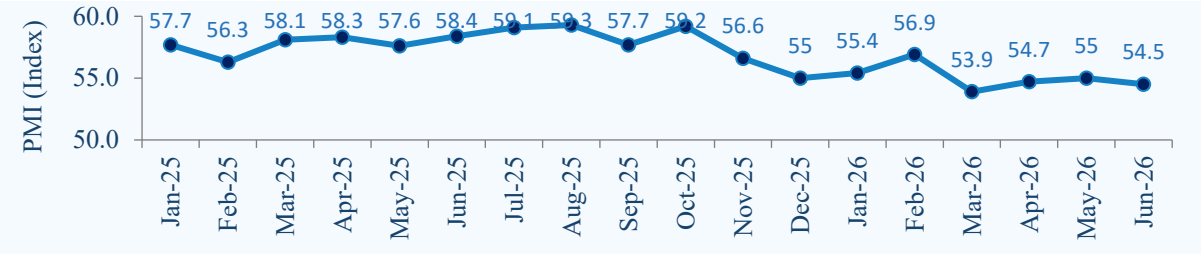
Between FY2020-21 and FY2025-26, India's IIP expanded at a CAGR of 6.1%, driven by growing demographics, rising incomes, and supportive government policies. Public capital spending and initiatives such as Make in India, Atmanirbhar Bharat, and the PLI schemes have been central to strengthening domestic manufacturing and fostering innovation. The manufacturing sector has gained strength by recoveries in automotives, electronics, and pharmaceuticals, supported by resilient consumer demand. Additionally, investments in digital infrastructure and Industry 4.0 adoption are enhancing productivity and competitiveness. With these structural shifts, coupled with GDP growth, stable inflation, and improving logistics and green practices, India's industrial base is positioned for durable expansion and stronger foreign investment inflows.

Exhibit 7: Index of Industrial Production (IIP), India, FY2018-19 to FY2025-26



Note: India's data is represented in fiscal years. For e.g. FY2018-19 data refers to April 2018 to March 2019; Source: RBI, IMF, Frost & Sullivan

Exhibit 8: Purchasing Manager's Index (PMI), India, January 2025-June 2026



Note: A PMI reading above 50 signifies an expansion in the manufacturing sector compared to the previous month, while a reading below 50 indicates a contraction. A PMI of exactly 50 reflects a balance, where the number of manufacturers experiencing improved business conditions is equal to those facing a decline. Source: MoSPI – India, Frost & Sullivan

India's manufacturing sector has continued to demonstrate a strong upward trajectory, with PMI readings consistently above the 50-point threshold. This reflects robust growth in new orders, both domestic and export-led, alongside production gains at multi-year highs. The surge has been supported by competitive labor costs, strong consumer demand, and FDI inflows, as well as structural reforms and industrial policy initiatives like Make in India and the PLI schemes. At the same time, India has benefited from global supply chain diversification as firms look beyond China, further cementing its role as a competitive, cost-effective production hub.

While manufacturing PMI has consistently remained above the 50-point expansion threshold, it has recently moderated in recent months, indicating that manufacturing activity continues to expand, but at a slower pace. The moderation largely reflects elevated input and logistics costs arising from the US-Iran conflict, alongside global trade uncertainty and softer external demand, which have weighed on business sentiment and production momentum. Nevertheless, resilient domestic demand, continued infrastructure investment, and government initiatives such as Make in India and the PLI schemes are expected to support manufacturing activity over the medium term, reinforcing India's position as a preferred global manufacturing and supply chain destination.

In addition, India's expanding network of trade agreements, including the India–UK Comprehensive Economic and Trade Agreement (CETA), the Comprehensive Economic Partnership Agreement (CEPA) with the UAE, and ongoing negotiations with the European Union, are expected to improve market access, strengthen export competitiveness, and support long-term manufacturing growth.

2.5 India's Manufacturing Attractiveness

Capital Expenditure-Led Growth Model: India's manufacturing growth is anchored in a sharp expansion of public capital expenditure, rising from INR 3.1 trillion in FY2018-19 to a budgeted INR 12.2 trillion for FY2026-27, reflecting a CAGR of 18.7%. Sustained public investment in transport, logistics, industrial infrastructure, and urban development continues to strengthen the operating environment for manufacturers by improving connectivity, reducing logistics costs, and enhancing supply chain efficiency.

Moreover, budget 2026-27 prioritizes high-value manufacturing through India Semiconductor Mission (ISM) 2.0, increasing the outlay for the Electronics Components Manufacturing Scheme (ECMS) to INR 400 billion, launching the INR 100 billion Biopharma SHAKTI programme, and introducing a Scheme for Rare Earth Permanent Magnets to strengthen domestic critical mineral value chains. Additionally, the Ministry of Chemicals

& Fertilizers has been allocated approximately INR 1.77 trillion, underscoring the strategic importance of chemicals, pharmaceuticals, and agri-inputs in enhancing industrial competitiveness and supply chain resilience.

Clean Energy as a Competitive Advantage**:** The clean-tech push is integral to India's industrial strategy. Between 2024 and 2028, 22.8 GW of new onshore wind capacity is scheduled, complemented by the Green Hydrogen Mission, backed by INR 197.4 billion in public funding and aimed at crowding INR 8.0 trillion in private investment by 2030. Incentives for EV batteries, electrolyzes, and solar PV cells are creating a new industrial base with high export and employment multipliers, while positioning India as a low-cost manufacturing hub in the global energy transition.

Demographic Leverage and Workforce Realignment: India's cost-competitive and youthful workforce remains a core driver of manufacturing expansion. With skilling initiatives tied to industry demand, productivity is rising in electronics, automobiles, and renewable sectors. By FY2029-30, manufacturing is expected to account for 17.6% of total employment, aligning with the target of 7.9 million jobs created annually.

2.6 Union Budget 2026-27 – Key Initiatives for Chemical & Agriculture industry

Chemical Industry

- Three dedicated Chemical Parks: The Budget proposes a scheme to support states in establishing three dedicated Chemical Parks through a cluster-based, plug-and-play model, supported by a budget estimate of INR 600 crore; this initiative is aimed at strengthening domestic chemical manufacturing, reducing import dependence, and improving industrial competitiveness.
- Biopharma SHAKTI: A ₹10,000 crore programme over five years has been launched to strengthen domestic biologics and biosimilars manufacturing through new and upgraded pharmaceutical research institutions, clinical trial infrastructure, and regulatory capacity.
- Rare Earth Permanent Magnets: The Budget introduces a dedicated scheme alongside Rare Earth Corridors in mineral-rich states (Odisha, Kerala, Andhra Pradesh, and Tamil Nadu) to strengthen domestic mining, processing, and manufacturing of rare earth permanent magnets, supporting downstream chemical processing and clean energy supply chains.

Agriculture Industry

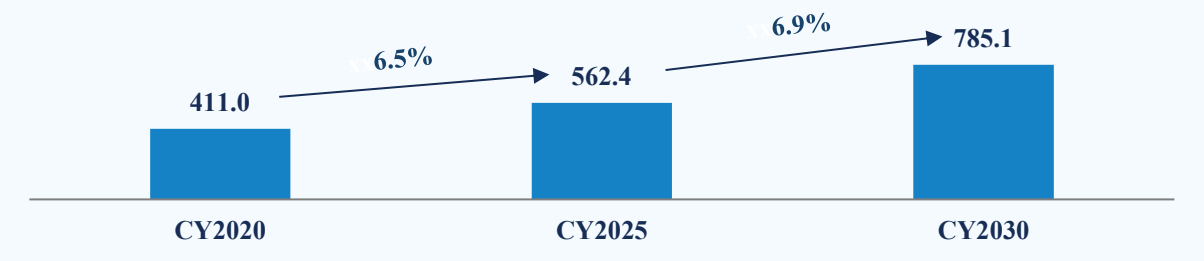
- PM Dhan-Dhaanya Krishi Yojana (PMDDKY): The government continues implementing PMDDKY across 100 low-productivity districts, focusing on improving agricultural productivity, irrigation, storage, and crop diversification, thereby supporting long-term demand for fertilizers, crop protection chemicals, and agricultural inputs.
- National Mission on High Yielding Seeds: Continued emphasis on developing climate-resilient, high-yielding seed varieties is expected to improve farm productivity while increasing demand for quality fertilizers, micronutrients, and crop protection products.
- Mission for Aatmanirbharta in Pulses: Continued support for self-sufficiency in pulses through improved seed varieties and assured procurement is expected to encourage higher adoption of agricultural inputs.
- Horticulture and Value Chain Development: Continued investments in production, post-harvest infrastructure, processing, and marketing of fruits and vegetables are expected to strengthen demand for fertilizers, specialty chemicals, and crop protection products across the horticulture value chain.

3. Global Agriculture Market Overview

3.1 Overview of Global Agricultural Spend

Growing government spending, increasing market value, and significant investments from global institutions like the World Bank and nonprofit organizations like the Gates Foundation are among the characteristics of global agricultural spending. According to OECD- FAO projections, the value of agricultural gross production worldwide would reach USD 4.82 trillion in 2025, growing at an anticipated 3.44% annual pace through 2029. On similar note, global agriculture spending is expected to have reach USD 562.4 billion in 2025, up from USD 411 billion in 2020. It is anticipated to reach USD 785.1 billion by 2030 at CAGR 6.90%.

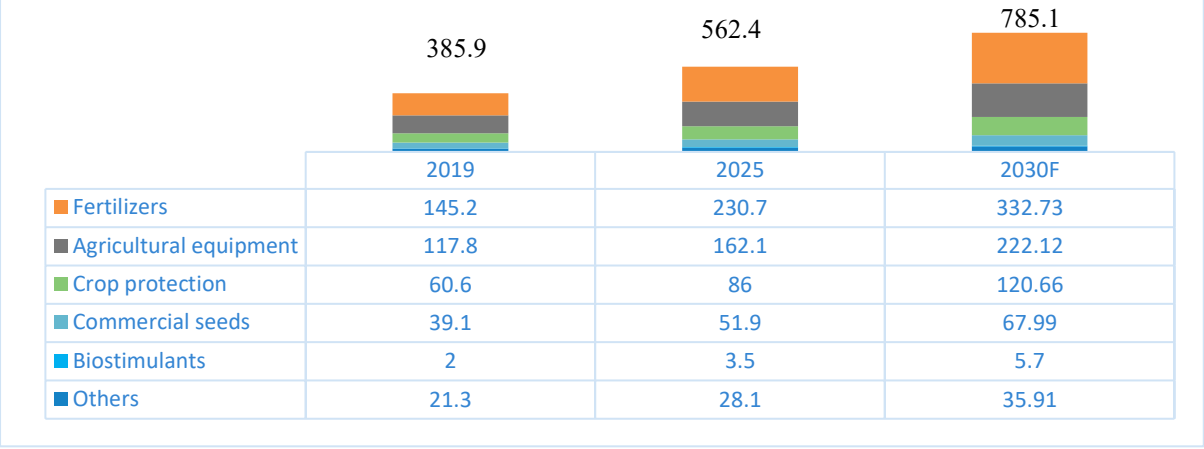
Exhibit 9: Global Agriculture spend; 2020-2030, By Value, USD Billion



Source: Frost & Sullivan Analysis

The global market for agricultural inputs, which includes seeds, fertilizers, crop protection, and biostimulants, is a huge and intricate sector that drives agricultural production and food security. With an increasing trend toward sustainable practices and biological goods, these inputs are distributed globally through international trade to enhance plant health, manage pests, and increase agricultural yields. It is estimated that in 2025 the ferilizer spent was ~USD 230.7 billion followed by agricultural equipment & Crop Protection at USD 162.1 Billion & USD 86 billion respectively.

Exhibit 10: Global Agriculture Input spend by category 2019, 2025, 2030F, By value USD Billion



	2019	2025	2030F
Fertilizers	145.2	230.7	332.73
Agricultural equipment	117.8	162.1	222.12
Crop protection	60.6	86	120.66
Commercial seeds	39.1	51.9	67.99
Biostimulants	2	3.5	5.7
Others	21.3	28.1	35.91

Others include irrigation and water management and miscellaneous spends

Source: Frost & Sullivan Research and analysis

3.2 Impact of current geo-political situation with Russia and China on India's manufacturing sector

As the world economy is being reshaped by trade conflicts, tariffs, and sanctions, Russia, China & India are working to revive the alliance as a hedge against economic and political isolation.

The combined GDP (PPP) of India, Russia, and China is $53.9 trillion, or approximately one-third of the world's total economic production. Their combined exports totalled $5.09 trillion, or about one-fifth of all merchandise exports worldwide. This money is moving across continents, boosting international trade, and bringing billions of people together through industry, innovation, and technology. China's dominance in manufacturing, Russia's energy dominance, and India's service economy with its enormous untapped markets are the three nations' respective strengths. India's digital infrastructure, service sector strength, and critical market size are what are increasingly securing this trinity, even as China contributes manufacturing scale and Russia offers energy depth.

More than just an economic partnership, the convergence of China, Russia, and India signifies the creation of a new global order in which Eurasian nations influence international trade. Russia will provide its economic partners with cheap energy and related resources. By investing in Indian companies, China will up the ante and reach both local and international markets. India is about to re-enter the global export ecosystem where Future narratives are moving away from "China+1" and toward "India+2." Further, India can have Fertilizer security with imports from Russia along with, stable fertilizer prices.

3.3 Major Agriculture Producing Regions

United States, China, India, and Brazil are the biggest producers of agricultural products. Germany, France, Mexico, Turkey, and Russia are other significant producers. Although specific crops or products may differ, these nations top in overall production. For example, China leads in vegetables, the United States in maize, India in paddy, milk and pulses, and Brazil in coffee and sugar.

Crop Production Volume (2024-25)	Top 3 producers		
Rice - 545.73 Mn Tons	India- 28%	China- 27%	Bangladesh 7%
Maize- 1.33 Bn Tons	USA- 33%	China-23%	Brazil- 10%
Cotton- 1,561 Lakh Bales	China- 29%	India- 20%	Brazil- 15%
Millets-30.0 Mn Tons	India- 40%	Niger -12%	China- 9%

Source- USDA

According to USDA, for marketing year 2025-26, rice production was ~545.73 Million Ton out of which India produced ~28% (154.02 Million Tons) followed by China at 27% (146.33 Million Tons) and Bangladesh at 7% (37.65 Million tons). India & China almost accounted for ~55% of the total global production making them significant countries in global rice production. Their significance is a result of their extensive agricultural acreage, ideal climates, government assistance, productive farming, and high domestic consumption. Because of their combined production and exporting operations, these two countries have a significant impact on the world's rice supply and pricing, making them essential to global food security.

Global maize production ranged at 1.33 Billion tons in 2025-26 with United States producing ~33% (432.34 Million Tons) of the global maize production. It is followed by China & Brazil at 23% (301.24 Million Tons) & 10% (138.00 Million Tons) respectively. USA has been consistently number one producer of maize thanks to use of genetically modified seeds, favorable climate & use of advanced practices & machinery.

Around 1521 lakh bales, or 26.54 million tons, of cotton is expected to be produced worldwide in 2025–2026, a 2.15% increase over the previous year. China and India continue to be the two largest producers in the world, accounting for over 29% and 20% of the total, respectively. As the main cash crop for millions of farmers, a major source of employment, and an essential raw material for their enormous textile industries, cotton is of enormous economic and social significance in China and India. Both countries are among the largest consumers of cotton in the world, and the demand for cotton-based goods like clothing and home textiles is being driven by the growing middle class. These nation's government policies assist cotton growers, control the market, and guarantee a steady supply of this essential crop.

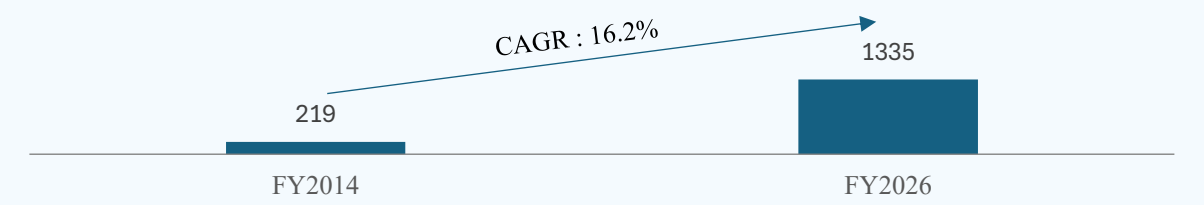
Global millet production in 2025-26 is estimated to be around 30.02 million tons, with India leading as the largest producer, accounting for approximately 40% of the total production followed by Niger & China at 12% & 9% respectively. Millet production is becoming more and more significant for health, climate resilience, and food security, especially because it requires less input than other cereals and can grow in harsh environments. Millets are hardy, drought-resistant crops that require minimal water and can withstand extreme temperatures, making them crucial for food security in vulnerable, dry, and semi-arid regions. Millets are packed with dietary fiber, protein, vitamins, minerals, and antioxidants, offering a more nutrient-dense alternative to rice and wheat.

3.4 Overview of the Agricultural Sector in India

3.4.1 Market Overview

India’s agricultural sector continues to evolve with significant strides in production and acreage, driven by a combination of technological advancements, government support, and strategic shifts in crop management. FY 2025-26 marked a period of notable developments, with key crops showcasing resilience and growth despite global challenges. India’s agricultural and allied sector has embarked on an impressive expansion journey, exhibiting an encouraging average annual growth rate of 10.06% from FY 2021-22 till FY 2025-26, reaching a size of ₹56,653.00 billion in FY 2025-26.

Exhibit 11: Increase in Agriculture Budget assigned (₹ In Bn)



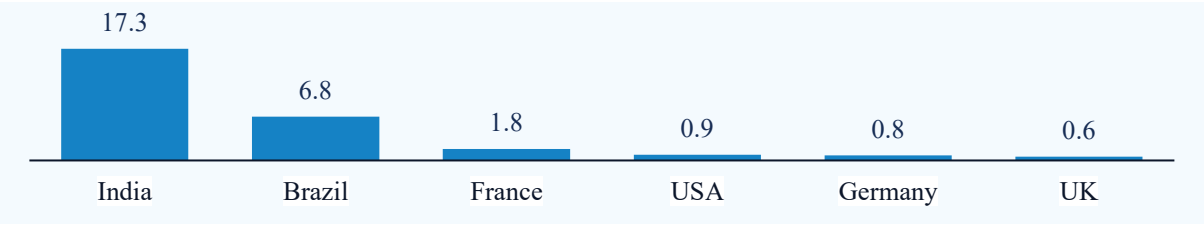
Source: PIB, Frost & Sullivan

The sector indicates a robust expected CAGR of nearly 13.64% between FY 2025-26 and FY 2029-30, poised to propel the market to an estimated size of ₹66,020.52 billion. The budget assigned for the Department of Agriculture, Cooperation & Farmers Welfare demonstrated an increase of 16.2% CAGR in the past 9 years under the current administration reaching ₹1335 Bn in FY2026.

3.4.2 Review of Indian Agri and Global Benchmarking

Agriculture has historically been a cornerstone of economic activity worldwide, particularly in developing nations, where it serves as a primary source of income to 50-55% of the population, employment to 45-50% population, and food security for the nation. However, with increasing industrialization and the diversification of economies, the share of agriculture in GDP has steadily declined globally. This shift is most pronounced in developed nations, where mechanized and highly efficient agricultural systems have reduced the sector's relative contribution. In contrast, developing countries like India still rely heavily on agriculture, showcasing its socio-economic importance.

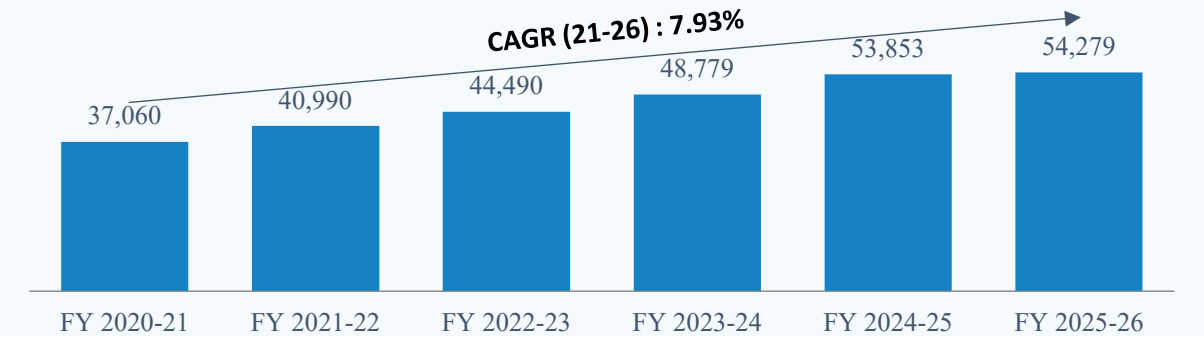
Exhibit 12: Share of Agriculture, Forestry & Fishing in GDP (CY 2020 to 2025 aggregate) in %



Source: WorldBank

India stands out globally with agriculture contributing an aggregated 17.3% to its GDP (average from CY 2020 till CY 2025), 16.2% in FY 2025-26, significantly higher than developed economies such as the USA (0.9%), Germany (0.8%), and the UK (0.6%). This disparity reflects India's heavy reliance on agriculture for employment and livelihoods. Despite contributing less to developed economies, their agriculture sectors are characterized by higher efficiency and advanced technologies. In contrast, India's agricultural productivity is constrained by fragmented landholdings, low mechanization, and limited infrastructure. These challenges highlight the need for structural reforms and modernization to improve productivity while reducing dependency on agriculture for economic stability.

Exhibit 13: India's Agriculture and allied sector GVA at Current Prices, (₹ In Bn)



Source: Economic Survey 2023-24, MOSPI, UPAG

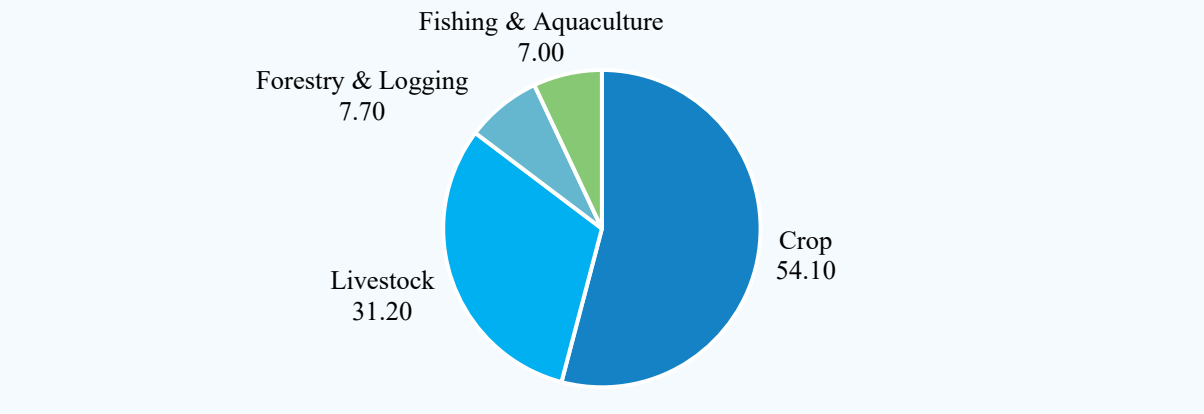
Between FY 2020-21 and FY 2025-26, India's agriculture and allied sectors expanded from ₹37,060 billion to ₹54,279 billion, delivering a solid CAGR of 7.93 %. Real GVA growth improved from 2.7% in FY 2025 to 3.1 % in FY 2026, reflecting stronger policy execution, greater access to credit, and wider adoption of farm technologies. This trajectory signals a resilient sector that has maintained momentum despite weather volatility, shifting trade

dynamics, and structural inefficiencies. Yet, the expansion also highlights a deeper imbalance. Agriculture continues to engage nearly half of India's workforce while contributing only around 17 % to GDP. This reflects the sector's low productivity base and limited mechanisation. Growth has come more from price gains and acreage expansion than from sustainable improvements in yield or efficiency. Addressing these gaps will require consistent policy alignment, better water management, and continued investment in innovation and extension services.

For the seed and crop protection industries, the rising GVA points to a structural uplift in input intensity. As farmers seek to extract more output per hectare, demand for higher quality seeds and more, effective crop protection solutions is strengthening. The push toward higher productivity, supported by public investment and digital adoption, is expanding the market for hybrid and climate-resilient seed varieties. At the same time, erratic rainfall patterns and increasing pest pressures are creating a shift toward biologicals and targeted crop protection products that offer both efficacy and environmental safety.

The trend also reflects a more commercial mindset among farmers. With improved market access, better price discovery, and institutional credit, input purchases are becoming more planned and ROI-driven. This behaviour favours organized players offering reliable brands, strong technical support, and integrated crop solutions. As India's agricultural growth becomes more technology-led and market-linked, consumption of advanced seeds and crop protection products will rise in tandem, providing a long-term growth runway for the industry.

Exhibit 14: India's Gross Value Output from Agriculture and Allied Sector- FY 2023-24 (in %)



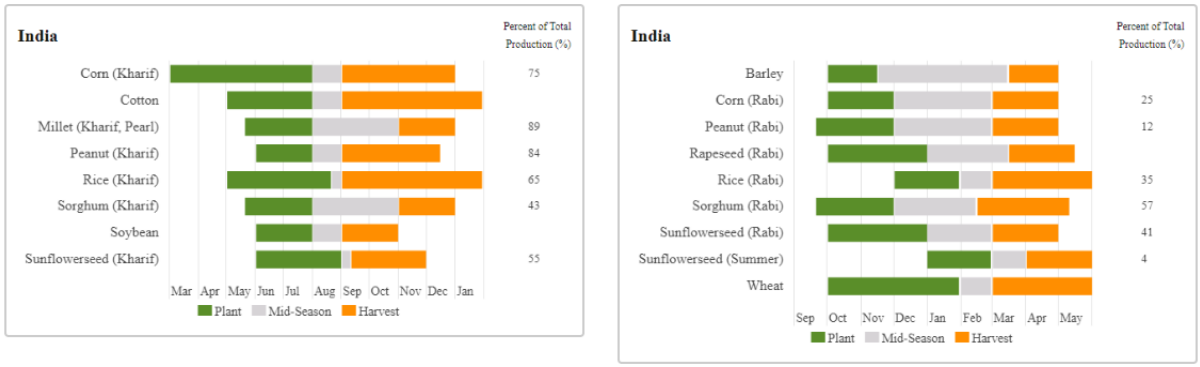
Source: MOSPI

India's agricultural output remains anchored in crop production, which contributes 54.1 percent of total sectoral value. Livestock accounts for 31.2 percent, followed by forestry and logging at 7.7 percent and fishing and aquaculture at 7.0 percent. The composition reflects the continued dominance of traditional cropping systems, but it also signals untapped potential in allied segments that can provide income diversification and risk mitigation for rural households. The next phase of agricultural growth will depend on expanding these allied activities and integrating them with the broader agri-value chain. Livestock, aquaculture, and forestry not only create secondary income streams but also enhance resource efficiency through circular models such as integrated farming and waste recycling. Their expansion, coupled with value-added processing, can cushion farmers against the volatility of crop income and strengthen rural economic resilience.

3.4.3 Coverage on cropping cycle

Cropping cycles, which frequently include crop rotation to preserve soil health and manage pests, are the whole, recurring sequence of planting and harvesting various crops on the same land throughout time. As opposed to a crop cycle, which is the growth of a single crop, it involves the planned succession of several crops in order to guarantee biodiversity, soil fertility, and a steady harvest from a field over the long term. Cropping cycle of some othe countries I given in exhibit below:-

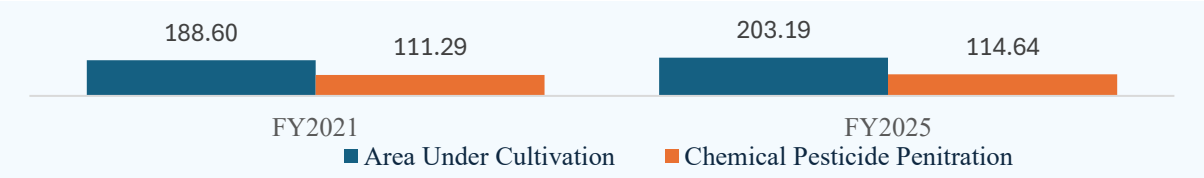
Exhibit 15: Cropping Cycles



3.4.4 Drivers of Indian Agricultural Sector

Growth in land area for food grain crops in India : India's cultivated land base has expanded steadily, increasing from 188.6 million hectares in FY21 to 203.2 million hectares in FY25, a CAGR of 1.9 %. Over the same period, chemical pesticide–treated acreage grew from 111.3 to 114.6 million hectares, translating to a CAGR of 0.7%. This widening differential indicates that while total cultivation is rising, input penetration is increasing at a slower pace, suggesting substantial untapped potential particularly in semi-arid and rainfed regions where adoption remains uneven.

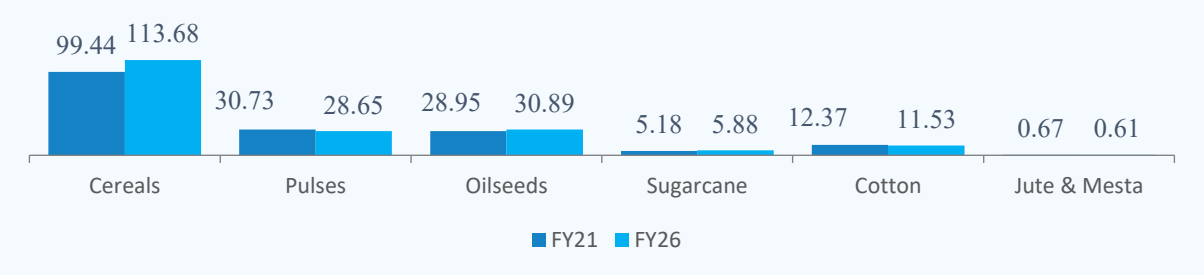
Exhibit 16: Historic Growth in Cultivatable Land and Penetration of Chemical Pesticides (FY 21 to FY25) Million Hectares



Source: Directorate General of Plant Quarintine and Storage, data is updated only till FY 25 and hence FY 26 not updated during the time of the filing.

Cereal crops remain the backbone of Indian agriculture, rising from 99.44 to 113.70 million hectares, supported by resilient monsoons and adoption of high-yield seed varieties. This expansion reinforces cereals' central role in food security but also highlights the pressure on water and soil resources in high-output states. Oilseeds have shown strong momentum, increasing from 28.95 to 30.89 million hectares, driven by the National Mission on Edible Oils (NMEO) and favorable price dynamics. This expansion reflects a structural shift toward higher-value crops aligned with import substitution goals. Pulses, at 28.65 million hectares, have reduced slightly from FY21 levels of 30.73 million hectares.

Exhibit 17: Historic Growth in Acreages for major crops (Million Hectares) (FY 2020-21 to FY 2025-26)



Source: Third Advance Estimate, Ministry of Agriculture and Farmer Welfare, Indian Budget, Digital Sansad – Q&A, PIB

Sugarcane acreage rose from 5.18 to 5.88 million hectares, supported by ethanol demand and crop diversification policies, while cotton declined from 12.37 to 11.53 million hectares as erratic rainfall and pest incidence weighed on farmer economics. Jute and mesta continued their long-term decline amid weakening global demand and competition from synthetics.

For the seed industry, the acreage mix; points toward sustained demand for hybrid and high-yielding varieties in cereals and oilseeds, as well as continued investment in stress-tolerant pulses and cotton hybrids. For crop protection, the broadening of cultivated area and rising intensity in cereals and oilseeds will sustain demand for herbicides and fungicides, while increasing climate variability will heighten reliance on pest management solutions. Together, these trends indicate a steady transition toward more input-intensive, technology-driven farming that favors organized, innovation-led players in both seeds and agrochemicals.

Crop Yields in India : India's average crop yields are far below global standards. For instance, the average yield for crops in India is around 9.16 tons per hectare, compared to over 39 tons per hectare in countries like UK and 17 tons per hectare in USA. Similarly, water use efficiency is low, with agriculture accounting for nearly 80% of total water usage, but much of it is wasted due to inefficient irrigation practices. This inefficiency in resource use is becoming increasingly untenable in the face of climate change, which is expected to exacerbate water scarcity and make weather patterns more unpredictable.

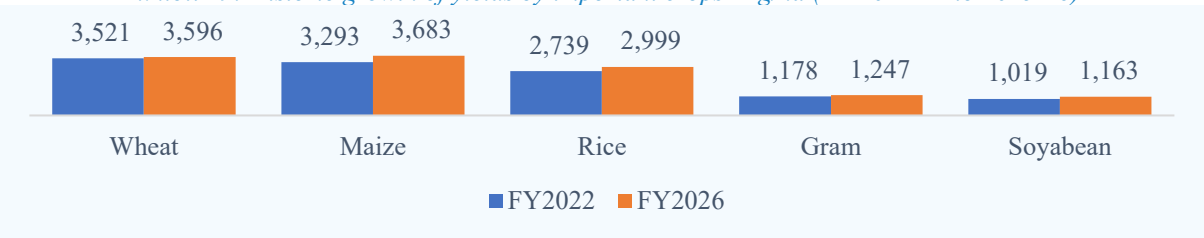
Exhibit 18: Aggregated Crop yield comparison by countries (tons/hectare) – CY2023

Country	Tons/ha
Brazil	12.40
China	13.20
India	9.16
UK	39.92
USA	17.19

Source: FAOSTAT, ICAR

India's agricultural yields have strengthened across major crops between FY 2021-22 and FY 2025-26, reflecting gradual but tangible progress in seed quality, input efficiency, and farm-level technology adoption. Wheat yields rose from 3,521 kg/ha to 3,596 kg/ha, supported by the growing use of rust- and heat-tolerant seed varieties and wider adoption of precision irrigation. The steady replacement of older seed lines with newer, climate-resilient hybrids has reduced crop losses and improved consistency in output across northern states.

Exhibit 19: Historic growth of yields by important crops- Kg/ha (FY 2021-22 to 2025-26)



Source: Ministry of Agriculture and Farmer's Welfare

Maize has been the standout performer, with yields climbing from 3,293 to 3,683 kg/ha, driven by hybrid seed penetration and increased mechanization. The crop's rising importance in feed and industrial use has incentivized farmers to invest in higher-value seed and more rigorous pest management, lifting both productivity and input intensity. Rice yields have similarly improved from 2,739 to 2,999 kg/ha, aided by the uptake of stress-tolerant and water-efficient varieties under government-supported programs. The spread of direct-seeded rice (DSR) methods and integrated pest management (IPM) has also enhanced water use efficiency and reduced disease incidence, reinforcing the link between agronomic precision and yield gains.

Pulses have shown modest yield growth, with gram moving from 1,178 to 1,247 kg/ha, but the shift toward disease-resistant and early maturing varieties is helping stabilize output despite climatic variability. In soybean, yields rose from 1019 to 1,163 kg/ha, reflecting the adoption of drought-tolerant hybrids and better farm practices in traditionally rainfed regions such as Madhya Pradesh and Maharashtra. These crops illustrate the increasing responsiveness of yield to seed innovation and targeted crop protection rather than to expansion in acreage.

Supporting government policies are also boosting agricultural production in India. In Fiscal Year 2026, the Government's fertilizer subsidy bill alone was estimated at approximately Rs. 1.86 trillion. Further, the Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) scheme provides an annual direct income transfer of Rs. 6,000 per farmer to all landholding farmers, further supplementing farmers' financial capacity to procure agricultural inputs.

As farmers gain access to better genetics and tailored pest solutions, yield improvements are becoming more uniform across geographies. The shift toward hybridization, coupled with more rational pesticide and nutrient application, is strengthening farm economics and reducing volatility in output. The relationship between yield growth, quality seeds, and effective crop protection is now mutually reinforcing with improved genetics raise productivity potential, while scientific crop protection ensures that potential is realized on the ground. In India, demand for crop protection products and natural crop solutions, and seeds is closely tied to the Kharif (typically

April–September) and Rabi (typically October–March) sowing and application windows. Purchases by distributors, retailers and farmers are concentrated in the pre-season and peak season months, while off-season demand is typically lower

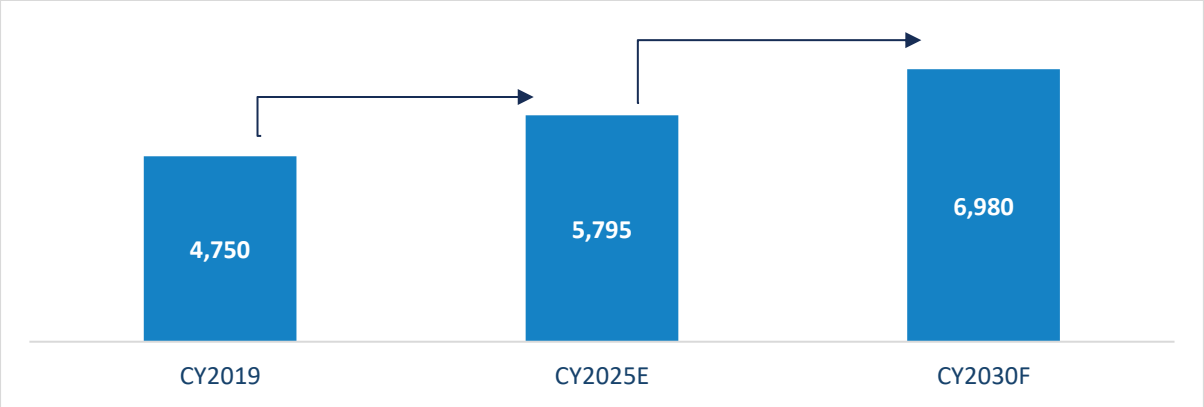
4. Global and Indian Chemical Industry Review

4.1 Global Chemicals Market Overview

The global chemicals market was valued at around USD 5795 Billion (Bn) in CY2025 with China accounting for the largest market share (41%) in the segment followed by European Union (14%) and United States (13%). India accounts for ~4.5% market share in the global chemicals market. The global chemicals market is expected to grow at ~3.8% CAGR, reaching USD 6980 Bn by CY2030. Going forward the APAC is anticipated to grow at the fastest rate during the forecast period (2025-30F). The chemicals markets in Europe & North America are relatively mature and hence would record comparatively slower growth.

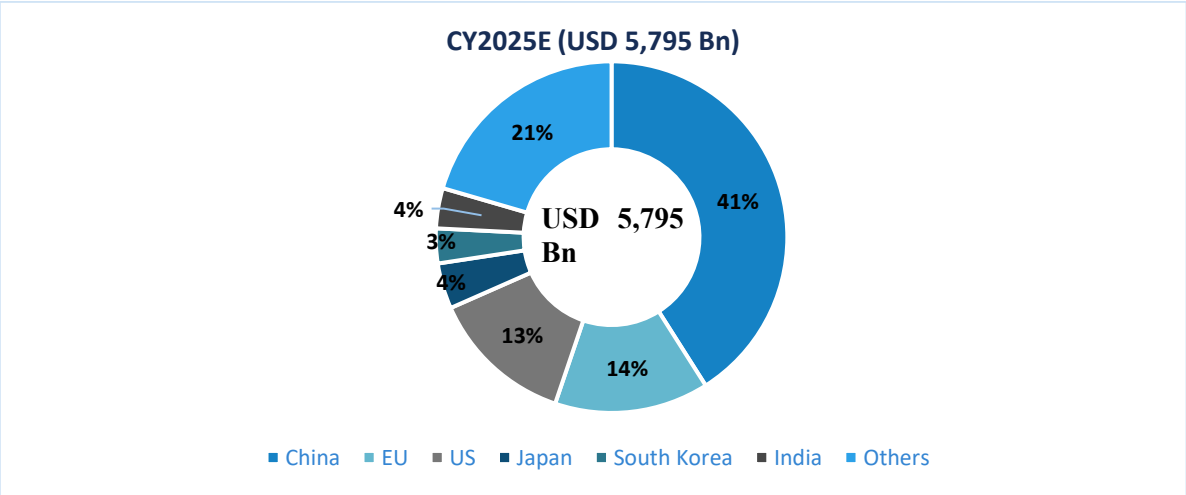
Worldwide, the competitive landscape has changed significantly over the last ten years. The BRICS countries (Brazil, Russia, India, China, and South Africa) accounted for over 48 % of global chemical sales in CY2025. Together with the EU27 and the USA and the BRICS accounted for more than 75% of global chemical sales, in CY2025. The remaining global chemical sales were generated mainly by emerging countries in Asia and the Middle East.

Exhibit 20: Global Chemicals Market; Historic and Forecast CY2019-2030F (USD Billion)



Source: CEFIC, Frost & Sullivan Analysis

Exhibit 21: Global Chemicals Market by Geography CY 2025 (USD Billion)



Source: Frost & Sullivan

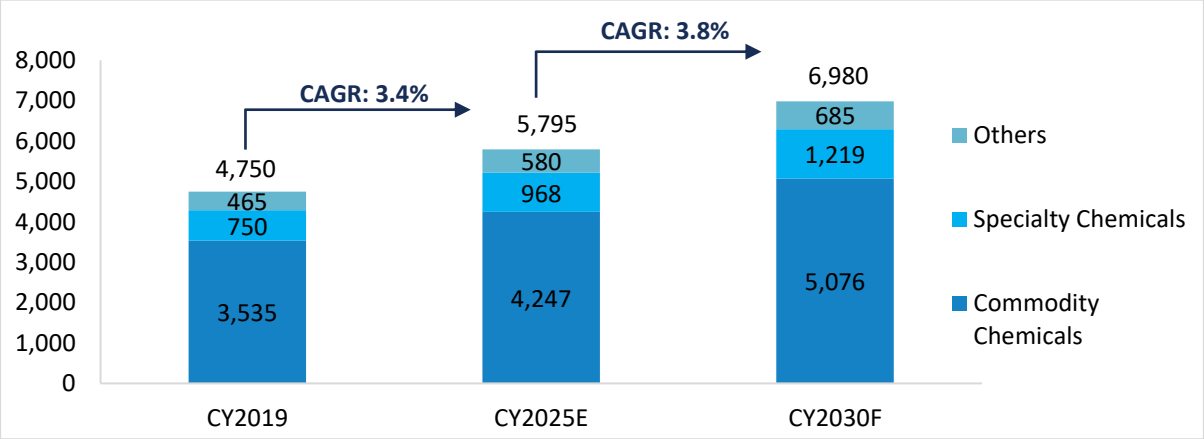
4.2 Global Chemicals Market by Type

The commodity chemicals market includes basic chemicals that are manufactured in large volumes. These include plastics, synthetic fibers, films, certain paints and pigments, explosives, and petrochemicals. There is limited product differentiation within the sector and products are sold for their composition. The market remains highly fragmented, with leading players such as Dow Chemical and BASF SE each accounting for less than 5% of global market share, followed by companies including Bayer AG, DuPont de Nemours, and AkzoNobel. Collectively,

these major players represent only a small portion of the market, while over 85% of global sales are distributed among numerous regional and international producers. Key end-use industries include basic and specialty chemicals, textiles, automotive, consumer appliances, furniture, pulp and paper, oil refining, aluminium processing, and other industrial manufacturing sectors. The global commodity chemicals market was valued at approximately USD 4,247 Bn in CY2025 and is projected to grow at a ~3.6% CAGR, reaching USD 5,076 Bn by CY2030.

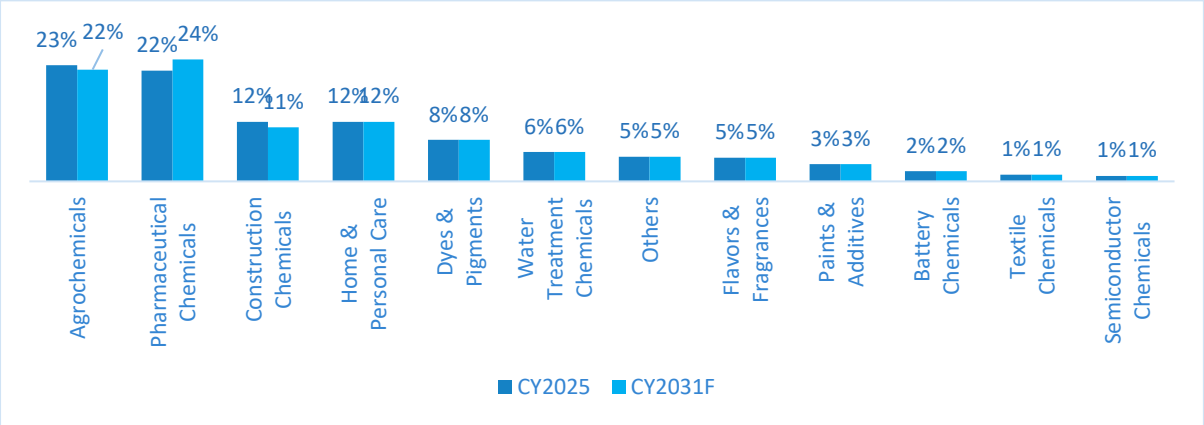
The specialty chemicals market is characterized by high-value, low-volume products that deliver specific performance attributes and are tailored to end-use applications. The segment encompasses fine chemicals, additives, pharmaceuticals, advanced polymers, adhesives, sealants, specialty paints, pigments, and coatings, catering to diverse industrial and consumer markets. The industry is highly fragmented and continues to witness consolidation as manufacturers pursue portfolio optimization, technological capabilities, and geographic expansion. While specialty chemical producers remain exposed to elevated feedstock and energy costs, the sector is increasingly shaped by factors such as innovation-driven product development, changing customer preferences, substitution by alternative technologies, and evolving regulatory standards. The global specialty chemicals market was valued at approximately USD 968 Bn in CY2025 and is expected to grow at a ~4.7% CAGR over the next five years, reaching USD 1,219 Bn by CY2030.

Exhibit 22: Global Chemicals Market by Type CY 2019 till 2030F (USD Billion)



Source: Frost & Sullivan Analysis

Exhibit 23: Global Specialty Chemicals by Application CY 25



Source: Frost & Sullivan Analysis

The global specialty chemicals industry can be segmented by the final end-user industry that these chemicals find applications in. Every end-industry varies in complexities of specialties required and thus offer unique opportunities for specialty chemical players in terms of technology, competitive landscapes, profitability and corporate collaborations for growth and market penetration.

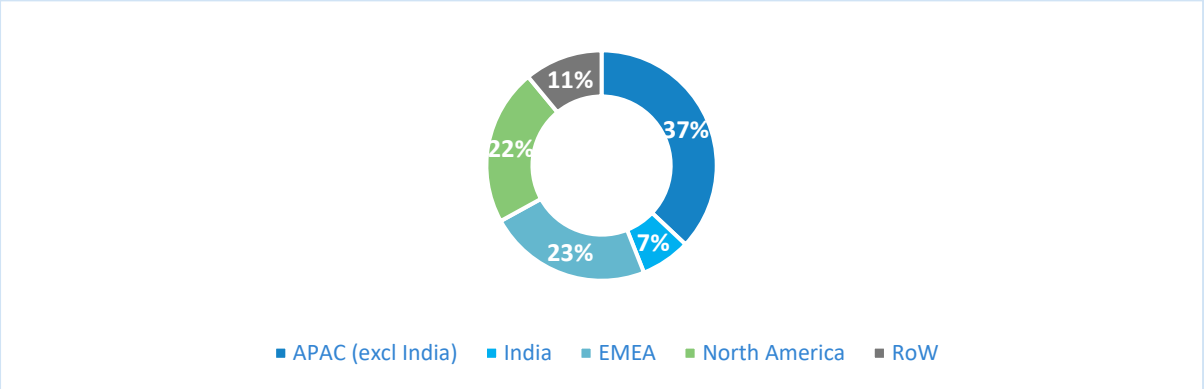
There's significant overlap in this characterization method. Market-oriented groups frequently encompass multiple functional chemicals serving the same market, whereas functional chemicals are typically utilized by various markets. This differentiation is primarily for the sake of convenience when discussing strategic aspects of business segments, rather than indicating a substantial variance in the products themselves

At the global level, specialty chemical demand is led by agrochemicals at about 23%, followed by pharmaceutical chemicals at around 22%, together contributing nearly 45% of total demand. Growth in these segments is supported by rising global food security concerns, increasing crop protection intensity, expanding generic drug manufacturing, and higher healthcare spending across emerging markets.

Construction chemicals account for roughly 12% of demand, while home and personal care contributes close to 12% as well. These segments are benefiting from infrastructure investments in Asia and the Middle East, urbanization, premiumization trends in personal care, and growth in sustainable and performance-enhanced formulations. Dyes and pigments represent about 8% of the market, supported by packaging, coatings, and textile applications, while water treatment chemicals at nearly 6% are driven by tightening environmental regulations and industrial wastewater treatment requirements. Flavors and fragrances, at approximately 5%, continue to grow in line with global FMCG and consumer lifestyle shifts.

Emerging segments such as battery chemicals at around 2% and semiconductor chemicals at just over 1% reflect increasing diversification toward EVs, energy storage, and electronics manufacturing. Textile chemicals at about 1%, paints and additives at around 3-4%, and other applications at roughly 5% further underline the diversified nature of the global specialty chemicals landscape. Overall, the sector is witnessing steady mid- to high-single-digit growth globally, with advanced materials and sustainability-linked applications growing at comparatively faster rates.

Exhibit 24: Global Specialty Chemical Demand By Region CY 25



Source: Frost & Sullivan Analysis

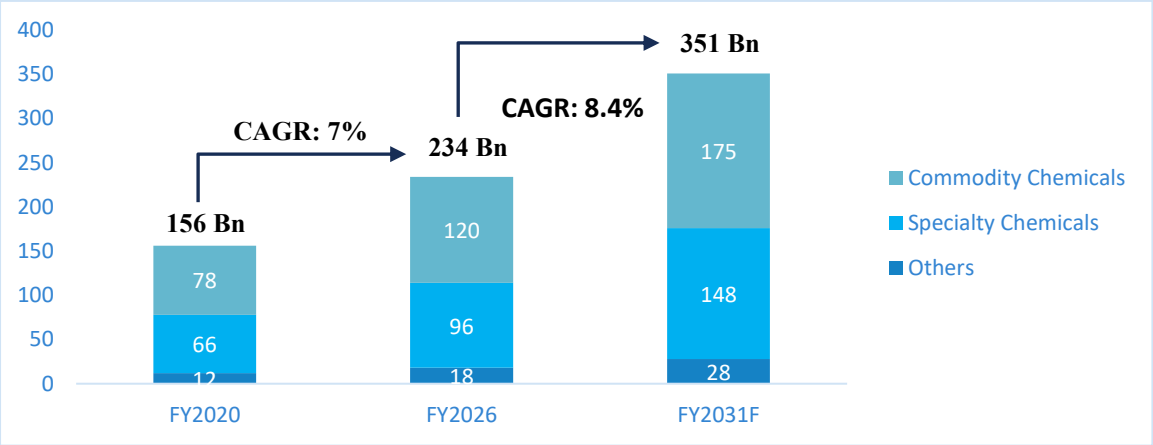
The United States has chosen to keep and, in places, harden Section 301 measures on China after its 2024 review, preserving tariffs across expansive lists that include numerous chemical inputs and intermediates. That pushes American buyers to diversify qualified supply beyond mainland China and rewards producers that can ship tariff-neutral into the US market. Europe is taking a different route: its Carbon Border Adjustment Mechanism enters its paid phase in 2026, raising the cost of carbon-intensive imports (fertilizers are explicitly covered) and nudging sourcing toward lower-emission producers or local EU capacity; at the same time, REACH-style scrutiny is tightening across hazardous classes, with PFAS restrictions advancing at national and EU levels. Together, these US–EU moves ratchet up compliance and landed costs for "brown" supply, and they shift order books toward producers with credible low-carbon, traceable, and regulation-ready portfolios.

China remains central on both demand and supply, but its own policy stance is reshaping specialty sub-markets. Export controls on gallium and germanium (key to compound semiconductors) and new licensing on graphite (battery anodes) have tightened availability and raised geopolitical risk premia across electronic and energy-transition chemistries. For global formulators, the practical response has been to rebalance sourcing toward allied jurisdictions, accelerate dual-supplier qualification outside China, and expand inventory buffers on critical inputs.

4.3 Indian Chemical Market Overview

The Indian chemicals market was valued at USD 234 Bn in year FY2026 (~4% share in the global chemical industry) with the commodity chemicals accounting for more than ~50%. It is expected to reach ~USD 351 Bn by FY 2031, with an anticipated growth of ~8.4% CAGR. Specialty chemicals industry forms ~40% of the domestic chemical market, which is expected to grow at a CAGR of around ~9% between FY2026 and FY2031.

Exhibit 25: Indian Chemicals Market by Type FY2020-2031F (USD Billion)



Source: Frost & Sullivan Analysis

Note: Indian chemical industry generally showcases Agrochemicals & Fertilizers and Pharmaceuticals API outside of Specialty chemicals. In the above graph the specialty chemicals section, however, is inclusive of the 2 categories to maintain consistency with the Global section. Agrochemical & Fertilizer and Pharmaceuticals API contribute to more than 55% of the specialty chemical space in India.Others mainly includes biotechnology.

CAGR Table for above graph:

CAGR	Commodity Chemicals	Specialty Chemicals	Others
FY2019-FY2026	7.0%	6.4%	7.4%
FY2026-2031F	9.2%	9.0%	7.8%

Note: Indian chemical industry generally showcases Agrochemicals & Fertilizers outside of Specialty chemicals. In the above graph the specialty chemicals section, however, is inclusive of Agrochemicals & Fertilizers to maintain consistency with the Global section.

The Specialty chemicals industry is driven by both domestic consumption and exports. India's specialty chemical companies are gaining favour with global MNCs because of the geopolitical shift after the outbreak of Covid-19 as the world looks to reduce its dependence on China. In FY2020, China accounted for 15-17% of the world's exportable specialty chemicals, whereas India accounted for merely 1-2% indicating that the country has large scope of improvement and widespread opportunity. Post Covid scenario, India's share in specialty chemicals sector has doubled up and increased to 4%. It is anticipated that Specialty chemicals will be the next great export pillar for India.

Home and personal care chemicals, water treatment chemicals, construction chemicals, agrochemicals etc. are areas where specialty chemicals find their applications. The growth of the market is in conjunction with the overall growth of the Indian economy. Aarti Industries, Atul Limited, Vinati Organics, Alkyl Amines, Navin Fluorine are the bigger players prevalent in the Indian Specialty chemicals market.

The "Make in India" campaign is also expected to add impetus to the emergence of India as a manufacturing hub for the chemicals industry in the medium term. Through incentives, subsidies and grants under this campaign, Indian companies could gain further ground as the global companies would want to reduce dependence on China after the COVID-19 pandemic and shift their supply chains. The decline in raw materials prices could also help the margins and reduce working capital need. However, input costs are a pass through for most companies and benefits could be limited. Overall, the specialty chemicals industry is likely to continue to perform well in the near to medium term and is expected to capitalize on the Make in India benefits to assume leadership position in the market.

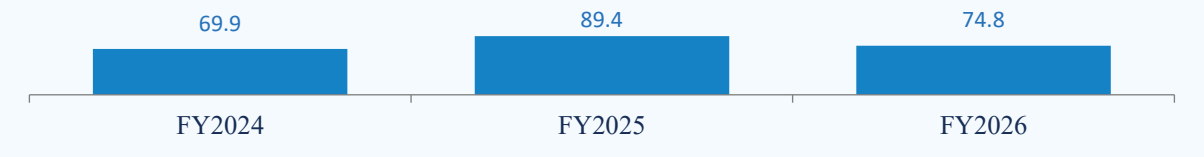
The exports are on the rise in India is becoming a central manufacturing hub for such chemicals. Tightening of environmental norms (e.g., REACH means Registration, Evaluation, Authorisation and Restriction of Chemicals Regulations) in developed countries and the slowdown of China are contributing to the growth of exports.

China's specialty chemicals market has seen a downturn in recent years due to various factors; most prominent being the introduction of stringent environmental norms. Tightening environmental protection added new business operating costs and led to factory closures in high-polluting sectors, which weighed on industrial production. Stricter environment regulations have negatively impacted industrial output since FY2017. The tightening of environmental protection norms in China since January 2015 resulted in increase in operating

costs, closure and relocation of manufacturing facilities. Additionally, the labour cost (hourly cost of compensation) in China was lower than that of India till FY 2007. Over FY2005-2015, the average labour cost in China increased nearly 19-20% CAGR, against 4-5% CAGR in India. Under these circumstances, the growth of the Chinese specialty chemicals market has also been slowing down. In addition, the recent trade friction between the United States and China has reduced Chinese exports to the United States by approximately 3% from 20% in FY 2018 to 17% in FY 2019. This continuing trade war has also opened export avenues for other Asian countries and India is being looked at as one of the key sourcing destinations. While these may not be permanent trends, these will involve significant costs of production for Chinese companies, enabling India to significantly strengthen its position in the global supply chain and position itself as a viable alternative for global players seeking a de-risked supply chain while containing sourcing costs.

The recent downturn observed in China's specialty chemicals industry is serving as an opportunity for Indian manufacturers, who have now gained a cost advantage over their Chinese counterparts.

Exhibit 26: Historic FDI Equity Inflow in Chemical Industry FY 24 till FY 26 in Value INR Billion

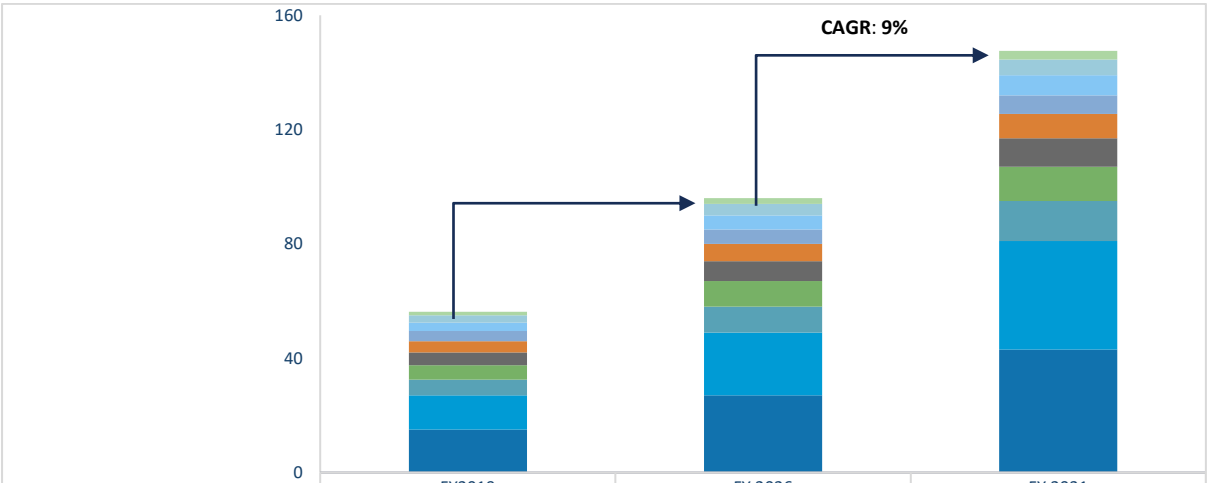


Source: FACT SHEET ON FOREIGN DIRECT INVESTMENT (FDI) INFLOW, DPIIT

Foreign direct investment (FDI) has played a pivotal role in the sector's growth, with FDI inflows into India's chemical industry (excluding fertilizers) reaching pre-pandemic levels. FDI equity inflow into India's chemical industry rose 28% in FY2025 to INR 89.4 billion before moderating 16% to INR 74.8 billion in FY2026, leaving the sector 7% above its FY2024 base. The FY2025 peak was driven by a concentrated set of large specialty chemical and CDMO transactions.

The government's policy framework, including Petroleum, Chemicals, and Petrochemicals Investment Regions (PCPIRs), Production-Linked Incentives (PLI) schemes, and revised import-export regulations, has facilitated significant capital inflows into the sector. India's competitive advantages, including low labour costs, skilled workforce, and a robust manufacturing ecosystem, have further strengthened its position as a global chemical manufacturing hub.

Exhibit 27: Indian Specialty Chemicals by Applications FY 2026 and 31(F)



	FY2019	FY 2026	FY 2031
Flavours & Fragrances Ingredients	1.3	2	3
Dyes and Pigments	2.5	4	5.5
Water Treatment Chemicals	3	5	7
Textile Chemicals	3.5	5	6.5
Paints & Coatings Additives	4	6	8.5
Home & Personal Care	4.5	7	10
Others	5	9	12
Construction Chemicals	5.5	9	14
Pharma API	12	22	38
Agrochemicals & Fertilizers	15	27	43

Source: Source: Frost & Sullivan

Traditionally, low-cost labour and raw material availability were the advantages enjoyed by Indian manufacturing companies. Increasingly, though, specialty chemicals companies are focusing beyond these traditional cost advantages. Product development capabilities have become progressively more important across various segments and differentiate the top and bottom performers.

Indian chemical industry generally showcases Agrochemicals & Fertilizers and Pharmaceuticals API outside of Specialty chemicals. Agrochemical & Fertilizer and Pharmaceuticals API contribute to more than 55% of the specialty chemical space in India.

5. Global Crop Protection Market

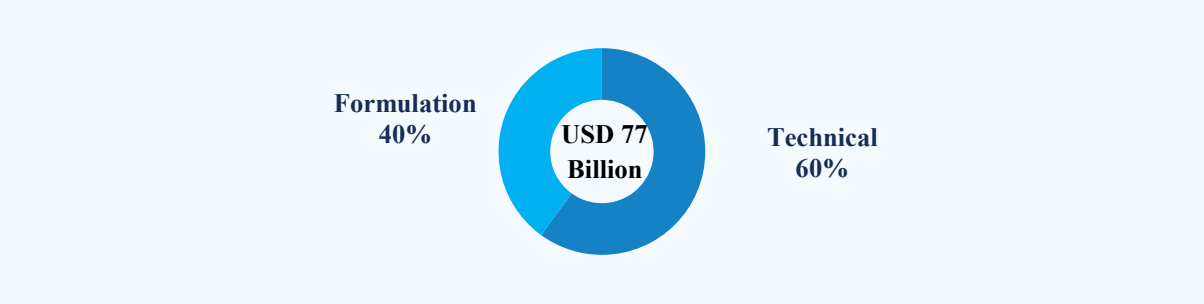
The crop protection market was valued at around USD 77 billion during CY2025 and is expected to reach USD 95 billion during CY2030F, growth with a CAGR of 4.2% during the forecast period. The global crop protection market has experienced steady growth over the past few years, driven by the increasing demand for food, advances in agricultural technology, and the need to manage growing pest and disease pressures.

Exhibit 28: Global Crop Protection Market by Value (USD Bn), CY2019-CY2030F



Source: Frost & Sullivan

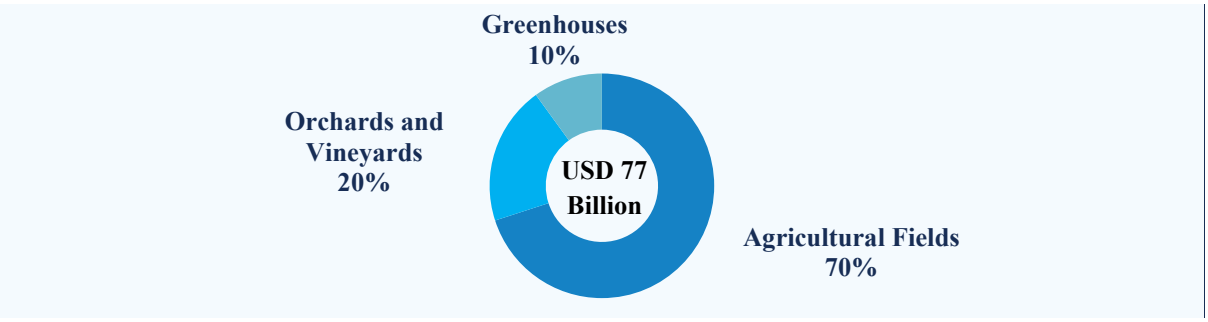
Exhibit 29: Global Crop Protection Market Segmentation by Production Stage, CY2025



Source: Frost & Sullivan

The Technicals market in Agrochemicals involves the bulk production of active ingredients (AI), which are the core molecules used in pesticides formulations. This involves large-scale manufacturing of these active ingredients, which are then used in formulations in different forms. The Formulation market, on the other hand, involves processing these active ingredients into end-use products like sprays, granules, and liquids. Although the *formulation market is smaller in volume, it has a higher per-unit value* because it includes additional substances such as carriers, solvents, and stabilizers that enhance the efficacy, safety, and ease of application of the pesticides.

Exhibit 30: Segmentation of Global Crop Protection Market by Applications, CY2025

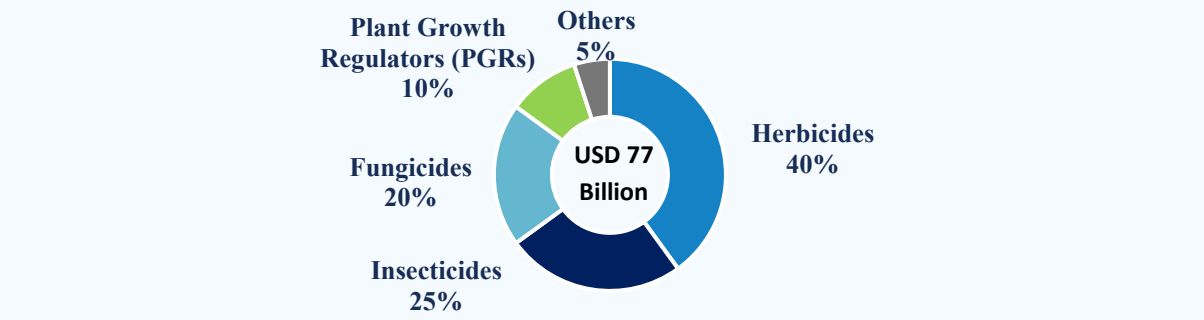


Source: Frost & Sullivan

- **Agricultural Fields:** Crop protection chemicals in agricultural fields are essential for protecting crops such as cereals, vegetables, fruits, and oilseeds. These chemicals help manage weeds, insects, and diseases, all of which can drastically affect yield and quality.
- **Orchards and Vineyards:** Orchards and vineyards require precise management due to the vulnerability of fruit-bearing plants. Pests such as codling moths in apple orchards or grapevine moths in vineyards can cause significant damage. Fungicides are applied to prevent diseases like powdery mildew or downy mildew, which can destroy grapevines or fruit trees. The use of crop protection chemicals in this sector ensures that the plants remain healthy and produce high-quality fruits, essential for market demand.
- **Greenhouses:** Crop protection chemicals such as insecticides and fungicides are used in greenhouses to maintain optimal plant health by managing pests like aphids or whiteflies, and fungal infections like mildew. These chemicals ensure that the crops grown in these optimized environments remain healthy, preventing yield losses and maintaining high-quality produce.

Crop protection chemicals are segmented based on product types like insecticides, herbicides, fungicides, etc. or depending on the biodegradability index associated with the chemicals.

Exhibit 31: Global Crop Protection Market by Product Type, CY2025



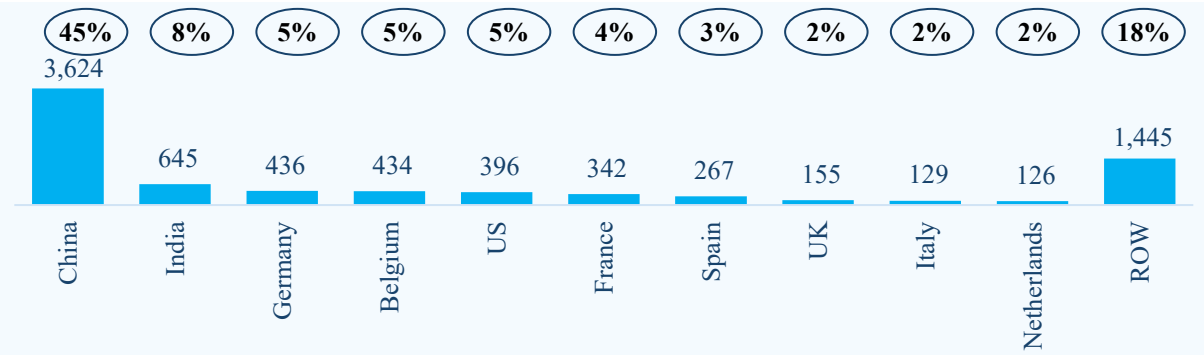
Source: Frost & Sullivan

- **Herbicides:** Herbicides dominate the global agrochemical market, primarily due to their widespread use in large-scale cultivation of cereals, oilseeds, and soybeans. Herbicide-resistant weeds are becoming a major challenge, driving demand for rotational herbicides and herbicide-tolerant crop systems. Latin America and North America lead in consumption, fueled by genetically modified (GM) crops.
- **Insecticides:** Used extensively for targeting pests like aphids, caterpillars, and beetles, particularly in high-value crops (fruits, vegetables, and cotton). Adoption is stabilizing in developed markets due to integrated pest management (IPM) practices but remains critical in pest-heavy regions such as Asia-Pacific and Africa.
- **Fungicides:** Consumption of fungicides is high in regions with high humidity and disease-prone climates like Europe and Latin America. Fungicides are critical for protecting high-value crops such as grapes, potatoes, and bananas.
- **Plant Growth Regulators (PGR):** Increasingly used in yield optimization and stress mitigation for crops like cereals, cotton, and sugarcane. PGR consumption is poised to grow as companies focus on climate-resilient agriculture and explore synergies with precision farming technologies.
- **Others:** Others include rodenticides that is used for targeting rodents like rats, used in storage & protection of grain, and bactericides which is used for targeting bacterial infections in plants, mainly in horticulture and fruits.

5.1 Global Crop Protection Chemicals Exports by Countries

Key exporting countries leverage their manufacturing capacity, technological advancements, and access to raw materials to meet both regional and global agricultural needs.

Exhibit 32: Global Agrochemicals Exports by Country in KT, CY2025 and Share (%)



Source: Frost & Sullivan

5.2 Global Formulation Market Trends

- **Microencapsulation Technology:** Increasing adoption of microencapsulation for controlled release and targeted delivery. This ensures the active ingredient is released gradually, reducing environmental impact and increasing efficacy. This enables more precise application, reduces the frequency of re-application, and minimizes residues on crops.
- **Water-Based Formulations:** Rising demand for safer, eco-friendly, and low-solvent water-based formulations, particularly in fungicides and herbicides. It is utilized for seed treatment, foliar sprays, and soil-applied formulations.

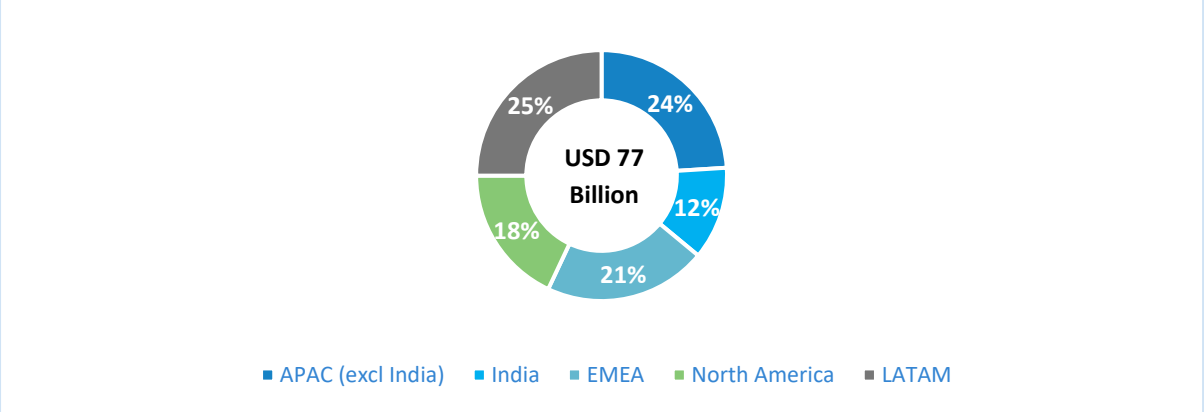
- **Bio-based Formulations:** Bio-based formulations are increasingly preferred in the agrochemical industry as they utilize natural or renewable resources, aligning with the global push for sustainable and eco-friendly agricultural practices. By offering an alternative to synthetic chemicals, bio-based formulations not only meet stringent regulatory standards but also enable agrochemical companies to access regulated organic markets and cater to environmentally conscious consumers.
- **Oil Dispersion and Emulsifiable Concentrates:** Oil Dispersion (OD) and Emulsifiable Concentrates (EC) formulations are gaining prominence due to their superior adhesion, rain fastness, and ability to penetrate pests effectively. These formulations are especially beneficial for crops like rice, soybeans, and wheat, where consistent protection under adverse weather conditions is critical. For instance, OD formulations in fungicides enhance their ability to stick to crop surfaces even during heavy rainfall, while EC formulations improve the absorption of insecticides into pest cuticles.

5.3 Global Crop Protection Chemicals by Region

The Crop Protection market dynamics varies by region, influenced by agricultural practices, regulatory environments, and climate challenges. In North America and Europe, large-scale mechanized farming, high regulatory standards, and a focus on sustainability drive the demand for advanced Crop Protection solutions.

In Asia-Pacific, with its mix of smallholder and commercial farming, there is growing reliance on traditional chemicals for pest control and ensuring food security. Latin America sees significant demand due to extensive farming of cash crops like soybeans and corn. Meanwhile, Africa's crop protection market is expanding rapidly, driven by climate challenges and pest outbreaks threatening food production.

Exhibit 33: Segmentation of Global Crop Protection Demand by Geography, CY2025

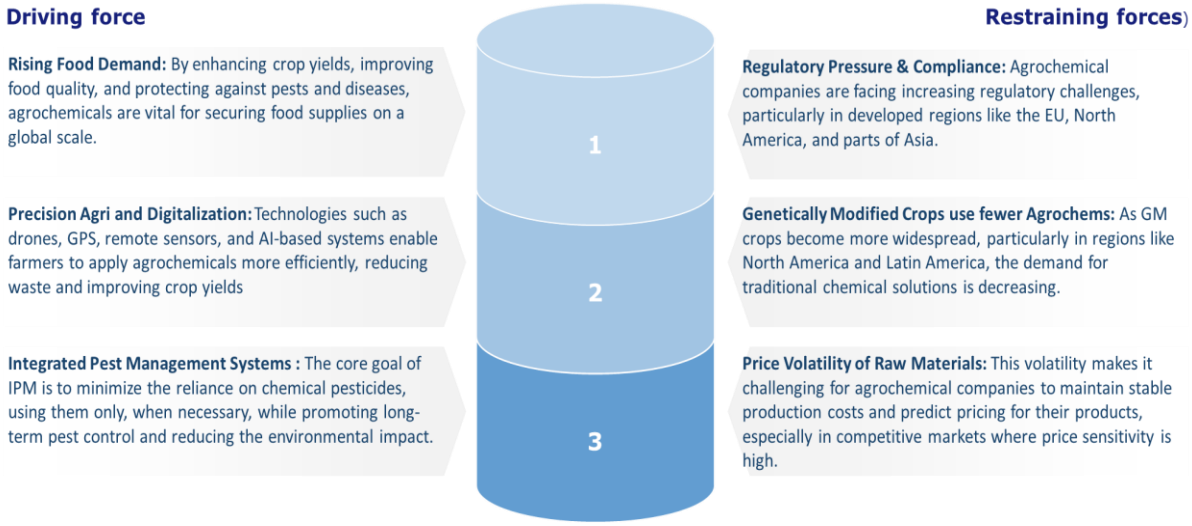


Source: Frost & Sullivan

The Asia Pacific (APAC) region leads the Global Crop Protection market driven by the extensive agricultural base in countries like China, India, and Southeast Asia.

Latin America holds 25% of the market, primarily due to the region's vast agricultural land dedicated to cash crops such as soybeans, corn, and coffee. This region's rapid expansion in large-scale farming operations drives consistent demand for crop protection products. In North America, agricultural innovation, mechanization, and advanced farming practices are prevalent. The region's regulatory environment, which emphasizes environmental safety and sustainable farming practices, also shapes the demand for crop protection solutions. In Europe, sustainability and stringent regulatory frameworks dominate the agricultural sector market dynamics and demand for Agrochemicals. The emphasis on reducing pesticide residues, adopting integrated pest management (IPM), and minimizing environmental impact is reshaping crop protection strategies. In contrast, the Middle East and Africa face unique challenges that drive the need for crop protection solutions. The Middle East's adverse climates and water scarcity along with limited arable land puts larger pressure on agricultural productivity, making pest and disease management vital for crop survival. In Africa, rapid population growth, along with changing climate conditions, is exacerbating pest and disease outbreaks that threaten staple crops

5.4 Growth Drivers and Restraints of Global Crop Protection Market

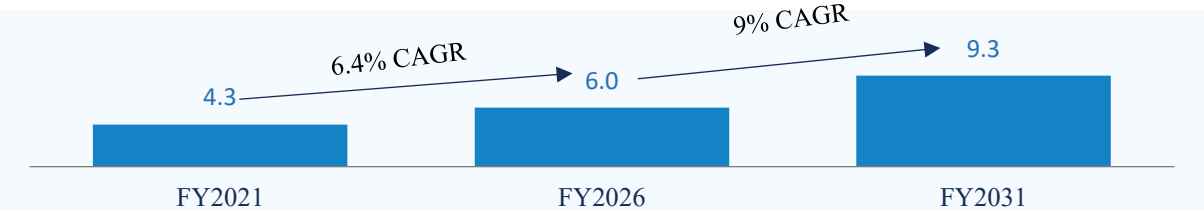


6. Indian Crop Protection Market

6.1 Overview

The Indian branded formulated crop protection chemicals market has grown steadily over the past five years, supported by structural shifts in agriculture, evolving pest dynamics, and a gradual move toward more targeted solutions. The market was valued at about USD 6 billion in FY26, up from USD 4.3 billion in FY21, and is expected to reach approximately USD 9.3 billion by FY31. This represents a healthy expansion that reflects both rising awareness among farmers and a diversification of product categories. Active ingredients in crop protection accounted for about USD 3.6 billion in FY26, estimated to reach USD 5.68 Billion in FY30. The total crop protection market inclusive of technical and formulations was estimated to have grown from USD 5.95 Billion in FY 20 to USD 14.20 Billion in FY 30.

Exhibit 34: Indian Branded Crop Protection Market (USD Billion)



Source: Frost & Sullivan

Note: Estimation has been done for FY26 & FY30 basis historic consumption data acquired from the Department of Plant Quarantine & Storage along with several published database, company annual reports and internal analysis.

India's pesticide consumption remains concentrated in a group of agriculture-intensive states, with Uttar Pradesh, Jammu & Kashmir, Maharashtra, Telangana, Punjab, West Bengal and Haryana together accounting for 72-75% of national volumes. Uttar Pradesh, at 20.2%, is the largest market, supported by paddy, wheat and sugarcane. Weed pressure from barnyard grass, flat sedge and Phalaris minor keeps herbicide use high. Jammu & Kashmir ranks second at 12.4% despite a modest cropped area, reflecting the conversion of valley farmland into dense apple orchards and the resulting dependence on high-dose protectant fungicides.

Maharashtra, at 12.2%, remains among the largest users. Cotton in Vidarbha and Marathwada drives steady insecticide demand, while the western Maharashtra sugarcane belt anchors herbicide offtake and the grape, onion and pomegranate clusters around Nashik, Sangli and Solapur account for the bulk of fungicide use. Telangana, at 9.2%, continues to record some of the highest application intensity in the country, as cotton and chilli.

State	Consumption Share in Chemical Pesticide Share FY25
Uttar Pradesh	20.2%
Jammu & Kashmir	12.4%
Maharashtra	12.2%
Telangana	9.2%
Punjab	7.3%
West Bengal	6.6%
Haryana	6.0%
Tamil Nadu	2.9%
Rajasthan	2.9%
Karnataka	2.7%
Gujarat	2.7%
Chhattisgarh	2.6%
Andhra Pradesh	2.5%
Others	9.7%

Source: Company Annual Reports, Media Articles, Directorate General of Plant Quarantine and Storage, PIB, Digital Sansad, Frost & Sullivan Analysis

Note: Weighted distribution was applied on volume consumption by states as published by the Directorate General of Plant Protection & Storage (FY25) along with value estimates derived through primary interviews (FY 24 & 25)

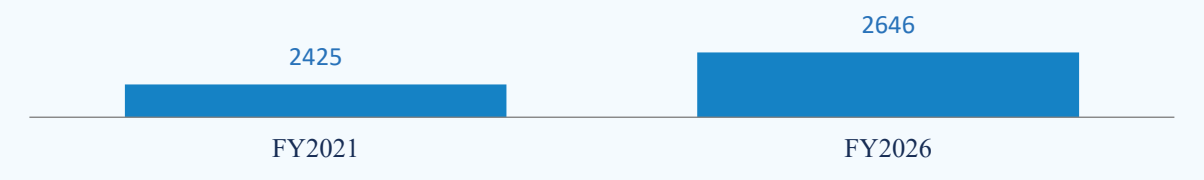
At the time of the publication FY26 reports were not reported by the Directorate General of Plant Protection & Storage

6.2 Growth Drivers

The category is growing due to following factors:

Increase in Yields of Major crops: Steady improvement in farm productivity has become one of the most important contributors to the expansion of the crop protection market. National average yields have increased from 2,425 kg/ha in FY21 to 2,646 kg/ha in FY26, supported by better irrigation coverage, improved seed varieties, and precision use of inputs. The growth in yield, though moderate at about 10 %, reflects the structural strengthening of Indian agriculture rather than short-term output gains.

Exhibit 35: Increase in Indian Crop Yields across Foodgrains (kg/Ha)



Source: Third Advance Estimate, Ministry of Agriculture and Farmer Welfare, Indian Budget, Digital Sansad – Q&A, PIB

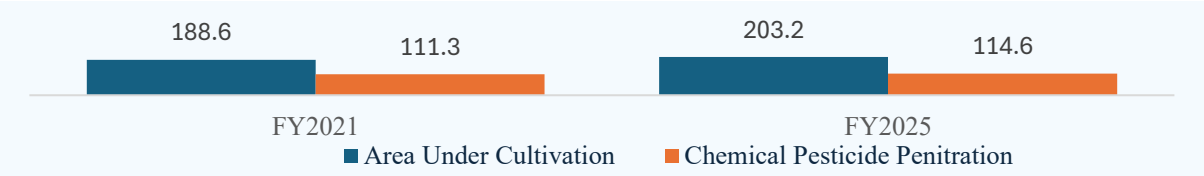
This productivity gain has been most visible in paddy, maize, wheat, and horticulture crops. In eastern Uttar Pradesh and Bihar, hybrid paddy varieties such as *Swarna Sub-1* and *MTU-1010* have pushed average yields up by nearly 8–10 %, but they have also created higher susceptibility to brown planthopper, stem borer, and leaf folder, driving regular insecticide use. Punjab and Haryana, which already have among the highest paddy yields in the country, have focused on maintaining productivity through better weed control in the face of resistant *Phalaris minor* in wheat. This has spurred steady demand for newer post-emergent herbicides like clodinafop and fenoxaprop.

In Madhya Pradesh and Maharashtra, where maize and soybean acreage has grown, yield improvements have coincided with a shift toward more systematic fungicide application to manage leaf spot, rust, and powdery mildew. For many years soybean farmers struggled with weed management. Products were available, but they were not giving the effective solution farmers needed. Weeds were reducing yields, and farmers wanted something that offered broad-spectrum weed control, longer duration of protection, and complete crop safety. Farmers increasingly rely on sequential sprays and seed treatment chemicals to secure incremental yield gains in these crops. In Andhra Pradesh and Telangana, yield improvements in chilli and cotton have been closely linked to better crop protection adoption particularly against thrips, aphids, and bollworms, which remain the main constraints on yield. The higher returns from horticulture and vegetable cultivation in these southern states have further encouraged investment in both chemical and bio-based pest management solutions.

Overall, higher productivity per hectare is raising the economic risk of crop loss, making pest management a more integral part of cultivation rather than an optional expense. This linkage between yield and protection intensity is expected to deepen as farmers adopt shorter-duration and high-yielding hybrids that require tighter crop protection cycles to realize their potential.

Increase in crop acreages: India's cultivated land base has increased from 188.6 million hectares in FY21 to 203.2 million hectares in FY25, growing at a 1.9% CAGR. Over the same period, the area treated with chemical pesticides rose from 111.3 to 114.6 million hectares at a 0.7 % CAGR. The gap between these two trends shows that agriculture is expanding faster than pesticide usage, which leaves significant room for further penetration, especially in semi-arid, rainfed and smallholder-dominated regions where adoption remains inconsistent.

Exhibit 36: Historic Growth in Cultivatable Land and Penetration of Chemical Pesticides (FY 21 to FY25) Million Hectares



Source: Directorate General of Plant Quarintine and Storage, data is updated only till FY 25 and hence FY 26 not updated during the time of this report curation.

This expansion in cultivated area, combined with more diversified cropping, is strengthening the runway for crop protection products. Growth in cereals and oilseeds has been particularly important, since these crops respond strongly to herbicide and fungicide programmes. Rising pest variability linked to climate and higher value share

from horticulture and commercial crops are also supporting regular usage across key states. With agriculture itself on a steady growth path and more districts gaining access to irrigation and extension services, the broader cultivated base is translating into a wider and more consistent demand footprint for crop protection.

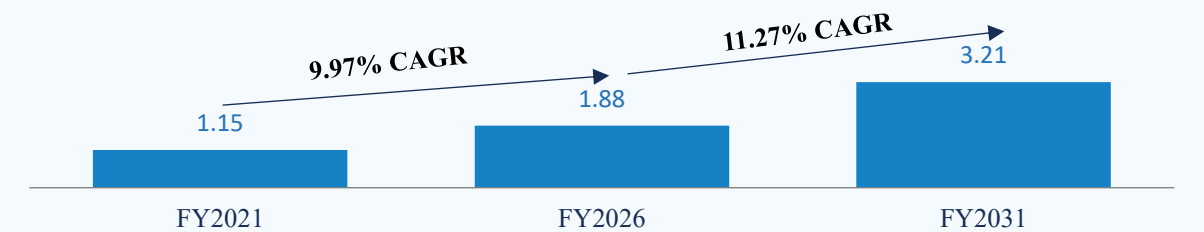
Growth in MSP: Over the last five years, MSPs for key crops have consistently increased, improving rural incomes and supporting farmer sentiment. Soyabean showcased the highest growth.

Commodity	FY21	FY26	CAGR (%)
Paddy (Common)	1868	2441	5.50%
Wheat	1975	2585	5.53%
Maize	1870	2410	5.20%
Groundnut	5550	7517	6.26%
Soyabean (Yellow)	3950	5708	7.64%
Cotton (MS)	5726	8267	7.62%
Cotton (LS)	6025	8667	7.54%

Source: Ministry of Agriculture and Farmer Welfare, PIB, Prices are INR/Quintal

Rising Role of CDMO in Agrochemicals: India's agrochemical CDMO market is witnessing robust growth, driven by increased outsourcing from global innovators. As multinational firms reduce their in-house manufacturing burden due to high capital costs, Indian CDMO players are stepping in with scalable capacity, regulatory compliance, and strong IP protection practices.

Exhibit 37: Indian Agrochemicals- CDMO Market by Value (USD Bn), FY2021-FY2031F



Source: F&S Analysis

The segment is projected to see a 2.5x increase in value between FY2021 and FY2031, supported by long-term contracts, focus on high-performance molecules, and R&D collaboration. For Indian players, this trend enhances export visibility and supports backward integration into technical-grade production.

6.3 Challenges/Threats of the crop protection market

Regulatory Delays and Uncertainty in Molecule Approvals: The Indian crop protection industry operates within an evolving but often uncertain regulatory framework. The Insecticides Act of 1968 and the pending Pesticide Management Bill (PMB) have created ambiguity around data protection, renewal procedures, and new molecule registration timelines. It typically takes four to six years for a new active ingredient to receive approval in India, compared to two to three years in major export markets. This delay discourages the introduction of newer, low-toxicity molecules and limits the industry's ability to refresh its product portfolio. Frequent state-level bans on certain formulations—such as Paraquat, Monocrotophos, and Glyphosate—add further inconsistency in availability, affecting product planning and channel confidence.

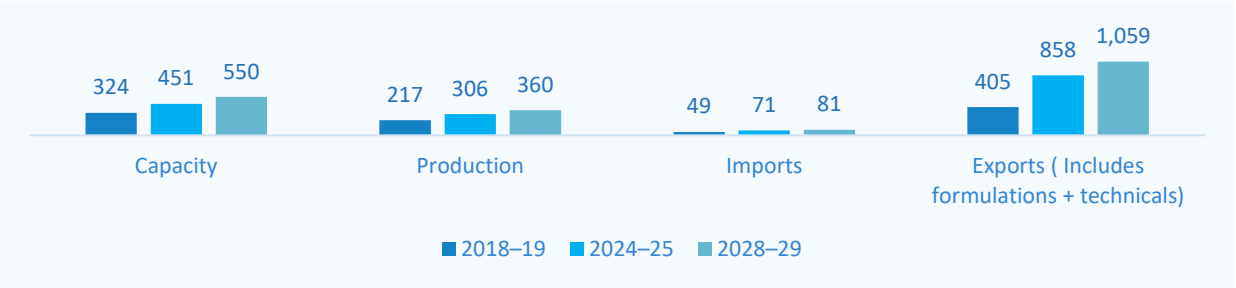
Prevalence of Counterfeit and Substandard Products: A study by FICCI in 2015 found out that counterfeit products in India accounted for 20-25% by value and around 30% by volume. The issue is acute in states with weaker retail oversight, such as Bihar, Odisha, Assam, and parts of Uttar Pradesh, where smallholders often rely on unregistered dealers or informal traders. These products undermine farmer confidence, reduce efficacy due to lower active content, and damage the reputation of organized manufacturers. Counterfeits also distort demand estimates, making inventory management difficult for legitimate players

Fragmented Distribution and Limited Technical Advisory: While India has over 250,000 retail points selling crop protection products, the distribution structure remains uneven and inefficient. Larger states such as Uttar Pradesh, Gujarat, and West Bengal account for over one-third of distributors, leaving several high-growth regions especially Jammu & Kashmir, the Northeast, and eastern India under-served. Many dealers operate as general input suppliers with limited agronomic training, leading to improper product recommendations and misuse. The lack of structured extension support and post-sale guidance restricts adoption of newer formulations and reduces application efficiency. This fragmentation also raises logistics costs for manufacturers, particularly those serving smaller markets where volume turnover is low.

6.4 India's Production, Import and Export Market Landscape

India continues to strengthen its position as a major global hub for crop protection manufacturing and exports. Installed technical-grade capacity has increased from 324 thousand tonnes in 2018–19 to 451 thousand tonnes in 2024–25, and is expected to reach 550 thousand tonnes by 2028–29. Capacity growth remains concentrated in Gujarat, Maharashtra and Andhra Pradesh, where chemical clusters and port access support efficient scale-up. Production has followed a similar trajectory, rising from 217 thousand tonnes in 2018–19 to 306 thousand tonnes in 2024–25, with output projected to reach 360 thousand tonnes by 2028–29 as new lines stabilise and more multi-step synthesis is brought in-house.

Exhibit 38: India Crop Protection Capacity, Production, Import and Export



Source: Directorate of Plant Protection, Quarantine & Storage, Ministry of Chemicals and Petrochemicals * note – Exports include Technicals as well as Formulations while Production No. s and Capacity is for Technicals as provided by the Govt. of India.

CAGR (FY25-FY29): Capacity (5.09%), Production (4.15%), Exports (5.4%)

Exports remain the strongest driver of the industry. Outbound shipments have expanded from 405 thousand tonnes in 2018–19 to 858 thousand tonnes in 2024–25, and are forecast to reach 1.06 million tonnes by 2028–29. Growth is supported by India's cost-competitive manufacturing, broader process capability, and the industry's shift toward more compliant, cleaner production routes that meet regulatory expectations in key markets across Latin America, North America and Africa.

Exhibit 39: India Crop Protection Export by Country FY2026

Country	*Export % Share*
BRAZIL	*23.4%*
U S A	*12.4%*
BANGLADESH PR	*6.1%*
VIETNAM SOC REP	*4.6%*
CHINA P RP	*3.6%*
INDONESIA	*2.5%*
NIGERIA	*2.1%*
U ARAB EMTS	*2.0%*
AUSTRALIA	*1.9%*
TANZANIA REP	*1.9%*
COLOMBIA	*1.8%*
COSTA RICA	*1.8%*
ARGENTINA	*1.6%*
KENYA	*1.6%*
THAILAND	*1.5%*
Others	*31.2%*

Source: Directorate of Plant Protection, Quarantine & Storage for FY 26.

In value terms, Brazil and the United States together make up nearly 35 % of India's total pesticide exports, reflecting India's strong presence in the soybean, maize, and cotton segments that dominate Latin American agriculture. Other important destinations include Bangladesh (6.1%), Vietnam (4.6%), and China (3.6%), which collectively indicate India's growing penetration in regulated and semi-regulated markets. Exports to China have also risen in last few years, reflecting complementary trade in intermediates and low-cost formulations. The European Union as a block contributes over 10 % through destinations such as France, the Netherlands, and the UK. The strong export momentum has been driven by India's cost competitiveness, process chemistry capabilities, and a growing portfolio of post-patent actives. Companies are leveraging these strengths through backward

integration and expansion of technical-grade capacity, while several mid-sized players are scaling up for contract synthesis to serve multinational clients. The industry's shift toward formulation exports has also widened market access to countries in Africa, Southeast Asia, and Latin America where regulatory barriers are lower and branded formulations find growing demand.

The strong export momentum has been driven by India's cost advantage, process chemistry expertise, and increasing focus on post-patent molecules. Indian companies are scaling up technical-grade capacity and investing in backward integration to secure raw materials and intermediates, especially in Gujarat, Maharashtra, and Andhra Pradesh. Many mid-sized firms are also entering custom synthesis and contract manufacturing for global innovators, supplying off-patent actives and intermediates to regulated markets. The industry's growing formulation export base is expanding its reach across Latin America, Africa, and Southeast Asia, where the demand for affordable, broad-spectrum agrochemicals continues to rise.

This export and production capacity growth aligns closely with the global wave of molecule patent expiries expected over the next few years. As several high-value active ingredients lose patent protection, Indian manufacturers are positioned to benefit from process innovation, competitive synthesis routes, and cost-efficient scaling. With an established base of multi-purpose plants, access to skilled chemists, and strengthening regulatory compliance, India is well placed to capture a significant share of the upcoming generic opportunity in crop protection.

Exhibit 40: Active Ingredients recently expired/expiring (2023-2029)

Active Ingredient	Patent Expiry Year	Usage Category	Specific Applications	Patent Holder
Bixafen	2023	Fungicide	Broad-spectrum fungicide for cereals	Bayer Crop Science
Chlorantraniliprole	2024	Insecticide	Controls chewing insects in crops like soybean, fruits and vegetables, rice, cotton, maize, pome fruit, sugarcane, potato, and cereals	Corteva Agriscience and FMC
Cyantraniliprole	2026	Insecticide	Targets lepidopteran larvae, thrips, aphids, and other chewing and sucking insects across multiple crops	Corteva Agriscience, FMC, and Syngenta
Flubendiamide	2023	Insecticide	Used to control lepidopteran pests in rice, cotton, corn, and grapes	Bayer Crop Science
Fluopicolide	2023	Fungicide	Applied on grapes, potatoes, fruits, and vegetables to combat various fungal diseases	BASF
Fluopyram	2023	Fungicide	Effective against diseases like gray mold, powdery mildew, apple scab, and others in grapes, apples, and various vegetables	BASF
Isopyrazam	2023	Fungicide	Controls pathogens in cereals and bananas	Sumitomo Chemical
Mandipropamid	2023	Fungicide	Used against late blight in potatoes and tomatoes	BASF
Penflufen	2023	Fungicide	Targets seed and soil-borne pathogens in potatoes and cereals	BASF
Penthiopyrad	2023	Fungicide	Promotes stronger, healthier roots for higher crop productivity	BASF
Pinoxaden	2026	Herbicide	Selective control of grass weeds in wheat and barley	Syngenta
Pyriofenone	2023	Fungicide	Developed to control powdery mildew in cereals and grapevines	Sumitomo Chemical
Pyroxsulam	2023	Herbicide	Addresses grass and broadleaf weeds in cereals	Syngenta
Saflufenacil	2023	Herbicide	Used to control broadleaf weeds in soybean, maize, sugarcane, and cereals	FMC
Sedaxane	2023	Fungicide	Provides protection against seed, soil, and air-borne pathogens in various crops	Syngenta
Thiencarbazone-methyl	2023	Herbicide	Selectively controls grasses and broadleaf weeds, primarily in corn	Bayer Crop Science
Florpyrauxifen-benzyl	2029	Fungicide	Used for the control of powdery mildew in a variety of crops, including fruits, vegetables	OATAgrio Co.

Active Ingredient	Patent Expiry Year	Usage Category	Specific Applications	Patent Holder
Sulfoxaflor	2027	Insecticide	Controlling sap-sucking pests on crops like cotton, soybean, cereals, fruits, and vegetables.	Corteva
Benzovindiflupyr	2028	Fungicide	Used for fungal diseases such as blight, mildew, rust, scab, and leaf spot in crops like corn, soybean, ornamental plants, and turf.	Syngeta

The expiry of these patents marks a significant turning point for generic players, particularly in India, the world's third-largest agrochemical exporter. As exclusivity lapses, domestic formulators and CDMO firms gain access to high-efficacy, globally validated actives without incurring R&D costs, allowing them to:

- Expand portfolios with differentiated and premium formulations
- Offer cost-effective alternatives in regulated and emerging markets
- Capture market share in high-growth segments like rice, cotton, horticulture, and pulses

This transition is particularly timely, as farmers globally are seeking effective replacements for aging chemistries and governments are phasing out high-toxicity actives. Molecules like Chlorantraniliprole and Flubendiamide, once premium and proprietary, can now be integrated into broader portfolios at accessible price points, enhancing both market penetration and value realization

6.5 Regulatory reforms shaping the Indian Agrochemical Industry

Strengthening of the Insecticides Act, 1968 and Rules, 1971 – The Act remains the cornerstone of pesticide regulation, covering import, manufacture, sale, transport, distribution, and use. Administration is with the Department of Agriculture and Family Welfare (DA&FW) via the Directorate of Plant Protection, Quarantine & Storage (DPPQS). There is now growing pressure to improve coordination with the Department of Chemicals & Petrochemicals (DCPC), since many industry-facing issues sit outside DA&FW's mandate.

Simplified Registration Pathways for Bio-Pesticides (Section 9(3B)) – To encourage eco-friendly alternatives, the Registration Committee has issued simplified guidelines. Provisional registrations are granted for two years based on strain confirmation by ICAR-NBAIM and quality checks by the Central Insecticide Laboratory. These measures are driving bio-pesticides adoption, which currently represents ~4.2% of the Indian market but is forecast to grow at ~10% annually.

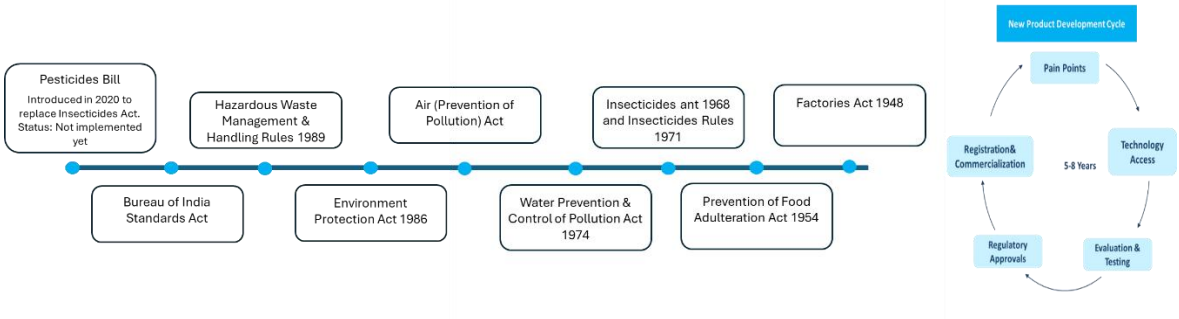
Phasing Out of Highly Hazardous Pesticides (HHPs) – India is aligning with global efforts to withdraw highly toxic formulations.Central Insecticide Board regularly reviews hazardous insecticides. They have banned the usage of Monocrotophos 36% SL, while policies encourage the development of low-toxicity molecules, organic products, and neem-based formulations.

Revised Export Registration Guidelines – Export facilitation has become a policy priority. The Registration Committee has created simplified categories (A-I to B-IV), most of which do not require full toxicology or chemistry data. Instead, basic published information suffices, and for registered bio-pesticides, no additional data is needed. Certificates of registration are mandated to be issued within 15 days, with "fast track" provisions for Star Export Houses to process approvals within 5 working days.

Mandatory Label and Leaflet Notifications (2022 Amendment) – Following industry consultations, DA&FW issued a Gazette notification in November 2022 to standardize pesticide labels and leaflets. This regulation aims to strengthen farmer safety, ensure accurate usage instructions, and align packaging requirements with international norms.

India is emerging as a global hub for technical-grade agrochemical manufacturing due to its low-cost production capabilities and expanding R&D investments. Leading players are investing in technical-grade production to reduce reliance on imports of active ingredients and to control production costs. Additionally, government's "Make in India" initiative and incentives for chemical manufacturers are fostering investments in technical production.

Exhibit 41: Indian Pesticide Regulation Snapshot



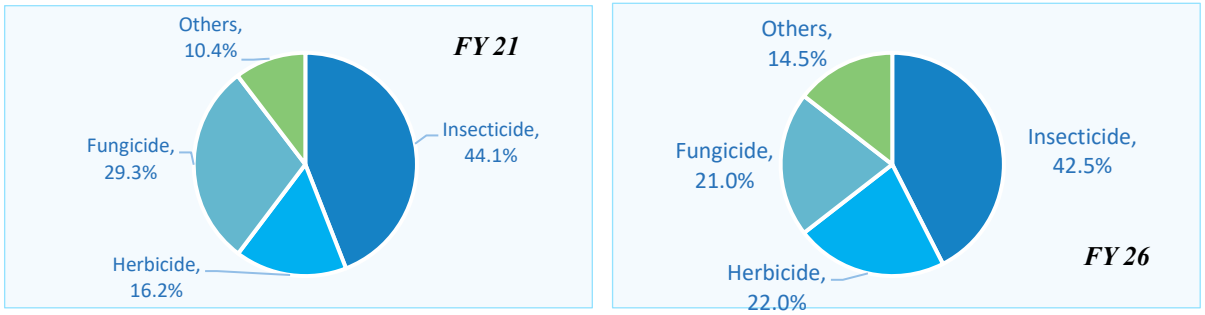
The registration process for agrochemical active ingredients is often lengthy with manufacturers having to adhere to a strict regulatory regime, including obtaining registrations under Section 9(3) of the Insecticides Act, 1968, therefore creating a barrier for entry for any run off the mill operators.

On the other hand, India formulations market is experiencing steady shift towards sustainable solutions. Rising environmental concerns and government initiatives have pushed the market towards bio-based formulations and low-residue chemicals. Growing adoption of crop-specific formulations tailored to major Indian crops like rice, wheat, sugarcane, and cotton. Customized solutions are being developed to address region-specific pest and soil challenges. The Indian formulation manufacturing players are set to benefit from the US-China trade war, with China expected to dump raw materials and technical at a cheaper price in diversified market baskets. This will enable formulation players to expand their margin contribution, therefore resulting in healthier balance sheets.

6.6 Indian Branded Formulation Market Size By Types

India's crop protection market is steadily reshaping its product mix as farmers adjust to changes in cropping patterns, weed pressure, climate variability and labour availability. India formulations market is experiencing steady shift towards sustainable solutions. Rising environmental concerns and government initiatives have pushed the market towards bio-based formulations and low-residue chemicals. In value terms, insecticides remain the largest category, although their share softened from 44.1 % in FY 21 to 42.5% in FY26 as usage becomes more targeted and other segments expand faster. Herbicides continue to gain ground, rising from 16.2 % to 22%, supported by labour shortages, higher weed resistance and stronger adoption in cereals, soybean and cotton. Fungicides, at 29.3 % in FY21, settled at 22 % in FY26, reflecting stable but more regionally concentrated demand in paddy and horticulture.

Exhibit 42: Indian Branded Formulation Crop Protection Chemicals Consumption By Product Type (FY 21 ; FY 26) : By Value



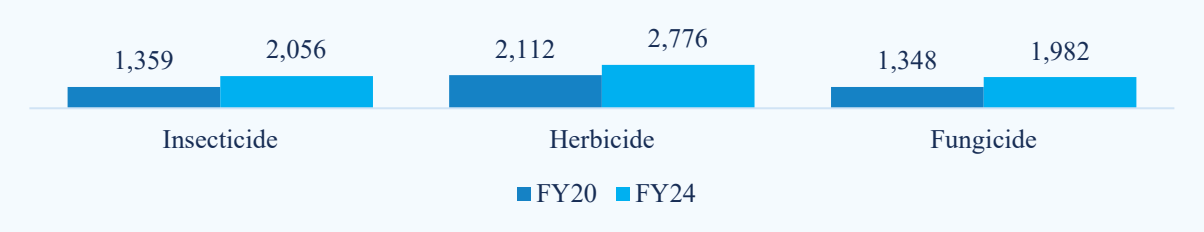
Source: Frost & Sullivan

Notes: Others consists of rodenticides,bio-pesticides, plant growth regulators and others

Note: Estimation for consumption for FY 26 (volume and pricing used to calculate value) is listed by Department of Plant Quarantine and Storage and FY 26 was estimated basis historical data, FY26 first estimate and current revenue bifurcation gathered by primary interviews.

In value terms, herbicides now command a disproportionate contribution because of higher pricing. The average realization for herbicides in FY24 stands at ~₹2,776.41/kg or L, compared with ~₹2,055.81 for insecticides and ~₹1,981.69 for fungicides. Despite lower volumes, herbicides are now almost at par with fungicides in total value.

Exhibit 43: Average Price By Branded Formulation Pesticides (INR/Kg or Litre)



Source: Directorate General of Plant Quarantine and Storage. Data for FY25 wasn't published during the time of the filing. Mean pricing has been considered for each year post mapping major molecules contribution to the demand consumption

The most significant change in India's crop protection landscape lies in the rise of herbicides. Their share in total market value has increased sharply, even as volume growth remains moderate. This is not simply a function of acreage expansion it stems from a higher willingness to pay for performance. As labour costs rise and manual weeding becomes less viable, farmers are adopting multi-stage herbicide programs that combine pre- and post-emergent products, often with differentiated chemistry suited to soil and water conditions. The higher price realisation of herbicides reflects a dual trend: adoption of selective, crop-safe formulations and the movement toward integrated weed management systems. While fungicides continue to account for slightly higher physical volumes, herbicides have nearly closed the gap in value contribution. This transition illustrates how technology, mechanisation, and precision application are beginning to define competitiveness in the Indian crop protection market.

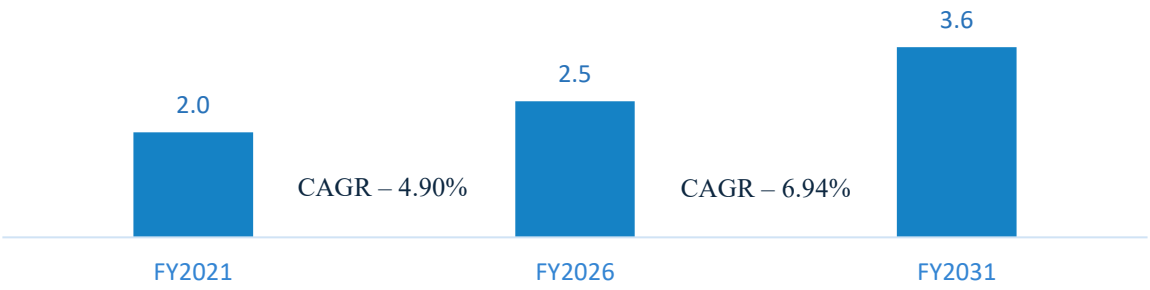
Bio-pesticides and other biological inputs have recorded the sharpest growth, rising to 14% of total consumption in FY25, even though average prices remain comparatively low. Their expansion reflects a clear policy and market convergence: growing awareness of soil health, residue concerns for export crops, and public initiatives supporting sustainable agriculture. The current pricing level of ~₹1,001/kg or L suggests that biologicals remain a volume game rather than a value one but one with increasing strategic importance. Integration with chemical programs is now common practice, especially in high-value horticulture and vegetable clusters in states such as Andhra Pradesh, Maharashtra, and Tamil Nadu. This structural broadening of crop protection portfolios toward non-chemical solutions has encouraged established players to formalize dedicated biological divisions. Crystal Crop's GreenAg division exemplifies this emerging alignment, focusing on bio-stimulants, soil-health enhancers, and bio-control agents designed to complement conventional chemistry. This approach reflects an industry-wide shift from product-based selling toward program-based crop management, blending chemical efficiency with biological resilience.

Note – Directorate General of Plant Quarantine and Storage has not released full FY 2025 volume shares and pricing data as of July 2026. Hence the prices provided are till FY 2024.

6.7 Indian Branded Formulation Insecticide Market Landscape

India's insecticide market, valued at USD 2.5 billion in FY26, is projected to grow to USD 3.6 billion by FY31, reflecting a compound annual growth of over 6.94%. Despite a declining share in total crop protection volume, insecticides remain a strategic pillar due to their indispensability in combating sucking pests, borers, and chewing insects. Their relevance spans across key crops such as cotton, paddy, soybean, and vegetables, where multi-stage pest pressure necessitates repeated applications.

Exhibit 44: India Insecticide Market in Value Terms (USD B)



Source: Frost & Sullivan

Note: Based on consumption approach

Unlike herbicides, where mechanization and weed specificity drive growth, insecticides are seeing a polarization between high-volume legacy molecules and high-value precision chemistries. Among the latter, chlorantraniliprole stands out as the single largest contributor to value share (13.2%), despite accounting for less than 2% of physical volumes. This disparity is a function of its elevated pricing (~₹7,500/litre) and targeted efficacy against lepidopteran pests in rice and sugarcane. Its acceptance reflects a growing willingness to pay for extended residual control and reduced application frequency.

Exhibit 45: Branded Formulation Insecticides consumption in India by active molecules (FY25)

Molecule	% Value Contribution	Presence of Crystal Crop
Chlorantraniliprole	13.20%	CRYSTAL
Imidacloprid	8.69%	CRYSTAL
Chlorpyriphos	8.54%	CRYSTAL
Fipronil	6.67%	CRYSTAL
Spinosad	6.22%	
Malathion	4.45%	
Quinalphos	4.06%	
Emamection Benzoate	3.92%	CRYSTAL
Profenophos	3.77%	CRYSTAL
Thiamethoxam	3.43%	CRYSTAL
Acephate	3.29%	CRYSTAL
Indoxacarb	2.96%	
Dimethoate	2.61%	
Cartap Hydrochloride	2.60%	CRYSTAL
Monocrotophos	2.30%	CRYSTAL
Cypermethrin	2.30%	CRYSTAL
Flubendiamide	2.04%	
Acetamiprid	2.03%	CRYSTAL
Fenvalerate	1.91%	
Dichlorvos (Diclorvos/DDVP)	1.61%	
Buprofezin	1.33%	CRYSTAL
Diafenthiuron	1.18%	CRYSTAL
Lamda-cyhalothrin (Lambda-cyhalothrin)	1.17%	CRYSTAL
Spinetoram	1.11%	
Fenobucarb(BPMC)	0.92%	CRYSTAL

Spiromesifen	0.71%	
Flonicamid	0.57%	
Deltamethrin	0.55%	
Pymetrozine	0.54%	
Abamectin	0.49%	
Thiodicarb	0.48%	
Clothianidin	0.44%	
Thiacloprid	0.42%	
Bifenthrin	0.33%	
Allethrin	0.30%	
Carbofuran	0.29%	
Chlorpyriphos + Cypermethrin	0.27%	

Similarly, imidacloprid (8.7%) and fipronil (6.7%) command a disproportionate value contribution relative to volume. Imidacloprid remains a go-to systemic solution against aphids and whiteflies in cotton and horticulture. Its inclusion in seed treatment packages and as a foliar spray ensures year-round relevance. Fipronil, by contrast, is increasingly being deployed in combination therapies and offers strong soil-based control in crops like sugarcane, reinforcing its role in crop-stage-specific interventions.

Key Insecticides Players

Chlorpyriphos, a traditional workhorse with a 16.2% volume share, contributes just 8.5% to the value mix, reflecting price suppression and regulatory overhang. Yet, its continued use especially in rice nurseries and for termite control in sugarcane showcases the dependence on broad-spectrum organophosphates in certain geographies. It also appears in combinations (e.g., with cypermethrin), although such mixes now contribute less than 0.3% of value, signalling their gradual sunset. Emerging mid-tier performers include spinosad (6.2%) and emamectin benzoate (3.9%), which cater to resistant pest populations in vegetables and pulses. Spinosad's share has grown significantly due to its selective profile, safety in IPM programs, and utility in export-linked crops. Emamectin, similarly, benefits from its effectiveness against lepidopterans and is widely adopted in chilli and cotton belts.

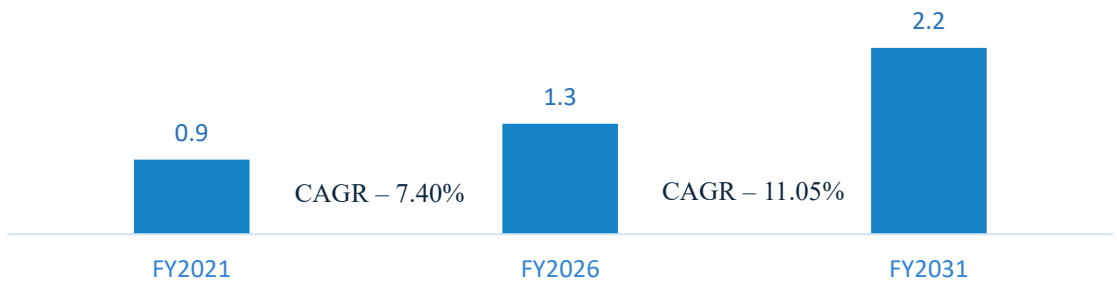
A notable shift is underway in the cotton insecticide segment, with increased grower attention toward broad-spectrum sucking pest control. Within this space, newly introduced brands have made a sharp impact. One such brand launched in 2025- Jivora by Crystal, designed specifically for cotton's complex pest pressure, has already garnered 20% usage share among aware growers, with 30% spontaneous recall, surpassing initial expectations for a debutant (a report by Q&Q insights). These trends are supported by the growing market footprint of acetamiprid (2.0%), thiamethoxam (3.4%), and spinosad (6.2%), all of which are active components in sucking pest portfolios.

The molecule acetamiprid, for instance, has increased its value contribution from 1.5% to 2.0% in just two years, despite modest volume growth, indicative of price stability and sustained demand. This trend supports the rise of brands offering quick knockdown and crop greening effects, which are key attributes growers are now seeking.

6.8 Indian Branded Formulation Herbicide Market

India's herbicide segment has shifted from a niche to a strategic mainstay within the crop protection ecosystem, expanding from USD 0.9 billion in FY21 to USD 1.3 billion in FY26F, with projections touching USD 2.2 billion by FY31. The branded formulation herbicide market exhibits the fastest growth rate among Insecticides, Herbicides and Fungicides. While it accounts for less than 20% of volume share, its value contribution has surged disproportionately driven by rising farm wages, shrinking sowing windows, and the adoption of crop-specific, selective weed control programs.

Exhibit 46: India Branded Formulation Herbicide Market in Value Terms (USD B)



Source: Frost & Sullivan Analysis

Agricultural labour is increasingly scarce and expensive in key grain-producing states, pushing farmers toward cropping systems with narrower planting windows and higher mechanization footprints, such as zero-tillage wheat and DSR in paddy. Within this backdrop, Pretilachlor has emerged as a volume anchor in transplanted paddy systems, recording the highest absolute volume in FY26. Its use is deeply entrenched across eastern India—particularly West Bengal, Bihar, Odisha, and Assam—where short turnaround times between harvest and replanting make early-season weed suppression essential. Under puddled conditions, Pretilachlor reduces dependence on labour-intensive manual weeding, and despite flat YoY volume growth, its stable pricing (₹586/L) and consistent fit within monsoon rice systems have sustained its top-three market value position (~10%).

Building on these structural shifts in weed-management practices, the broader herbicides segment nonetheless witnessed a correction from FY23 to FY24. Uneven and delayed monsoons across major rice and soybean belts, elevated channel inventories carried from prior seasons, softer farm-gate prices, and a compressed spraying window due to delayed sowing collectively tempered category demand. Additionally, value contraction was amplified by global price corrections in key molecules and tighter regulatory oversight in selected states. FY25 and FY26, however, marks a clear recovery, with most estimates placing category expansion in the 8–12% range as inventories normalize and demand stabilizes. Within this recovery environment, Crystal Crop has been one of the few companies who grew at a materially higher rate of about 17-18% over in FY26 over FY25, supported by a more balanced herbicide portfolio, increasing adoption of its selective chemistries, and strong execution in core cropping markets.

Exhibit 47: Branded Formulation Herbicides consumption in India by active molecules (FY25)

Molecule	% Value Contribution	Presence of Crystal Crop
2,4-D Amine Salt	9.93%	CRYSTAL
Pretilachlor	9.73%	CRYSTAL
Glyphosate	9.15%	CRYSTAL
Chlodinafop-Propargyl	8.45%	CRYSTAL
Metsulfuron Methyl	5.68%	CRYSTAL

Molecule	% Value Contribution	Presence of Crystal Crop
Butachlor	4.76%	
Metribuzin	4.16%	CRYSTAL
Bispyribac Sodium	3.68%	CRYSTAL
Atrazine	3.32%	CRYSTAL
Pendimethalin	2.40%	CRYSTAL
Chlorimuron Ethyle	2.35%	CRYSTAL
Imazethatyr	2.06%	CRYSTAL
Isoproturon	1.62%	
Paraquat Dichloride	1.34%	CRYSTAL
Propaquizafop	1.24%	
Quizalofop Ethyl	1.23%	CRYSTAL
Anilophos	1.06%	
Oxyfluorfen	1.03%	CRYSTAL
Diuron	0.82%	
Tembotrione	0.74%	CRYSTAL
Carfentrazone Ethyl	0.45%	CRYSTAL
Oxadiargyl	0.41%	CRYSTAL
Fenoxaprop-P- Ethyl	0.41%	
Chlodinafop-Propargyl + Sodium Acifluorfen	0.38%	CRYSTAL

Key Herbicides Players

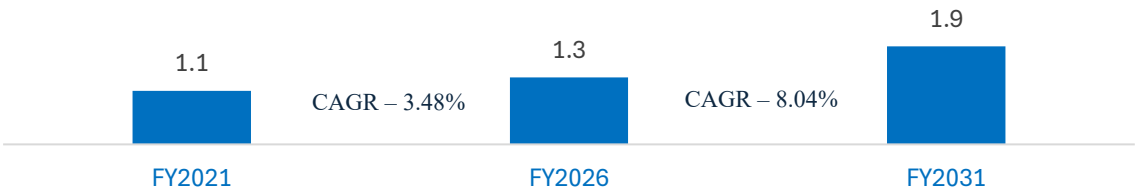
CRYSTAL Safex PI BAYER PARIJAT UPL SUMITOMO CHEMICAL

Pretilachlor has emerged as a volume anchor in transplanted paddy systems, with the highest absolute volume at in FY24. Its use is deeply entrenched in eastern India, West Bengal, Bihar, Odisha, and Assam where farmers face short turnaround between harvest and replanting. Here, it provides early-season weed suppression under puddled conditions, reducing dependence on labour-intensive manual weeding. Despite flat YoY growth, its stable pricing (₹586/L) and consistent fit in monsoon rice systems sustain its top-3 market value rank (~10%).

6.9 Indian Branded Formulation Fungicide Market

India's Fungicide segment is in sustained growth phase, with value demand expected to expand from USD 1.3 billion in FY 26 to USD 1.9 billion by FY31, marking a CAGR of 8.04%.

Exhibit 48: Indian Fungicide Market in Value Terms (USD Bn)



Source: Frost & Sullivan Analysis

Note: Based on consumption approach

The broader adoption of monoculture and high-density cropping systems, especially in fruits, vegetables, and plantation crops, has made fungicide applications non-negotiable. In addition, export-driven sectors such as grapes, chillies, pomegranates, and basmati rice are pushing for MRL-compliant, systemic fungicides, driving a shift away from legacy molecules

Exhibit 49: Indian Fungicide Consumption by Active Ingredients (FY 25)

Molecule	% Value Contribution	Presence of Crystal Crop
Sulphur	20.91%	CRYSTAL
Carbendazim	16.41%	CRYSTAL
Mancozeb	13.33%	CRYSTAL
Copper Oxychloride	6.08%	CRYSTAL
Thiophanate-Methyl	4.44%	
Azoxystrobin	4.04%	CRYSTAL
Tricyclazole	3.96%	CRYSTAL
Tebuconazole	3.55%	CRYSTAL
Propiconazole	3.45%	CRYSTAL
Dodine	3.13%	
Metalaxyl	2.71%	
Propineb	2.68%	
Zineb	2.11%	
Hexaconazole	1.47%	
Thiram	1.36%	
Carbendazim+Mancozeb	1.16%	CRYSTAL

Key Fungicides Players

CRYSTAL · Safex · PI · BAYER · MEGHMANI ORGANICS LTD. Chemistry of Success at Work · greenwell · HERANBA INDUSTRIES LIMITED · INDOFIL INDUSTRIES LIMITED

The market remains volume-heavy at the base with traditional broad-spectrum fungicides such as sulphur, which alone contributes over 50% of national fungicide volume, but just around 20% by value, highlighting its role as a cost-effective yet indispensable molecule. Sulphur's widespread use in grapes (Maharashtra, Karnataka), chillies (Andhra Pradesh), and mangoes (Telangana) reinforces its base-load relevance, particularly in managing powdery mildew and scab. In contrast, carbendazim and mancozeb, two legacy molecules, jointly represent over 20% of consumption volume, and around 25–30% of value. Their low-cost profile, along with broad registration across cereals and vegetables, sustains high acreage adoption. However, the category is undergoing a marked shift with these base molecules increasingly being used in combinations, such as Carbendazim+Mancozeb, to address resistance build-up and provide multi-site activity.

Among newer chemistries, azoxystrobin, though contributing less than 1% by volume, has emerged as a disproportionately large contributor to value nearing 4% of fungicide segment value thanks to its pricing premium and targeted usage in paddy (Punjab, Tamil Nadu), vegetables (Karnataka), and grapes. Its low-dose, high-potency nature and broad-spectrum efficacy are increasingly favoured by progressive growers. Another molecule showing strong price-to-volume skew is tricyclazole, which makes up just over 1% of volume, but accounts for nearly 4% of segment value. Its relevance in controlling blast in paddy has made it a mainstay in eastern India (Odisha, West Bengal, Bihar), especially under high humidity conditions. Its inclusion in government procurement lists has further anchored its position.

7. Global Seeds Market Overview

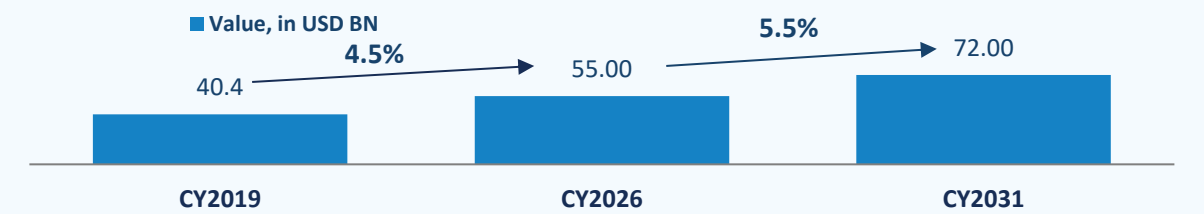
7.1 Overview of the global seeds industry & Market Size

Along with fertilizers and crop protection sector, the seed industry is part of the input sector at the start of the agri-food value chain. Today, there is a thriving seed industry globally, made up of numerous seed companies who have multiple products in hybrid, research varieties, openly pollinated varieties as well as genetically modified crops. Apart from being governed by the laws and rules that apply to the industry, it is also subject to the different demands and impacts of the downstream participants and, eventually, the customer.

7.2 Market Segmentation based on (value & volume split)

The global seed industry is estimated to be valued at USD 55 Billion in 2026. It has grown with CAGR 4.5% from 2020. Further the industry is forecasted to reach USD 72 Billion by 2031 with a CAGR 5.5%.

Exhibit 50: Global Seed Industry Market Size, By Value (CY2019-2026- 2031)



Source: Frost & Sullivan Analysis

Rising food demands from a growing population, the increasing adoption of costly advanced and organic seeds, and disruptive forces like trade barriers and climate change are all contributing to the rise in seed prices worldwide.

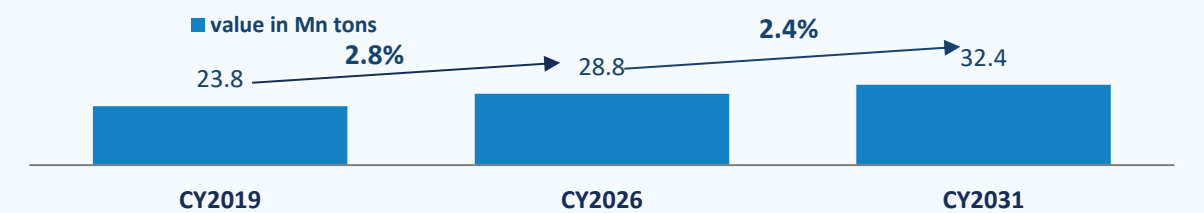


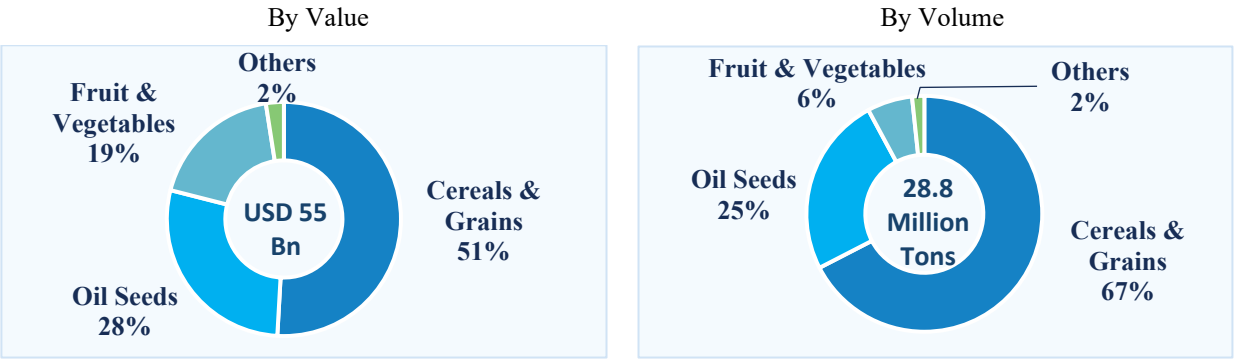
Exhibit 51: Global Seed Industry Market Size, By Volume (CY2019-2026- 2031)

Source: Frost & Sullivan Analysis

In terms of volume, the market is estimated to be 28.8 million tons in 2026 and is anticipated to grow to 32.4 million tons by 2030 with CAGR 2.4%. Players like BASF, Bayer, Limagrain, Syngenta, Corteva are the key players in global seed industry.

Cereals and Grains are estimated to account for ~67% (on volume terms) of the global seed industry with approx. volumes of 18.9 million tons in 2025. On Value terms the market accounted for ~51.1% in 2026E. In value terms, Corn and Rice seeds account for the majority of the share in the seed industry with shares ranging between 80-82% in Cereals and Grain category. These are followed by wheat and sorghum seeds. Bayer, Corteva, Syngenta, Vilmorin-Limagrain, KWS are some of the notable companies for corn seed. Rice portfolio is strong for Bayer, Corteva, BASF & Sakata Seed.

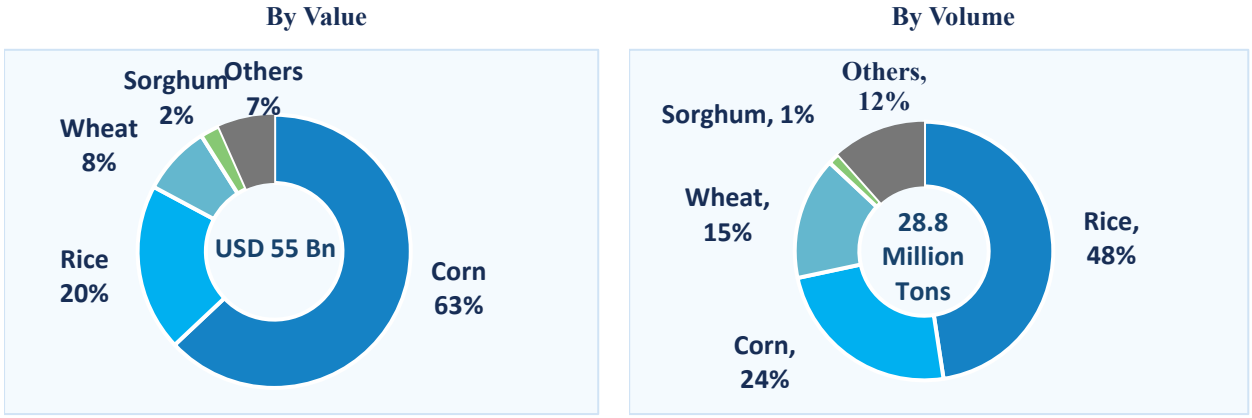
Exhibit 52: Global Seed Industry Segmentation- By Crops group, CY2026



Source: Frost & Sullivan Analysis

Oilseed segment is estimated to account for ~25% of the volume of global seed industry in 2025E. Major oil seeds across globe are Soybean, Canola/ Rapeseed and Sunflower. Soybean oilseed is largest market segment with ~ 49-50% market share in oilseed segment followed by Canola/rapeseed. Companies such as Bayer, Corteva, KWS and Syngenta are some of the key players in oilseed industry.

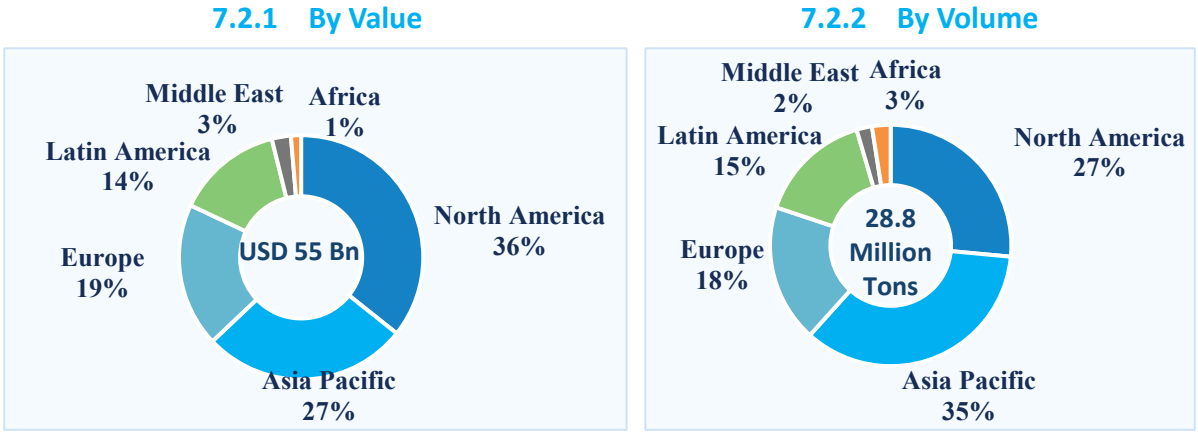
Exhibit 53: Global Seed Industry Segmentation- By Crops, CY2026



Source: Frost & Sullivan Analysis

By value basis, North America accounted for ~36% of the market share majorly due to large consumer base for premium, high-quality seeds driven by health and sustainability concerns. It is followed by Asia Pacific at 27% and Europe at 19%. In 2025, on volume basis, Asia Pacific region is estimated to accounts for ~35% of the global seed industry followed by North America at 27%, Europe at 18%, Latin America at 15% and Middle East and Africa at 5%. The global seed market grew in every region, with North America being the largest market in terms of value of seeds due to high value seeds sold in the region along with higher %age of GMO crops. North America is followed by Asia Pacific.

Exhibit 54: Global Seed Industry Segmentation- By Region, CY2026



Source: Frost & Sullivan Analysis

7.3 Factors impacting the Crop yield

Climate

- Climate has a significant impact on agriculture. Agriculture depends significantly on water, land, and other climate-related natural resources. Climate change (temperature, precipitation, and time of frost) makes agricultural activities more challenging in some areas while perhaps extending the growing season or enabling the cultivation of other crops in others.
- The pace and intensity of climate change, as well as how well farmers are able to adjust, determines how it affects agriculture.
- According to recent published paper, globally, rising temperatures have a negative impact on crop yields, and these effects are amplified when temperature increases above certain thresholds. In wheat, for example, a 1 °C temperature increase would cause a 6.1% yield loss if the temperature rise was less than 2.38 °C; if the temperature rise was greater than 2.38 °C, the yield loss would increase to 8.2% per 1 °C warming. Similarly,

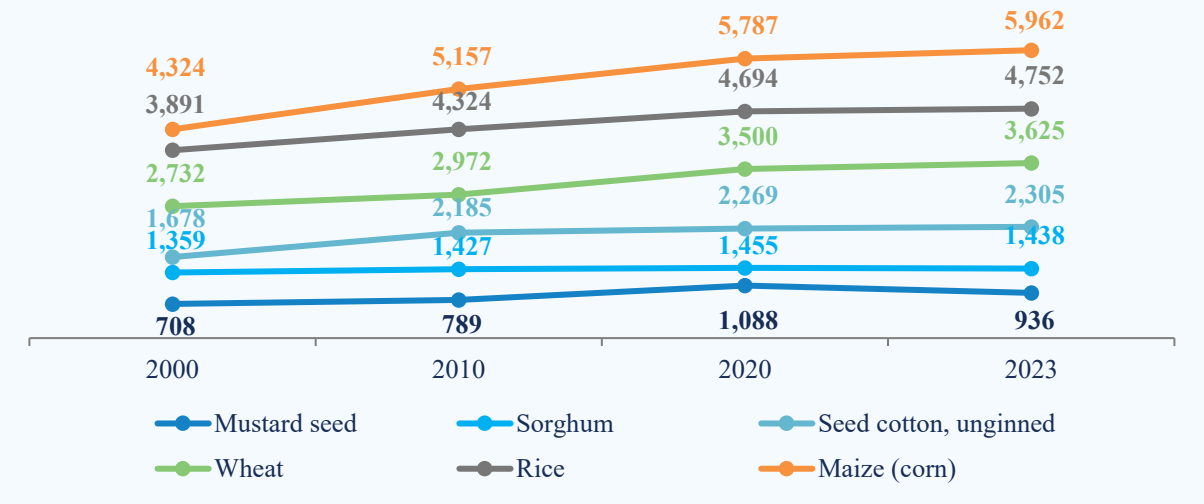
as the temperature rises above the 3.13 °C threshold, the loss in rice yields for every °C increase becomes 7.1% instead of 1.1%.

- Climate change continues to interfere with harvest schedules and agricultural yields, whether through increased intensity and frequency of natural disasters, flooding, drought, or seasonal irregularities, leaving farmers with low profit margins. Climate change and agriculture are closely intertwined, with the former directly affecting the latter.
- These climate effects can be neutralized by using climate smart agricultural practices such as use of climate smart crops, sustainable soil management, integrated pest management and improved water management.

R&D

- The implications of a wide range of agricultural innovations, including genetically modified varieties, fertilizer and pesticide technologies, farm machinery, adaptive microbial technology, and agronomic and management practices (integrated management of nutrients and pests), and how they can be used to increase crop productivity, have been made possible by technological development and research programs.
- Plant breeding is a labour-intensive, costly, and time-consuming process that could be overcome by modern biotechnology and genome editing techniques.
- High quality germplasm libraries are difficult to build and take time.
- R&D contributes in enhancing plant yield by innovating new breeding techniques & different technologies, developing formal seed systems for enhanced reach and making this information accessible to stakeholders involved.

Exhibit 55: Increased Global Yields



Source: FAOSTAT

The above exhibit depicts how the productivity of certain crops have changed over the years. Research and Development (R&D) boosts crop productivity by creating higher-yielding, resilient crops through genetic engineering and selective breeding**.**

Area under Cultivation

Although expanding the "Area under Cultivation" generally improves crop output overall, its impact on crop yield—or productivity per unit of land—depends on a number of factors, including resource availability, land quality, and agricultural practices. Although increased farmed area immediately boosts overall production, yield may drop if the additional area contains degraded land or if labor, water, or nutrient inputs are dispersed too widely, resulting in lower productivity per acre.

7.4 Entry Barriers

Regulatory Barrier- Seed companies are severely impacted by changes in policies related to seeds, agriculture, or biotechnology. For example, laws pertaining to breeding, export-import, seed prices, intellectual property rights, and genetically modified (GM) crops can all have a significant impact. Each country has its own laws and rules governing the breeding, testing, and distribution of seeds. These regulations apply to genetic exclusivity, environmental concerns, product viability, performance, and labelling. Before being permitted to operate, seed companies must fulfil these regulations. Also complying with the various laws and regulations raises the cost of doing business.

Market Dynamics & Competition Barrier- Seed companies compete with a number of domestic and international businesses in their market. Market dynamics, competitive pricing tactics, or developments in seed

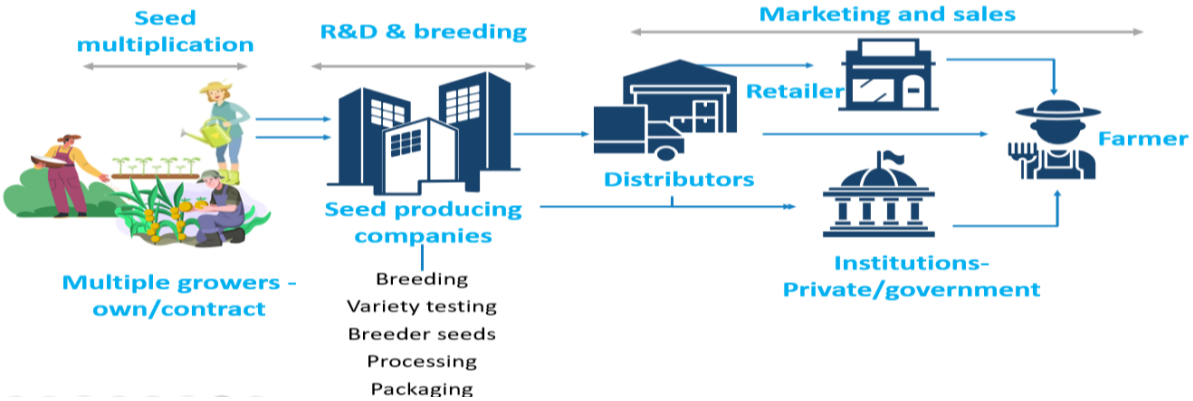
technology can all have an effect on a new player's entry, market share, and profitability. It can be challenging for new businesses to get farmers to test their products because well-known brands frequently have loyal customers. Farmers place high value on product performance, therefore brand building for newcomers in this market may take longer than for established rivals. Farmers are shifting toward branded seeds because they want high-quality, consistent results, and high yields from particular brands. This leads to brand loyalty and repeat business, even if the price is higher. Additionally, the branded hybrids come with multiple advantages of disease resistance, insect resistance & herbicide tolerance. The demand for branded, innovative, and high-value seed products is also rising as a result of technology developments and the creation of organic and climate-resilient seed variants. Farmers are also becoming more aware of the new technologies and innovation that are available for their use. Thus, seed companies can leverage upon these advantages of farmers shifting towards branded seeds.

R&D Barrier- A significant barrier to entry in seed industry is the time-consuming and expensive R&D required to develop new, proprietary seed varieties. R&D spending by businesses varies extensively, ranging from a small single-digit portion of revenue to around 30%. The strategic significance of R&D as a differentiator for firms can be seen by this variation.

Brand Loyalty-It can be challenging for new businesses to get farmers to test their products because well-known brands frequently have loyal customers. Farmers place high value on product performance, therefore brand building for newcomers in this market may take longer than for established rivals.

7.5 Supply chain for seeds globally, Production – Own vs Contract Farming, modes of distribution

Seed industry comprises of value chain actors, methodologies, technological innovation and management practices (TIMPs), seed systems, trade, all governed by policy and regulatory frameworks. The development of the seed industry is essential for food security on a local, national, and international level. Good seeds are essential to ensure the food security since it influences crop success in terms of productivity and yield. This makes it important to have access to high-quality seed.



Seed companies invest in activities such as Breeding, Variety testing (company level; grower's trials; Official; Distinctness, Uniformity and Stability (DUS) Testing; Value for Cultivation, Use, and Sustainability (VCUS) Testing), Variety registration, Plant Variety Protection – PVP, Production of foundation, breeder & commercial seeds, and Promotion and selling of seeds.

Global seed companies have multiple growers across globe who help in seed multiplication. This makes it easier for trading seeds across the globe. Many of these growers are on contract basis with the seed companies. Developing professional seed growers poses a challenge in terms of cost, capacity building and in providing the buy-back guarantee for the quantity of seed they produce. Some companies also opt for seed production on own lands, but this requires significant investments. These grown seeds are then processed in the processing facilities of the seed companies which can be located in the same region or across globe. Transporting seeds from producing locations to processing facilities and then distributing it to farmers in the inadequate rural infrastructure is a challenge.

Further the processing facilities need to have multiple equipment such as cleaner, destoner, gravity separator, graders and dryers. The cost of infrastructure, equipment, operation and maintenance - required to support seed processing, testing and storage as well as training and supervision of staff and contracted farmers is huge.

Post processing, seed are packed and labelled as per the regulatory requirement of countries. Then the seeds are dispatched through a distributor from where it is sold to farmer directly or with another intermediary called as of retailer.

7.6 Sustainability in Seed Industry

The seed sector promotes innovation in environmentally friendly distribution and packaging methods. In an effort to minimize their environmental impact, seed businesses are looking into other materials and modes of delivery in response to the increased emphasis on reducing plastic waste and carbon emissions. These programs, which range from improved supply chain logistics to biodegradable seed coatings, show the seed industry's dedication to sustainability.

In addition to promoting crop breeding and genetic improvement, the seed industry fosters partnerships with various farmers, researchers, policymakers, regulators, and industry leaders to develop sustainable solutions for the problems facing modern agriculture through its pursuit of innovation, science, and technology.

The innovation and leadership of the seed industry will remain crucial in fulfilling the needs of the 21st-century agri-food sector as we tackle the problems of feeding a growing world population while preserving our planet's resources. In 2023, Syngenta invested USD 244 million in sustainable agriculture breakthroughs.

Sustainability commitments: By creating and making public its sustainability promises, the seed industry can employ a data-driven, ESG-informed approach to long-term sustainability that promotes transparency and ongoing development.

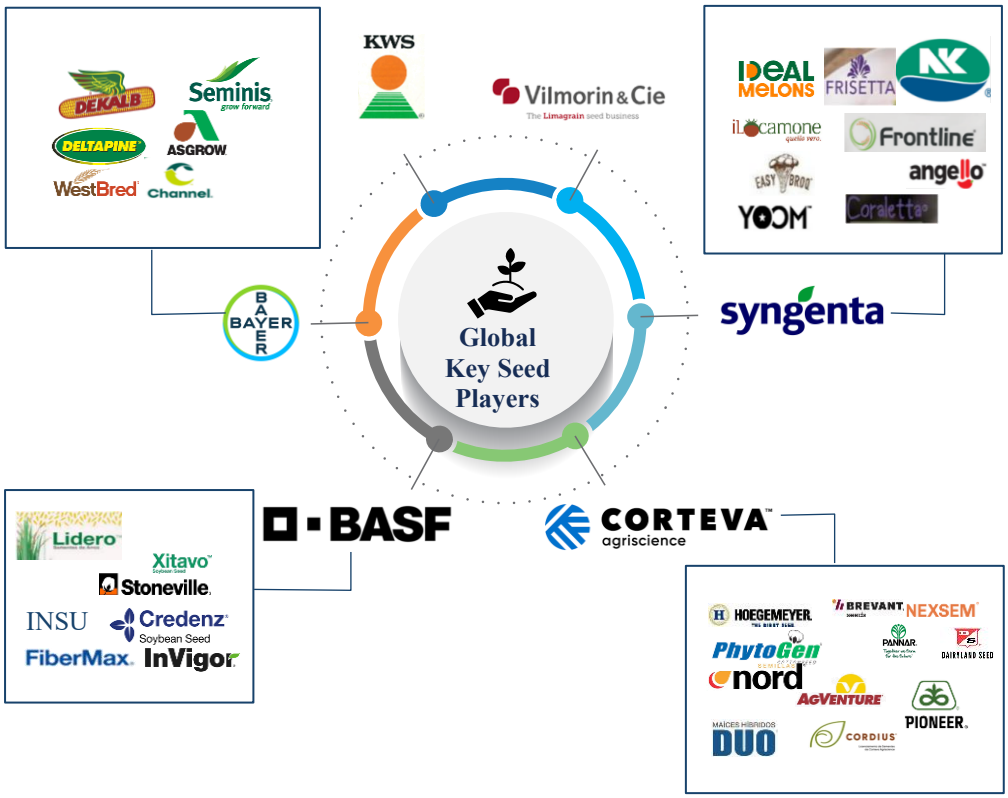
7.7 Key trends & opportunities driving the market growth.

7.7.1 Key Trends

Consolidation of Industry- Due to more regulations and fewer markets for expansion, agrochemical companies were facing decreasing opportunities for profit by the 1980s. As a result, they expanded on their already established relationships with farmers by entering the seed industry, which was more attractive sector of the agricultural input market. A large portion of this transition came from acquiring more established seed companies rather than from competing with them. The agrochemical businesses' market shares were increased by each acquisition, as well as expanded their distribution networks for seeds and germplasm. The number of worldwide agrochemical & seed companies eventually decreased as a result of major agrochemical companies buying out hundreds of previously independent biotechnology and seed companies and merging with one another, thus concentrating the seed sector. The 1990s saw a significant shift in the commodity crop seed sector as companies were able to produce seeds that were resistant to specific pesticide applications thanks to advancements in genetic engineering. Through acquisitions, chemical companies like Monsanto and DuPont aimed to increase their share of the seed industry. Monsanto alone acquired sixty separate seed and genomics companies between 1980 and 2014. The USDA discovered that during the 1990s and 2000s, more than 200 commodity seed companies were either acquired or went out of business. Acquisition of smaller players has been a widely used and successful strategy for increasing market share in Agrochem and seeds industry

Currently, more than half of all the seeds are sold worldwide by 5-6 firms, and in the United States, only 2-3 companies sell the majority of the seeds for several staple commodity crops like corn, soy, canola, and cotton.

Exhibit 56: Key players & seeds brands in Global Seed Industry



Source: Company Website, Frost & Sullivan

These behemoths not only control seed sales but also oversee seed breeding operations and lock up their genetics and well-known proprietary features through patents and burdensome license agreements.

Bayer-Monsanto merger, Dow Chemical-DuPont merger, Corteva- Dow – Dupont- Pioneer, ChemChina acquisition of Syngenta were some of the major consolidations that the seed industry saw since 2015. The trend seems to continue with the new formed corporation acquiring regional, biological, smart- digital agriculture companies to increase their strength in different sectors.

- **Releasing more GM products-**

  The growing need for food worldwide, coupled with the problems of climate change, insect infestations, and finite land resources, has led to a major trend in the seed industry: the release of more genetically modified (GM) crops. The main factors contributing to this rise are increased crop yields, better resistance to pests and diseases, increased resilience to environmental stressors like drought, and a decreased need for chemical pesticides. The development of GM seeds is also being stimulated by technological developments in biotechnology, such as gene editing, and digital agriculture, opening the door to a future with more robust and productive crops.

  In more than 75 countries, GMOs are cultivated, imported, and/or subjected to field testing. Despite national laws governing genetically modified organisms differing, thirteen crops globally have commercially available genetically modified versions which include Alfalfa, Apple, Canola, Corn (Corn), Cotton, Eggplant, Papaya, Pineapple, Potato, Soybeans, Squash, Sugar Beets and Sugarcane. Some other foods are the result of traditional plant breeding and are not GMOs are Tangelos, Seedless watermelon, Grape tomatoes, Broccolini and Baby carrot.

  The trend is also further accelerating by increasing adopting of GM cultivation across globe. Year 2024 saw a 1.9% increase in the global area planted of genetically modified crops, reaching a new record of 209.8 million hectares. Ten distinct GM crops were grown in 28 different nations, with soybeans being the most extensively planted.

- **Utilization of artificial intelligence/ generative AI to drive innovations**

  Through improving breeding and genetics, strengthening seed quality testing and certification, streamlining field operations and monitoring, and even revolutionizing customer engagement, artificial intelligence (AI) and generative AI are driving innovation in the seed sector. These technologies lead to more effective, sustainable agriculture and improved food security by facilitating the development of improved crop varieties

with desired traits, quicker and more accurate quality assessments, precise field management using drone technology, and data-driven decision-making throughout the seed value chain.

In Breeding & genetics, AI can help in Advanced phenotypic assessment by identifying key quantitative trait loci (QTLs) & Accelerate trait development by analysing vast genetic data to predict the performance of different genotypes.

In Seed Quality Testing and Certification, subtle patterns in seed characteristics can be detected using AI-powered images helping in early detection of seed born diseases or internal defects. AI can also help in ensuring uniform testing across batches.

In April 2024, with the use of Google Cloud technologies, BASF Japan has announced that it would create and introduce a unique generation artificial intelligence chatbot consultant service for users of its Xarvio® Field Manager crop management support system. The chatbot service will give Japanese users of Xarvio® Field Manager quick, personalized responses to product use around-the-clock. It is powered by Vertex AI, Google Cloud's gen AI Gemini platform. Text, pictures, and video are included in customized answers when necessary.

- **Investments in Novel Seed Technologies** – Companies across the globe are investing in R&D for advancing the innovation in seed technologies. Approximately USD 4-6 Billion dollars have been invested in start-ups using **CRISPR (clustered regularly interspaced short palindromic repeats)** in agriculture over the last ten years, according to presentations delivered at World Agri-Tech in March 2024.

  Research on plant gene editing has received substantial support or investment from the public sector. The use of cutting-edge methods like **CRISPR-Cas9 (associated protein 9)** to change the genomes of crops would probably result in a future demand for less agrochemicals. This is because it is anticipated that the next generation of seeds would deliver higher crop yields with less water and agricultural inputs. A few companies, for instance, have created herbicide-tolerant seedlings, which have actually increased the use of particular herbicide classes.

  Scientists at Tel Aviv University in Israel have developed tomatoes that require less watering thanks to CRISPR technology, while scientists at UC Davis have utilized the technology to generate a rice strain that is immune to a fungal disease that is predicted to flourish in a warming climate.

  Another important innovation was that of Double Haploid technology. Method is implemented in different crops more than 20 years ago. It's allows shortening the inbreeding process significantly (vs conventional inbreeding - e.g. repeated self-pollination cycles) and the obtention of fully homzygous lines.

7.7.2 Key Opportunities

Going forward, innovation-driven differentiation, M&A-driven geographic expansion, and stronger farmer engagements to extract more value will probably continue to be the key opportunities in seed sector.

- **Shift towards branded seeds-** Farmers are shifting toward branded seeds because they want high-quality, consistent results, and high yields from particular brands. This leads to brand loyalty and repeat business, even if the price is greater. This change is influenced by a number of factors, including governmental initiatives to enhance seed quality and traceability as well as market variables including brand reputation, advertising, and promotional activities like field demos. Additionally, the branded hybrids come with multiple advantages of disease resistance, insect resistance & herbicide tolerance. The demand for branded, innovative, and high-value seed products is also rising as a result of technology developments and the creation of organic and climate-resilient seed variants. Farmers are also becoming more aware of the new technologies and innovation that are available for their use. Thus, seed companies can leverage upon these advantages of farmers shifting towards branded seeds.
- **New breeding breakthroughs for differentiations** - The rise in crop yields and agricultural productivity over the past 70-80 years, from the invention of hybrid crops to the adoption of high-yielding varieties during the Green Revolution, is mostly attributable to a number of biological innovations in seeds.
- In the next ten to twenty years, the seed industry is expected to undergo a number of changes and developments; new breeding breakthroughs that accelerate the generation of high-quality seeds were deemed most likely among these changes. The widespread adoption of biotech crops in low-income nations and new global mechanism(s) to access genetic resources and knowledge and share benefits are the other breakthroughs expected. In order to further grow the seed sector, global agricultural companies are investing a substantial amount of money in agricultural research and development.

  Companies such a Bayer have invested in Precision breeding which makes use of artificial intelligence (AI) technology to guide genetic modifications and gain access to more data, enabling scientists to precisely pinpoint the modifications required to eliminate undesirable plant features or highlight desirable ones in a timely and accurate manner. In the end, precision breeding yields seed variants years ahead of schedule, customized to growers' specific field circumstances.

Other research which has growth opportunities are - counter season breeding & production and focus on abiotic tolerance factors like water, radiation, temperature, humidity, salinity, precipitation and so on.

- **Leveraging M&A to optimize portfolio and extend geographical presence:** In addition to expanding the current product line, a common goal of M&A transactions in the seed sector has been to expand the geographic reach of the acquiring companies, particularly in areas where their distribution network was weak.

  Working together throughout the entire agricultural value chain—from seed production to processing—can open up new possibilities, such creating vegetable seed chains focused on exports. Companies can access new technology, share R&D expenses, and improve their market positions by forming strategic alliances and collaborations.

  By acquiring Monsanto, Bayer increased both its footprint in North and South America in addition to growing its seed businesses. ASL, one of the most creative melon breeding companies worldwide, was fully acquired by BASF in 2023 owing to the company's vegetable seeds division. In addition to expanding BASF's breeding and seed production in France, this helped strengthen BASF's market position in the melon seed market.

  Prominent seed producers have already transitioned from being simple suppliers of seeds to intricate providers of integrated product offers, with a significant emphasis on advanced digital services. Syngenta, for example, increased access to the latest seed treatments by expanding its internal Seedcare Institute network and acquiring Brazil's Strider, a pioneer in farm management technology. Corteva acquired 100% stake in PhytoGen Seed Company, LLC, making it the sole owner of the intellectual property, including patents, trademarks, proprietary germplasm and information.

7.8 Regulatory status of pending biotech/GM crop projects globally. Key Policies and Regulations applicable to the Industry.

A significant advancement in the seed industry regulatory scenario during the past century is the 1991 Convention of the International Union for the Protection of New Varieties of Plants (UPOV). According to the treaty, the breeder's right must be provided for perennial crops for at least 20 years after the award date, and for types of trees or vines for at least 25 years.

Policies impacting new plant varieties & their products are: -

Variety registration	General environmental or liability laws
Seed laws and regulations	Food/feed laws and regulations
Phytosanitary regulations	Seed treatment regulations
Biotechnology/GMO regulations	

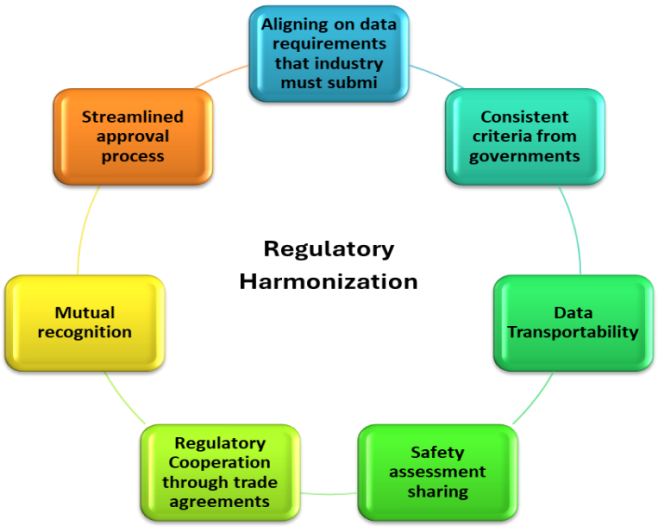
Seed laws & regulations, Environment laws, food/ feed laws, seed treatment regulations are different across globe and seed companies must adherer to these laws in each country for doing business.

Every time seed is imported into a nation, it must comply with that nation's phytosanitary import regulations. Import licenses are typically needed, and phytosanitary certificates may not always be in accordance. Different import/export nations manage seed re-export in different ways. This may lead to trade interruptions aren't always technical or risk proportionate.

This is also true for GM seeds. Some nations require more research, which frequently don't add value to the evaluation of their safety, while others need studies to be repeated annually, even when nearby nations with similar growth conditions have already conducted the studies.

On the other hand, significant inventions may reach the market more predictably, effectively, and uniformly if laws and regulations in different countries and regions were to become increasingly similar to one another. This strategy is called "regulatory harmonization." A recently conducted poll by International Seed Federation indicated that the regulations governing the global seed industry are not uniform at the moment. But more than a hundred specialists on seeds that predict, during the next 20 years, there will probably be a global harmonization of the regulatory environment. A wide range of alignments between national regulatory systems and requirements are included in regulatory harmonization.

Governments having uniform standards for the regulatory review process, globally accepted technical guidelines, standards, and principles, exchanging data and evaluations, and approving a product if it has already been approved by another regulatory body are all examples of alignment.

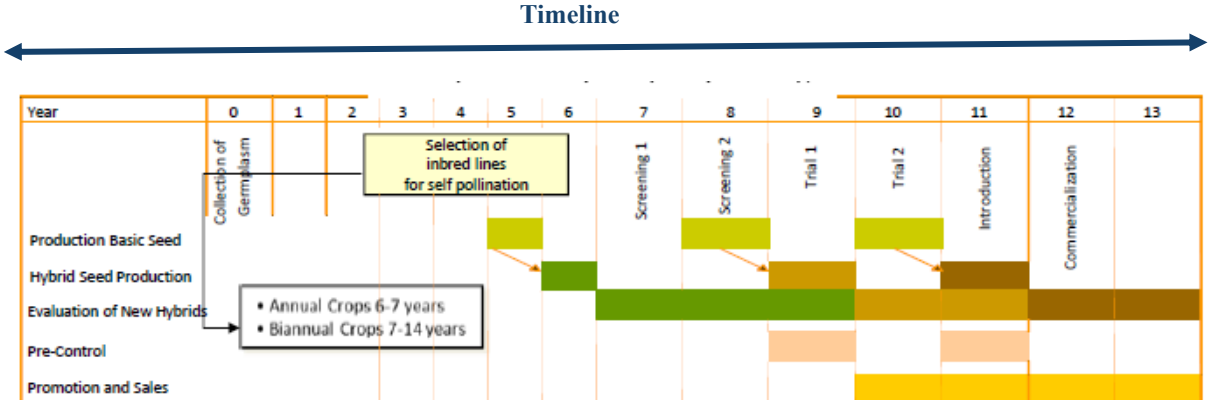


In addition to facilitating faster and more reliable innovation delivery to farmers, regulatory harmonization can boost global regulatory agency productivity and cut down on effort duplication. National autonomy should not be sacrificed in order for countries to cooperate on regulatory harmonization; there are numerous ways to do so, from exchanging safety assessment findings to harmonizing data requirements.

7.9 Seed R&D Process and Funnel

Seed companies have to go through multiple stages of R&D before launching a new product. It starts right from pre-breeding stage. The investments and time involved is huge and companies across globe are trying to optimize in terms of timelines as well as costs by using new breeding technologies. Broad stages from research to selling of seeds are:-

- Pre-breeding
- Breeding
- Variety testing (Company level, Growers trials, Distinctness, Uniformity and Stability- DUS, Value for Cultivation and Use – VCU)
- Variety Registration, Plant Varieties Protection (PVP)
- Production of basic seeds
- Production of Hybrid (commercial seed)
- Promotion and Selling



Source: International Seed Federation

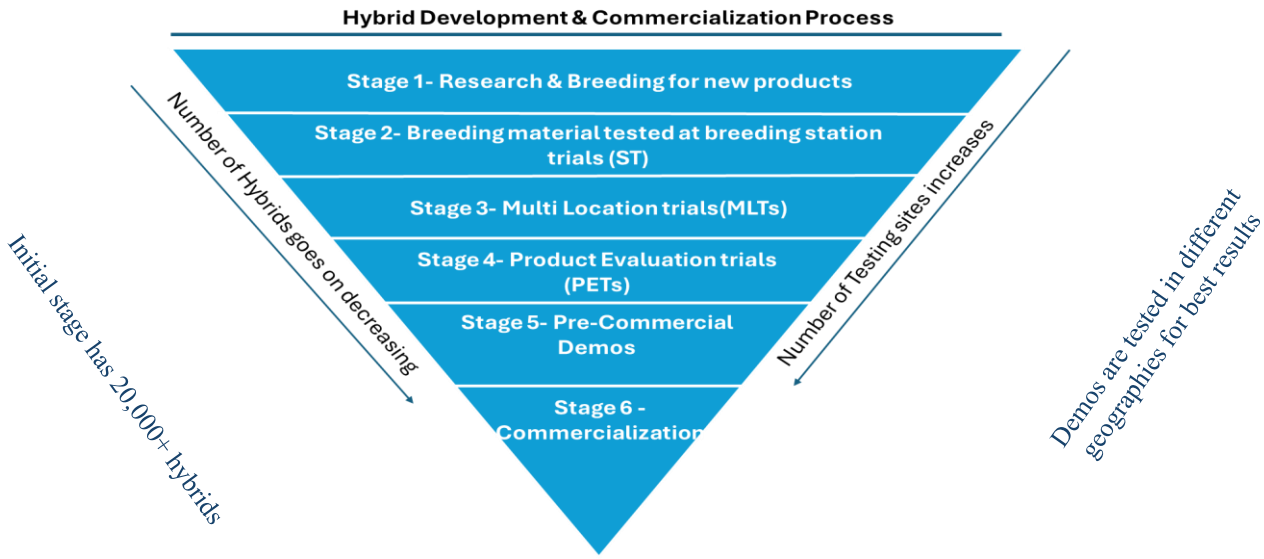
Breeding is long and expensive process. Investments decisions by Global Seed Companies majorly impacts the outcomes. From collection of germplasm to commercialization, it takes ~10-12 years depending upon whether crop can be grown in multiple seasons or just once annually. Companies often undergo mergers and acquisitions to access the best germplasms.

Artificial intelligence and generative artificial intelligence are driving innovation in the seed sector through improving breeding and genetics, strengthening seed quality testing and certification, streamlining field operations and monitoring, and even revolutionizing customer. These technologies lead to more effective, sustainable agriculture and improved food security by facilitating the development of improved crop varieties with desired

traits, quicker and more accurate quality assessments, precise field management using drone technology, and data-driven decision-making throughout the seed value chain.

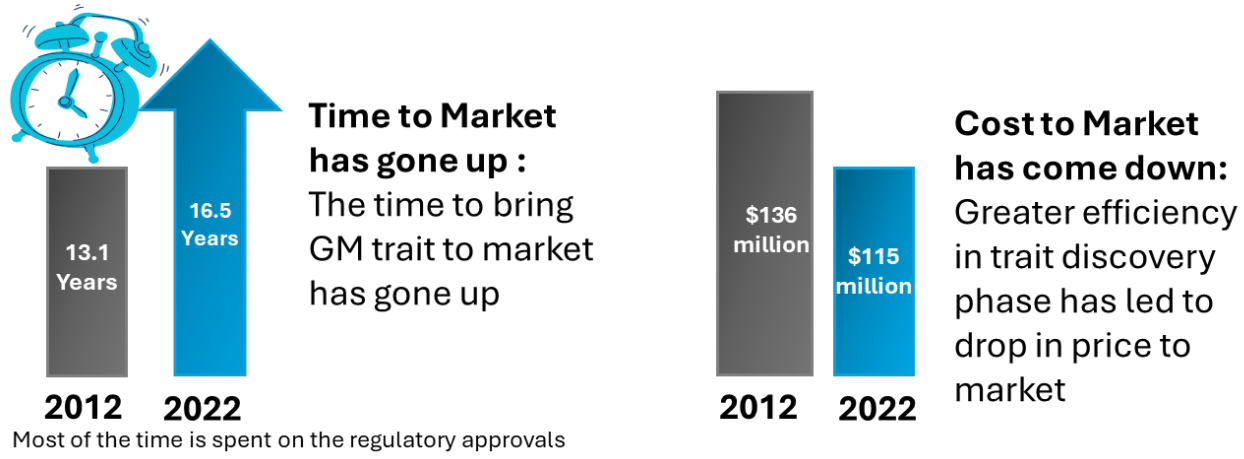
Seed companies have to carry out breeding research at multiple strategic locations. The concerned breeders advance and assess the breeding material generated in these breeding facilities, and promising entries are advanced to the following generation while keeping the intended goal in mind. These breeding stations produce hybrids that must pass rigorous testing phases, such as Multi Location Trials, Product Evaluation Trials, and Pre-Commercial demos. Five primary criteria are used to assess each product: grain yield, milling yield, disease tolerance, grain quality, and lodging tolerance. Prior to the release of the new product(s), farmers and the sales team are involved in the pre-commercial demo stage to register their input, which is mostly regarded as an important component along with the consistency of field data.

Exhibit 57: Commercialization process for Hybrid seeds



Source: Primary interactions, Frost & Sullivan Analysis

For GM crops, the timeline from research to commercialization are still longer. According to CropLife International it takes ~16.5 years for commercialization of GM crops.



Source: CropLife International

8. Indian Seed Industry Overview

8.1 Evolution of the Seeds industry

Encouraged by the Green Revolution in the 1960s and 1970s and the 1988 New Policy on Seed Development, India's seed industry transitioned from a public seed distribution system that existed prior to independence to a vibrant, mixed public-private sector. The National Seed Corporation (NSC) was founded in 1963, the Seeds Act of 1966 was passed, and the National Seeds Project (NSP) was launched in 1975. These significant events improved infrastructure and quality control in seed industry.

Additionally, it marked the start of a formal seed industry in one of the world's most significant agricultural markets. The current seed industry in India was shaped by a number of policies.

Year	Comments
1948	Agricultural colleges fall under the department of agriculture
1961-1966	Establishment of Central Seed Corporation 1963. This enabled establishment of foundation and certified seed production, assisting marketing of seeds and training of people involved in seed programs. This also paved way for the establishment of scientific seed industry in the country. Indian manufacturers were encouraged to develop seed processing equipment, while field inspections methods and seed standards were set up.
1966-1969	National Seeds Corporation (NSC) provided expert services to FAO for designing high capacity processing plants in its annual. 1966 seed act bill was introduced in the parliament. 1969 the seed act bill came into force.
1969-1974	• Tarai development corporation was established in 1969 with assistance of World Bank, It is renamed as U.P. seeds and TARAI development corporation on first July 1978. • Involvement of G.B. Pant University of Agriculture and Technology resulted in an integrated development and compact area approach. Strict quality control. Integrated approach for marketing of seeds. • In 1971 Indian Society of Seed Technology was formed. • **Green revolution** – Started in the early 1960's, green revolution started the introduction of high-yielding varieties of rice and wheat to increase food production. India is continuing its Green Revolution program by adopting Schemes promoting components of Green Revolution like plant breeding, irrigation development, and financing of agrochemicals.
1974-1977	• National commission on agriculture carried out a review of seed industry and proposed its expansion on commercial lines. • Development of System of national registry of varieties • Encourage MSMEs and development and fabrication of seed processing equipment • Storage of breeder seed and nucleus seed should be done under controlled condition. • Grow out test should be integral part in seed testing. • Department of agriculture should have three distinct wings like input aspects, law enforcement and seed certification. • GOI decided to establish seed production agencies.
1997-2002	• National Seed Policy was implemented in 2002 to provide appropriate climate for the seed industry. It helped in safeguarding the interest of Indian farmers and conservation of agro biodiversity. • The seed sector grew steadily during this period with the establishment of several private seed companies dealing with both field crops and vegetables. Single biggest change in the seed scenario was experienced in this period. First, the introduction of PPV&FR Act, 2001 and the second release of Bt cotton in India in 2002. • The rapid expansion of Bt cotton production area (reaching to ~90% in 10 years) has enhanced the demand for Bt cotton hybrid seed by 220%
2003-2007	• Implementation of PPVFRA Rule-2003 and draft of The New Seed Bill was submitted to address all seed related issue which will replace all other existing Acts regarding seeds. • Promote Seed Village concept/ Compact area approach. Small group of farmers are trained to undertake production of seeds of various crops and cater to the needs of themselves and also fellow farmers of the same and neighbouring villages in appropriate time and at affordable cost. • PPVFRA-2007- Protection of Plant Varieties and Farmer's Right Authority, New Delhi.
2017-present	• With the introduction of improved varieties with breeder seeds, present day Indian seed industry is farmer centric. It also relies on the individual State Seed Corporations to provide support in terms of infrastructure, technologies, approach and management culture to survive in the competitive market. This will enhance their contribution in the national endeavor of increasing food production to attain food & nutritional security.

8.2 Seed discovery / breeding is long gestation and research intensive

Breeding seeds requires extensive research. High-yielding, pest-resistant, and climate-resilient crop varieties can be developed rapidly by combining conventional crossbreeding with cutting-edge methods including gene editing,

marker-assisted selection, and AI/big data analysis. A big pool of germplasm with diverse traits is essential for discovery of new high performing varieties.. This multi-year, intricate process is one of the most R&D-intensive industries in the world, requiring a large investment in R&D and driving sustainability, rural development, and agricultural output.

To understand the links between genes and phenotypes, a variety of scientific fields are applied, including genetics, agronomy, molecular biology, and data science.

It can take several years of repeated crosses, selection, and extensive field testing to assess performance in a number of environmental conditions before a single new seed variety is developed & commercially released. Average time of releasing a variety can be as low as 4-5 years or as high as 8-10 years. Thus, a new entrant in the seed industry has a very slim chance of competing against the well-established players unless they have a strong R&D backup. Well established players in terms of good R&D infrastructure- research labs, research stations, advanced equipment; skilled workforce; good germplasm bank; understanding of different laws & intellectual property rights are at advantage for succeeding in long term.

Furthermore, for operations like germination testing, seed labs in India need a highly controlled environment that includes precisely controlled temperature and humidity, sufficient lighting, hygienic and well-maintained facilities, rodent and insect control, and specialized equipment. These controls, which are frequently required by National Seed Testing Guidelines and Regulations, are essential for accurate seed testing and guarantee the quality and viability of seeds.

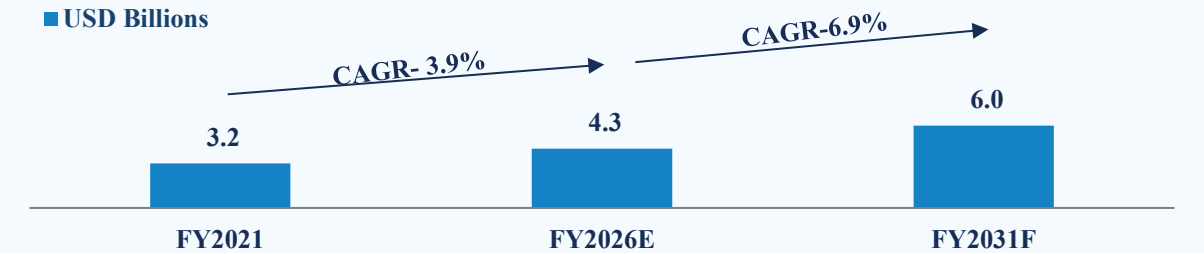
Crystal Crop is one of the few companies in Indian Seed Industry which has dedicated R&D farms for rice, maize, cotton, sorghum, mustard, fodder, vegetables, pearl millet and flower for breeding nurseries and trials. The R&D Team comprises of skilled experts with the necessary background, which aids Crystal Crop in creating high-quality, tried-and-tested solutions that meet farmer's and market demands. High quality germplasm libraries take time to build. Crystal has rich pool of germplasm and hybrid pipeline: 60 applications for Plant Variety Protection (PVP) in pearl millet and sorghum were submitted; 11 of them were approved, while the remaining 23 are currently being reviewed by authorities. In order to further improve the necessary characteristics, the company purchased new breeding lines from ICRISAT. High quality germplasm libraries take time to build and competitors like Crystal Crop excel in having built and excellent high quality germplasm library over decades.

8.3 Indian Seed Industry

India is positioned as a major global market and a developing hub for seed industry thanks to the country's sizable rapidly expanding seed industry. The industry focuses primarily on raising agricultural productivity, guaranteeing food security, and enhancing exports, and it is propelled by government regulations, the adoption of new technologies, and the move towards high-yielding hybrid varieties. The adoption of better seed technology, research and development expenditures, and farmers' growing awareness of advantages like insect resistance and increased yields are important drivers.

The Indian seed market is estimated at 4.3 USD billion in FY2025–2026 and it is increasing at a compound annual growth rate (CAGR) of 7.4% from FY2026–FY2031. By FY2031F, it is anticipated to reach a value of USD 6 billion. It includes hybrid, OPV and GMO seeds. The market for seeds is increasing as a result of the increased demand for food, animal feed, and biofuels.

Exhibit 58: India seed market, USD billions



Source: Frost & Sullivan

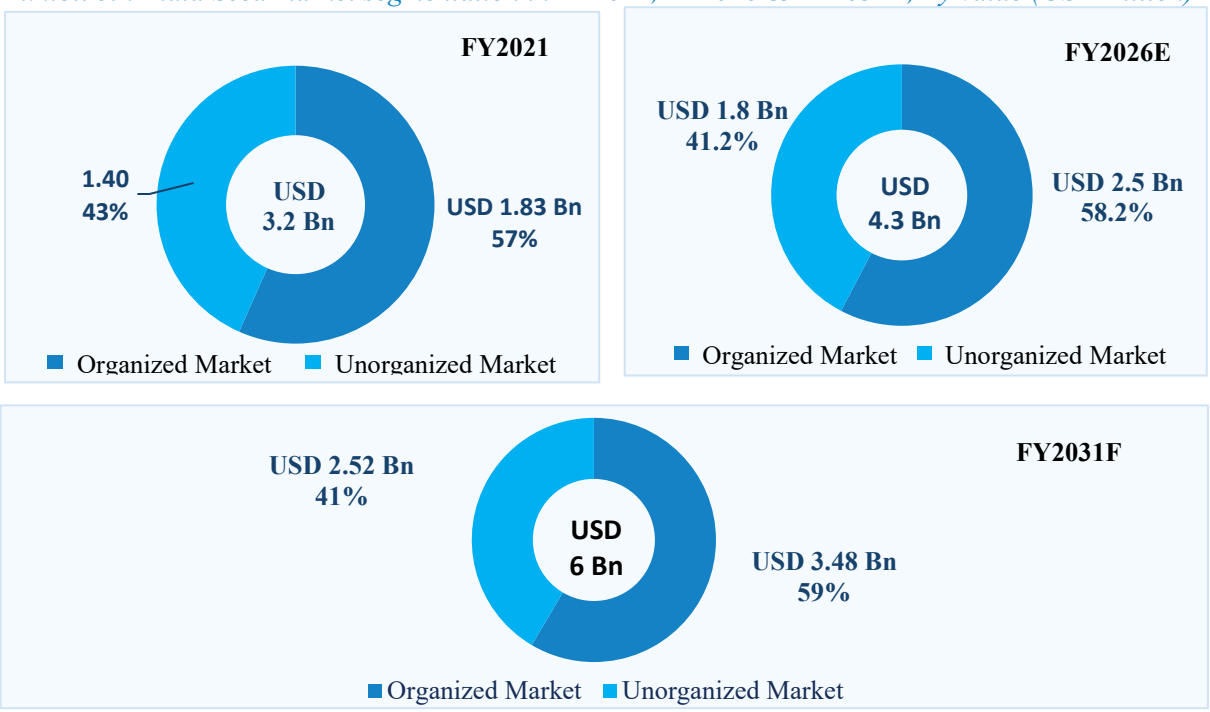
A key factor in creating a foundation for this seed industry has been the active involvement of the public and private sectors. Private sectors players such as Mahyco, Rasi Seeds, Kaveri seeds, Crystal Crop, Advanta, Seedworks, etc play critical role. Crystal crop is one of the leading companies in Seeds sector in India which has been consistent with strategic acquisitions of strong brands and businesses from leading MNCs which have given access to their customer base and increased market share. Crystal Crop operates across all strategic crops in Indian markets namely cotton, pearl millets, mustard, sorghum, fodder crops, rice, maize, wheat, vegetables and flowers giving it a diverse base across the country. They have several industry collaborations:

- With Bayer for Bollgard II, a sub-licensing agreement for cotton. The core objective being driven to strengthen cotton seed portfolio with insect resistance hybrid
- With BASF with a commercial agreement for Clearfield to enable a non-GMO herbicide tolerant mustard hybrids
- With Tritomic (Netherlands) to develop next gen mustard hybrids.

8.4 Market Segmentation of Indian Seed Industry

With well-known seed production companies and government agencies, the organized seed market in India accounts for over 58% of the total market in 2026. International corporations like Bayer, BASF, Corteva, and Advanta Seeds are part of the organized sector, as are Indian businesses like Crystal Crop, Mahyco, Seedworks,

Exhibit 59: India Seed market segmentation in FY2021, FY2026 & FY2031F, By value (USD Billion)

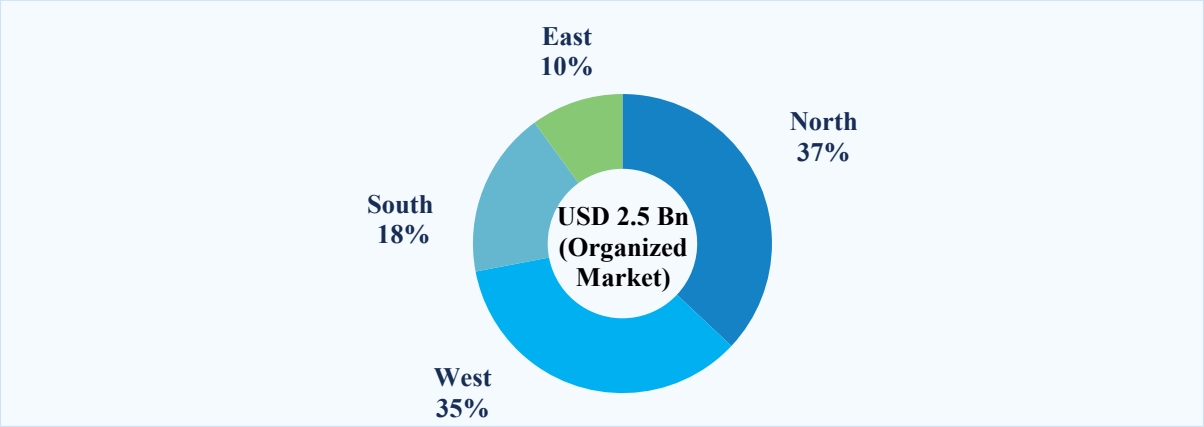


Source: Frost & Sullivan Analysis

Rasi Seeds, Kaveri, VNR seeds and many others. Almost all sell both vegetable and field crops and have a fairly broad product variety.

There are several local, regional, and small businesses functioning in the seed market, making the unorganized sector extremely fragmented. In India, farmers frequently preserve and trade their own seeds instead of buying from official seed firms, a practice known as the "unorganised" seed market. This practice is in contrast to the expanding organized seed market, which is seeing a trend toward hybrid and high-yielding varieties as well as increased private sector engagement.

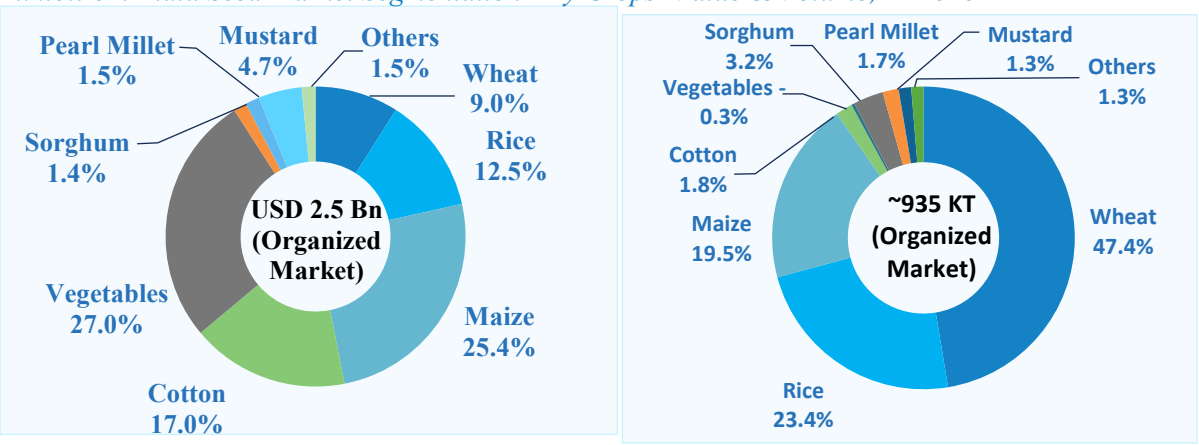
Exhibit 60: Indian Seed Market Segmentation - Region wise, FY2026



Source: Frost & Sullivan, Primary Inputs

Staple crops like wheat & rice make up to 20-22% by value followed by Cotton at 15-17% of the organized seed market. Vegetable seed dominates the market in terms of value, contributing ~27% of the organized seed market. Need for intensive research and development (R&D) for hybrid vegetable seeds, the labor-intensive and specialized processes involved in seed production, seasonal weather and pest challenges and the perishable nature of seeds that require careful storage makes vegetable seeds dearer.

Exhibit 61: India Seed Market Segmentation - By Crops- Value & Volume, FY2026



Source: Frost & Sullivan Analysis, Primary Inputs

In volume terms, wheat & rice contribute ~70-72% of organized seed market. India's rural economy, food security, and farmer livelihoods all depend on wheat and rice crop, with high-quality seeds being essential for increasing yields and guaranteeing sustainable farming methods. The significance of these staple crops goes beyond their function in the broader economy, as they give farmers financial stability and help India become a major producer of these vital crops.

8.5 Key Crops, brands & players in Indian Seed Industry

8.5.1 Cotton

Due to their excellent yields and resistance to pests, Bt (Bollgard) cotton seeds are the most widely used types of cotton seed in India. Transgenic (Bt) hybrids are preferred because they are genetically altered to withstand bollworms and other pests, reducing crop losses and farmers' production expenses.

India is one of the largest producers of cotton in world. India's cotton acreage for the 2025-26 crop year was 115.85 lakh hectares compared to the 114.82 lakh hectares planted in 2024-25. The top cotton-sowing states for 2024-25 were Maharashtra (38.44 lakh ha), Gujarat (20.82 lakh ha), and Telangana (18.51 lakh ha).

The Indian seed market sold 4.1 - 4.3 crore packets of cotton seed in FY2026. In FY2021, the Indian cotton market was valued ~ INR 35,000- INR 35,500 million. By 2031F, it is projected that the market will have grown from INR 35,000-36,000 Mn in FY2026 to ₹ 45,000-46,000 Mn. From FY2026 and 2031F, the Indian cotton market is anticipated to expand at a CAGR of ~5 %.

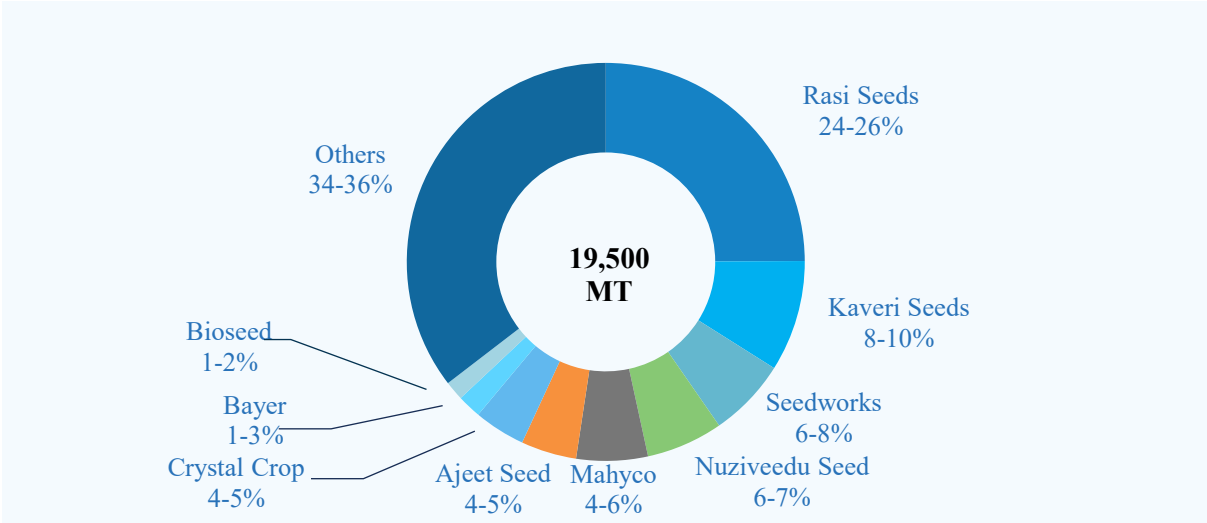
Segmentation of the market is done based on the maturity duration as following:

Segment	Maturity Duration	Industry size
Early Maturity	<140- 150 days	25-30%
Medium Maturity	150-170 days	40-45%
Late Maturity	170- 180+ days	20-25%

The High-Density Planting System (HDPS), which involves planting plants at higher densities to maximize crop standability and output, has an attractive market opportunity in cotton in India. The availability of early maturing compact varieties (less than 150 days) with synchronous boll bursting is essential to the HDPS system's success because harvesting is done manually. Companies are spending money on research into these kinds of varieties, which should propel volume growth in India. Due to market disruptions and uncertainty brought on by the unauthorized distribution of HTBT seeds, the cotton segment faced challenges. The illegal spread of herbicide-tolerant BT (HTBT) cotton, which has not received regulatory authorities' approval, is one of the structural issues the cotton sector is still facing. Farmers are drawn to HTBT because it is convenient and lowers weeding expenses, however uncontrolled seed distribution of these seeds has significant concerns, such as contaminating the environment, losing trait purity, and undermining confidence in accredited seed systems.

Despite of the challenges, companies such as Crystal Crop, Rasi seeds, Mahyco, Nuziveedu seeds, Nath Bio gene are investing in the next generation cotton seeds which have increased yields, improved resistance to pests (especially pink bollworm and sucking pests), and adaptability in a range of agroclimatic zones.

Exhibit 62: Market shares of prominent players in Cotton segment, FY2026



Note: Above market shares are based on volume trends

Source: Primary stakeholders, Frost & Sullivan Research and Analysis

Some of the major companies in cotton seed market are Rasi seeds, Kaveri Seeds, Crystal Crop, Mahyco, Ankur seeds, SeedWorks, Nuziveedu Seeds and Ajeet seeds. Crystal Crop has 19+ varieties in cotton in different segments from medium maturity to late maturity, uniform big boll size & good crop appeal. Since 2021, 9 varieties of Crystal Crop's cotton seed have been notified in both segments of rainfed and irrigated.

8.5.2 Paddy

Paddy is significant crop in India and a major part of the country's agriculture and diet. In FY 2025–26, the area for paddy cultivation in India was 528.32 lakh hectares, producing 1,540.24 Lakh Tons. Uttar Pradesh with the largest area at 73.3 lakh hectares, contributing 13.88% to total production followed by West Bengal with 55.9 lakh hectares (10.5%) & Telangana with 48.09 lakh hectares (9.10%). Paddy continues to be a resilient crop with hybrid paddy's stable demand, improved margins led by value-rich offerings.

The market for rice seeds is slightly hybridized, with open-pollinated and research types continuing to rule the market. In India, the OPV rice market has moved from farm-saved or bulk seeds to high-quality packed seeds and seed treatment products. Research rice, also known as OPV rice, still dominates the Indian rice seed market and makes up 85–90% of the country's total rice market volume.

In 2021, the Indian hybrid rice seed market was valued ~ INR 12,500 - INR 14,000 million. According to estimates, the segment will be worth INR 15,500–16,500 million in 2026E and will grow at a compound annual growth rate (CAGR) of 6.5–7.0% to reach INR 20,500–21,000 million in 2030. Approximately 8–10% of rice is currently hybridized, with an estimated 4-4.3 million hectares under hybrid cultivation.

Companies are investing in R&D in early maturity and disease resistance varieties along with improved productivity and climate resilience goals. New hybrid rice traits in India focus on enhancing yield, improving stress tolerance (drought, salinity, temperature), and increasing disease & pest resistance such as Brown Plant Hopper (BPH) and diseases like Bacterial Leaf Blight (BLB)

The seed segment for hybrid rice in Indian seed market are basis days of maturity and grain type as following:

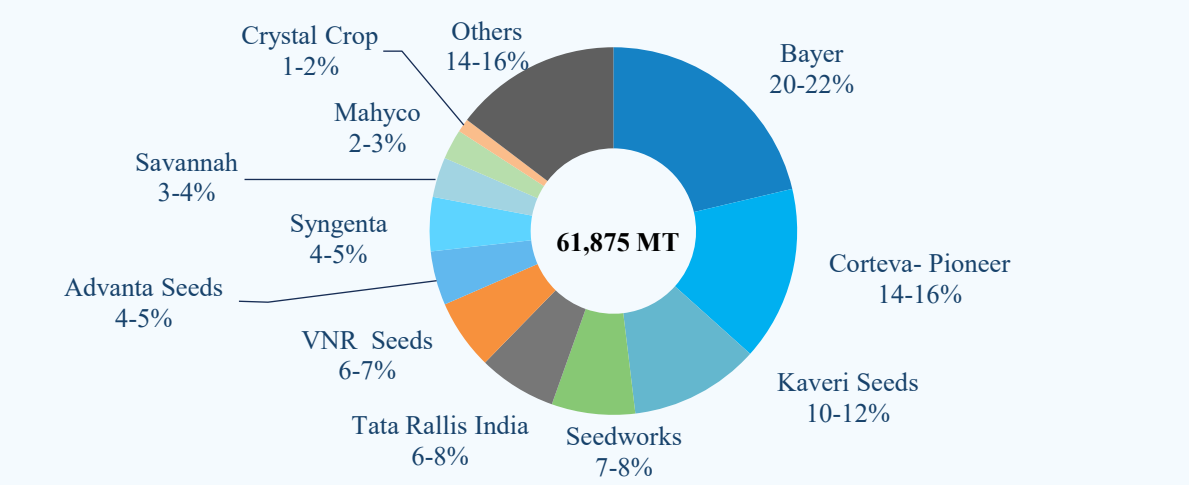
Segment	Maturity Duration, days	Industry size
EM- Early Maturity	90-105	12-15%
ME- Medium Early Maturity	110-125	33-40%
MM- Medium Maturity	125-140	40-43%
LM- Long/Late/Full Maturity	140+	5-8%

In terms of volume, 58,000–60,000 tons of hybrid rice seeds are anticipated to be sold in India in 2026. For hybrid paddy, the medium maturity sector makes up 40–43% of the market, the medium early segment 33–40%, the early maturity segment 12–15%, and the late maturity section 5–8%.

In the hybrid rice market, Bayer leads with its "Arize" brand having 14+ distinct Arize varieties, which yield 20–35% higher than standard kinds, are sold by Bayer in India. Bacterial leaf blight (BLB) is naturally avoided by six of these Arize cultivars. In the hybrid rice market, other noteworthy players include Tata Rallis-Dhanya, Advanta, Syngenta, Mahyco, VNR Seeds, Corteva-Pioneer Seeds, and Kaveri Seeds.

Crystal Crop has hybrid paddy products in early, medium maturity segments with suitability across India.

Exhibit 63: Market shares of prominent players in Hybrid Rice segment, FY2026



Note: Above market shares are based on volume trends

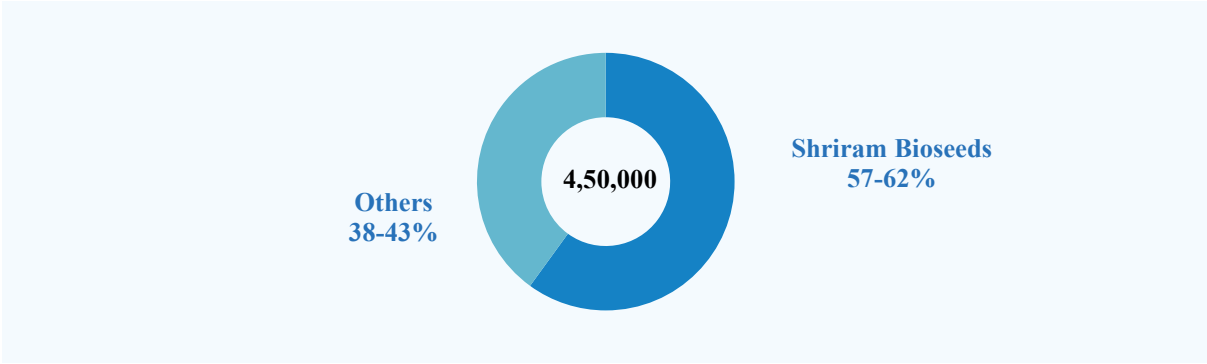
Source: Primary stakeholders, Frost & Sullivan Research and Analysis

8.5.3 Wheat

The size of the Indian wheat seed market is significant due to the nation's prominence as a major producer of wheat and the increasing emphasis on creating high-nutrient, climate-resilient seed varieties to improve food security. Alongside a surge in consumer demand for high-protein wheat products, key trends include increased research and development in biotechnology and advanced farming practices for drought and disease tolerance. Wheat seeds are distributed through a variety of channels by a number of participants in the market, including cooperatives, private seed companies, and government organizations. In 2025-26, wheat was cultivated on 336 Lakh Ha in rabi season In India.

The Indian market for wheat seeds is majorly research and open-pollinated seeds. Hybridization is very minimal or nonexistent. Shriram Bioseeds is a major player in the Indian wheat seed market, offering cultivars like Annapurna, Vasudha, and Ganga gold. Among the other companies in the wheat seed industry are Crystal Crop, Mahyco, Ankur, Ajit, Eagle, and JK Agri.

Exhibit 64: Market shares of prominent players in Wheat segment, FY2026



Note: Above market shares are based on volume trends

Source: Primary stakeholders, Frost & Sullivan Research and Analysis

8.5.4 Maize

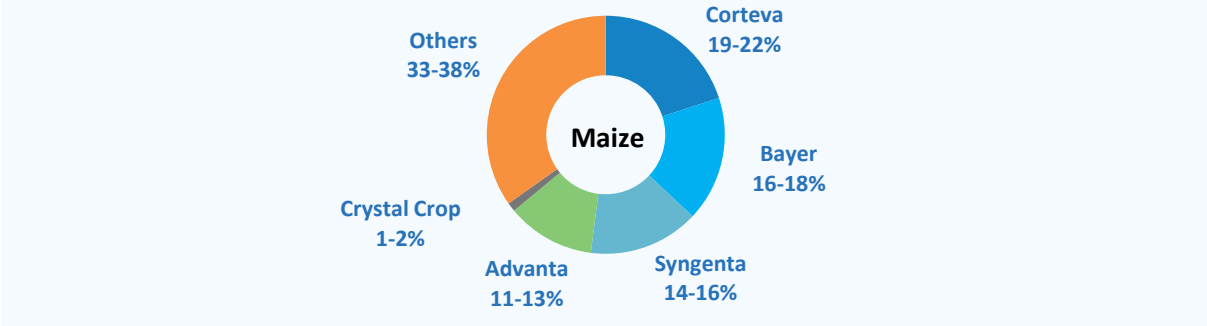
For the Indian seed industry, maize seed is crucial as it supports industrial uses including the manufacturing of starch and biofuels, as well as food security and a burgeoning animal sector. Producing and distributing high-yielding maize hybrid seeds is the industry's major priority in order to fulfill rising demand, boost productivity, and support India's long-term feed, fuel, and industrial security goals. With its excellent yields (MSP ~₹2,400/quintal for 2025–26), reduced water requirements, and government support, maize has grown in popularity among farmers. In FY 2025-26, maize was cultivated on 144.08 lakh Ha in India.

The crop can be grown year-round in a variety of agro-ecological zones and allows for several harvests in numerous states. India used to import maize, but because to developments in hybrid varieties and farming methods, it now exports grain, seed, and value-added goods like sweet corn and baby corn.

Maize is a crucial feedstock since the government's biofuel program seeks to raise the amount of ethanol blended into petrol, with a target of 20% by FY 2025–2026 and 30% by 2030. It is anticipated that this project will increase the demand for maize by an additional 18–20 million tons, promoting environmental sustainability and energy security.

The market for hybrid maize is estimated to be ~ INR 41,000-43,000 in FY 2026 and is estimated to grow at CAGR 5-5.5% till FY 2031. The leading companies in the Indian corn seed market are Bayers, Syngenta, Corteva-Pioneer seeds, and Advanta. Indian farmers greatly trust the more than 25 high-yielding hybrid corn seed products in Bayer's Dekalb (DKC) brand line. With a primary concentration in central and southern India, Syngenta's corn hybrids (NK, S brand) have propelled them to the top of the markets in Karnataka, Andhra, Maharashtra, MP, Rajasthan, and Tamil Nadu. Advanta offers corn varieties with high shelling %ages, tip fills, wilt resistance, and lodging tolerance under the PAC and ADV brands. Crystal Crop has 13+ varieties in different segments from with wider adaptability, high tolerance to stalk rot & foliar disease, late maturity and orange to yellow and white grain colour.

Exhibit 65: Market shares of prominent players in Maize segment, FY2026



Note: Above market shares are based on volume trends

Source: Primary stakeholders, Frost & Sullivan Research and Analysis

8.5.5 Pearl Millet

India's pearl millet seed market is primarily distinguished by its significant production—Rajasthan leading the cultivation —and the extensive use of hybrid seeds, which have significantly raised crop yields. Its' often called bajra in India. The crop's drought resistance and nutritional significance are what drives the market. Besides being

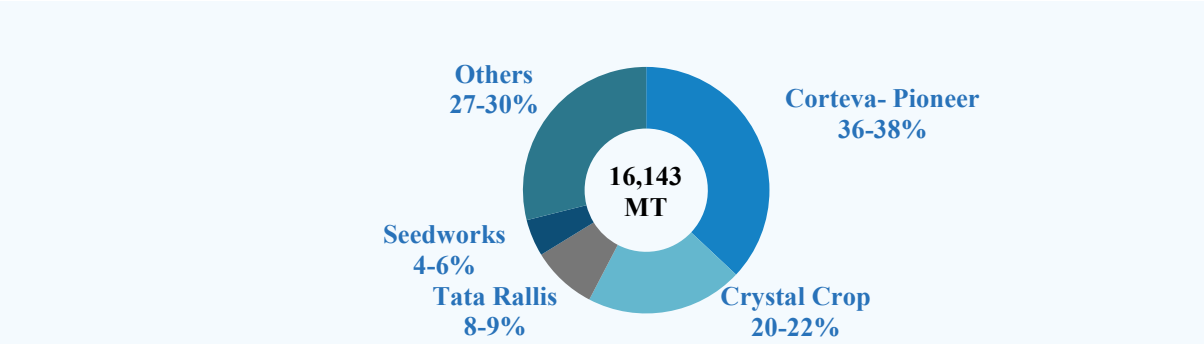
used as food and animal feed, it is further used in alcohol, fuel, and food processing. The All India Coordinated Research Project on Pearl Millet (AICRP-PM) is a unique research project in India that aims to improve the crop.

With distribution networks extending from distributors to retailers, private seed companies and public research organizations such as the ICAR-AICRP on Pearl Millet are important participants. Almost 60% of the entire pearl millet area is under hybrids. In FY 2026, pearl millet was cultivated on 69.63 Lakh Ha.

The pearl millet market in India was valued at approximately INR 2,700-2,900 million in 2021 and is projected to increase at a compound annual growth rate (CAGR) of 6-6.5% from INR 3,950 - 4,400 million in 2026E to 2031F, reaching INR 5,600-6,400 million. Among the desired characteristics of the pearl millet crop are its long and compact earhead, medium bold grain in an appealing color, and high tillering.

The seed industry has benefited greatly from private companies' efforts in hybrid pearl millet research and development.

Exhibit 66: Market shares of prominent players in Pearl Millet segments, FY2026



Note: Above market shares are based on volume trends

Source: Primary Stakeholders, Frost & Sullivan Research and Analysis

Pearl millet seed is offered by players such as Corteva- Pioneer seeds, Crystal Crop, Tata Rallis- Dhanya, SeedWorks, Kaveri seeds, Nath seeds and Mahyco.

Crystal Crop is amongst the top three players in pearl millet market in Indian seed industry in 2025-26 with market share of 20-22%. Crystal Crop has the strong R&D program for pearl millet that goes back to decades. “Proagro” is the brand that resonates with farmers across India. Compact cylindrical- long panicles, excellent grain & fodder yields, lodging tolerance & wider adaptability are some of the features of Proagro hybrids. Total of 6 varieties of Crystal Crop’s pearl millet seed have been notified in segments of late kharif, summer and early.

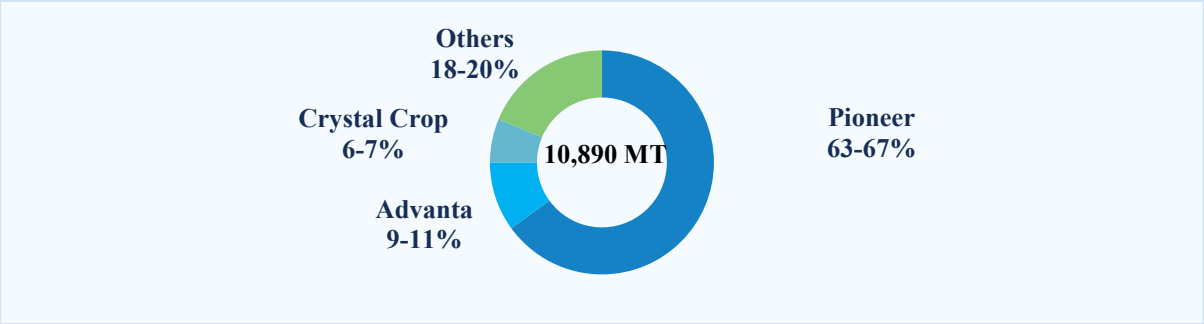
8.5.6 Mustard

Mustard, also known as rapeseed is cultivated majorly in Rabi season. India's market for hybrid mustard seeds is growing due to government programs like the National Food Security Mission-Oilseeds (NFSM-OS), which encourage high-yielding hybrid varieties. In FY 2025–26, mustard acreage in India were 94.27 lakh Ha. In India.

India's mustard seed business is focused on both hybrid and research. In 2026, the research mustard market is expected to be worth INR 800–950 million. It is projected to grow at a CAGR 4-4.5% rate until 2030, when it is expected to reach INR 1050–1,250 million. The market for hybrid mustard was valued between INR 5,000 and INR 5,600 million in 2021. It is estimated to increase to about INR 7,400 million in 2026E, and it is anticipated that this amount will increase at a CAGR of 6.0% until 2030F, , when it will reach INR 9,800–10,000 million. Segmentation for hybrid mustard is as follows: -

Segment	Maturity Duration, days
EM- Early Maturity	<100
ME- Medium Early Maturity	100-120
MM- Medium Maturity	120-130

Exhibit 67: Market shares of prominent players in Mustard segments, FY2026



Note: Above market shares are based on volume trends

Source: Primary Stakeholders, Frost & Sullivan Research and Analysis

With a market share of roughly 63–67%, Corteva-Pioneer seeds dominate the market. Crystal Crop is amongst the top three players in mustard market in Indian seed industry in 2025-26 with market share of 6-7%. Hytech Seeds, Mahyco, and Shriram Bioseed are other major players. In addition to bold grains with a high oil content and varying maturity periods, companies now provide mustard products that are resistant to stem rot and white rust. Total of 5 varieties of Crystal Crop's mustard seed have been notified in medium and early maturity segment.

8.5.7 Vegetables

The market for vegetable seeds is anticipated to grow at CAGR 9–10% from 2026 to 2031, from INR 58,000-62,000 million to INR 92,000–98,000 million. This growth would be fueled by increasing hybrid adoption, changing consumer preferences, and growing consumer demand.

In 2018, the market was worth approximately INR 47,500 million. India's vegetable seed market is extremely competitive, with several companies dominating several crop categories and the presence of unorganized businesses. Vegetables are more hybridized than the markets for cereals and oilseeds.

Exhibit 68: Market shares of prominent players in Vegetable segment, FY2026

Vegetable category	Market size in 2025E (Tons)	Hybridization	Key players along with Market shares
Okra 	2,050	>80%	Advanta ~24-26% Bayer 19-20% Rasi 5-6%
Chilli 	140-150	>80%	Mahyco Seminis Syngenta HM Clause
Cauliflower 	60-65	~50-60%	Syngenta, Seminis and Advanta occupy ~50% of the market share
Brinjal 	60-70	~60%	Mahyco, Ankur, Seminis, and VNR seeds collectively hold 50% market share
Tomato 	85-95	>80%	Syngenta (Sahoo variety) Bayer Namdhari Indo- American
Gourds* (Bottle Gourd, Bitter Gourd, Ridge Gourd, cucumber) 	420-440	>90%	Bottle gourd - Mayhco, East west, and VNR seeds. Bitter gourd - East West, VNR Seeds, HM Clause and Rasi Seeds Cucumber - East West and Rasi Seeds

Source: Primary stakeholders, Frost & Sullivan Research and Analysis

8.6 Marigold Flower Seed Market in India

Marigold is a commercially and medicinally significant crop that is widely grown for industrial, pharmacological, and ornamental uses. Marigold has strong antioxidants, anti-inflammatory, antibacterial, anticancer, and healing properties. It is rich in carotenoids, flavonoids, terpenoids, phenolic acids, and essential oils.Over 200,000 hectares of marigold cultivation occurs worldwide, with India, China, Ethiopia, Kenya and Mexico, making significant contributions to the phytopharmaceutical and floriculture industries.

With 255 thousand hectares devoted to the crop, expected yearly production of marigold flower is 1,754 thousand metric tons in 2024. India alone produces majority of the world's marigold, mostly in states of like Karnataka, Tamil Nadu, Andhra Pradesh, West Bengal, and Uttar Pradesh.

The seed market for marigold cut flowers ranges between 4000- 4500 Kgs. Out of this, about 40-45% seeds are produced in India, and the rest are imported. Thailand is the major supplier of marigold seed to India. The seed market for marigold flowers is expanding at a rate of between 5% - 7% annually. Some of the major players in marigold seed market are Crystal Crop(I&B seeds), Syngenta, East west seeds, Hyveg, Ashoka seeds & Sakata seeds. Crystal Crop acquired I&B seeds to strengthen its marigold product portfolio. The Company has a market share of approximately 25%–35% of the marigold seed market, based on sales during the previous three years. This market position was achieved through the Company's erstwhile wholly owned subsidiary, I&B Seeds Private Limited ("I&B"), which was amalgamated with the Company during FY 25-26.

8.7 Seed -Replacement rate in India

Seed Replacement Rate (SRR) refers to the %age of the total sown area of a particular crop that is cultivated using certified or quality seeds, rather than farm-saved seeds. It is the key indicator of farmers' adoption of high-quality seeds in India's agricultural landscape. Increasing crop output, guaranteeing food security, and encouraging sustainable farming methods all depend on improving SRR.

In order to encourage the use of high-quality seeds, the Indian Department of Agriculture and Farmers Welfare strives to increase the Seed Replacement Rate (SRR) through programs like the Sub Mission on Seed and Planting Material (SMSP). The government wants to increase the SRR for important commodities including oilseeds, pulses, and paddy in order to boost farmer income, increase agricultural productivity, and meet national food security targets. With the general goal of increasing the use of certified seeds rather than farm-saved seeds, the government has set target SRRs for several crop kinds. The prescribed norms of Seed Replacement Rate are 33% for self-pollinated crops, 50% for cross-pollinated crops, and 100% for hybrids.

Private companies play a pivot role in making new hybrids available for increasing the seed replacement rate in country. Companies have invested in research programs for crops such as paddy, pearl millet, cotton, maize and so on. Crystal Crop has strong R&D capabilities with **6.7 % (of seed revenue) investment in seed R&D in FY 2025 and FY 2026**, showcasing the strong commitment to R&D. Over the years, Crystal Crop has grown the investment in seed R&D at a CAGR of 30.49% from FY 2024 (INR 232.22 million) to FY 2026 (INR 395.42 million). Crystal Crop is also engaged in the R&D of open-pollinated variety seeds for wheat, rice and mustard. It is the only Indian company which has technologically and commercially collaborated with BASF for R&D on mustard seed. There are 14 Breeding locations for Crystal Crop R&D in field Crops. Some of the new research/breeding technologies used by Crystal Crop:-

i) Bollgard II® in Cotton (Genetically modified) from Bayer Crop Science for protection of the crop from bollworms
ii) Clearfield® technology (Non-genetically modified) in Mustard for herbicide resistance to Imidazolinone
iii) Collaborative funded project on enhancement

8.8 Collaboration By Crystal Crop in Seed Industry

Over the years, Crystal Crop has established itself as a progressive force in the Indian seed industry, actively engaging in strategic collaborations and technology partnerships to drive innovation and sustainable growth. The company has signed several key agreements aimed at enhancing crop performance, farmer profitability, and industry advancement.

Crystal Crop entered into a sub-license agreement to utilize the Bollgard II® insect resistance trait in its cotton hybrids, a technology that has been instrumental in strengthening its cotton seed portfolio. In addition, Crystal Crop signed a commercial agreement with BASF to integrate the Clearfield® non-GM herbicide resistance trait into its mustard hybrids, reinforcing its commitment to offering innovative yet sustainable solutions. More recently, Crystal Crop inked a partnership with Triatomic,(Netherlands) for technological and commercial collaboration on advanced trait development in mustard; this pioneering project, currently under progress, holds

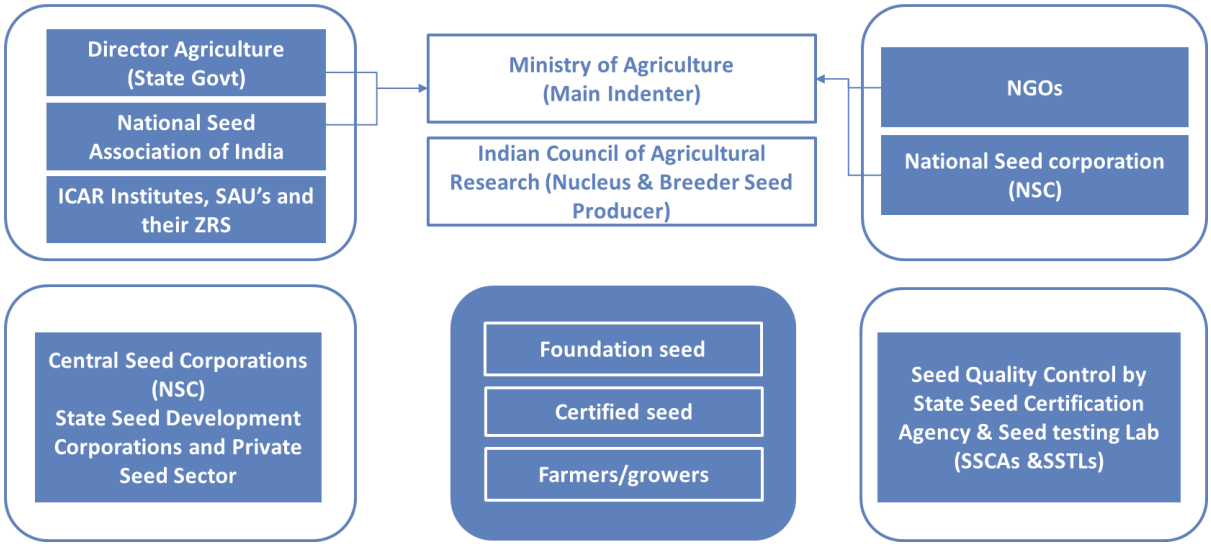
the potential to redefine Indian mustard cultivation and is expected to reach commercialization within the next two years.

Expanding its footprint beyond field crops, Crystal Crop (I&B Seeds) is also making strides in the vegetables and flowers segment. In collaboration with the World Vegetable Centre and member companies of the Asia and Pacific Seed Association (APSA), the company is engaged in two special research programs: Okra Breeding (for developing hybrids resistant to Yellow Vein Mosaic Virus and Enation Leaf Curl Virus) and Luffa Breeding (for developing improved lines and hybrids). These initiatives reflect Crystal Crop's forward-looking approach to strengthening research-led innovation and contributing meaningfully to the evolution of Indian agriculture.

8.9 Supply chain of seed industry in India

Research and development is the first step in India's seed industry supply chain, which results in the development of foundation and breeder seeds by a number of public and private companies. Contract farmers or seed companies then multiply these seeds. The seeds are transported to processing facilities for grading, cleaning, quality control, and packaging after harvest. Farmers receive the packaged seeds via a multi-tiered network of distributors and retailers. Through departmental stores and agricultural cooperatives, the government contributes to the distribution of subsidized seeds.

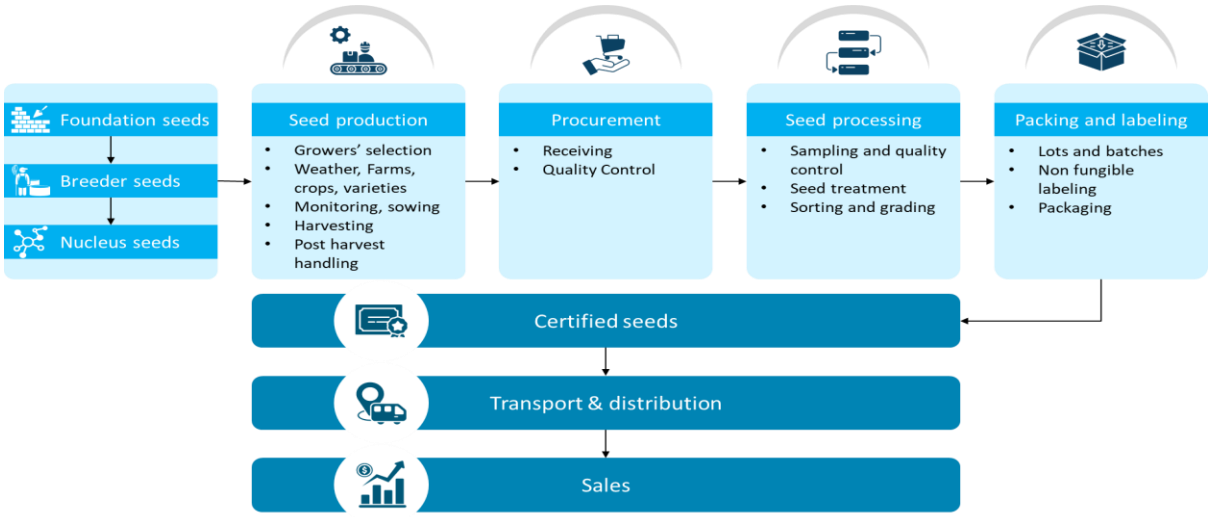
Exhibit 69 : Public sector seed supply chain in India



Source: Frost & Sullivan

State Seed Corporation are engaged in the production and distribution of seeds. The National Seed Corporation (NSC) uses contract farming and its own marketing network to produce varieties of national significance. Universities and research organizations that produce new varieties are part of the National Agricultural Research Education and Extension System (NARES). Seeds are distributed by cooperatives and state departments of agriculture, frequently with subsidies

Exhibit 70: Private sector seed supply chain in India



Source: Frost & Sullivan

Indian as well as multinational companies contribute significantly to the production and distribution of premium seeds for different crops. Companies like Crystal Crop, Mahyco, Seedworks, Advanta, Kaveri seeds invest a significant portion of their revenue towards R&D for new crops. Post development of good varieties, the breeder seeds are given to selected growers so they can multiply them. The quality of seeds is crucial to produce food; hence growers play a significant role in India's seed value chain.

After buying them from growers, the seeds undergo further processing and packaging before being sold to farmers. Cleaning, grading, sorting, and chemically treating seeds for improved outcomes are all parts of seed processing. At every step of the process, quality assurance is taken care of.

End users, or farmers, purchase seeds through a variety of channels, including online and physical ones. Middlemen like distributors and retailers are examples of offline channels, and they are very common in the Indian seed market. Additionally, several online e-commerce platforms were created especially for agricultural inputs.

8.10 Key Trends and factors driving the market growth.

8.10.1 Trends

Shift towards hybrid varieties- Farmers are leaning towards using hybrid seeds for better growth in various climates and higher yields per acre. These seeds are intended to reduce crop losses by more efficiently fending off diseases and pests. Farmers can benefit from better income by using hybrid seeds since they are more reliable. The size, color, and flavor of crops cultivated from hybrid seeds are more consistent. Also, hybrid seeds have quicker harvesting times giving farmers ample time to plan for next crop.

Moreover, high-yield hybrid seeds are essential for food security because of the increased demand for food brought on by India's growing population. Every year, the seed industry improves hybrids even more, which is probably going to continue because of the advantages they provide.

Use of modern Technology - Biotechnology, precision farming, and digital tools are examples of modern technologies used in India's seed sector to enhance seed quality, production, and sustainability. Using gene editing and breeding to create pest- and climate-resistant varieties are important breakthroughs. From production to farmer access, digital solutions like blockchain, AI, drones, and QR codes improve efficiency, traceability, and monitoring across the whole seed value chain. Scientists are developing seeds that are appropriate for the local soil and climatic conditions by using new breeding techniques like genetic selection and molecular markers, which promote superior seed types. As a result, seeds are also getting more resilient to harsh weather and pests, which means there are fewer crop failures and more food produced through same acreages.

Demand for special traits- Increased yield, climate resilience, and improved nutritional content are the main factors driving demand for crop traits in India, especially for value-added agricultural products like millets and high-value vegetables as well as staple crops like rice and wheat. Interest in new developments like gene editing is fueled by the high demand for biofortified grains to fight malnutrition and for features that increase insect resistance and climate change tolerance. Additionally, characteristics for organic agriculture and certain market needs—such those for food processing or textile industries (like cotton)—are also becoming increasingly significant.

8.10.2 Growth Drivers

Growing Food need: The need for a variety of foods, grains, fruits, and vegetables is fueled by a big and increasing population as well as rising wages. This calls for improved seeds to increase crop yields.

Technological Developments: The development of disease-resistant, climate-resilient, and high-yielding seed types is being accelerated by developments in biotechnology, genomics, marker-assisted selection, and gene editing.

Government Assistance: Growth is made possible by favorable government initiatives and policies, such as those that fund research and development, increase the rate at which seeds are replaced, and encourage the production of high-quality seeds.

Adoption of Hybrid Seeds: Farmers are increasingly using hybrid seeds due to their high production, adaptability, and stress resistance, which has greatly aided in the growth of the industry.

Export Potential: India can increase its share of the global seed market by exporting high-yielding seeds to other Asian and African nations thanks to its advantageous location and variety of agroclimatic zones.

Public-Private Sector Cooperation: Proactive cooperation between private companies and public research organizations promotes advancement in seed breeding and aids in tackling the issues of food security and climate change.

Along with above drivers, increasing bio-fuel blending will also increase the demand for crops required for bio-fuel production such as sugarcane, corn, and rice.

8.11 Regulatory status of pending biotech/GM crop projects in India

Currently, India only allows the commercial production of Bt cotton. However, a number of other genetically modified crop projects, including GM mustard and GM brinjal, have been approved for environmental release but are hampered by public opposition, legal challenges, and judicial reviews. Additionally, some genetically modified foods and animal feed ingredients made from corn and soy are permitted to be imported into India. To promote research, genome-edited crops are now free from strict GM agricultural rules.

The main regulatory body responsible for approving genetically modified crops is the Genetic Engineering Appraisal Committee (GEAC), while the Food Safety and Standards Authority of India (FSSAI) oversees imported food items.

Crop	Status
Bt Cotton	Biotech- Derived crop approved for commercial cultivation
Bt Brinjal	Moratorium was placed on its introduction in 2010 due to public opposition
GM Mustard	Cleared by the GEAC for environmental release in 2022, but its commercialization is under judicial review
GM Maize	India does not permit the commercial cultivation or import of GM maize for food and feed purposes
GM Soyabean	Import of GM soybean oil and soymeal for animal feed is permitted but import of GM soybean seeds and other GM food/feed products is prohibited

8.12 Key threats and challenges to Indian seeds market

Unpredictable climate change:

Heat waves, droughts, floods, and other extreme weather phenomena are becoming more frequent and provide a serious risk to seed production.

Elevated temperatures can alter seed size and vigor, interfere with crop phenology, and lower germination rates.

As a result of changing climates, crops may be distributed differently geographically and new insect pests and diseases may emerge, endangering seed health and requiring additional pest control.

Policy & Regulatory Challenges:

The planned Seed Bill of 2019 has been stalled for years, and the current Seeds Act of 1966 is seen as outdated. This delays the introduction of new, improved seed varieties and produces regulatory ambiguity.

New seed varieties must pass a regulatory process that varies from state to state and is frequently drawn out and complicated. Thos affects small & medium scale business

Presence of Counterfeit seeds in Market:

Widespread availability of counterfeit seeds is a serious risk, particularly during times when demand is high. This degrades the quality of the seed, harms the reputation of reliable seed manufacturers, and may cause farmers to experience crop failure.

Overuse of farm-saved or uncertified seeds:

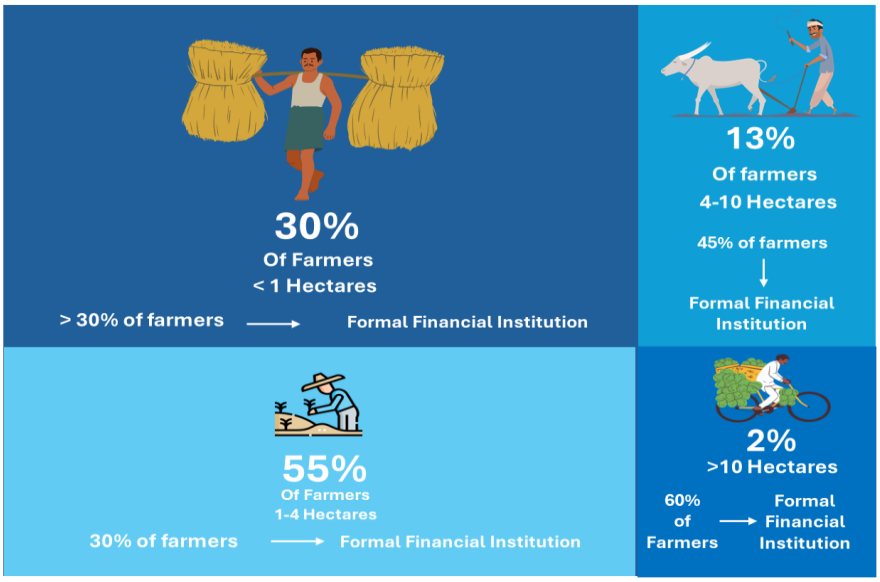
A lot of farmers still use these seeds, which can result in inferior quality, lower yields, and increased vulnerability to pests and illnesses.

9. Overview of the Indian Farm Equipment Market (Sprayers and Harvesters)

Mechanisation in Indian farming for several years was synonymous with tractorisation. While tractors still dominate, the ecosystem is now expanding to include a broader range of equipment which include sprayers, harvesters, planters, and precision tools. Driven by shifts in landholding structure, labour availability, and technology. The result is an industry that is gradually moving from scale-led growth to efficiency-led modernisation.

More than four out of five Indian farmers operate on less than four hectares of land. About 30% cultivate plots smaller than one hectare, while 55% manage between one and four hectares. Only 15% of farmers have holdings above four hectares, and a mere 2% own more than ten

Exhibit 71: Farm Holding Structure in India

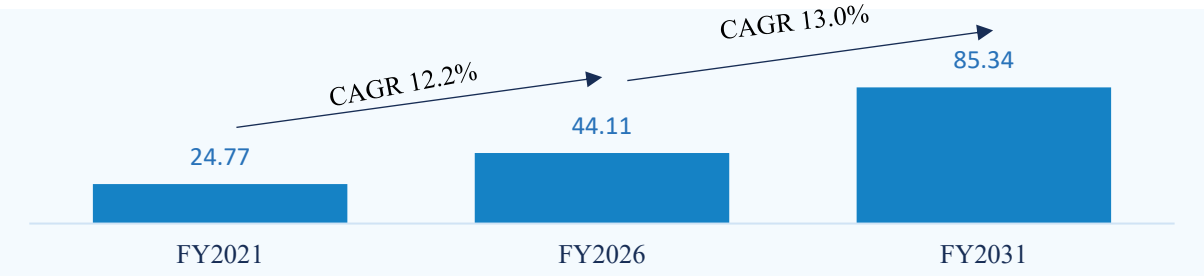


Source: Central Food Grains Procurement Portal, PIB & Frost & Sulilvan Analysis

The most decisive factor accelerating mechanisation today is labour availability. Rural labour shortages, once confined to certain regions, are now widespread due to large-scale migration toward non-farm employment. Younger workers increasingly prefer construction and services over agricultural labour, citing lower physical drudgery and more predictable wages. For farmers, this has created recurring stress during key agricultural operations, especially transplanting, weeding, and harvesting where timeliness is crucial. A missed window can reduce yield or force costly re-sowing. As a result, the cost of agricultural labour has risen sharply, outpacing growth in farmgate prices. In several states, the daily wage for farm labour has more than doubled in the past decade, while real productivity gains remain modest. Mechanisation thus becomes a form of risk management ensuring tasks are completed on time, with predictable quality and lower dependency on seasonal labour availability.

Smaller machines such as power weeders, mini-harvesters, and low-cost sprayers have become increasingly important for bridging this gap. Unlike tractors, which primarily address land preparation, these implements directly substitute labour in repetitive, time-sensitive operations.

Exhibit 72: Branded Agriculture Sprayers and Harvesters Market in India (In INR Billion)

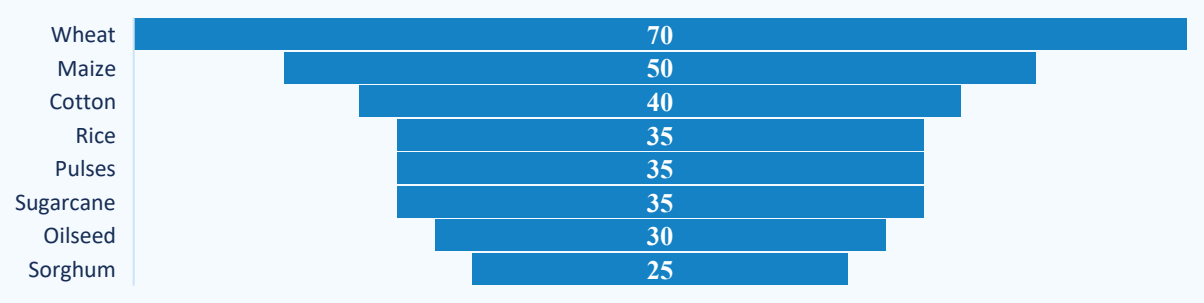


Source: Secondary Sources, 58th report research and development in farm mechanization for small and marginal farmers in the country- , Frost & Sulilvan Analysis

Sprayers and Harvestors form a market valued at ₹24.77 billion in FY21, expected to rise to ₹44.11 billion by FY26 and ₹85.34 billion by FY31 implying a compound annual growth rate of about 13%. The drivers are both economic and technological. Rising pest incidence, erratic rainfall, and the shift towards higher-value crops such as horticulture and pulses have increased the need for precise and efficient crop protection. Simultaneously, smaller, fuel-efficient, and battery-powered sprayers have made mechanised spraying viable for fragmented holdings. On the harvesting side, the expansion of paddy and maize cultivation in eastern India and the spread of custom hiring centres have accelerated adoption of small combine harvesters.

The diffusion of technology is not uniform across crops. Mechanisation is relatively advanced in wheat (69%) and rice (53%), moderate in maize (46%) and pulses (41%), and limited in oilseeds, cotton, sugarcane, and sorghum, where mechanisation ranges between 33% and 39%. Activity-wise, seedbed preparation and harvesting are mechanised in most regions, while sowing, weeding, and crop protection remain under-served. This unevenness is where the next phase of growth lies.

Exhibit 73: Farm Mechanization Penetration In India by Crops



Activities with the highest manual intensity and lowest mechanisation- transplanting, weeding, spraying are precisely where labour shortages are most acute. In these segments, smaller and affordable equipment can make the largest immediate impact on productivity. This explains the rapid expansion of the sprayer segment, where mechanised spraying not only substitutes for labour but also reduces input waste and improves precision.

The dominant narrative in India's mechanisation journey is shifting from ownership to access. With most farmers unable to justify or finance direct equipment purchase, shared-use models have gained traction. The Sub-Mission on Agricultural Mechanisation (SMAM) and various state-level initiatives have created more than 37,000 custom hiring centres and 17,000 farm machinery banks since 2014. These centres enable farmers to rent equipment for specific tasks and durations, spreading the cost of capital across multiple users.

10. Operational & Financial Benchmarking

10.1 Key Players – Branded Formulation Crop Protection Chemicals Market

- **Sumitomo Chemicals:** SCIL focuses on importing, licensing and formulating proven global actives such as fludioxonil and epoxiconazole for the Indian market. It does not run an open CDMO business but maintains two integrated sites at Roha and Ahmednagar (MH) to locally produce and register these chemistries across cereals, cotton and horticultural segments
- **Bayer Crop Science:** Bayer's India arm delivers end-to-end crop-science: discovering novel molecules globally, toll-manufacturing select actives at its QPP plant in Ankleshwar (GJ), and marketing premium herbicides, bio-fungicides and seed treatments under brands like FENDONA and BOUNDARY all supported by R&D hubs in Bengaluru (KA) and Monheim (DE).
- **Rallis India -** A subsidiary of Tata Chemicals, Rallis India combines crop-science formulations (under brands like RALLIGOLD and GEOGREEN) with custom synthesis manufacturing. Its plants in Maharashtra and Gujarat, support high-volume production of insecticides, herbicides, biofertilizers and specialty polymers, all backed by a Mumbai R&D centre and a robust B2C distribution network.
- **Dhanuka Agirtech:** Dhanuka Agritech operates an asset-light, partnership-driven model focused on in-licensing and formulating herbicides, insecticides and fungicides for major crops such as rice, cotton and wheat. It boasts over 300 product registrations and a pan-India distribution network, with primary formulation plants at Noida (UP) and Neemrana (RJ). Recently, it has begun backward-integration at its Dahej (GJ) technical-grade pesticide facility to secure raw-material supply and expand its in-house actives capability
- **Crystal Crop –** Crystal Crop participates across the high-value end of the crop-protection market, with its portfolio aligned to account for 60-66% of the high valued chemistries across insecticides, herbicides and fungicides. Over more than two decades, under it's portfolio has strong brands with high recalls and awareness/equity with Indian farmers, supported by it's product performance, a deep rural presence, and farmer-centric engagement _ For example, in the fast paced world of agrochemicals, where most products have a lifecycle of just 8 to 10 years, Bavistin has achieved something extraordinary Bavistin which is one of Crystal's longest running fungicide brands for over five decades, recorded over 100% awareness among surveyed grape farmers with usership increasing in Khraif 2025 with over 40% of farmers identifying it as their preferred brand (Q&Q Research & Insight Findings). A report by the same research organization found Amora (launched in FY 22) for Soyabean section herbicide, the brand has currently reached an awareness of 85%. Amora holds a high wallet share among the herbicide segment and is emerging as one of the most preferred brand. Another brand called Proclaim reported brand awareness of over 100% (Grapes -95%; Soyabean and Rice – 100%).

  The company's crop protection branded businesses under Crystal and Saffire, have delivered a strong growth of over 46.08% from FY 2024 to FY 2026, significantly outperforming the industry average of 10–13% over the same period. The Maharashtra Technical Unit and Gujarat Technical Manufacturing Unit are strategically located within major industrial estates, close to key agricultural markets. Their proximity to ports and strong industrial infrastructure makes them ideal for both domestic distribution and export operations, providing a competitive advantage and supporting long-term business growth.
- **Kaveri Seeds-**Kaveri seeds today is agriculture company specializing in Hybrid Seeds in key Indian crops. With more than 1,00,000 production growers on 65,000 acres of land across 12 different agro-climatic zones , company has a diverse portfolio of seeds catering to key crop segments to enable crops for diverse agro – climate and soil conditions.
- **Advanta Seeds-** Advanta – a UPL company - is the global seed company which is at forefront of developing germplasms tailored to answer the need for climate-smart and high nutrition crop. Company's sub-brands, Alta Seeds & Pacific Seeds, along with key partnerships with leading technology companies, make them powerhouse of innovation, capable of offering seeds of the future to customers worldwide.
- **Rasi Seeds-** Founded in 1973, Rasi Seeds (P) Ltd. portfolio spans key crops including cotton, maize, paddy, mustard, wheat, and pearl millet—empowering farmers across the country with reliable, high-yielding seed varieties.
- **Corteva Agriscience**- Company has been developing and characterizing hybrid seeds for farmers in India, while continuing to be one of the nations' leading suppliers of improved hybrid seeds. Corteva work's closely with more than 4 million farmers to get the right product on the right acre to maximize their productivity and profitability. Pioneer is one of the leading brand in India for maize, mustard and sorghum.
- **Mahyco**- Founded in 1964, Mahyco is focused on research and development, production, processing, and marketing of seeds for India's farming fraternity. Mahyco operates processing facilities with a total capacity of 350 metric tons per day. These processing plants, located at Dhanora (Maharashtra), Kallakal (Telangana), Nizamabad (Telangana), and Saha (Haryana) are specialized in handling hybrid varieties of cotton, vegetables and field crops

- .**Seedworks**- Seedworks is the seed research and development company engaged in research, production and marketing of hybrid seeds for rice, cotton, pearl millet, mustard, vegetables and fruits and open-pollinated variety ("OPV") seeds for rice, wheat and mustard. Company has also expanded their footprint in the African continent and intend to commence commercial operations in Kenya, Malawi, Burkina Faso and Nigeria, focusing on cotton and vegetable crops.

Multinational corporations such as Bayer, Corteva, and Syngenta continue to dominate the top end of the value chain through proprietary molecule development, while Indian firms like Crystal Crop, Sumitomo Chemicals, Dhanuka Agritech, and Rallis India have increasingly differentiated themselves through operational flexibility, strategic brand acquisitions, and localized product innovation. The product mix across leading companies reveals that while insecticides remain the largest category by revenue contribution, the market is progressively balancing with herbicides and fungicides as Indian agriculture mechanizes and shifts toward integrated pest and disease management.

Unlike global peers that rely heavily on centralised R&D ecosystems, India's competitive edge lies in homegrown innovation tailored for its agro-climatic diversity with agro-chemical companies research specific to India's soil and plant profile. Some companies who are top innovators in the space with high patent filing are Crystal Crop, Rallis India, Sumitomo, Bayer, Syngenta and others, with Crystal emerging as one of the domestic leaders in Innovation in India, who research and develop formulation products which are centric to India's need based on it's agro-climatic conditions and soil , pests & crop reality profile . The company has one of the highest innovation turnover rate among domestic and global agrochemical companies operating in India and additionally exhibits a strong capability in intellectual property creation. The company has filed 28 patents as of CY2025, reflecting its sustained focus on R&D, out of which 18 patent applications have been examined and granted in India. One of the successes that has come out of the R&D Labs of Crystal is through Azotrix. Survey of rice farmers showed that 82% of farmers said that Azotrix provides effective control of rice blast. (Q&Q Research & Insights)

With a combination of R&D and extensive breeding programs, Crystal Crop's seeds business has created high-performing brands such as proagro , surpass and mahalaxmi which are trusted by farmers across regions in India. Over the years, their seeds products have established themselves as a progressive force in the Indian seed industry, with them, actively engaging in strategic collaborations and technology partnerships to drive innovation and sustainable growth

In distribution, the sector faces a natural saturation curve. Once a brand achieves deep penetration among distributors and retailers, incremental market share expansion becomes constrained by channel loyalty rather than geography. To navigate this, companies have begun segmenting their go-to-market architecture. For example, Crystal Crop with it's 14,500 – 15,000 distributors as of FY 26 follows a unique Go-to-Market (GTM) approach by operating two independent sales teams and brand portfolios, enabling differentiated engagement across price segments and rural markets therefore avoiding retail saturation.

Another critical differentiator across the Indian crop protection sector lies in consolidation strategy. With limited new molecules entering the post-patent pipeline, growth increasingly depends on access to established, trusted brands. Crystal Crop has been among the most active acquirers in the Indian agrochemical space, having integrated iconic brands such as Gramoxone (Syngenta), Bavistin (BASF), Dursban and Nurelle D (Dow), and Tilt (Syngenta), Proclaim (Syngenta), Blue Copper (Syngenta), Furadan (FMC) into its portfolio. These acquisitions have not only expanded its presence across insecticides, herbicide and fungicide categories but have also provided immediate market access through inherited customer equity and distribution channels along with enabling a company like Crystal build a strong brand equity with Indian farmers, supported by product performance, a deep rural presence, and farmer-centric engagement . This acquisition-led growth model represents the operational benchmark within India's agrochemical ecosystem, where brand transfer and in-licensing of proven actives often deliver faster market traction than new product launches.

From a supply chain perspective, the industry is also witnessing a quiet reconfiguration. Over 60% of India's technical-grade agrochemicals are still imported, making flexibility a strategic imperative rather than a choice. Crystal Crop stands out as one of the few domestic players with the flexibility to "Make or Import" based on market dynamics, supported by collaborations across global suppliers and backward integration into intermediates and formulations. This operational adaptability enables it to manage raw material volatility while sustaining cost competitiveness a capability that increasingly defines leadership in the Indian agrochemical value chain.

M&A and Collaborations

Consolidation has become one of the defining forces shaping the agrochemicals and seeds industry in India and overseas. The competitive environment has moved from simple product proliferation to a sharper focus on technology depth, operational efficiency, and stronger farmer engagement. As a result, companies are pursuing acquisitions that allow them to build capabilities faster than organic growth would permit.

Across crop protection, firms are using M&A to strengthen three areas: access to technical-grade manufacturing, expansion of formulation capacity, and the ability to offer differentiated chemistries aligned with changing

regulatory norms. Restrictions on older active ingredients, rising compliance requirements, and tightening export standards have pushed companies to secure portfolios that are more stable, more targeted, and easier to scale across markets. Acquiring niche brands and proprietary molecules has also become a way to reduce reliance on single-crop revenue streams and respond to the rising shift toward herbicides and fungicides.

In the seeds segment, consolidation is driven by the need for superior genetics, climate-ready hybrids, and scale in research programs that require long development cycles. Companies are buying breeding platforms, regional leaders, and specific high-performing hybrids to deepen their presence across cotton, maize, rice, and vegetables. With the government pushing for self-reliance, including missions on high-yielding and climate-resilient seed varieties, players with strong R&D pipelines and structured product funnels have become attractive acquisition targets.

Company Acquiring	Brand Acquired/Description of Acquisition
Crystal	Acquired the brand "Luphos" from Cheminova India Ltd Acquired the well-known brand "Bavistin" from BASF, Germany Acquired the (i) lease rights of the land, and the buildings and structures Constructed thereon; and (ii) assets (plant and machinery, equipment, furniture, fixtures and other assets in January 2018 from Cytec India (Solvay Group) Acquired the well-known Brands -Furadan, Splendour, Affinity Force and Metcil from FMC India Private Limited & its affiliates Acquired the well-known Brands –Proclaim, Tilt & Blue Copper from Syngenta India & it's affiliates Acquired three well-known brands Dursban, Predator and Nurelle D from Dow Agrisciences (Corteva India) Acquired famous agrochemical's Brand "Gramoxone" from Syngenta Ethoxysulfuron business from Bayer A.G. including Brand Sunrice in India, Thailand, Bangladesh and Vietnam ; Technology know-how Patent of Ethoxysulfuron mixture
Sumitomo	Acquired a majority stake in Barrix Agro Sciences operating in businesses such as IPM, IPNM, pheromone traps, chromatic sheets
Bayer	Merger with Monsanto India
Rallis India	Acquired majority stake in Metahelix Life Sciences for expanding seed and biotech portfolio
Dhanuka	Acquisition of active ingredients, trademarks, marketing & global commercialization rights for Fungicide actives Iprovalicarb, Triadimenol (and Melody brand family) from Bayer AG Active technical collaboration with Corteva AgriScience, FMC Corporation, Oro Agri, Arysta Life Science, Hokko Chemical, Mitsui, Nissan Chemical Corporation, Nippon Soda and OAT Agrio
Syngenta	NA

10.A. Operational Benchmarking

10.2 Product Portfolio and Revenue Mix for Crop Protection Companies

Companies	Product Portfolio			Revenue Mix	Innovation Turnover Index/Rate
	Insecticide	Herbicide	Fungicide		
Crystal	58	62	35	FY 24: Insecticides: 38.53% Herbicides: 33.02% Fungicide: 25.26% Others : 3.18% FY 25: Insecticides: 34.67% Herbicides: 37.20% Fungicide: 26.26% Others : 1.87% FY 26 Insecticides: 31.97% Herbicides: 38.11% Fungicide: 23.92% Others : 6.01%	FY26: 19.56% FY 25: 18.03% FY 24: 16.02% New Product Launched: Crop Protection Brands: FY24 : 5 FY 25: 14 FY26: 3 Seeds: FY24 : 6 FY 25: 5 FY26: 12
Sumitomo	107	91	32	FY 24: Insecticides: 42%; Herbicides: 22%, Plant Growth Regulators: 9%, Metal Phosphides: 9%, Fungicides: 8% AND & EHD: 10% FY 25: Insecticides: 40%. Herbicides: 21%, Plant Growth Regulators: 11%, Metal Phosphides: 9%, Fungicides : 10% AND & EHD: 9%	

				FY 26: Insecticides: 41%. Herbicides: 24%, Plant Growth Regulators: 9%, Metal Phosphides: 10%, Fungicides : 8% AND & EHD: 8%	
Bayer	21	11	11	Bayer crop sciences reports its revenue in it's annual report under one segment which is AgriCare	
Rallis India	34	18	24	FY 26 : Crop Care : 83% Seeds : 17% FY 25: Crop Care: 84% Seeds: 16% FY 24: Crop Care: 84% Seeds: 16%	FY 26 : 17.5% FY 25: 14% FY 24: 16% New Product Launched: Crop Protection Brands: FY24 : 13 FY 25: 6 FY 26 : 12 Seeds: FY24 : 6 FY 25: 3 FY 26: 30
Dhanuka	34	20	20	FY 24: Insecticides: 49%; Fungicides: 19% Herbicides: 28% Others: 4% FY25: Insecticides: 35% Fungicides: 16% Herbicides: 32% Others: 17% FY26: Insecticides: 35% Fungicides: 19% Herbicides: 31%	FY 25: 14.93% FY 24: 13.29% FY 23: 12.75%

				Others: 15%	
Syngenta	5	5	6	Syngenta reports in global and not regional subsidaries	

10.3 Operational Benchmarking of key seed players in India

Companies	Product Portfolio										
	Cotton	Rice/ Paddy		Mustard		Pearl millet		Wheat		Vegetables	
	GM	Hybrid	OPV/ Research	Hybrid	OPV/ Research	Hybrid	OPV/ Research	Hybrid	OPV/ Research	Hybrid	OPV/ Research
Crystal Crop Protection	✓	✓	✓	✓	✓	✓	×	×	✓	✓	✓
SeedWorks (US Agriseeds)	✓	✓	✓	✓	✓	✓	×	×	✓	✓	×
Mahyco	✓	✓	✓	✓	✓	✓	×	×	✓	✓	✓
Kaveri Seeds	✓	✓	✓	✓	×	✓	×	×	✓	✓	×
Nuziveedu Seeds	✓	✓	✓	✓	×	✓	×	×	✓	✓	×
Rasi Seeds	✓	✓	✓	✓	✓	✓	×	×	✓	×	×
Advanta Seed	×	✓	×	✓	×	✓	×	×	×	✓	×
Tata Rallis	✓	✓	×	✓	×	✓	×	×	×	✓	×
Corteva- India	×	✓	×	✓	×	✓	×	×	×	×	×
Syngenta- India	×	✓	×	×	×	×	×	✓	✓	✓	×
Bayer- India	×	✓	×	×	×	×	×	×	×	✓	×
Crystal Crop Protection	✓	✓	✓	✓	×	✓	×	×	×	✓	×

Source: Company websites, Secondary research

Company	No of Crops	No of field crops	No of vegetable crops

Crystal Crop Protection (Seed)	27	8	19
Kaveri Seeds	15	9	6
Syngenta	26	2	24
Advanta Seeds	30	7	23
Corteva Agriscience Seeds	NA	NA	NA
Rasi Seeds	7	7	0
Mahyco	22	11	11
Seedworks	21	7	14
Nuziveedu Seeds	15	9	6

Source: Company websites, Secondary research

10.B. Financial Benchmarking

10.4 Revenue, INR Million

Company	FY24	FY25	FY26	CAGR, FY 24-26
Crystal Crop	22,299.27	26,905.10	31,519.68	**18.89%**
Sumitomo	28,439.47	31,485.24	32,383.15	**6.71%**
Bayer*	51,062.00	54,734.00	56,750.00	**5.42%**
Rallis India*	26,483.80	26,629.40	28,966.50	**4.58%**
Dhanuka	17,585.44	20,351.52	20,197.90	**7.17%**
Kaveri Seeds	11,484.05	12,049.70	13,947.63	**10.21%**
Syngenta*	53,616.00	*Not released*	*Not released*	***Not released***
Advanta Seeds	42,240.00	46,780.00	*Not released*	***Not Calculatable***
Corteva Agriscience Seeds*	22,196.00	*Not released*	*Not released*	***Not Calculatable***
Rasi Seeds	12,297.64	*Not released*	*Not released*	***Not Calculatable***
Mahyco	16,360.70	*Not released*	*Not released*	***Not Calculatable***
Seedworks	5,226.88	*Not released*	*Not released*	***Not Calculatable***
Nuziveedu Seeds	11,243.26	*Not released*	*Not released*	***Not Calculatable***

Note: Standalone balance sheet has been considered for these companies. All the financial information / KPIs for listed industry peers mentioned above is on a consolidated basis (unless otherwise available only on standalone basis) and is sourced from the annual reports and investor presentation as available of the respective company for the relevant year.*

Source: Company annual reports, Tofler, Frost & Sullivan

Crystal Crop Protection is one of fastest-growing Indian seed companies in terms of revenue (CAGR- 28.49%) between Fiscal 2024 and Fiscal 2026 amongst the companies considered in this report.

10.5 Revenue from Sale of Products, INR Million

Company	FY24	FY25	FY26	CAGR, FY 24-26
Crystal Crops				
Crops Protection	18,367	22,010	24,766	**16.12%**
Seeds	3,544	4,699	5,852	**28.49%**
Sumitomo				
Crops Protection	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*
Seeds	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*
		Bayer*		
Crops Protection	39,828	42,693	*43,130*	**4.06%**
Seeds	7,659	9,305	*10,783*	**18.65%**
Rallis India*				
Crops Protection	20,007	19,491	20,928	**2.27%**
Seeds	4,117	4,129	4,772	**7.67%**
Dhanuka				
Crops Protection	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*
Seeds	*No Seed Business*	*No Seed Business*	*No Seed Business*	*No Seed Business*
Kaveri Seeds				
Crops Protection	*No CP Business*	*No CP Business*	*No CP Business*	*No CP Business*
Seeds	11,065	11,612	*Not released*	-
Syngenta*				
Crops Protection	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*
Seeds	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*

Advanta Seeds				
Crops Protection	*No CP Business*	*No CP Business*	*No CP Business*	*No CP Business*
Seeds	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*
Corteva Agriscience Seeds *				
Crops Protection	*No CP Business*	*No CP Business*	*No CP Business*	*No CP Business*
Seeds	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*
Rasi Seeds				
Crops Protection	*No CP Business*	*No CP Business*	*No CP Business*	*No CP Business*
Seeds	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*
Mahyco				
Crops Protection	*No CP Business*	*No CP Business*	*No CP Business*	*No CP Business*
Seeds	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*
Seedworks				
Crops Protection	*No CP Business*	*No CP Business*	*No CP Business*	*No CP Business*
Seeds	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*
Nuziveedu Seeds				
Crops Protection	*No CP Business*	*No CP Business*	*No CP Business*	*No CP Business*
Seeds	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*	*Bifurcation not reported*

Note: Standalone balance sheet has been considered for these companies.*

Source: Company annual reports, Tofler, Frost & Sullivan

10.6 Gross Margin, INR Million

Company	FY24	FY25	FY26
Crystal Crop	6,934.40	9,225.71	12,130.67
Sumitomo	10,688.70	12,896.00	13,609.15
Bayer	21,946.00	20,746.00	22,975.00
Rallis India	10,706.30	10,821.10	11,690.20
Dhanuka	6,863.50	8,160.97	8,133.40
Kaveri Seeds	5,683.89	5,920.10	6,681.78
Syngenta	19,532.00	*Not Reported*	*Not Reported*
Advanta Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Corteva Agriscience Seeds	20,704.00	*Not Reported*	*Not Reported*
Rasi Seeds	6,317.00	*Not Reported*	*Not Reported*
Mahyco	8,162.00	*Not Reported*	*Not Reported*
Seedworks	3,122.00	*Not Reported*	*Not Reported*
Nuziveedu Seeds	6,459.00	*Not Reported*	*Not Reported*

Source: Company annual reports, Tofler, Frost & Sullivan

10.7 Gross Margin, %

Company	FY24	FY25	FY26
Crystal Crop	31.10%	34.29%	38.49%
Sumitomo	37.58%	40.96%	42.03%
Bayer	42.98%	37.90%	40.48%
Rallis India	40.43%	40.64%	40.36%
Dhanuka	39.03%	40.10%	40.27%
Kaveri Seeds	49.49%	49.13%	47.91%
Syngenta	36.40%	*Not Reported*	*Not Reported*
Advanta Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Corteva Agriscience Seeds	93.30%	*Not Reported*	*Not Reported*
Rasi Seeds	51.40%	*Not Reported*	*Not Reported*
Mahyco	49.90%	*Not Reported*	*Not Reported*
Seedworks	59.70%	*Not Reported*	*Not Reported*
Nuziveedu Seeds	57.50%	*Not Reported*	*Not Reported*

Source: Company annual reports, Tofler, Frost & Sullivan

10.8 EBITDA, INR Million

Company	FY24	FY25	FY26
Crystal Crop	2,090.61	3,152.76	4,562.29
Sumitomo	4,745.75	6,320.53	6,708.65
Bayer	9,725.00	6,896.00	8,737.00
Rallis India	3,111.50	2,867.60	3,612.70
Dhanuka	3,274.43	4,166.09	4,034.77
Kaveri Seeds	2,858.19	2,909.39	3,368.16
Syngenta	5,302.00	*Not Reported*	*Not Reported*
Advanta Seeds	9,320.00	11,380.00	*Not Reported*
Corteva Agriscience Seeds	10,377.00	*Not Reported*	*Not Reported*
Rasi Seeds	3,311.00	*Not Reported*	*Not Reported*
Mahyco	74	*Not Reported*	*Not Reported*
Seedworks	353	*Not Reported*	*Not Reported*
Nuziveedu Seeds	2,162.00	*Not Reported*	*Not Reported*

Source: Company annual reports, Tofler, Frost & Sullivan

10.9 EBITDA Margin, %

Company	FY24	FY25	FY26
Crystal Crop	9.38%	11.72%	14.47%
Sumitomo	16.69%	20.07%	20.72%
Bayer	19.05%	12.60%	15.40%
Rallis India	11.75%	10.77%	12.47%
Dhanuka	18.62%	20.47%	19.98%
Kaveri Seeds	24.89%	24.14%	24.15%
Syngenta	9.90%	*Not Reported*	*Not Reported*
Advanta Seeds	22.10%	24.30%	*Not Reported*
Corteva Agriscience Seeds	46.80%	*Not Reported*	*Not Reported*
Rasi Seeds	26.90%	*Not Reported*	*Not Reported*
Mahyco	0.50%	*Not Reported*	*Not Reported*
Seedworks	6.80%	*Not Reported*	*Not Reported*
Nuziveedu Seeds	19.20%	*Not Reported*	*Not Reported*

Source: Company annual reports, Tofler, Frost & Sullivan

10.10 Adjusted EBITDA

Company	FY24	FY25	FY26
Crystal Crop	2,090.61	3,226.28	4,771.69

Sumitomo	*Not Reported*	*Not Reported*	*Not Reported*
Bayer	*Not Reported*	*Not Reported*	*Not Reported*
Rallis India	*Not Reported*	*Not Reported*	*Not Reported*
Dhanuka	*Not Reported*	*Not Reported*	*Not Reported*
Kaveri Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Syngenta	*Not Reported*	*Not Reported*	*Not Reported*
Advanta Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Corteva Agriscience Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Rasi Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Mahyco	*Not Reported*	*Not Reported*	*Not Reported*
Seedworks	693	*Not Reported*	*Not Reported*
Nuziveedu Seeds	*Not Reported*	*Not Reported*	*Not Reported*

Source: Company annual reports, Tofler, Frost & Sullivan

10.11 Adjusted EBITDA Margin

Company	FY24	FY25	FY26
Crystal Crop	9.38%	11.99%	15.14%
Sumitomo	*Not Reported*	*Not Reported*	*Not Reported*
Bayer	*Not Reported*	*Not Reported*	*Not Reported*
Rallis India	*Not Reported*	*Not Reported*	*Not Reported*
Dhanuka	*Not Reported*	*Not Reported*	*Not Reported*
Kaveri Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Syngenta	*Not Reported*	*Not Reported*	*Not Reported*
Advanta Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Corteva Agriscience Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Rasi Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Mahyco	*Not Reported*	*Not Reported*	*Not Reported*
Seedworks	19.20%	*Not Reported*	*Not Reported*
Nuziveedu Seeds	*Not Reported*	*Not Reported*	*Not Reported*

Source: Company annual reports, Tofler, Frost & Sullivan

10.12 Profit After Tax, INR Million

Company	FY24	FY25	FY26
Crystal Crop	872.37	1,183.92	1,449.14
Sumitomo	3,697.44	5,064.43	5,429.75
Bayer	7,405.00	5,680.00	6,892.00
Rallis India	1,478.70	1,251.30	1,838.80
Dhanuka	2,390.93	2,969.60	2,872.35
Kaveri Seeds	2,998.81	2,822.81	2,958.33

Syngenta	4,061.00	*Not Reported*	*Not Reported*
Advanta Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Corteva Agriscience Seeds	10,630.00	*Not Reported*	*Not Reported*
Rasi Seeds	2,615.00	*Not Reported*	*Not Reported*
Mahyco	288.00	*Not Reported*	*Not Reported*
Seedworks	50.00	*Not Reported*	*Not Reported*
Nuziveedu Seeds	2,255.00	*Not Reported*	*Not Reported*

10.13 Profit After Tax Margin

Company	FY24	FY25	FY26
Crystal Crop	3.84%	4.33%	4.56%
Sumitomo	12.58%	15.49%	16.04%
Bayer	14.28%	10.16%	11.94%
Rallis India	5.55%	4.64%	6.26%
Dhanuka	13.33%	14.34%	13.92%
Kaveri Seeds	24.75%	22.56%	20.77%
Syngenta	7.60%	*Not Reported*	*Not Reported*
Advanta Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Corteva Agriscience Seeds	47.90%	*Not Reported*	*Not Reported*
Rasi Seeds	21.30%	*Not Reported*	*Not Reported*
Mahyco	1.80%	*Not Reported*	*Not Reported*
Seedworks	0.90%	*Not Reported*	*Not Reported*
Nuziveedu Seeds	20.10%	*Not Reported*	*Not Reported*

10.14 Return on Equity

Company	FY24	FY25	FY26
Crystal Crop	6.59%	8.31%	7.94%
Sumitomo	15.33%	18.81%	17.30%
Bayer	26.60%	19.90%	23.70%
Rallis India	8.31%	6.70%	9.30%
Dhanuka	20.64%	22.34%	18.62%
Kaveri Seeds	27.29%	25.78%	*Not Reported*
Syngenta	11.29%	*Not Reported*	*Not Reported*
Advanta Seeds	*NA*	*NA*	*Not Reported*
Corteva Agriscience Seeds	51.97%	*NA*	*Not Reported*
Rasi Seeds	21.61%	*NA*	*Not Reported*
Mahyco	2.19%	*NA*	*Not Reported*
Seedworks	5.68%	*NA*	*Not Reported*
Nuziveedu Seeds	21.18%	*NA*	*Not Reported*

Source: Company annual reports, Tofler, Frost & Sullivan

Note: ROE not annualized

10.15 Return on Capital Employed

Company	FY24	FY25	FY26
Crystal Crop	10.39%	16.38%	16.06%
Sumitomo	20.89%	22.83%	21.57%
Bayer	33.10%	24.50%	28.70%
Rallis India	10.86%	10.09%	12.40%
Dhanuka	25.01%	30.08%	24.22%
Kaveri Seeds	24.33%	18.71%	*Not Reported*
Syngenta	15.51%	*Not Reported*	*Not Reported*
Advanta Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Corteva Agriscience Seeds	51.43%	*Not Reported*	*Not Reported*
Rasi Seeds	30.91%	*Not Reported*	*Not Reported*
Mahyco	8.67%	*Not Reported*	*Not Reported*
Seedworks	10.30%	*Not Reported*	*Not Reported*
Nuziveedu Seeds	23.26%	*Not Reported*	*Not Reported*

Source: Company annual reports, Tofler, Frost & Sullivan

sNote: ROCE not annualized

10.16 Adjusted Return on Capital Employed

Company	FY24	FY25	FY26
Crystal Crop	10.39%	17.20%	17.98%
Sumitomo	*Not Reported*	*Not Reported*	*Not Reported*
Bayer	*Not Reported*	*Not Reported*	*Not Reported*
Rallis India	*Not Reported*	*Not Reported*	*Not Reported*
Dhanuka	*Not Reported*	*Not Reported*	*Not Reported*
Kaveri Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Syngenta	*Not Reported*	*Not Reported*	*Not Reported*
Advanta Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Corteva Agriscience Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Rasi Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Mahyco	*Not Reported*	*Not Reported*	*Not Reported*
Seedworks	*Not Reported*	*Not Reported*	*Not Reported*
Nuziveedu Seeds	*Not Reported*	*Not Reported*	*Not Reported*

Source: Company annual reports, Tofler, Frost & Sullivan

Note: Adjusted ROCE not annualized

10.17 Net debt to equity ratio

Company	FY24	FY25	FY26
Crystal Crop	0.41	0.65	0.41
Sumitomo	0.01	0.00	0.00

Bayer	*Not Reported*	*Not Reported*	*Not Reported*
Rallis India	0.07	0.03	0.03
Dhanuka	0.02	0.05	0.02
Kaveri Seeds	0.01	0.00	*Not Reported*
Syngenta	(0.24)	*Not Reported*	*Not Reported*
Advanta Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Corteva Agriscience Seeds	(0.22)	*Not Reported*	*Not Reported*
Rasi Seeds	0.01	*Not Reported*	*Not Reported*
Mahyco	(0.04)	*Not Reported*	*Not Reported*
Seedworks	0.88	*Not Reported*	*Not Reported*
Nuziveedu Seeds	-0.03	*Not Reported*	*Not Reported*

Source: Company annual reports, Tofler, Frost & Sullivan

10.18 Net working capital days

Company	FY24	FY25	FY26
Crystal Crop	174	141	139
Sumitomo	130	133	155
Bayer	*Not Reported*	*Not Reported*	*Not Reported*
Rallis India	*Not Reported*	*Not Reported*	*Not Reported*
Dhanuka	*Not Reported*	*Not Reported*	*Not Reported*
Kaveri Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Syngenta	181	*Not Reported*	*Not Reported*
Advanta Seeds	*Not Reported*	*Not Reported*	*Not Reported*
Corteva Agriscience Seeds	38	*Not Reported*	*Not Reported*
Rasi Seeds	118	*Not Reported*	*Not Reported*
Mahyco	150	*Not Reported*	*Not Reported*
Seedworks	*Not Reported*	*Not Reported*	*Not Reported*
Nuziveedu Seeds	150	*Not Reported*	*Not Reported*

Source: Company annual reports, Tofler, Frost & Sullivan

10.19 Total number of distributors

Company	FY 24	FY 25	FY26
Crystal Crop	8,992	12,581	14,823
Sumitomo	15,000+	15,000+	15,000+
Bayer	4,157	3,940	3,534
Rallis India	7,281	7,063	7,084
Dhanuka	6,500	6,500+	6,500+
Kaveri Seeds	3,785	3,222	*NA*
Syngenta	*NA*	*NA*	*NA*
Advanta Seeds	*NA*	*NA*	*NA*
Corteva Agriscience Seeds	*NA*	*NA*	*NA*
Rasi Seeds	*NA*	*NA*	*NA*
Mahyco	*NA*	*NA*	*NA*
Seedworks	NA	NA	NA

Nuziveedu Seeds	NA	NA	NA

Source: Company annual reports, Tofler, Frost & Sullivan

Crystal has built its presence through organic expansion, growing it's distribution base to one of the highest in the category and the acquisition of established brands, giving it sustained visibility among growers.

11. Key KPI's and definitions

KPI	Definition
Revenue from Operations	Revenue from operations is used by our management to track the revenue generated from the overall business and help assess the overall financial performance of our Company and also represents the scale of our business. It is calculated as revenue from sale of products, services and other operating revenue for the year. Revenue from Operations means the revenue from operations as appearing in the Restated Consolidated Financial Information for the relevant period / year.
Revenue from Sale of Products – Category Wise	Revenue from Sale of Products – Category Wise is calculated as revenue from crop protection and seeds business
Gross Margin	Gross Margin is used by the management to track information regarding the efficiency with which the Company is manufacturing its products and assess profitability at a manufacturing level. Gross Margin is calculated as Revenue from Operations as reduced by cost of materials consumed, purchases of stock-in-trade, changes in inventories of finished goods, stock-in-trade and work-in-progress.
Gross Margin (%)	Gross Margin % is calculated as Gross Margin for the period/ year divided by Revenue from Operations for the period/ year, multiplied by 100.
EBITDA	EBITDA is used by the management to track the operational profitability of the business EBITDA is calculated as Profit before share of loss of associate and tax plus depreciation and amortisation expense, finance costs and impairment of non-financial assets, as reduced by other income as per the Restated Consolidated Financial Information.
EBITDA Margin	EBITDA margin is an indicator of the operational profitability margin and financial performance of the business. It tracks operational efficiency and operational profitability of the business and assist in tracking the operational margin profile of our business benchmarked against our historical performance and against our peers. EBITDA Margin (%) is calculated as EBITDA divided by revenue from operations for the year, multiplied by 100.
Adjusted EBITDA	Adjusted EBITDA is calculated as the Profit before exceptional item, share of loss of associate and tax plus depreciation and amortisation expense, finance costs, impairment of non-financial assets and change in fair value of Compulsorily Convertible Debentures carried at fair value through profit or loss, as reduced by other income as per the Restated Consolidated Financial Information.
Adjusted EBITDA Margin	Adjusted EBITDA Margin (%) is calculated as Adjusted EBITDA divided by revenue from operations for the year, multiplied by 100.
PAT	Profit for the year track overall profitability of the business. PAT represents the restated Profit for the period / year as per the Restated Consolidated Financial Information.
PAT Margin	PAT Margin (%) track overall profitability of the business and assist in tracking the overall profitability of our business benchmarked against our historical performance and against our peers. PAT margin is calculated as PAT divided by Total Income for the year, multiplied by 100. Total Income is calculated as Revenue from operations plus other income for the year.
Return on Equity (ROE)	ROE is used by the management to track how efficiently the Company generates profits from shareholders funds and how well it is converting shareholders funds to generate profits. Return on Equity is calculated as Profit for the period/year divided by Total Equity for the relevant period, multiplied by 100. Total Equity will be as appearing in the Restated Consolidated Financial Information
Return on Capital Employed (ROCE)	ROCE is used by the management to track how efficiently our Company generates earnings from the capital employed in the business and how well it is converting its total capital to generate profits. ROCE is calculated as Earnings before interest and tax (EBIT) divided by Capital employed, multiplied by 100. EBIT is calculated as Profit before exceptional item, share of loss of

	associate and tax plus finance costs. Capital employed is calculated as the sum of Tangible net worth (i.e. Total assets excluding Goodwill, Other intangible assets and Intangible assets under development, deferred tax assets (net) as reduced by total liabilities excluding deferred tax liabilities (net)), non-current borrowings and current borrowings.
Adjusted Return on Capital Employed	Adjusted Return on Capital Employed is calculated as Adjusted Earnings before interest and tax (EBIT) divided by Adjusted Capital employed, multiplied by 100. Adjusted EBIT is calculated as Profit before exceptionals items, share of loss of associate and tax plus finance costs and change in fair value of Compulsorily Convertible Debentures carried at fair value through profit or loss. Adjusted Capital employed is calculated as the sum of Tangible net worth (i.e. Total assets excluding Goodwill, Other intangible assets, Intangible assets under development and deferred tax assets (net) as reduced by total liabilities excluding deferred tax liabilities (net)), non-current borrowings and current borrowings as reduced by cash and cash equivalents.
Net Working Capital Days / Cash Conversion Cycle	Net Working Capital Days is calculated as Inventory days plus Trade receivable days minus Trade payable days. Inventory days are calculated as closing Inventory for the period / year divided by revenue from operations for the period / year, multiplied by 365 days. Trade receivable days are calculated as closing Trade receivables for the period / year divided by Revenue from operations for the period / year, multiplied by 365 days. Trade payable days are calculated as closing Trade payable for the period / year divided by revenue from operations for the period / year, multiplied by 365 days.
Net Debt to Equity	Net debt / equity is calculated as net debt divided by total equity. Net Debt is calculated as total debt reduced by cash and cash equivalents
Innovation Rate	Innovation Rate indicates Revenue from new products launched in the last four years in Crystal Crop Protection Branded Formulation Business divided by Total Revenue of Crystal Crop Protection Branded Formulation Business in the relevant year / period, multiplied by 100
No. of Active Distributors	Number of active distributors indicates the number of distributors with who the company has generated revenue / sales and who are associated with the company from 01 April, 2022 to the relevant period / year end.

All financial information / KPIs for peers mentioned above is on a consolidated basis (unless otherwise available only on standalone basis) and is sourced from the annual report / investor presentation or MCA filings as available for the respective companies for the relevant year / period ended

12. Key Threats and Challenges to Crystal Crop

1) Crystal derives a significant share of its crop protection revenues from herbicides, which increased from 32% of revenue in FY24 to 37.45% in FY26, with strong positions in paddy and cereal. This creates an exposure to:

a. Variability in Kharif sowing in rice- and cereal-dominant states (eastern India, parts of north and central India)
b. Changes in farmer cash flows and input purchase behaviour in weak monsoon or flood years

While such variability can impact near-term offtake, Crystal's risk is moderated by:

- A balanced portfolio across insecticides, fungicides and herbicides, and presence across multiple crops and geographies
- A growing seeds business and presence across both Kharif and Rabi seasons, which helps smooth seasonal and regional shocks

Over the medium term, rising climate volatility tends to increase the need for selective, stress-tolerant and IPM-friendly solutions, aligning with Crystal's innovation-led positioning.

2) Smallholder-Farmer Economics, Price Sensitivity and Responsible Use

India's farm structure is dominated by small and fragmented landholdings, relatively low yields, and high dependence on monsoon and groundwater, leading to strong farmer price sensitivity and uneven input usage across regions.

This creates risks for Crystal such as:

- Slower adoption of premium formulations or newer combinations in lower-income, rainfed regions

- Under-dosing or misuse of crop protection products, which can affect realised field performance and farmer perception even for technically sound products

Crystal addresses this structural challenge through:

- A two-portfolio, two-sales-team GTM model that allows it to serve both value-conscious and premium segments without channel saturation, across 14,500–15,000 distributors as of FY26
- Farmer engagement, demonstrations and advisory-led selling, as seen in products like Azotrix, where independent surveys indicate strong perceived efficacy among rice farmers

3) Raw Material, Technical Supply and "Make-or-Import" Balancing

At an industry level, more than 60% of India's technical-grade agrochemicals are still imported, exposing the sector to volatility in global prices, logistics, regulatory actions in source countries and currency movements. As a branded formulations and technicals player, Crystal faces:

- Fluctuations in input costs and availability for key technicals and intermediates
- The need to continuously optimise between domestic manufacture and imports to protect margins and supply security

Crystal partially mitigates this through:

- A stated flexibility to "Make or Import" based on market conditions, supported by backward integration into intermediates and collaborations with global suppliers
- Ongoing capacity and process improvements within the broader Indian chemical ecosystem, which is moving toward cleaner, more competitive specialty and agrochemical manufacturing

4) Evolving Regulatory Norms and Portfolio Rebalancing

The Indian crop protection sector is increasingly subject to regulatory scrutiny on certain molecules, safety, environment, and residue norms, with discussions around the Pesticide Management Bill and tightening norms on Highly Hazardous Pesticides (HHPs).

For Crystal, which has a broad portfolio and several legacy as well as acquired brands, this can lead to:

- Potential restrictions, phase-outs or label changes on specific molecules or combinations over time
- The need for continuous investment in data generation, dossier upkeep and product substitution/upgrade

These are partly mitigated by Crystal's:

- Strong R&D and IP engine, with 28 patents filed as of CY2025 and 11 commercialized as of 31st March 2026, and one of the highest innovation turnover rates among domestic peers.
- Demonstrated ability to refresh its portfolio using new formulations, mixtures and in-licensed / acquired brands, keeping relevance across insecticides, herbicides and fungicides

Over time, as regulations favour safer, more efficient chemistries and better stewardship, companies like Crystal with innovation capability and regulatory experience are positioned to benefit from migration away from sub-scale, non-compliant players