CareEdge ANALYTICS & ADVISORY

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Industry Research Report

On

Agrochemical Industry in India

27th May 2025

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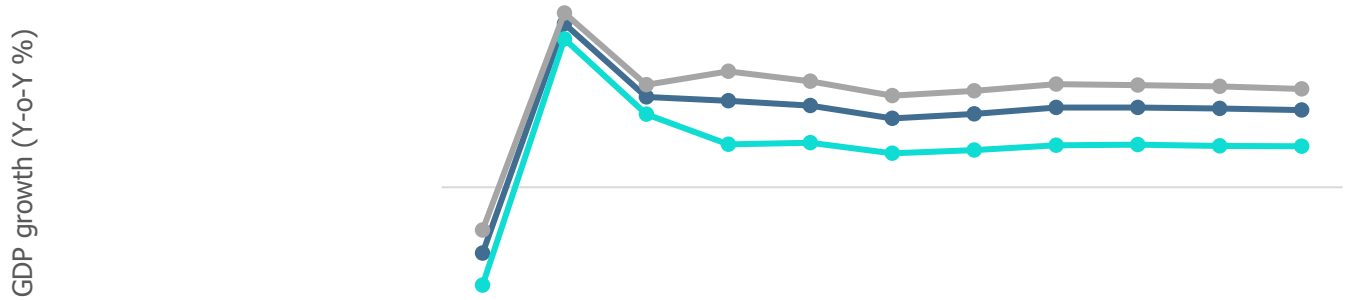
1 Economic Outlook

1.1 Global Economy

Global growth, which reached 3.5% in CY23, stabilized at 3.3% for CY24 and projected to decrease at 2.8% for CY25. Global trade is expected to be disrupted by new US tariffs and countermeasures from trading partners, leading to historically high tariff rates and negatively impacting economic growth projections. The global landscape is expected to change as countries rethink their priorities and policies in response to these new developments. Central banks priority will be to adjust policies, while smart fiscal planning and reforms are key to handling debt and reducing global inequalities.

Chart 1: Global Growth Outlook Projections (Real GDP, Y-o-Y change in %)



	CY20	CY21	CY22	CY23	CY24	CY25P	CY26P	CY27P	CY28P	CY29P	CY30P
World	-2.7%	6.6%	3.6%	3.5%	3.3%	2.8%	3.0%	3.2%	3.2%	3.2%	3.1%
Advanced Economies	-4.0%	6.0%	2.9%	1.7%	1.8%	1.4%	1.5%	1.7%	1.7%	1.7%	1.7%
Emerging Market and Developing Economies	-1.7%	7.0%	4.1%	4.7%	4.3%	3.7%	3.9%	4.2%	4.1%	4.1%	4.0%

Source: IMF – World Economic Outlook, April 2025; Notes: P-Projection

Table 1: GDP growth trend comparison - India v/s Other Economies (Real GDP, Y-o-Y change in %)

	Real GDP (Y-o-Y change in %)										
	CY20	CY21	CY22	CY23	CY24	CY25P	CY26P	CY27P	CY28P	CY29P	CY30P
India	-5.8	9.7	7.6	9.2	6.5	6.2	6.3	6.5	6.5	6.5	6.5
China	2.3	8.6	3.1	5.4	5.0	4.0	4.0	4.2	4.1	3.7	3.4
Indonesia	-2.1	3.7	5.3	5.0	5.0	4.7	4.7	4.9	5.0	5.1	5.1
Saudi Arabia	-3.6	5.1	7.5	-0.8	1.3	3.0	3.7	3.6	3.2	3.2	3.3
Brazil	-3.3	4.8	3.0	3.2	3.4	2.0	2.0	2.2	2.3	2.4	2.5
Euro Area	-6.0	6.3	3.5	0.4	0.9	0.8	1.2	1.3	1.3	1.2	1.1
United States	-2.2	6.1	2.5	2.9	2.8	1.8	1.7	2.0	2.1	2.1	2.1

Source: IMF- World Economic Outlook Database (April 2025)

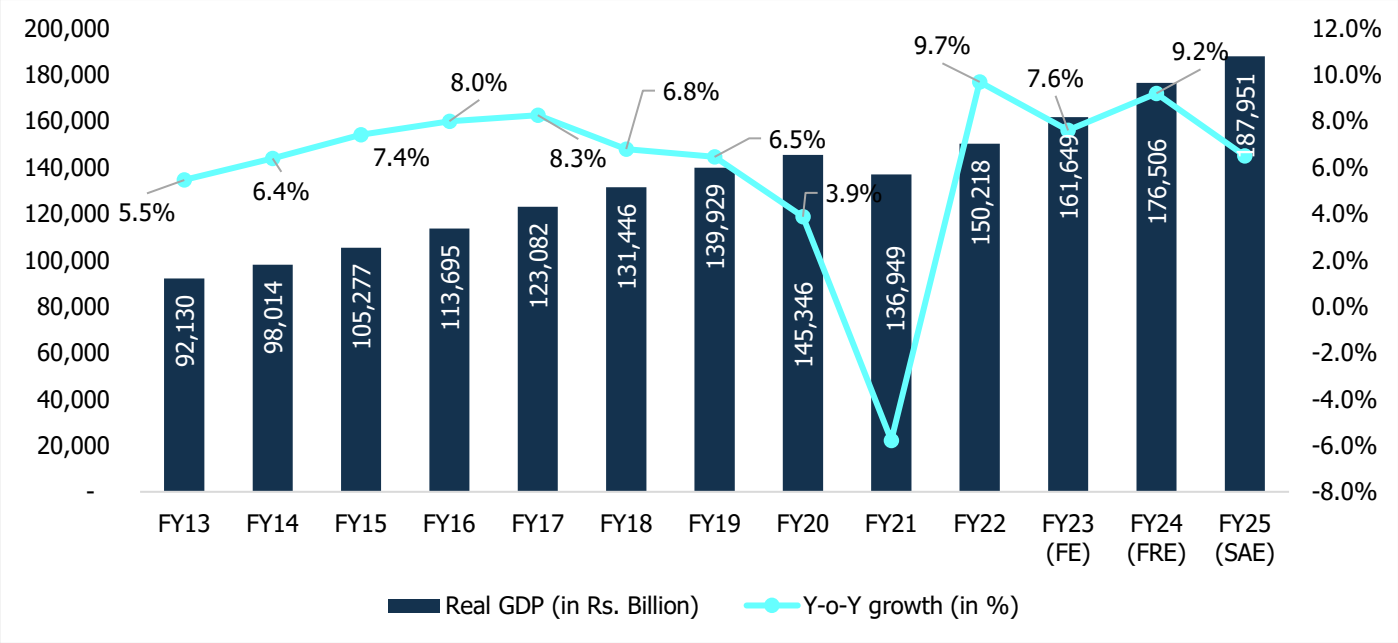
Note: P- Projections, E-Estimated; India's fiscal year (FY) aligns with the IMF's calendar year (CY). For instance, FY24 corresponds to CY23.

1.2 Indian Economic Outlook

1.2.1 GDP Growth and Outlook

Resilience to External Shocks remains Critical for Near-Term Outlook

Chart 2: Trend in Real Indian GDP growth rate



Source: MOSPI; Note: SAE- Second Advance Estimates, FRE – First Revised Estimates, FE – Final Estimate

India's real GDP grew by 9.2% in FY24 (Rs. 176,506 billion) which is the highest in the previous 12 years (excluding FY22 being 9.7% on account of end of pandemic) and is estimated to grow by 6.5% in FY25 (Rs. 187,951 billion), driven by double digit growth particularly in the Manufacturing sector, Construction sector and Financial, Real Estate & Professional Services. In FY25, GDP grew 6.5% Y-o-Y, with private consumption increasing by 7.6% and government spending increasing by 3.8% Y-o-Y.

GDP Growth Outlook

FY26 GDP Outlook: Real GDP growth is projected at 6.5%, driven by strong rural demand, improving employment, and robust business activity. The agriculture sector's bright prospects, healthy reservoir levels, and robust crop production support this growth. Manufacturing is reviving, and services remain resilient, despite global uncertainties. Investment activity is gaining traction, supported by healthy balance sheets and easing financial conditions. However, risks from geopolitical tensions, global market volatility, and geo-economic fragmentation persist

Persistent geopolitical tensions, volatility in international financial markets and geo-economic fragmentation do pose risk to this outlook. Based on these considerations, the RBI, in its April 2025 monetary policy, has projected real GDP growth at 6.5% y-o-y for FY26.

Table 2: RBI's GDP Growth Outlook (Y-o-Y %)

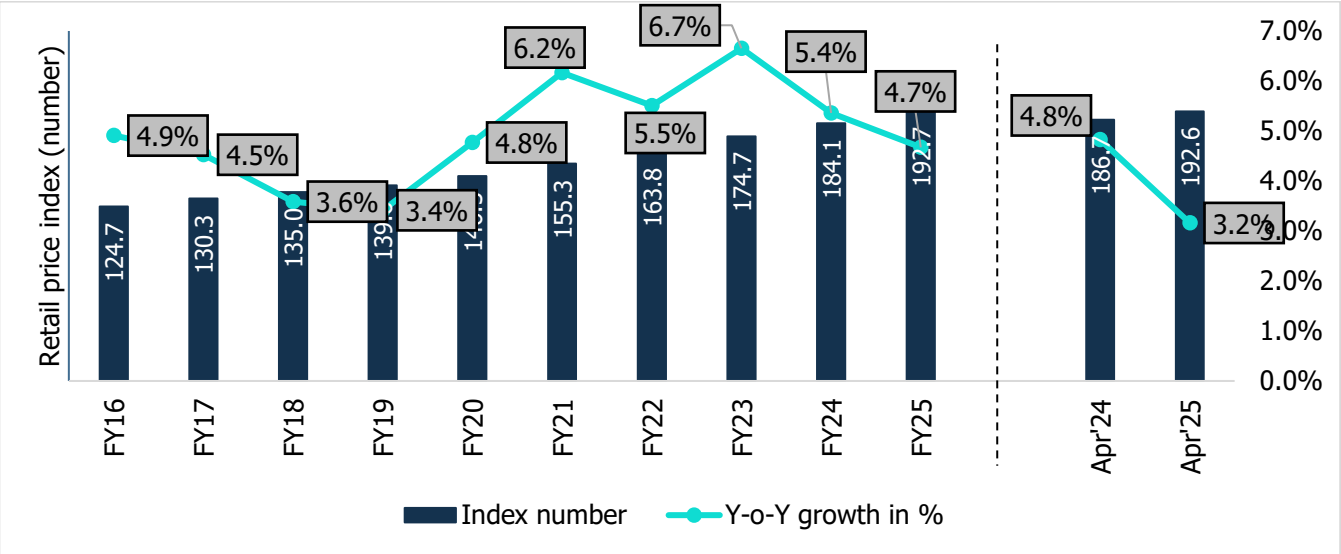
FY26P (complete year)	Q1FY26P	Q2FY26P	Q3FY26P	Q4FY26P
6.5%	6.%	6.7%	6.6%	6.3%

Source: Reserve Bank of India; Note: P-Projected

1.2.2 Consumer Price Index

The CPI (general) and food inflation in April 2025 over April 2024 (3.2%, provisional) witnessed lowest Y-o-Y inflation since July 2019. The moderation was driven by decline of price inflation in Vegetables, Pulses, Fruits, Meat and fish, Personal care and effects and Cereals.

Chart 3: Retail Price Inflation in terms of index and Y-o-Y Growth in % (Base: 2011-12=100)



Source: MOSPI

The CPI is primarily factored in by RBI while preparing their bi-monthly monetory policy. At the bi-monthly meeting held in April 2025, RBI projected inflation at 4.0% for FY26 with inflation during Q1FY26 at 3.6%, Q2FY26 at 3.9% and Q3FY26 at 3.8% and Q4FY26 4.4%.

Considering the current inflation situation, RBI has cut the repo rate to 6.00% in the April 2025 meeting of the Monetary Policy Committee.

Further, the central bank changed its stance to be accommodative. With a decline in food inflation, the headline inflation moderated during January-February 2025.

The economic growth outlook for India is expected to remain resilient, but it will require careful monitoring due to depreciation of the Indian rupee in recent months. Additionally, certain key sectors may face headwinds amid hiked tariffs from the US.

The RBI has adopted for a non-inflationary growth with the foundations of strong demand and supply with a good macroeconomic balance. The domestic growth and inflation curve require the policies to be supportive with the volatile trade conditions.

1.2.3 Contribution of Agriculture sector to GDP

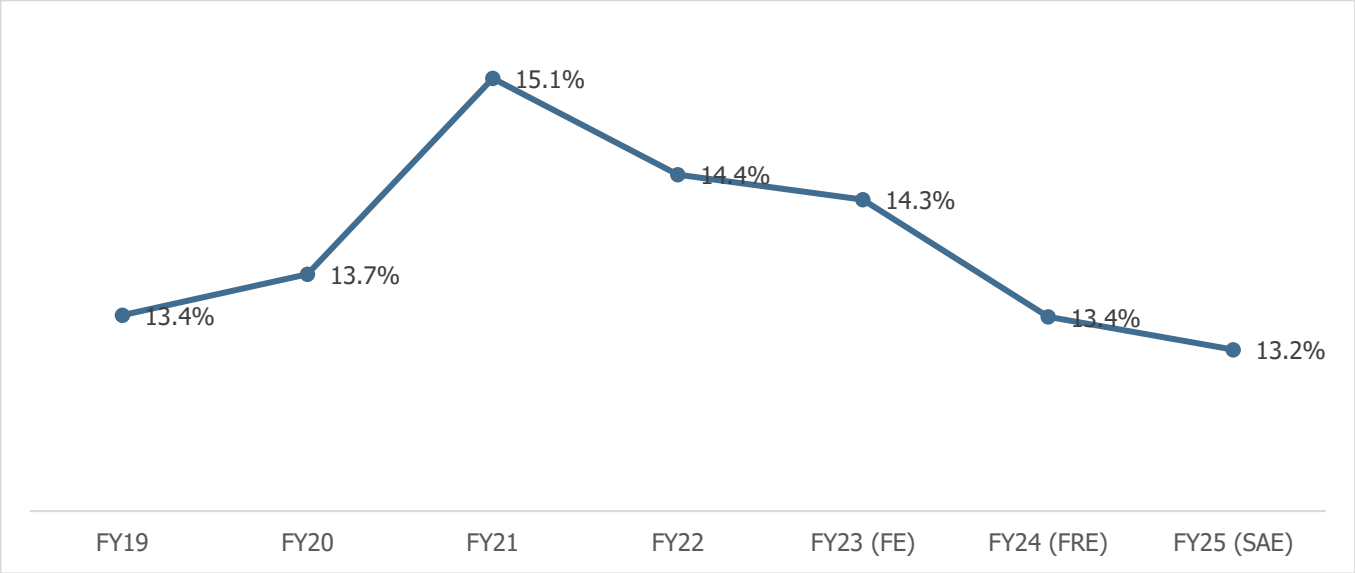
Agriculture has been a cornerstone of India's economy since independence, contributing significantly to GDP and supporting the workforce. While its share in GDP is expected to decrease to 13.2% in FY25, agriculture remains crucial for rural livelihoods, global trade, and sectors like food processing and textiles. Despite challenges like climate change, it continues to play a vital role in economic growth, poverty reduction, and social stability.Its growth is supported by government initiatives aimed at enhancing productivity, ensuring food security, and improving farmer welfare.

The Economic Survey highlights key strides in India's agriculture, with foodgrain production is 328.8 million tonnes in FY24 and oilseeds production increasing, reducing dependence on imports. Government initiatives

like e-NAM, FPOs, and PMKMY aim to improve agricultural efficiency, support farmer incomes, and provide social security, bolstering the sector's growth.

Additionally, the government promotes sustainable practices through PM-PRANAM and ensures financial stability with schemes like MSP and PMFBY, which covers over 610 lakh hectares in FY24. These efforts enhance productivity, food security, and farmer welfare, contributing significantly to agriculture's role in India's GDP.

Chart 4: Agriculture sector contribution to GDP (at constant prices)

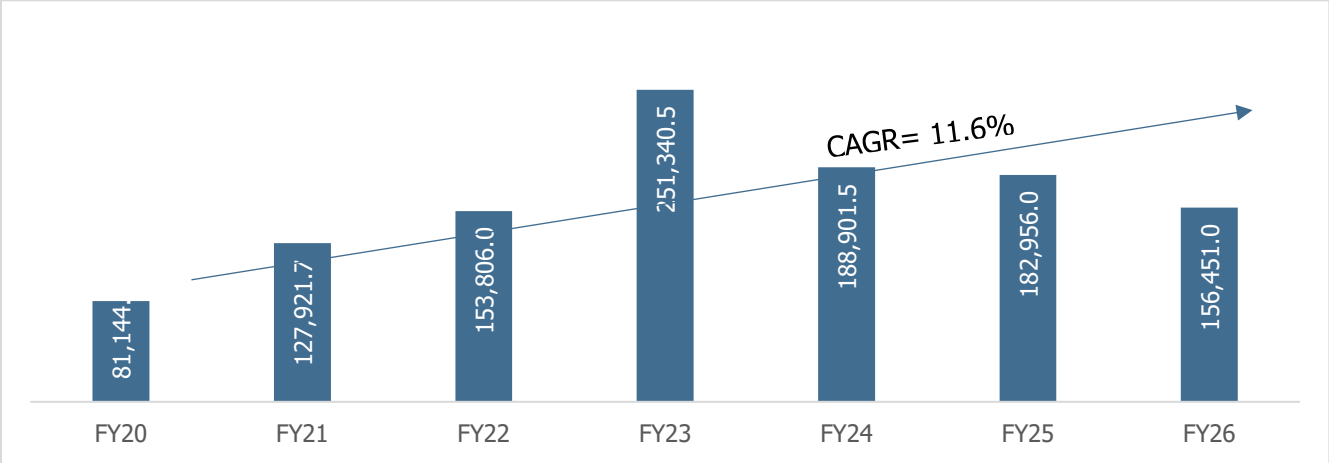


Source: MOSPI; Note: FRE – First Revised Estimates, FE– Final Estimate, SAE- Second Advance Estimates

1.2.4 Subsidies for fertilizers

Fertilizers are essential for enhancing soil fertility, boosting crop productivity, ensuring food security, and supporting the livelihoods of millions of farmers in India. As India is highly dependent on imports to meet the fertilizer and its raw material needs, the domestic prices, in turn, are influenced by the world prices. Thus, to avoid the burden of price hikes on farmers and disturbance in agricultural produce, the government provides subsidies on fertilizers to farmers through manufacturers. In previous year, considering the surge in prices of fertilizers, the government doubled the fertilizer subsidy for the Rabi season (from 1st October 2022 to 31st March 2023) to Rs. 51,875 crores as compared to Rs. 28,655 crores. The subsidy was doubled not only on account of surge in prices of fertilizers but also due to the geopolitical issues between Russia-Ukraine and logistics issues.

Chart 5: Subsidies provided to fertilizers sector



Source: Union Budget FY25 document

For FY26, the upfront subsidy budget decreased by 13% to Rs. 164,102.5 crore as compared to Rs. 156,451.0 crore in FY25. This will be adequate for the year on account of reduced prices of raw materials and natural gas. It will also aid the urea and complex fertilisers manufacturers to effectively manage their working capital requirement.

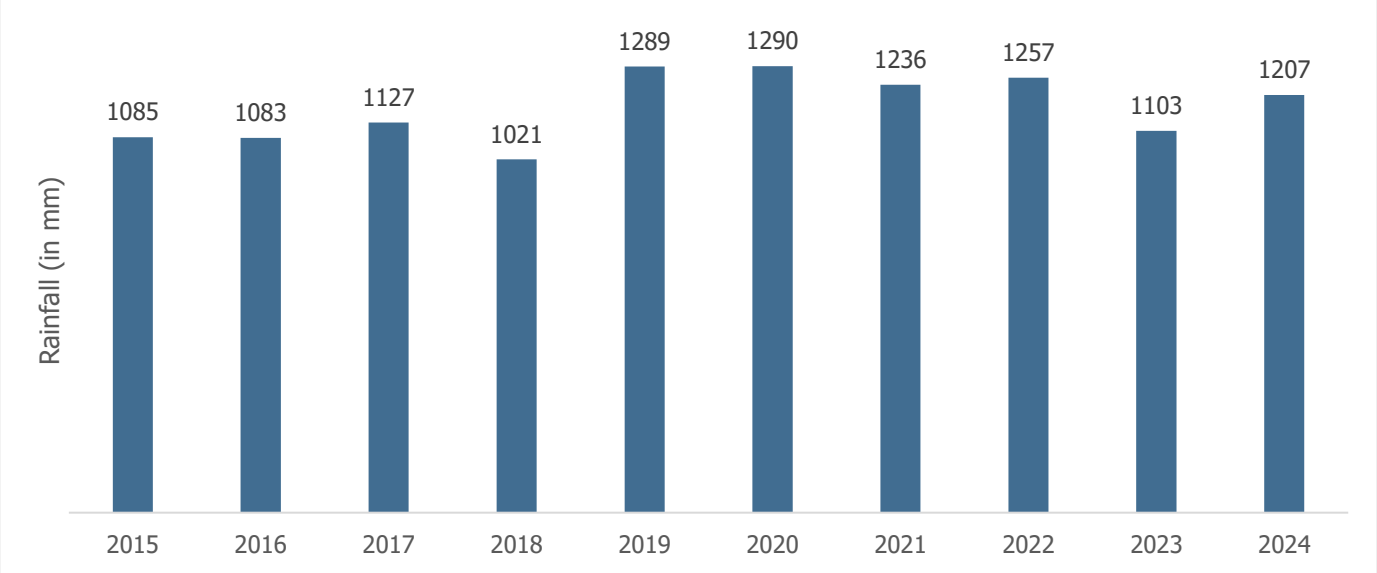
1.2.5 Monsoon in India

The rainfall in India in the past decade has decreased marginally owing to extreme weather conditions. This resulted in huge crop losses, adversely impacting the industry. Monsoons are integral to India, providing about 70% of annual rainfall and affecting major crops such as rice, wheat, sugarcane, soybeans, and groundnuts.

Between 2015 and 2024, India's annual rainfall has ranged between 1,021 mm (2018) and 1,290 mm (2020), showing a fluctuating but stable monsoon pattern. The high rainfall years 2019, 2020, and 2022 coincided with strong or neutral La Niña conditions in the Pacific Ocean, which are typically associated with enhanced monsoon activity over India.

In contrast, 2018 and 2023, which saw lower rainfall (1,021 mm and 1,103 mm respectively), were influenced by weak El Niño or transitional phases that tend to suppress rainfall. The sharp rise in 2019 and 2020 was also supported by positive Indian Ocean Dipole (IOD) phases, which enhance moisture inflow over the subcontinent. The 2024 monsoon delivered 1,207 mm of rain, which is above the long-period average (LPA) of 868.6 mm, aided by normal-to-positive IOD conditions and absence of strong El Niño signals.

Chart 6: Trend in Rainfall in India (In MM)



Source: CareEdge Research, Maia Research

While this consistent rainfall supports kharif crop sowing and water reservoir replenishment, it also brings warm and humid conditions conducive to the proliferation of pests and crop diseases. This environmental backdrop is expected to increase demand for agrochemicals and crop protection solutions. As a result, segments such as pesticides, fungicides, and herbicides are likely to see a boost, further promoting growth in the agriculture input and crop protection industry.

1.2.6 Top states- Major Crops Production (2023-24)

The major crops produced in top 3 states in India in 2023-24 are:

Table 3: Major crops state wise production

Food Grains:

Crop	State	Production (Lakh Tonnes)
Rice	Uttar Pradesh	157.2
	West Bengal	151.2
	Telangana	166.3
Wheat	Madhya Pradesh	212.8
	Punjab	177.8
	Uttar Pradesh	354.3
Maize	Karnataka	54.9
	Bihar	46.1
	Madhya Pradesh	43.3
Total Nutri/Coarse Cereals	Rajasthan	80.3
	Karnataka	76.1
	Madhya Pradesh	54.9
Gram	Madhya Pradesh	31.9
	Maharashtra	28.6
	Rajasthan	22.3
Tur	Maharashtra	10.2
	Karnataka	8.6
	Uttar Pradesh	3.8
Total Pulses	Madhya Pradesh	61.8
	Rajasthan	40.0
	Maharashtra	36.3
Total Foodgrains	Madhya Pradesh	398.4
	Uttar Pradesh	592.9
	Punjab	325.9

Oilseeds:

Crop	State	Production (Lakh Tonnes)
Groundnut	Gujarat	46.4
	Rajasthan	20.2
	Madhya Pradesh	9.9
Rapseed & Mustard	Rajasthan	59.8
	Uttar Pradesh	18.7
	Madhya Pradesh	17.5
Soyabean	Madhya Pradesh	54.7
	Maharashtra	52.3
	Rajasthan	11.7
Sunflower	Karnataka	0.7
	Haryana	0.3
	Odisha	0.2
Total Oilseeds	Rajasthan	95.7
	Madhya Pradesh	83.7
	Gujarat	71.9
Sugarcane	Uttar Pradesh	2055.6
	Maharashtra	1120.9
	Karnataka	418.1
Cotton	Gujarat	90.6
	Maharashtra	80.5

	Telangana	50.8
Jute & Metals	West Bengal	78.7
	Assam	6.8
	Bihar	9.9

Source: India Budget, Economic Survey
Note: 1. Data for the year 2023-24 is of 3rd Advance Estimates
2. Cotton Production in Bales, 1Bale=170 Kg
3. Jute & Mesta Production in Bales, 1Bale=180 Kg

1.2.7 Concluding Remarks

India's average crop yield is lower than the global average due to outdated practices, poor irrigation, and climate challenges. However, with technological advancements, better infrastructure, and improved practices, India has the potential to boost production, increase yields, and become more competitive in the global agricultural market.

India, with 14% of the global crop-protection market, is a key player in boosting agricultural productivity. Demand for chemicals is projected to grow from 61,097 tonnes in FY20 to 89,170 tonnes by FY36. The industry is adopting sustainable practices and innovations, driving food security and reducing agriculture's ecological impact, solidifying India's leadership in crop protection. As per the latest forecasts by various agencies including the IMD, the monsoon is expected to be normal this year as well as no impact from El Nino effect is expected.

Global economic growth faces headwinds from geopolitical tensions, volatile commodity prices, high interest rates, inflation, financial market volatility, climate change, and rising public debt. However, India's economy remains relatively strong, with an IMF forecast of 7% GDP growth in CY24 (FY25 according to the fiscal year), compared to the global projection of 3.2%. Key drivers include strong domestic demand, government capital expenditure, moderating inflation, and improving business confidence.

Public investment is expected to grow, with the government allocating Rs. 11.21 lakh crores for FY26. Private sector investment is also improving, reflected in new projects and capital goods imports. High-frequency indicators suggest the agriculture sector in Q3FY25 grew by 5.6% . Agricultural growth is supported by healthy kharif crop production, higher reservoir levels and better rabi sowing. Additionally, improvement in rural demand owing to healthy sowing, improving reservoir levels, and progress in south-west monsoon along with government's thrust on capex and other policy support will aid the investment cycle in gaining further traction.

2 Agri Inputs

India is an agrarian country, where more than 50% people are dependent on agriculture for their livelihood and is the largest producer of spices, pulses, milk, tea, cashew and jute & the 2nd largest producer of wheat, rice, fruits and vegetables, sugarcane, cotton and oilseeds. Agricultural inputs, essential for enhancing farm productivity and crop quality, encompass seeds, nutrients, and agrochemicals. High-quality seeds, including hybrid, open-pollinated, and genetically modified varieties, form the foundation of successful crop production by offering traits such as higher yield, disease resistance, and better adaptability. Nutrients, divided into macronutrients like nitrogen, phosphorus, and potassium, and micronutrients such as iron and zinc, are crucial for plant growth and development, typically provided through organic or synthetic fertilizers. Agrochemicals, including pesticides, herbicides, fungicides, and plant growth regulators, play a significant role in managing pests, diseases, and weeds, thereby ensuring healthy crop growth. The judicious use of these inputs can significantly boost agricultural productivity, ensure sustainability, and support food security, although challenges such as accessibility, affordability, environmental impact, and regulatory compliance need to be addressed to maximize their benefits and minimize potential risks.

Chart 7: Flow of Agricultural Inputs

1. Seeds-

Seed is the fundamental and most critical input for sustainable agriculture. The effectiveness of all other inputs largely depends on the quality of seeds. It is estimated that quality seeds contribute directly to about 15-20% of total production, depending on the crop, and this contribution can be increased up to 45% with efficient management of other inputs. The developments in the seed industry in India, particularly over the last 30 years, have been very significant. The Government of India undertook major restructuring of the seed industry through the National Seed Project Phase-I (1977-78), Phase-II (1978-79), and Phase-III (1990-1991), which strengthened the necessary seed infrastructure. This restructuring marked the first turning point in shaping an organized seed industry. Another significant milestone was the introduction of the New Seed Development Policy (1988-1989), which transformed the seed industry's character. The policy provided Indian farmers with access to the best seeds and planting materials available globally. It stimulated appreciable investments by private individuals, Indian corporations, and MNCs in the Indian seed sector, with a strong R&D base for product development in each seed company, emphasizing high-value hybrids of cereals and vegetables and hi-tech products such as Bt. Cotton. As a result, farmers now have a wide range of products to choose from, and the seed industry today operates with a 'farmer-centric' and market-driven approach. However, there is an urgent need for State Seed Corporations to transform themselves in terms of infrastructure, technologies, approach, and management culture to survive in the competitive market and enhance their contribution to the national endeavor of increasing food production to attain food and nutritional security.

The Indian seed program largely adheres to the limited generations' system for seed multiplication in a phased manner. The system recognizes three generations namely breeders, foundation and certified seeds and provides adequate safeguards for quality assurance in the seed multiplication chain to maintain the purity of the variety as it flows from the breeder to the farmer.

The seed industry is gaining attention due to the government authorizing FDI in the agriculture sector such as in development and production of seeds and planting material.

Apart from this, leading seed companies are inculcating digital technologies to mitigate threats of pests, climate etc. Along with this, data science, phenomic analysis, genomic sequencing etc. are being leveraged to enhance production. However, there are certain challenges that are hampering the growth of this sector. For instance, marginal investment in R&D, short shelf life, unpredictability of demand, and lack of effective monitoring mechanism, among others, are becoming a dampener in this growing sector.

2. Nutrients

Nutrients are essential for plant growth and development. They can be divided into macronutrients and micronutrients:

- **Macronutrients:** These are required in large quantities and include nitrogen (N), phosphorus (P), and potassium (K), commonly referred to as NPK. They are crucial for various plant functions such as growth, energy transfer, and water regulation.
- **Micronutrients:** Needed in smaller quantities, these include elements like iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), molybdenum (Mo), boron (B), and chlorine (Cl). They play vital roles in enzyme function and plant metabolism.

Nutrients are typically supplied through fertilizers, which can be organic (manure, compost) or inorganic (synthetic chemical fertilizers). In India, the nutrient input in agriculture involves a combination of organic and inorganic fertilizers, with a significant reliance on chemical fertilizers like nitrogen (N), phosphorus (P), and potassium (K). The Indian government promotes the Nutrient Based Subsidy (NBS) scheme, which subsidizes non-urea fertilizers to ensure their availability at affordable prices. This scheme encourages balanced fertilization, crucial for maintaining soil health and productivity. Recent efforts include the introduction of fortified fertilizers and promoting micronutrient-rich options to address soil-specific deficiencies.

Historically, the nutrient input in Indian agriculture has seen a substantial increase since the Green Revolution. However, imbalanced fertilizer use remains a challenge, often skewed towards nitrogen over phosphorus and potassium, leading to potential soil health issues. The government continues to adjust policies and subsidies to address these imbalances and promote sustainable practices.

Furthermore, there are other forms of nutrients such as biofertilizers and biostimulants that support plant growth. Unlike conventional fertilizers, which are typically chemical compounds, biofertilizers contain living organisms, whereas biostimulants are comprised of non-living substances.

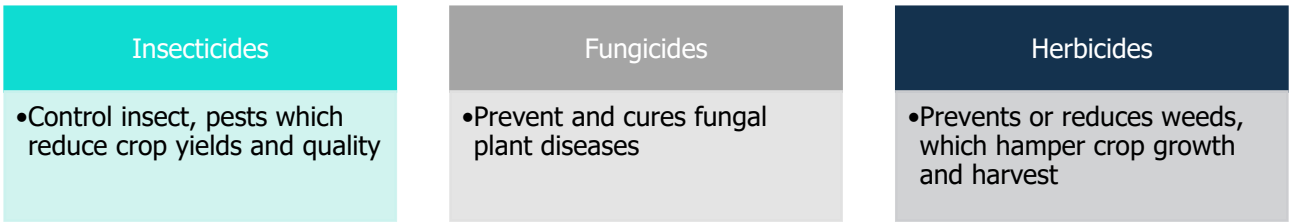
3. Agro-chemical

Agrochemicals (Crop protection products) are designed to protect crops from insects, diseases and weeds. They do so by controlling pests that infect, consume or damage crops. Uncontrolled pests significantly reduce the quantity and quality of food production. The Food and Agriculture Organization (FAO) estimates that up to 40% of food crops are lost due to plant pests and diseases annually. Furthermore, food crops must compete with 30,000 species of weeds, 3,000 species of nematodes and 10,000 species of plant-eating insects. Agrochemicals are the last and one of the key inputs in agriculture for crop protection and better yield. Notably, India is in top 5 global producer of agrochemicals.

The agrochemicals are diluted in recommended doses and applied to seeds, soil, irrigation water and crops to prevent damage from pests, weeds and diseases. Hence, for enhancing crop performance, increasing yields, or managing pests, agrochemicals remain the most relevant and reliable solution in the current agricultural context.

Agrochemicals are broadly classified as insecticides, herbicides, fungicides, rodenticides etc. depending on the type of pest they control.

Chart 8:Types of key Agro-Chemicals



3 Crop Protection & Nutrition Industry

The different types of nutrients and crop protection chemicals covered in the industry includes:
a. Bio-fertilizers
b. Pesticides
c. Bio stimulants

- **Bio-fertilizers**

Bio-fertilizers are substances that contain microbes, when supplied to soil boost fertility and contribute to plant growth. Bio-fertilizers are required to restore soil fertility and also help in increasing the crop yield. They are natural form of fertilizers.

- **Pesticides**

Pesticides are any substance or product that can prevent, destroy, repel, or mitigate pests.

- **Bio stimulants**

Bio-stimulants are substances used in seeds, plants, and rhizomes to stimulate natural processes and enhance nutrient availability and improve abiotic stress tolerance etc.

3.1 Global Crop Protection & Nutrition Market Size

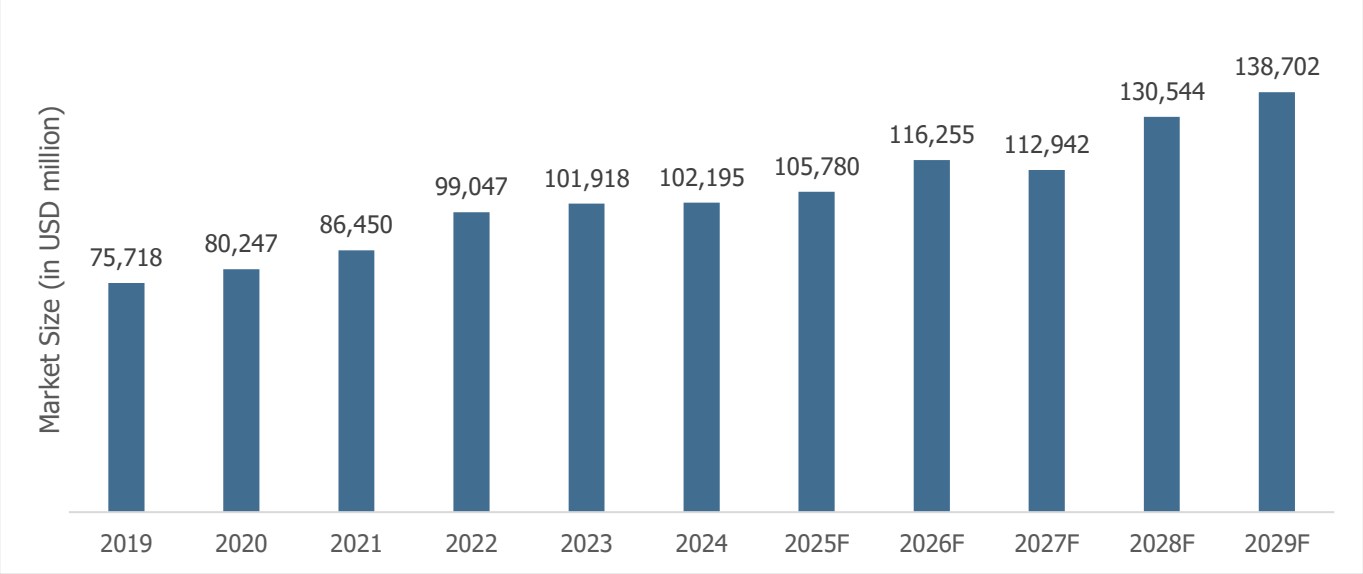
During 2019-2024, the market size of the global crop protection & nutrition industry grew at a CAGR of 6.2% on account of continuous growth in agricultural activities. After a steady growth till 2022, the industry observed a decline of about 2.4% in 2023 due to factors such as a slowdown in global demand, higher energy prices, and erratic monsoons. However, it is estimated to have grown by 2.2% y-o-y in 2024. The expansion will be attributed to the continuous upgrading of products and the development of technology and economic developments.

Further, Asia-Pacific (APAC), Europe and North America are the largest markets in terms of value owing to the rising demand for commercial farming and adapting to changes in crop mix. APAC region is well-known for its production of rice, soybeans, wheat, and horticultural crops such as fruits and vegetables, but it also faces issues that affect agricultural productivity due to a variety of weeds targeting staple and commercial crops. As a result, there is tremendous demand for crop protection chemicals. The rising use of pesticides and the adoption of sustainable farming methods in countries across this region are driving the demand for nutrition & crop protection chemicals.

Whereas Europe is the second-largest market for crop protection & nutrition, followed by North America. The robust growth in the USA and Canada is contributing to the increase in the North American region.

Further, the shift in consumption patterns, change in trends of agricultural practices, usage of fertilizers & chemicals by farmers to enhance crop yield and protect crops from pests, changing preferences of consumers including concerns over the safety of food, and chemicals used in crop cultivation are raising the demand for nutrition & crop protection chemicals. In addition, the healthy demand in the agriculture sector contributes to the industry's growth. Such factors are projected to facilitate the global crop protection & nutrition market growth at a CAGR of about 6.3% over the forecast period 2024-2029.

Chart 9: Global Crop Protection & Nutrition Industry Market Size

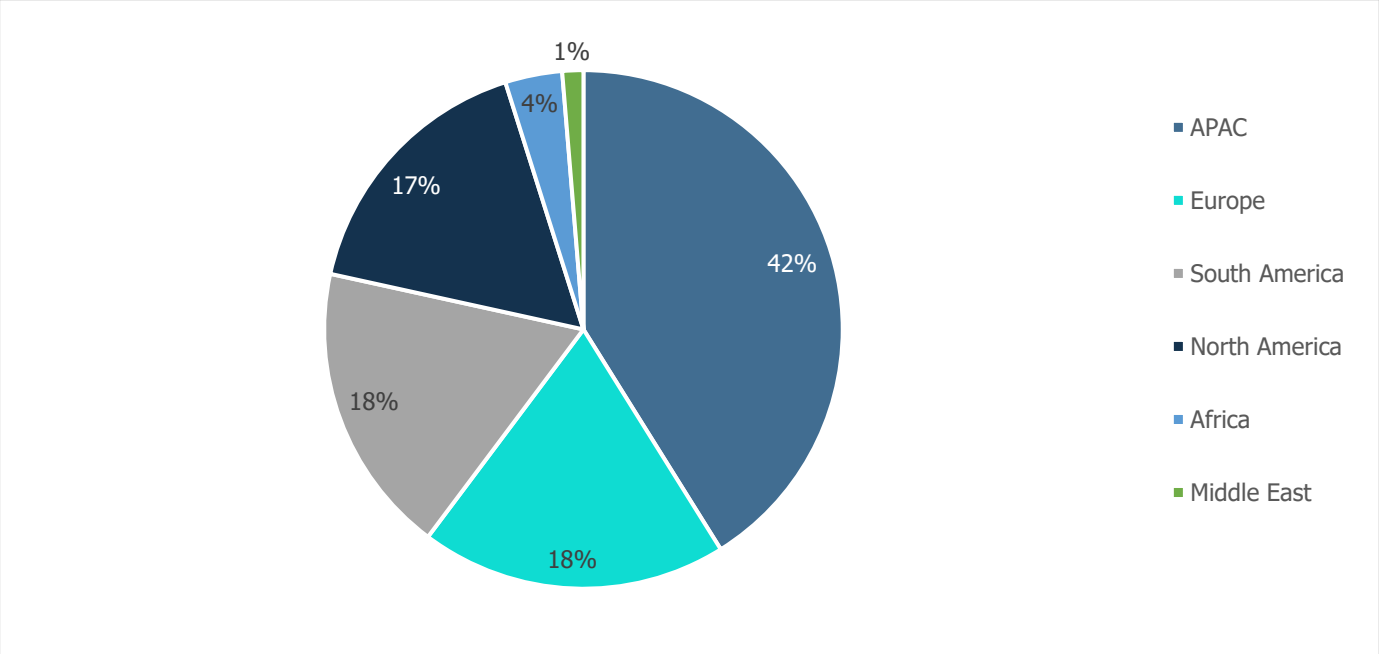


Source: CareEdge Research, Maia Research
Note: Data is for calendar year; 'F' denotes Forecast.

3.2 Global Crop Protection & Nutrition Industry - Demand Across Regions

The global crop protection & nutrition market is expected to grow on account of a substantial increase in the production of food products worldwide. The rising consumption of food grains globally is expected to fuel market expansion. The APAC region holds the maximum market share with 42% in consumption followed by Europe & South America at 18%. North America jointly accounted for 17% in 2024.

Chart 10: Region-Wise Global Crop Protection & Nutrition - Consumption Market Share in 2024



Source: CareEdge Research, Maia Research

1.2.1 APAC - Crop Protection & Nutrition Demand

Asia-Pacific will continue to be the dominant region in the crop protection & nutrition industry and is projected to grow by a CAGR of about 5.9% during the forecast period 2024-2029. Countries in this region, including China, India, Japan,

Australia, Indonesia, and Vietnam, are expanding the use of nutrition & crop protection chemicals in order to boost overall crop production and yield.

China is one of the largest producers and consumers of nutrition & crop protection chemicals across the globe. Despite COVID-19, the Chinese market has been catering to the demand and their exports have been stable. The rising consumption is driven by the thriving agriculture industry, innovations, and the growing awareness of crop protection chemicals. Moreover, factors such as the flourishing agricultural sector in the country, rising food demand, and a huge population are increasing the demand for nutrition & crop protection chemicals, leading to increased production. In addition to that, the country has implemented various policy measures that benefit agriculture and farmers such as agricultural tax relief and exemption, grain subsidies, seed subsidies, machinery subsidies, and increased funding for rural infrastructure.

India is one of the largest producers of nutrition & crop protection chemicals globally and has a diverse range of crops and agro-climatic zones. The agriculture sector in the country faces issues such as pests, diseases, and soil deterioration, driving the demand for nutrition & crop protection chemicals.

The crop protection & nutrition market growth in Japan is influenced by the diverse agricultural sector with a variety of crops, product innovations, advanced farming techniques, environmental regulations, and sustainable practices. Further, the increasing demand for fruits and vegetables, driven by consumer choices with regards to diet and health and significant demand for flowers and ornamental plants are fueling the demand in this region. Also, the rising population in the country is driving crop protection & nutrition demands to ensure food security. Moreover, Japan is likely to witness market expansion owing to large-scale farming operations, improved pest management measures, and investments in crop protection & nutrition industry to improve yield and safeguard crops.

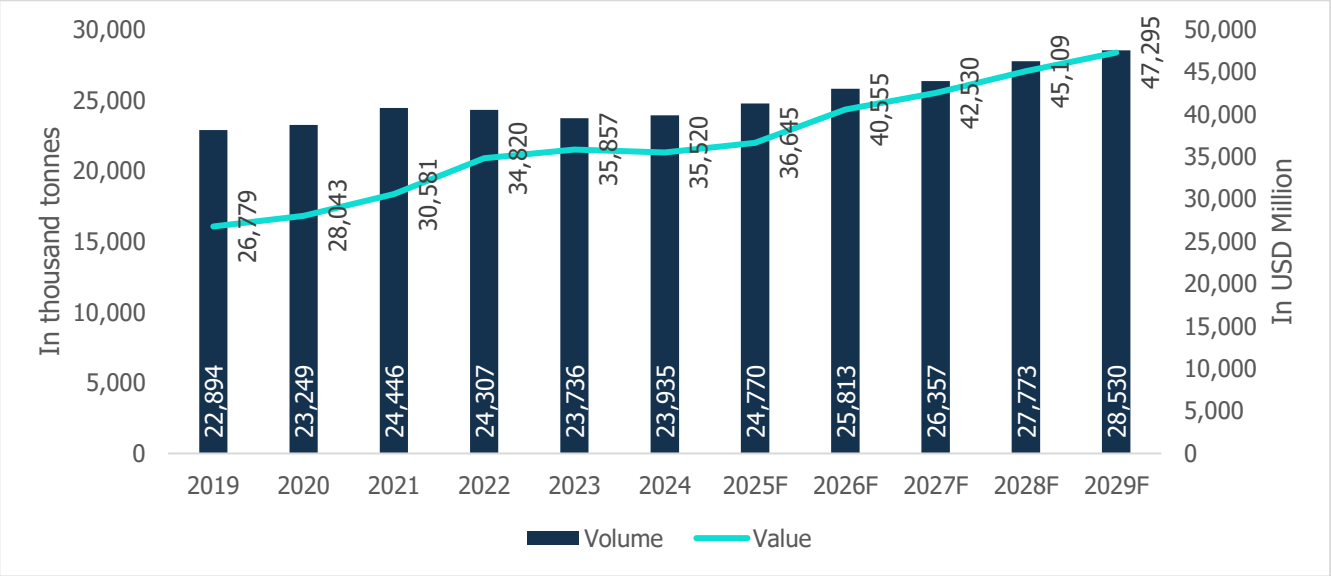
The Australia crop protection & nutrition market encompasses a wide range of products, including pesticides, fertilizers, and plant growth regulators, which play a vital role in crop protection, soil fertility management, and yield optimization. Crop protection & nutrition help farmers mitigate the impact of pests, diseases, and weeds, thereby ensuring healthy crop growth, minimizing yield losses, and maximizing farm productivity. The growth trajectory in this country reflects the crucial role of nutrition & crop protection chemicals in supporting sustainable agriculture, food security, and rural livelihoods in Australia.

Agriculture contributes significantly to Indonesia's economy, with the country being a major producer of commodities such as palm oil, rubber, and coffee. It also contributes to rice production. The country's agricultural sector is primarily focused on the production of export commodities such as rubber, cocoa, coffee, rice, and palm oil, as well as the cultivation of horticulture crops such as soybeans, maize, rice, fruits, and vegetables for domestic consumption, resulting in increased use of crop protection chemicals. As a result, farmers in the Indonesian market heavily rely on nutrition and crop protection chemicals and are widely utilized in agriculture to manage pests, crops, and weeds.

Vietnam's agriculture sector is characterized by small-scale farming and a varied range of crops such as coffee, rice and cashew nuts. Agrochemicals have an important role in raising crop productivity and quality in agriculture. The government's attempts to modernize agriculture and enhance exports will boost demand for agrochemicals in this region. The usage of crop protection chemicals like insecticides and herbicides is generally in high demand due to intense farming methods. Furthermore, the individuals shift to more nutritious options and organic food products will aid in the advancement of pesticides and contribute to the growth of the crop protection & nutrition market.

Moreover, rapid economic and population growth in emerging countries such as China and India are expected to drive the demand for food grains. This will continue to play a role in the development of the global market. Besides, technological advancements will continue to shape the industry with new and improvised technologies in order to boost the efficiency and effectiveness of crop protection & nutrition products. This, in turn, will increase the yield in the coming years.

Chart 11: Crop Protection & Nutrition Demand in APAC



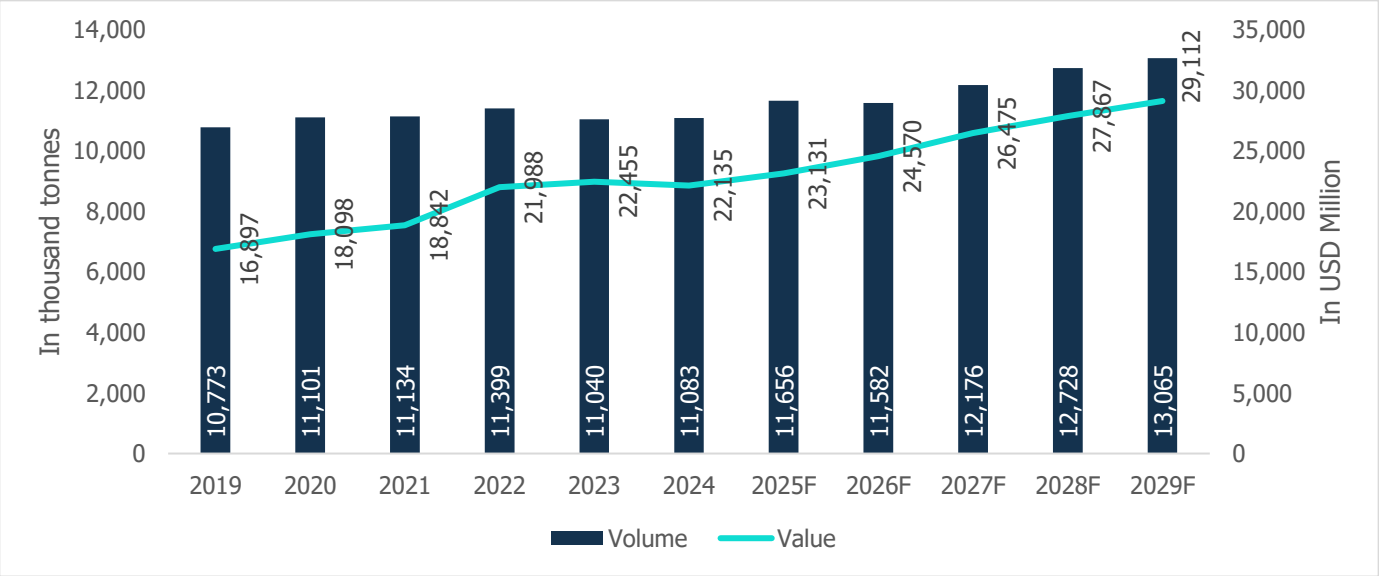
Source: CareEdge Research, Maia Research; F: Forecast

1.2.2 Europe - Crop Protection & Nutrition Demand

The crop protection & nutrition demand in Europe is projected to grow at a CAGR of 5.6% over the forecast period, 2024-2029. Europe accounted for 18% of the global demand for nutrition & crop protection chemicals in 2024. The region is rich in crop diversity with a range of crops including fruits, vegetables, cereals, wine grapes etc. Each of the crops has distinctive insect, disease, and weed stresses, prompting the requirement for agrochemicals made according to its management. For example, fungicides are widely used in vineyards to control fungal diseases and to protect grapevines against pests.

The demand for nutrition & crop protection chemicals is increasing as farmers seek to produce nutritious and high-quality crops. Furthermore, agrochemical pest control measures, availability of agricultural land, and investments made in the agricultural sector are expected to contribute to market growth. However, expansion may be impeded by a stringent regulatory system and environmental concerns.

Chart 12: Crop Protection & Nutrition Demand in Europe



Source: CareEdge Research, Maia Research; F: Forecast

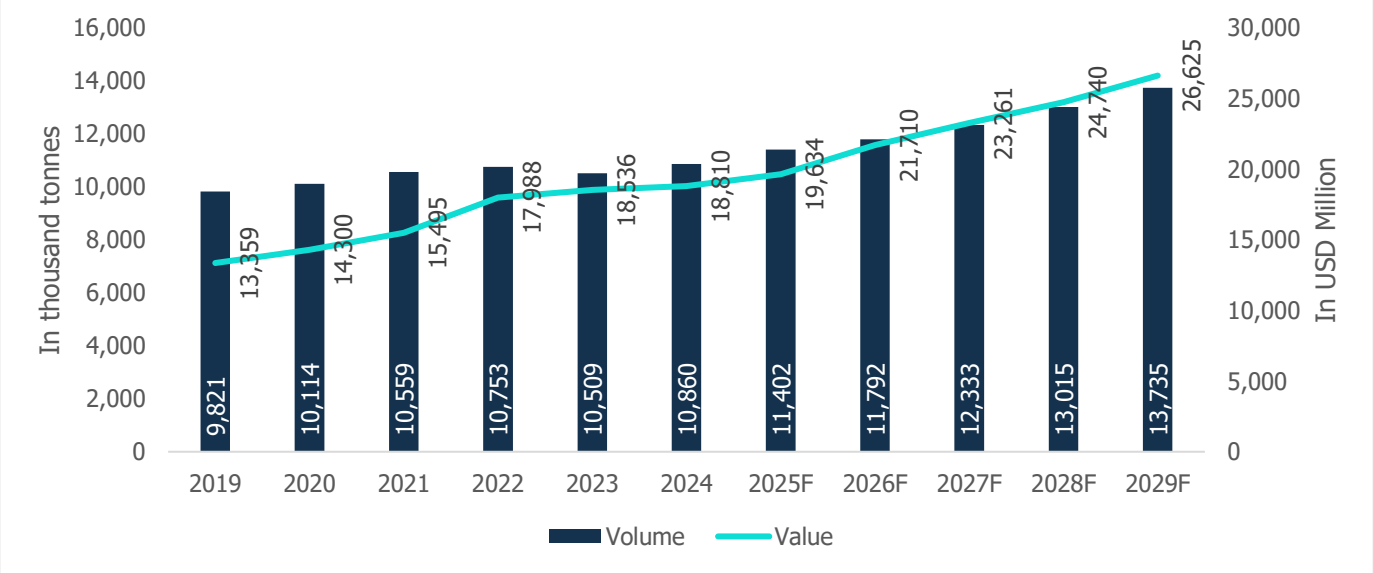
1.2.3 South America - Crop Protection & Nutrition Demand

The crop protection & nutrition market in South America was valued at USD 18,810 million in 2024. The increasing demand for food and agricultural products mainly, corn and soybeans, is driving the demand in this region. Accordingly, the expansion in the agriculture sector has resulted in increased usage of nutrition & crop protection chemicals.

Furthermore, there is a growing awareness of environmental and health concerns associated with chemical use. Although they help increase crop yield and overall productivity, they have a substantial impact on the ecosystem. This has led to a gradual shift toward advanced farming methods, the development of eco-friendly agrochemicals, and the expansion of organic farming.

Countries such as Brazil and Argentina have emerged as the fastest-growing markets for agrochemicals and are more inclined toward organic farming. Brazil is the largest country with vast agricultural operations and has a wide range of crop portfolios such as soybeans, sugar cane (cash crop), rice, cotton, coffee etc. Other countries like Paraguay, Chile and Colombia are also contributing to the growth in agrochemical industry because of their agricultural activities. Farmers are shifting to environmentally friendly and sustainable agriculture in order to avoid water and soil contamination and crop failures, which is fuelling market demand. Furthermore, the support from the Brazilian government is expected to boost the growth. The demand in this region is projected to grow by a CAGR of about 7.2% over the forecast period 2024-2029.

Chart 13: Crop Protection & Nutrition Demand in South America



Source: CareEdge Research, Maia Research; F: Forecast

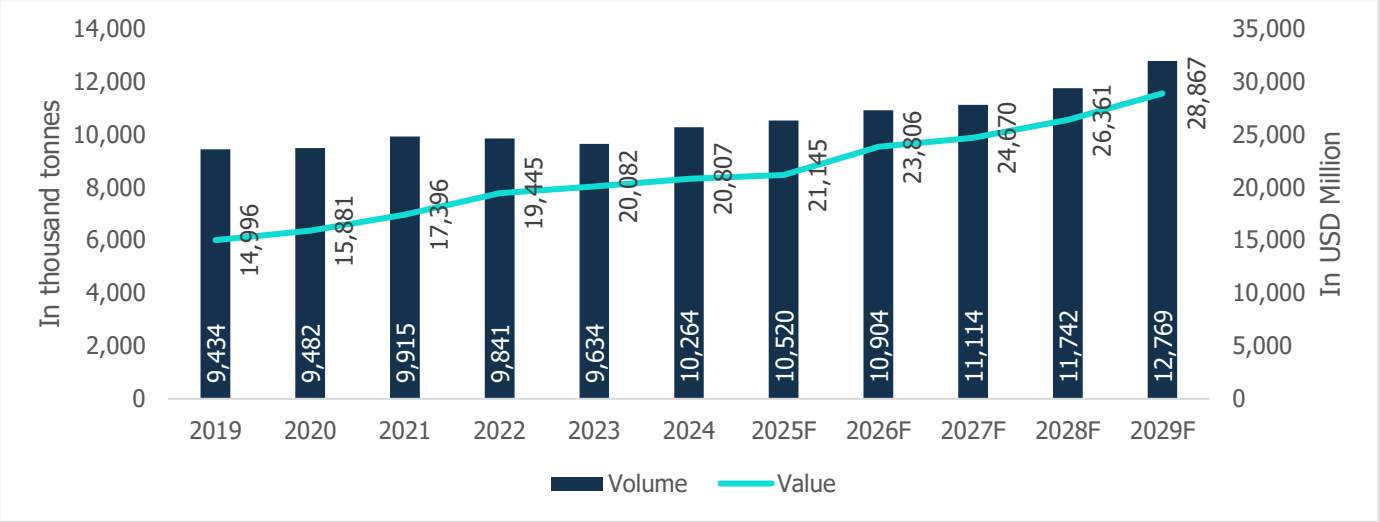
1.2.4 North America - Crop Protection & Nutrition Demand

The crop protection & nutrition market in North America was valued at USD 20,807 million in 2024. It has witnessed significant improvements and is growing on account of increased demand for food grains, shifting crop mix patterns, and environmental regulations.

The United States and Canada are major producers of a wide range of crops, including grains like corn and wheat, oilseeds like soybeans and canola, fruits, vegetables and specialty crops. Corn is an important crop in this region, mainly in the United States, where it is used for a multiple purpose such as food, livestock feed, production of ethanol, and industrial applications. On the other hand, soybeans are majorly grown in Canada as well as USA. Another major important cash crop, cotton is mainly cultivated in the southern United States. Other specialty crops produced in this region include almonds and other tree nut crops with California being the largest producer in this market.
The rising demand for nutritional food and the need to increase production & productivity have led to the utilization of agrochemicals by farmers to avoid crop loss. Moreover, the shift from synthetic chemicals to bio-based chemicals

has been observed in the region. This demand is driven by the rising adoption of sustainable agricultural practices, innovations in methods, and the expansion of organic farming to improve yield and maintain nutritional quality. Furthermore, investments in this area are expected to aid market growth. The demand in this region is projected to grow with a CAGR of 4.5% from 10,264 thousand tonnes in 2024 to 12,769 thousand tonnes in 2029.

Chart 14: Crop Protection & Nutrition Demand in North America



Source: CareEdge Research, Maia Research; F: Forecast

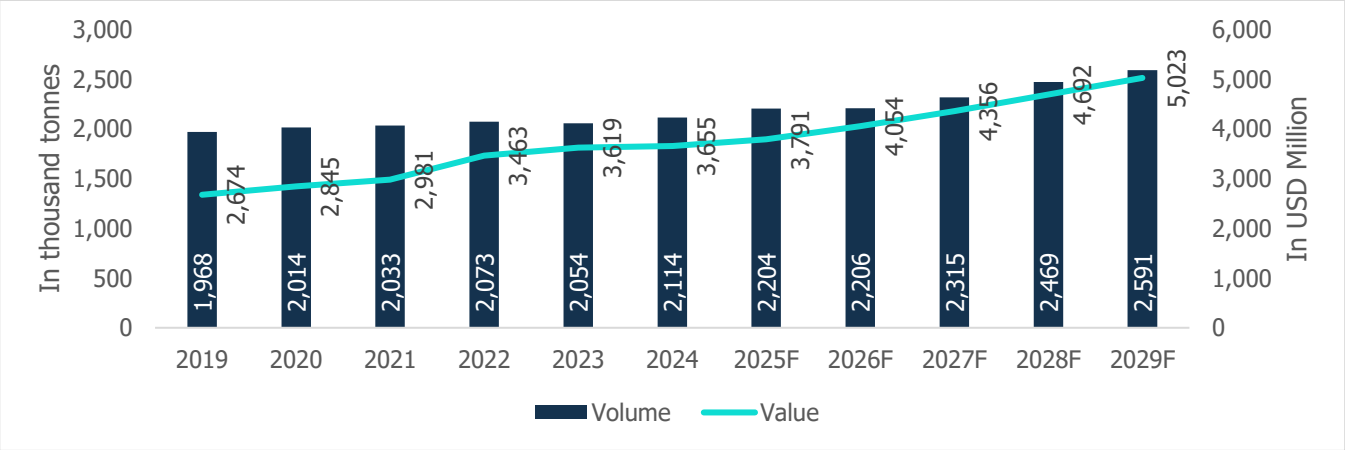
1.2.5 Africa - Crop Protection & Nutrition Demand

The demand in the African region has grown at a CAGR of around 1.4% during the period, 2019-2024. The crop protection & nutrition market was valued at USD 3,655 million in 2024. Factors such as the rising population, the increasing demand for food grains, and the growing awareness of utilizing nutrients and crop protection chemicals are expected to propel market growth.

In addition to rice, maize, fruits, and vegetables, Africa produces root and tuber crops such as sweet potatoes, cassava, plantain, yam, and taro. Bananas and plantains are important staples and food security crops in Sub-Saharan Africa. Furthermore, coffee is grown extensively in countries such as Ethiopia, Uganda, Tanzania, and Kenya, where it is a key export commodity.

The demand in this region is projected to grow at a CAGR of 4.2% over the forecast period 2024-2029. However, environmental risks and the growing use of synthetic/organic chemicals may hamper the growth.

Chart 15: Crop Protection & Nutrition Demand in Africa



Source: CareEdge Research, Maia Research; F: Forecast

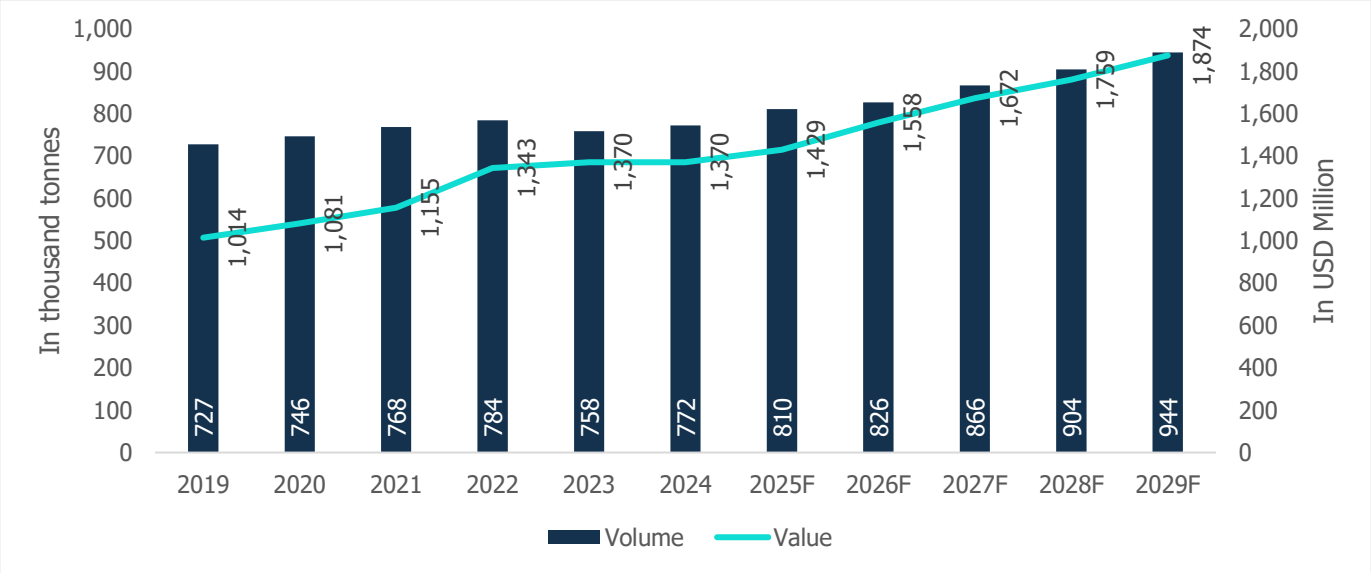
1.2.6 Middle East - Crop Protection & Nutrition Demand

The demand for nutrition and crop protection chemicals in the Middle East is limited mainly due to climatic conditions and water scarcity as agricultural production requires water for irrigation. Many Middle Eastern countries import in order to meet their domestic demand. The demand in the Middle East has grown at a CAGR of about 1.2% during the period 2019-2024.

The region primarily focusses on production of crops such as cereals like wheat and barley, fruits, vegetables, and specialty crops. In addition to that, citrus fruits like oranges and grapefruits are grown in Egypt, Morocco, and Israel countries. Besides Saudi Arabia, Egypt, Iran and Iraq are the largest producers of date palms in Middle East. Apart from this, olive cultivation is common in Middle Eastern Mediterranean nations such as Turkey, and Tunisia.

The horticultural industry in the Middle East has witnessed rapid transformation over the years with the adoption to greenhouse farming techniques. Further the support from government and adaptation to climate change has resulted in a substantial increase in productivity and improvement in the overall quality of their produce. As a result, the demand for nutrition and crop protection chemicals is on rise and is projected to grow at a CAGR of 4% to 942 thousand tonnes over the forecast period 2024-2029.

Chart 16: Crop Protection & Nutrition Demand in Middle East



Source: CareEdge Research, Maia Research; F: Forecast

3.3 India - Crop Protection & Nutrition Demand

The Indian crop protection & nutrition market is poised for growth due to the growing demand for food products. The demand has grown substantially over the last decade on account of increased agricultural output, growing population, and favorable government initiatives such as Make in India and Aatmanirbhar Bharat Abhiyan. Despite challenges such as a slowdown in global demand, crop failures due to erratic monsoons, high energy costs, geo-political tensions, etc., consumption of nutrients and crop protection chemicals increased in 2024.

Further, the rising population and depleting arable land are increasing the demand for food grains. The usage of nutrients and crop protection chemicals has increased to produce good quality crops and protect them from damage caused by pests and weeds. Also, environmental factors such as weather and rainfall patterns and warmer temperatures in various regions of the country have led to increased consumption of nutrients and crop protection chemicals and are expected to continue in future.

Moreover, the cost of manufacturing nutrients and crop protection chemicals in India is comparatively low because of the sufficient availability of manpower and tax benefits for the manufacturers. The production capacity in India not only meets domestic demand but also fulfils global demand. In addition, exports from India are increasing to cater to the demand across foreign countries and they contribute to a larger share of the market.

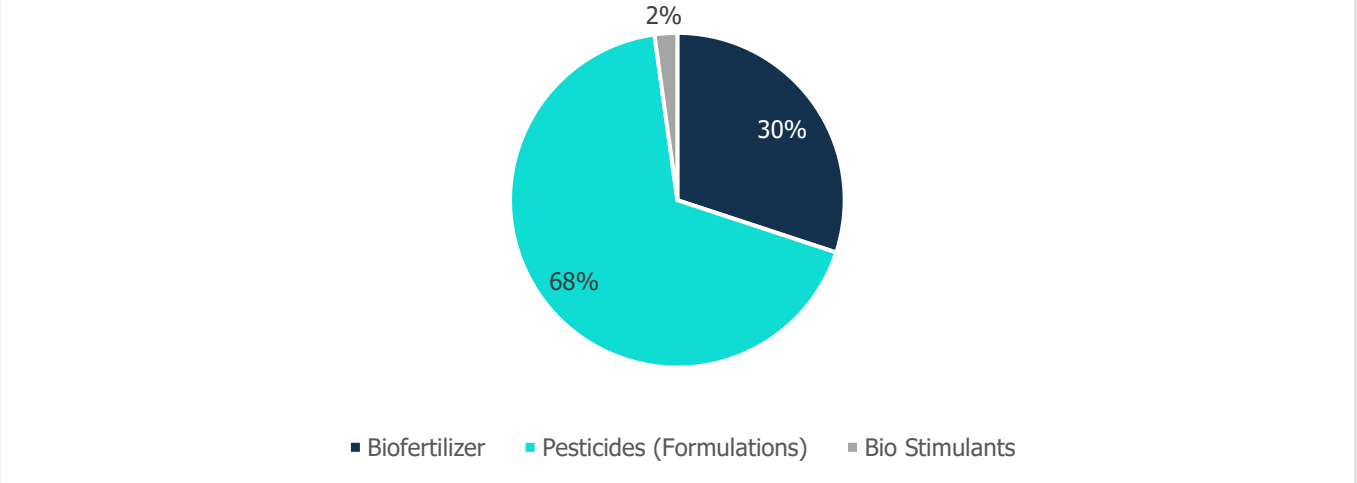
According to the World Trade Organization, India emerged as the second-largest exporter of agrochemicals globally in 2022 whereas it emerged as third-largest exporter in 2023. Also, the global manufacturers have shifted their production to India from China post-COVID-19, providing an edge for India to act as a global manufacturing hub. Besides, various initiatives such as 'Make in India' and the Production Linked Incentive (PLI) scheme have been taken by the government to increase production capacities in the country. The PLI scheme is also expected to strengthen domestic manufacturing and reduce imports in the country. This, in turn, is evaluated to bring more investments from the global nations.

Furthermore, nutrients and crop protection chemicals will continue to boost economic growth through improvements in agricultural output. Also, government support to develop the crop protection & nutrition industry is expected to aid market growth.

3.4 Global Crop Protection & Nutrition Consumption by Type

- Bio-fertilizers
- Pesticides
- Bio stimulants

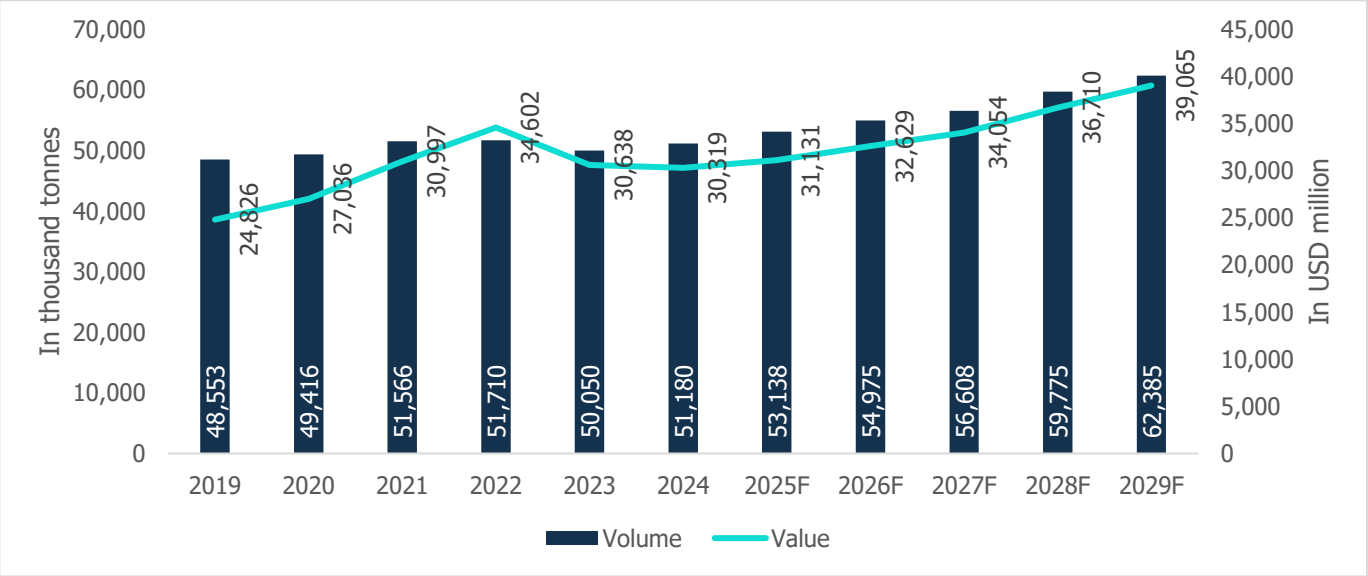
Chart 17: Global Consumption of Crop Protection & Nutrition by Type in Value Terms - 2024 (%)



Source: CareEdge Research, Maia Research

Bio-fertilizers are likely to rise in the medium term as there is more awareness of environmental risks associated with the use of chemical agrochemicals, particularly soil contamination and land degradation. They account for 87% of the total volumes consumed across the globe. Simultaneously, there is a need for a transition toward sustainable farming systems in the future considering the safety of the environment. The demand for bio-fertilizers is expected to grow with a CAGR of 5.2% and 4% in terms of value and volume, respectively, during the forecast period, 2024-2029.

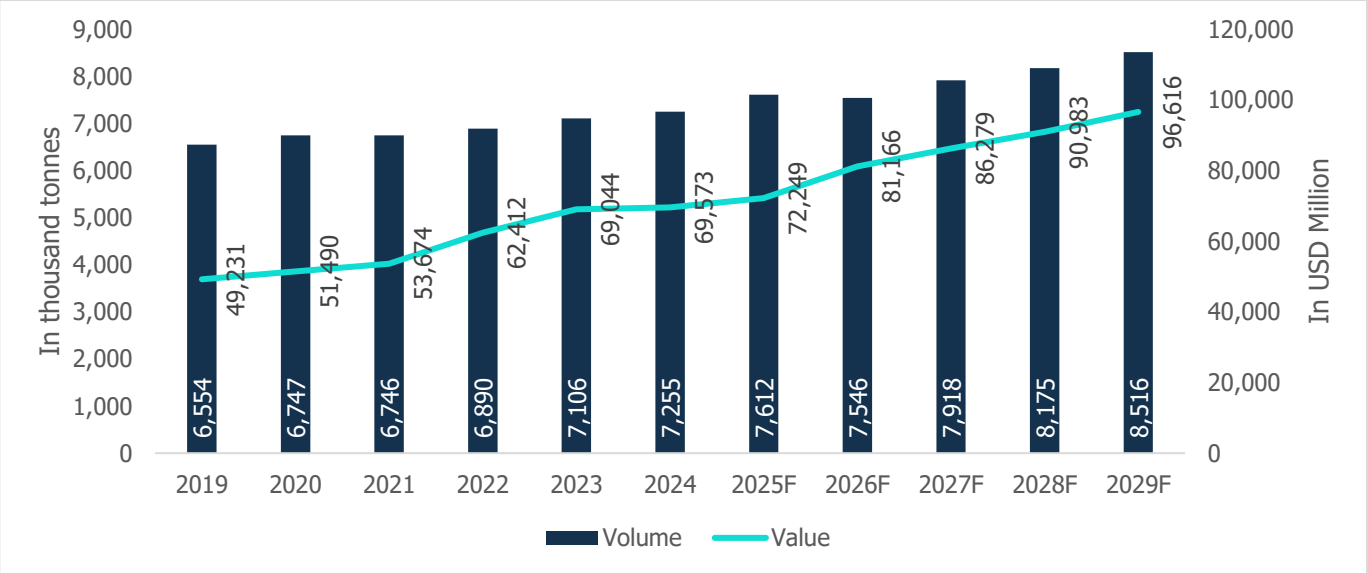
Chart 18: Global Consumption of Bio-fertilizers



Source: CareEdge Research, Maia Research: F: Forecast

On the other hand, pesticides account for 12% of the total volumes consumed in the industry but contribute 68% of the total agrochemicals revenue in the industry. Pesticides help farmers increase their crop productivity, offering protection from insects, weeds, fungi, rodents, bacteria, etc. Also, pesticide consumption in 2024 grew by 2% on a y-o-y basis on account of crop protection from pests, higher yields, and rising food grain production. The demand for these agrochemicals is expected to grow at a CAGR of around 3.3% during 2024-2029.

Chart 19: Global Consumption of Pesticides



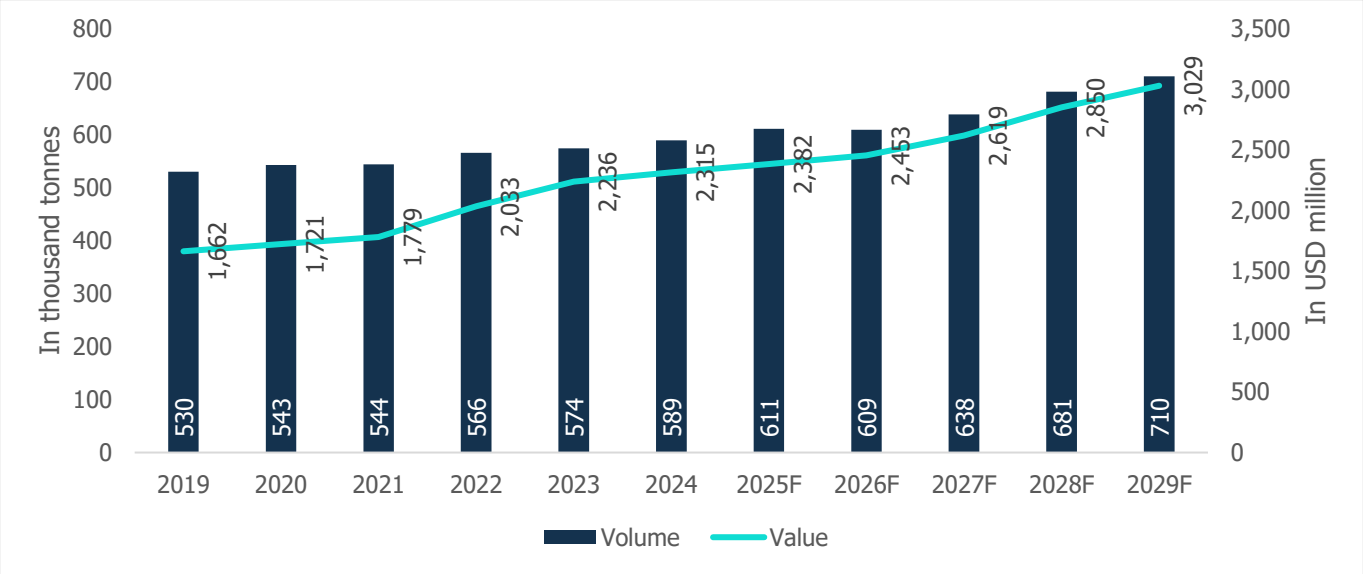
Source: CareEdge Research, Maia Research; F: Forecast
Note: The above data includes formulation grade

The global bio-stimulants market was valued at USD 2,315 million in 2024. The rising demand for organic food is boosting the demand for bio stimulants as consumers are now more concerned about their health and the nutritious content of the food. Organic food items do not utilize fertilizers or pesticides. Moreover, the usage of these stimulants assists farmers by increasing crop yields and enhancing tolerance to abiotic stress.

Further, the shift toward sustainable farming methods is gaining traction, and as a result, the demand for bio stimulants is going to expand going forward. It is projected to grow with a CAGR of 3.8% in terms of volumes and 5.5% in terms

of value during the forecast period, 2024-2029. However, the effectiveness of these stimulants and the lack of awareness among farmers are constraining factors for their growth.

Chart 20: Global Consumption of Bio stimulants



Source: CareEdge Research, Maia Research; F: Forecast

3.5 India - Agri-input Production by Type

The production of agri-inputs in India increased at a CAGR of 16.4% from 689 thousand tonnes in 2019 to 1,354 thousand tonnes in 2024. Pesticides constituted almost 57% share in overall agri-inputs production and are projected to grow by CAGR 3.6% during the period, 2024-2029. Further, the overall agri-inputs production during the forecast period 2024-2029 is projected to grow with a CAGR of 6.9% on account of rising demand for agricultural use.

Table 4: Production of Agri-inputs in India by Type (Thousand tonnes)

Particulars	2019	2021	2023	2024	2025F	2027F	2029F	CAGR 2019-2024	CAGR 2024-2029
Biofertilizer	111	315	450	503	591	735	873	35.28%	11.7%
Pesticides	514	624	745	772	781	856	925	8.48%	3.6%
Bio Stimulants	63	62	72	75	76	85	91	3.55%	3.9%
Total	689	1,001	1,267	1,354	1,448	1,676	1,889	14.47%	6.9%

Source: CareEdge Research, Maia Research; F: Forecast
Note: Pesticides data includes formulation grade

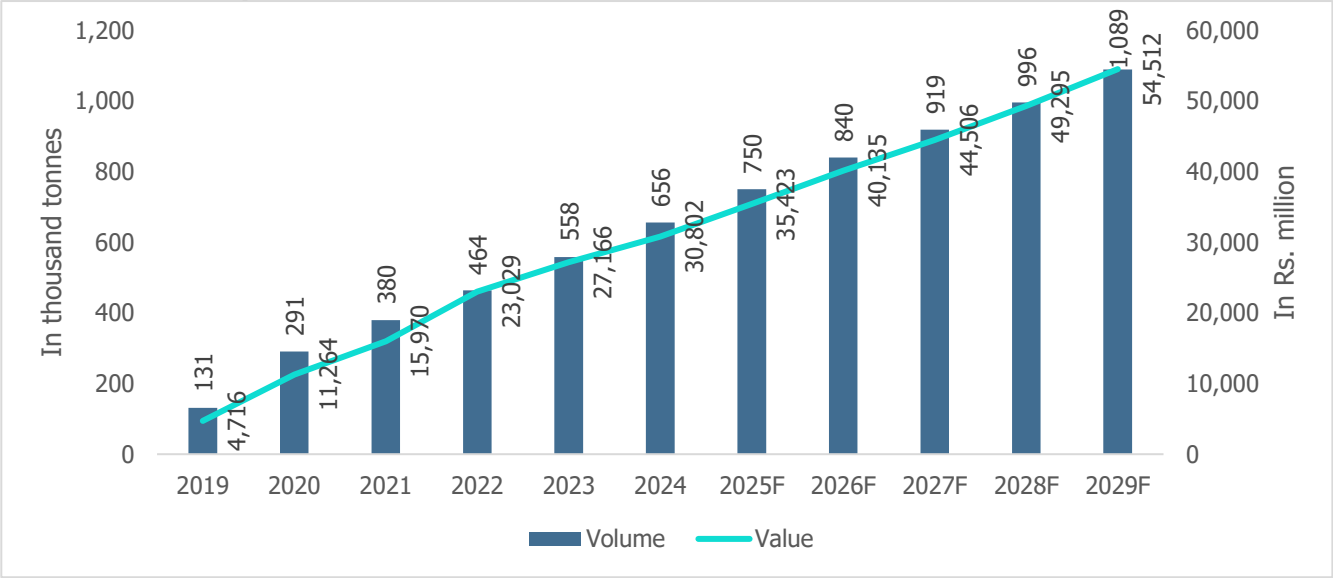
3.6 India - Agri-input Consumption by Type

The consumption of agri-inputs (bio-fertilizers, pesticides and pesticides) in India has increased at a CAGR of 38% during the period, 2019-2024.

Bio-fertilizers are natural fertilizers and demand for these mixtures is actively rising due to consumer preference toward organic commodities, increasing awareness among farmers, and government measures to promote sustainable practices of producing food products. These restore the natural nutrient cycle of the soil and build organic matter. Also, they are eco-friendly and cost-effective.

Bio-fertilizers were valued at Rs. 30,802 million in 2024 and are estimated to reach Rs. 54,512 million in 2029. While there will be steady consumption of this mixture, further growth will require time. Bio-fertilizers are projected to grow by a CAGR of 10.7% and 12.1% in volume and value terms, respectively, during the forecast period, 2024-2029.

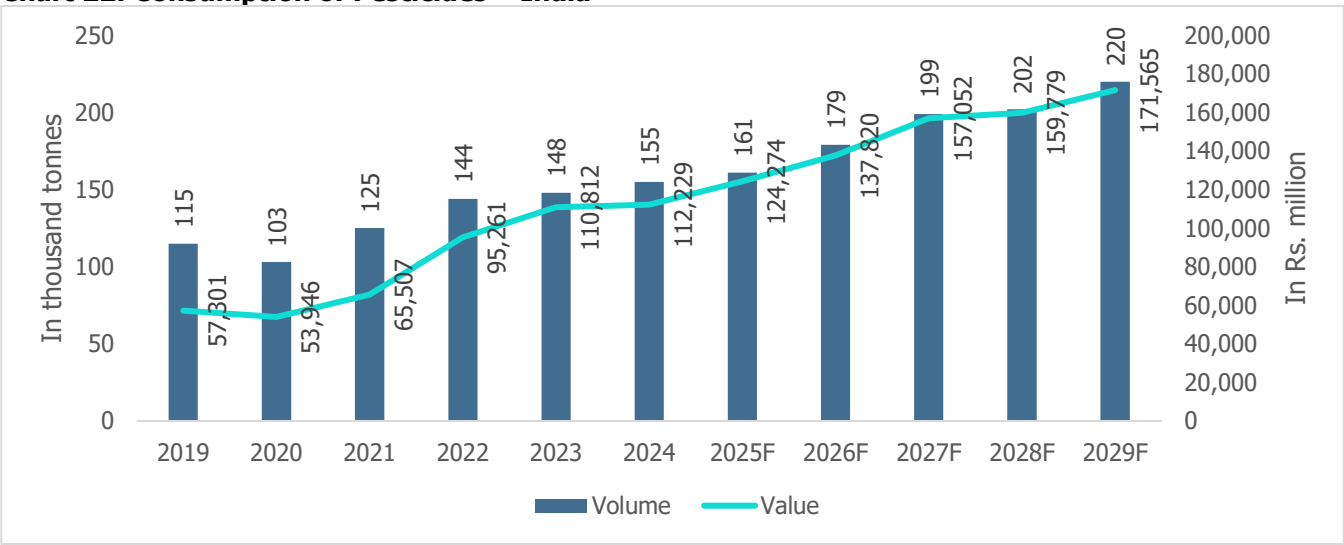
Chart 21: Consumption of Bio-fertilizers - India



Source: CareEdge Research, Maia Research

Further, the usage of pesticides has been increasing over the years. The demand is driven by the country's agricultural activities. Insecticides, fungicides, and herbicides are generally used for pest control in agriculture. In order to protect the crop from losses due to pests, farmers employ these chemical substances. These improve agricultural productivity and ensure food security in the country. The pesticide market in India, which registered a CAGR of 6.2% during 2019-2024, is projected to record a CAGR of 7.2% over the forecast period, 2024-2029. However, growth in this segment may be impeded due to soil contamination, environmental concerns, and risks associated with health.

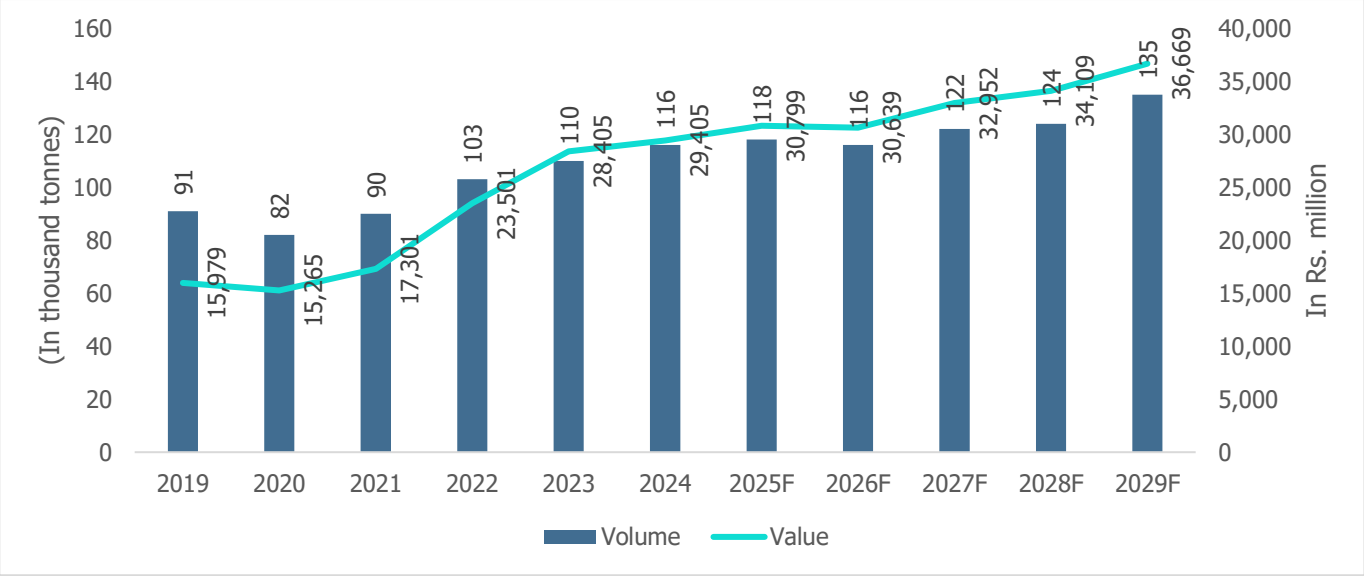
Chart 22: Consumption of Pesticides – India



Source: CareEdge Research, Maia Research
Note: The above data includes formulation grade

Bio-stimulants are another sustainable way to enhance the yield of crops and not affect the environment. There is a rising need for organic farming in India to safeguard adequate food availability while not compromising on the health factor. These are biologically derived substances applied to soil to improve nutrient uptake ability, and abiotic & biotic stress tolerance. The demand in this segment is expected to increase given the need for organic farming. Bio-stimulants are projected to increase by a CAGR of 4.5% and 3.1% in volume and value terms, respectively, during the forecast period, 2024-2029.

Chart 23: Consumption of Bio-stimulants – India



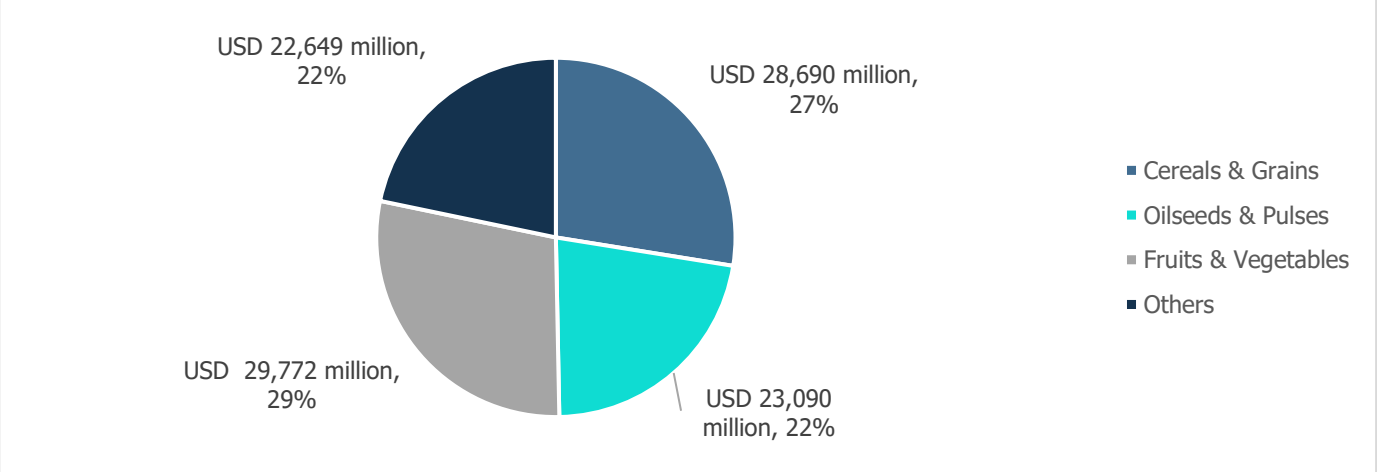
Source: CareEdge Research, Maia Research

3.7 Global Crop Protection & Nutrition Consumption by Application

With regard to application, the fruits and vegetables segment dominates the market with a 29% revenue share, followed by cereals & grains whose share is about 27% as of 2024. The demand for cereals and grains such as wheat, rice, corn, oats, barley, and quinoa are rising, especially in Asia-Pacific, due to the growing population in India and China. Further, the amount of consumption of pulses, cereals, and grains in western regions is increasing, attributed to the shifting consumer preferences, changing lifestyles, and adaption to nutritious food.

Moreover, the consumption of fruits and vegetables is increasing due to growing health consciousness among individuals. Accordingly, pesticides are being used to maintain good quality and protect the crop from pests. Another category, oilseeds and pulses, which constitute 22% of the total revenue is contributing towards the increase in demand. Such factors are fuelling the demand for nutrition and crop protection chemicals, playing a pivotal role in the advancement of these applications.

Chart 24: Share of Nutrition & Crop Protection Chemicals by Application in Global Market in Value Terms - 2024 (%)

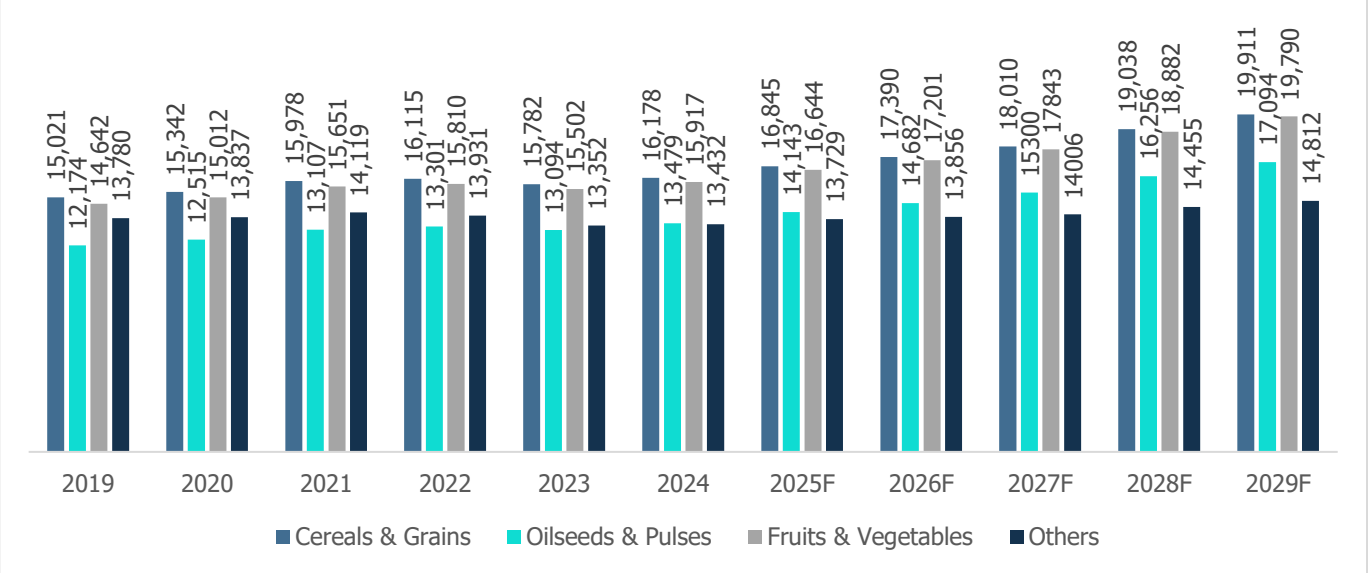


Source: CareEdge Research, Maia Research

Note: Nutrition & crop protection chemicals refer to bio-fertilizers, pesticides and bio stimulants

In terms of volume, the usage of nutrition & crop protection chemicals in cereals and grains and fruits and vegetables accounts 27% each. The demand for cereals and grains is projected to grow by a CAGR of 4.2% during the forecast period, 2024-2029. Whereas fruit and vegetables are projected to grow at a CAGR of 4.5% during the same period. While the demand for oilseeds and pulses, which account for 23%, is projected to grow at a CAGR of 4.8% during the same period.

Chart 25: Global Demand for Nutrition & Crop Protection Chemicals Across Applications (In Thousand Tonnes)

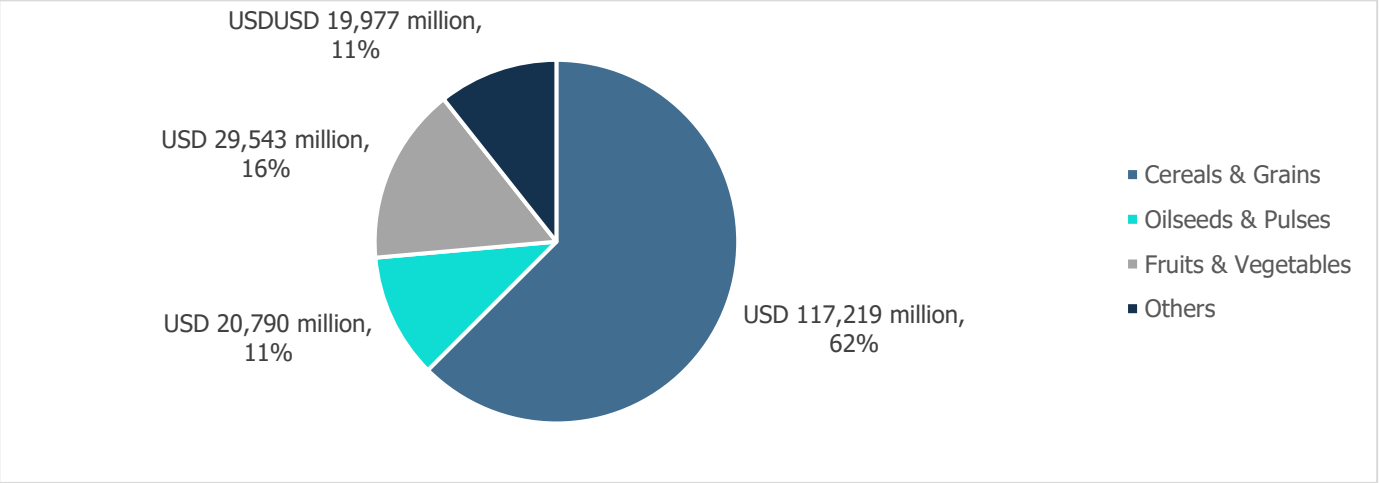


Source: CareEdge Research, Maia Research; F: Forecast
Note: Nutrition & crop protection chemicals refer to bio-fertilizers, pesticides and bio stimulants

3.8 India - Crop Protection & Nutrition Consumption by Application

The total revenue generated from the consumption of nutrition and crop protection chemicals was recorded at Rs. 1,87,530 million out of which cereals and grains generated a sum of Rs. 1,17,219 million while fruits and vegetables and oilseeds and pulses totalled Rs. 29,543 million and Rs. 20,790 million, respectively. In India, the cereals & grains segment accounts for the highest market share with 62% of the total revenue, followed by fruits and vegetables and oilseeds and pulses with about 16% and 11%, respectively, in 2024.

Chart 26: Share of Nutrition & Crop Protection Chemicals by Application in Indian Market in Value Terms - 2024 (%)



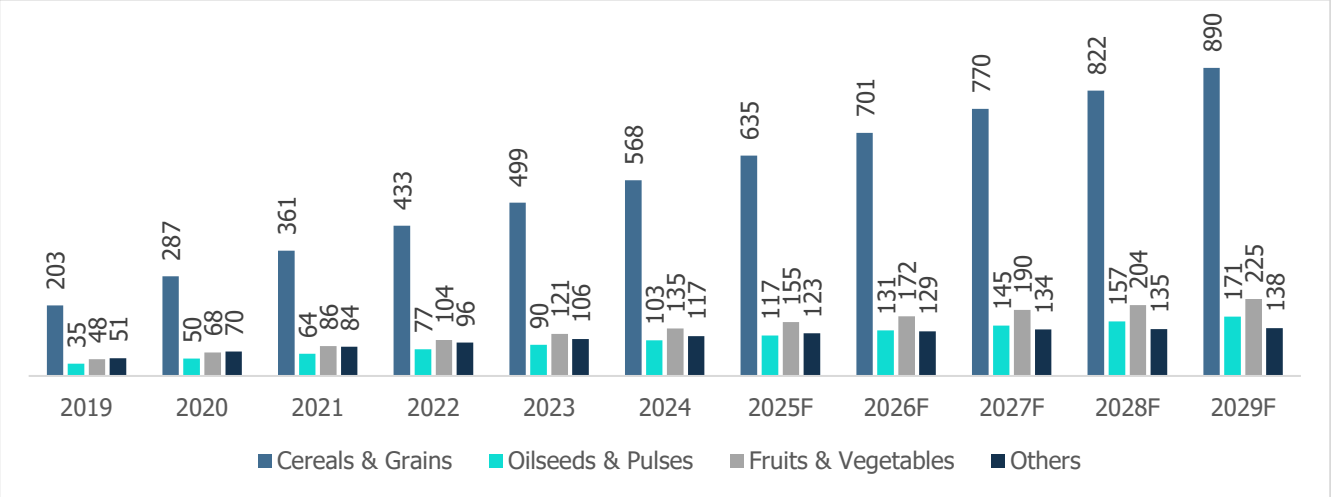
Source: CareEdge Research, Maia Research

Note: Nutrition & crop protection chemicals refer to bio-fertilizers, pesticides and bio stimulants

The demand for nutrition & crop protection chemicals across different applications in India is going to grow swiftly on account of rapid population growth, increased pest infestations, and decreased crop yields.

Whereas the demand for cereals and grains are expected to grow at a good pace over the years at a CAGR of 9.5% during the forecast period, 2024-2029. On the other hand, the demand for fresh fruits & vegetables and oilseed & pulses is projected to grow with a CAGR of 10.1% and 10.7%, respectively, during the same period.

Chart 27: Demand of Nutrition & Crop Protection Chemicals Across Applications in India (In Thousand Tonnes)



Source: CareEdge Research, Maia Research; F: Forecast
Note: Nutrition & crop protection chemicals refer to bio-fertilizers, pesticides and bio stimulants

4 Soil Fertility Status in India

- Soil health and quality are a matter of great concern for the Government of India. The Soil Health Card (SHC) scheme is a flagship programme launched in February 2015 under which are uniform norms followed across different states for analysis of the soil and thereby diagnose fertility-related constraints before making site-specific fertilizer recommendations.

- There were two cycles of this programme conducted namely: Cycle-I during 2015-17 and Cycle-II during 2017-19. Also, during the financial year 2019-20, the Model Villages Programme was taken up under the Soil Health Card (SHC) Scheme on a pilot basis.

- This programme included adopting one village per block for landholding-based soil sampling, testing, and distribution of soil health cards before conducting SHC-based demonstrations in each model village to scale awareness amongst farmers across India.

- In the Model Village Programme, with farmers' participation, sample collection is taken up at individual farm holdings instead of sample collection at grids. The scheme is managed by the Integrated Nutrient Management (INM) Division in the Ministry of Agriculture and Farmers Welfare, Government of India.

Under the SHC scheme, soil health condition is assessed with respect to twelve important soil parameters:
- Nitrogen (N), Phosphorous (P), Potassium (K) - primary macro-nutrients
- Sulphur (S) - secondary macro-nutrient
- Zinc (Zn), Iron (Fe), Copper (Cu), Manganese (Mn), Boron (B) - micro-nutrients
- Electrical Conductivity (EC), Organic Carbon (OC), pH - physical parameters

- As per the norms provided in the scheme's operational guideline, the soil samples collected from different locations are then analyzed in the soil testing labs. The authorities provide a report to the farmers once in 3 years after observing the soil regularly.

- This examination of the farmer's soil helps decide the type of crops to be cultivated for more income generation alongside giving remedial measures. To enable a comparison of the level of soil fertility in one area with another, it is desirable to have a single value for each nutrient, so the Nutrient Index (N.I.) value is one such measure of the nutrient-supplying capacity of soil to plants. The nutrient index is compiled using the assessment of soil fertility classified into three classes namely – low, medium, and high.

As of FY24, the state-wise distribution of soil nutrient indices are as follows:

S.No.	State	Low	Medium	High
1	Andhra Pradesh	N, Zn, OC	P, B, S, Fe, Mn, Cu	K
2	Arunachal Pradesh	—	N, P, B, S, Fe, Zn, Mn, OC, Cu	K
3	Assam	B	N, P, K, S, Fe, Zn, Mn, OC, Cu	—
4	Bihar	N	P, B, S, Fe, Zn, Mn, OC, Cu	K
5	Chhattisgarh	N, S, Zn, OC	P, B, Fe, Mn, Cu	K
6	Goa	—	N, P, B, S, Fe, Zn, Mn, OC, Cu	K
7	Gujarat	N, Zn	B, S, Fe, Mn, OC, Cu	P, K
8	Haryana	N, B, OC	P, K, S, Fe, Zn, Mn, Cu	—
9	Himachal Pradesh	N	P, B, S, Fe, Zn, Mn, OC, Cu	K
10	Jharkhand	N, OC	P, K, B, S, Fe, Zn, Mn, Cu	—
11	Karnataka	N, Fe, Zn, OC	P, B, S, Mn, Cu	K
12	Madhya Pradesh	N, Zn	P, B, S, Fe, Mn, OC	K
13	Maharashtra	N, S, Fe, Zn, OC	P, B, Mn, Cu	K
14	Meghalaya	Cu, S, Fe, Zn, Mn	N, P, K, B, OC	—
15	Mizoram	N, S, Fe, Mn	P, K, B, Zn, OC, Cu	—
16	Nagaland	S	N, P, B, Fe, Zn, Mn, OC, Cu	K
17	Odisha	N, Zn, OC	P, B, S, Fe, Zn, Mn, Cu	K
18	Punjab	N, K, Mn, OC	P, B, S, Fe, Zn, Cu	—
19	Rajasthan	N, Fe, Zn, OC	P, B, S, Mn, Cu	K
20	Sikkim	—	N, P, B, S, Fe, Zn, Mn, OC, Cu	K
21	Tamil Nadu	N, S, Fe, Zn, OC	P, B, S, Fe, Zn, Mn, OC, Cu	K
22	Tripura	N, Zn	P, K, B, S, Fe, Zn, Mn, Cu	—
23	Uttar Pradesh	N, S, Zn, OC	P, B, Fe, Zn, Mn, Cu	K
24	Uttarakhand	—	P, K, B, S, Fe, Zn, Mn, OC, Cu	—
25	West Bengal	S	N, P, B, Fe, Zn, Mn, OC, Cu	K
26	Andaman & Nicobar	N, P, K, S, OC	B, Fe, Zn, Mn, Cu	—
27	Jammu & Kashmir	Fe	N, P, B, S, Zn, Mn, OC, Cu	K
28	Puducherry	N	P, K, Fe, Zn, Mn, Cu	—

Source: EnviStats India 2024, Soil Health Card, Government of India

(Note: This '- 'denotes data is not available for the respective states; Nutrients - N: Nitrogen; P: Phosphorus; K: Potassium; S: Sulphur; Zn: Zinc; Fe: Iron; Cu: Copper; Mn: Manganese, B: Boron; OC: Organic Carbon)

Some inferences that can be made from these indices are:

- Nitrogen fertility has been generally low, except in the case of Meghalaya, Jammu & Kashmir, Goa, and Assam

- Potassium fertility status has been medium in most of the states
- Phosphorous fertility status has either been low or medium in the majority of the states
- As we can see above, the demand for Nitrogen, Potassium, and Phosphorous fertilizers will remain stable in the medium-to-long term as all three nutrients are available in low to medium quantities only.

Barren Land in Agriculture

India is the most populous country with 1.45 billion people in 2024. It has a variety of land use and land cover types, including evergreen forests, barren areas, cold/hot deserts, productive agricultural lands, glaciers, and sand dunes, among others. Climate-wise, there are areas with heavy rainfall and areas with little rainfall. Temperatures in some locations reach 50 degrees C during the summer, while temperatures in others drop to 30 degrees C.

Agricultural land in India constitutes about 60% of the total land area in 2022. Moreover, the availability of arable land (currently used land, or potentially capable of being used, to grow seasonal crops) is huge in the country with 180.11 million hectares according to the Ministry of Agriculture & Farmers Welfare.

On the other hand, the prevalence of barren land (unproductive or land not used for agriculture) in India is significant. However, these are generally not suitable for farming and are left untouched. Furthermore, factors such as deforestation, over-cultivation, and overgrazing contribute to the formation of these wastelands, which are exposed to environmental deterioration.

As per the Desertification and Land Degradation Atlas of India, prepared by the Space Applications Centre for the period 2018-19, 97.85 million hectares i.e. 29.77% of the total geographical area of the country is undergoing the process of desertification/land degradation.

Furthermore, it has become necessary to conserve the barren land in the country to use it for cultivation, development of crops, and preservation for the future. This, in turn, will build fertile land which will help produce good-quality crops leading to greener surroundings. Various schemes, such as the Green India Mission, the Compensatory Afforestation Fund Management and Planning Authority (CAMPA), the Nagar Van Yojana, and others, contribute to the prevention and restoration of forest landscape degradation.

Moreover, the Ministry of Environment, Forest, and Climate Change (MoEF & CC) promotes tree outside forests, recognizing that the country has enormous potential for increasing its Trees Outside Forest (TOF) area, especially through agroforestry expansion and the optimal use of wastelands and vacant lands.

State- Wise Details of Barren Land 2017-18 to 2022-23

State/Union Territory	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Andhra Pradesh	1,345	1,345	1,336	1,335	1,335	1,335
Arunachal Pradesh	37	37	37	37	37	37
Assam	1,216	1,215	1,217	1,209	1,180	1,180
Bihar	432	432	432	432	432	432
Chhattisgarh	287	288	287	288	294	287
Gujarat	2,069	2,077	2,077	2,087	2,080	2,078
Haryana	117	289	199	171	171	138
Himachal Pradesh	777	774	767	766	771	771
Jharkhand	584	579	584	580	586	568
Karnataka	793	769	752	743	742	740
Kerala	11	10	11	10	10	9
Madhya Pradesh	1,369	1,350	1,354	1,314	1,320	1,328
Maharashtra	1,835	1,849	1,882	1,951	1,975	1,986
Manipur	1	1	1	1	1	1

State/Union Territory	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Meghalaya	129	129	129	129	126	126
Mizoram	6	6	6	6	6	6
Nagaland	2	2	2	2	2	2
Odisha	976	1,016	948	1,109	978	1046
Punjab	43	41	35	35	36	38
Rajasthan	2,383	2,383	2,372	2,367	2,366	2,362
Tamil Nadu	458	458	457	457	457	457
Telangana	607	607	607	607	607	607
Tripura	8	8	8	8	8	8
Uttarakhand	250	249	249	249	250	250
Uttar Pradesh	444	442	438	438	392	385
West Bengal	9	8	8	8	8	8
A&N Island	2	2	2	2	2	2
Dadra and Nagar Haveli	-	-	-	-	-	-
Delhi	18	18	18	18	18	16
Jammu & Kashmir	303	308	298	295	295	302
Ladakh	UT was constituted in October, 2019		28	28	28	28
Puducherry	0	0	0	0	0	0
ALL INDIA	16510	16693	16542	16684	16515	16554

Source: Economics Statistics and Evaluation Division, Ministry of Agriculture and Farmers Welfare

Net Sown Area - Agricultural Land (In 000' hectares)

The net sown area pattern across different states during 2018-19 to 2022-23 is as follows:

State/Union Territory	2018-19	2019-20	2020-21	2021-22	2022-23
Andhra Pradesh	6,049	5,884	5,915	6,038	5,725
Arunachal Pradesh	234	235	242	243	253
Assam	2,723	2,699	2,724	2,749	2,744
Bihar	5,167	5,077	5,045	5,070	5,113
Chhattisgarh	4,679	4,635	4,623	4,631	4,592
NCT of Delhi	22*	22*	22*	22	22
Goa	128	127	127 (p)	127	126
Gujarat	9,390	9,787	9,822	9,720	9,748
Haryana	3,601	3,552	3,611	3,611	3,584
Himachal Pradesh	542	530	526	528	532
Jammu & Kashmir	713	720	736	733	733
Jharkhand	1,281	1,291	1,328	1,379	1,025
Karnataka	10,664	10,804	11,453	11,166	11,164
Kerala	2,034	2,026	2,035	2,029	1,990
Madhya Pradesh	15,205	15,512	15,800	15,823	15,848
Maharashtra*	16,815	16,722	16,650	16,590	16,491
Manipur*	441	331	410	393	382
Meghalaya	255	255	253	269	274
Mizoram	145*	145*	145*	145*	145
Nagaland	384	384	386	265	361
Odisha	4,006	4,102	4,179	4,322	4,269

State/Union Territory	2018-19	2019-20	2020-21	2021-22	2022-23
Puducherry	15	15	15	16	16
Punjab	4,119	4,127	4,126	4,113	4,110
Rajasthan	17,778	18,032	17,948	18,130	18,423
Sikkim*	77	77	77	77	83
Tamil Nadu	4,582	4,738	4,833	4,909	4,838
Telangana	4,660	5,500	5,927	5,625	5,897
Tripura	256	255	255	255	255
Uttar Pradesh	16,538	16,368	16368 (p)	16,096	16,121
Uttarakhand	648	638	621	594	568
West Bengal	5,248	5,250	5,282	5,281	5,216
ALL INDIA	**1,38,439**	**1,39,901**	**1,41,544**	**1,41,007**	**1,40,705**

Source: RBI Handbook of Statistics

Note: 'p' denotes provisional; '*' -

5 Minimum Support Price (MSP)

The government's price policy for major agricultural commodities seeks to ensure remunerative prices to the growers for their produce with a view to encourage higher investment and production and thereby safeguard the interest of consumers by making available supplies at reasonable prices.

The government fixes the MSP of 22 mandated agricultural crops on the basis of the recommendations of the Commission for Agricultural Costs & Prices (CACP) and after due consideration of the views of state governments and the concerned central ministries/departments.

The 22 mandated crops include:

Kharif crops which are typically sown in the rainy season include 14 major types of kharif crops namely paddy, jowar, bajra, maize, ragi, tur (arhar), moong, urad, groundnut, sunflower seed, soyabean (yellow), sesamum, nigerseed, cotton

Whereas Rabi crops which are sown in winter season include 6 major types of rabi crops namely wheat, barley, gram, Masur (lentil), rapeseed and mustard, safflower

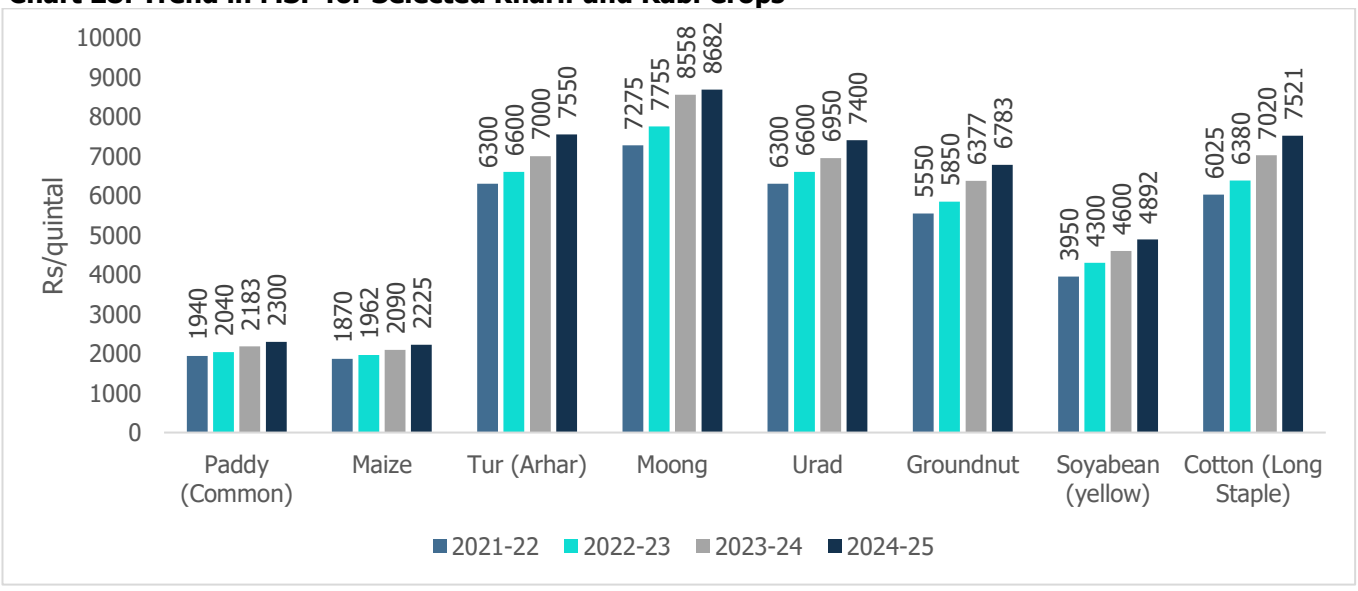
Apart from these, 2 commercial crops are also included viz. jute and copra

In addition to that, MSPs for toria and de-husked coconut are also fixed on the basis of MSPs for rapeseed & mustard and copra respectively.

While recommending MSPs, CACP considers important factors like cost of production, overall demand-supply conditions, domestic and international prices, inter-crop price parity, terms of trade between agricultural and non-agricultural sectors, and the likely effect on the rest of the economy, besides ensuring rational utilization of land, water and other production resources, and a minimum of 50% as the margin over cost of production.

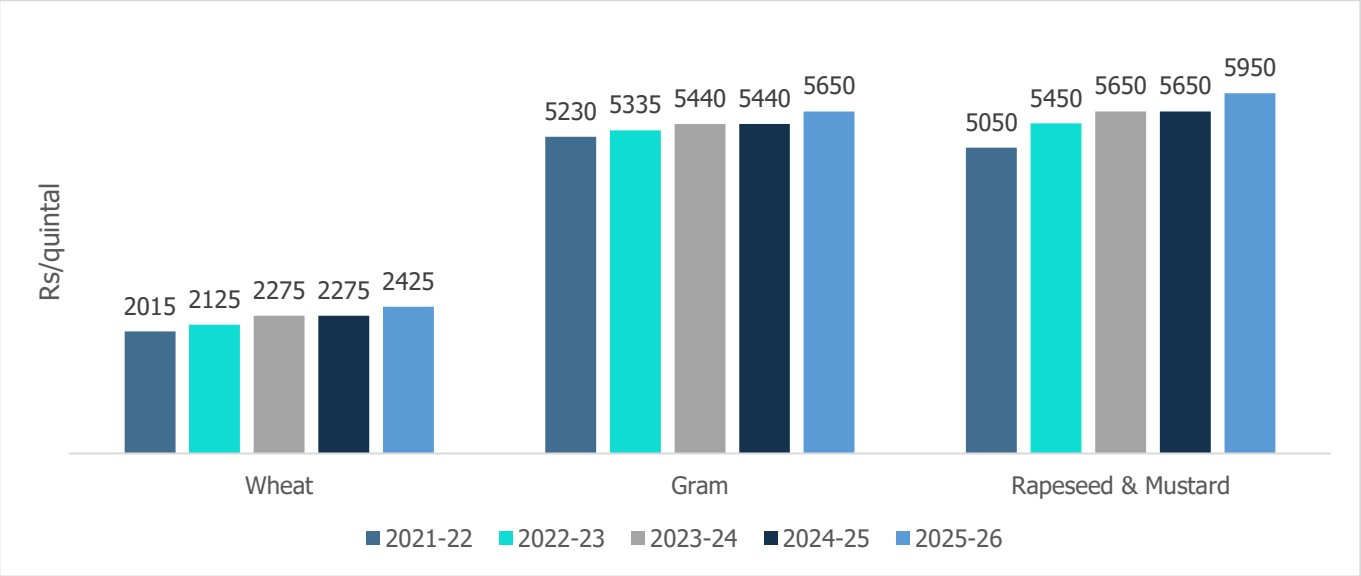
Accordingly, the government has increased the MSP for all mandated kharif, rabi, and other commercial crops with a return of at least 50% of India's weighted average cost of production from the agricultural year 2018-19 onwards. The MSPs announced for all the kharif and rabi crops for the last 5 years are as follows:

Chart 28: Trend in MSP for Selected Kharif and Rabi Crops



Source: Directorate of Economics and Statistics, PIB release

Chart 29: Trend in MSP for Selected Rabi Crops



Source: Directorate of Economics and Statistics, PIB release

Table 5: MSPs for all Kharif Crops During Past 5 Years (Rs. /Quintal)

S.No.	Crop	2020-21	2021-22	2022-23	2023-24	2024-25
1	Paddy (Common)	1,868	1,940	2,040	2,183	2,300
2	Paddy (Grade A) ^	1,888	1,960	2,060	2,203	2,320
3	Jowar (Hybrid)	2,620	2,738	2,970	3,180	3,371
4	Jowar (Maldandi)^	2,640	2,758	2,990	3,225	3,421
5	Bajra	2,150	2,250	2,350	2,500	2,625
6	Ragi	3,295	3,377	3,578	3,846	4,290
7	Maize	1,850	1,870	1,962	2,090	2,225
8	Tur (Arhar)	6,000	6,300	6,600	7,000	7,550
9	Moong	7,196	7,275	7,755	8,558	8,682
10	Urad	6,000	6,300	6,600	6,950	7,400
11	Groundnut	5,275	5,550	5,850	6,377	6,783
12	Sunflower Seed	5,885	6,015	6,400	6,760	7,280
13	Soyabean (yellow)	3,880	3,950	4,300	4,600	4,892
14	Sesamum	6,855	7,307	7,830	8,635	9,267
15	Nigerseed	6,695	6,930	7,287	7,734	8,717
16	Cotton (Medium Staple)	5,515	5,726	6,080	6,620	7,121
17	Cotton (Long Staple) ^	5,825	6,380	6,380	7,020	7,521

Source: PIB release

^Cost data are not separately compiled for Paddy (Garde A), Jowar (Maldandi) and Cotton (Long staple)

Table 6: MSPs for all Rabi During Past 5 Years (Rs. /Quintal)

S.No.	Crops	2020-21	2021-22	2022-23	2023-24	2024-25
1	Wheat	1,975	2,015	2,125	2,275	2,275
2	Barley	1,600	1,635	1,735	1,850	1,850
3	Gram	5,100	5,230	5,335	5,440	5,440
4	Lentil (Masur)	5,100	5,500	6,000	6,425	6,425
5	Rapeseed & Mustard	4,650	5,050	5,450	5,650	5,650
6	Safflower	5,327	5,441	5,650	5,800	5,800
7	Toria	4,650	5,050	5,450	-	-

8	Copra (Calendar Year) (Milling)	9,960	10,335	10,590	10,860	11,582
9	Copra (Calendar Year) (Ball)	10,300	10,600	11,000	11,750	12,100
10	De-husked coconut (Calendar Year)	2,700	2,800	2,860	2,930	3,013
11	Jute	4,225	4,500	4,750	5,050	5,650

Source: PIB release

6 Top 5 States- Major Crops

The major crops produced in top 5 states in India during kharif season in 2023-24 are:

Food Grains:

Crop	State	Production (Lakh Tonnes)
Rice	Uttar Pradesh	163.0
	Punjab	144.5
	West Bengal	115.2
	Chhattisgarh	78.2
	Telangana	93.5
	All India	1,114.6
Maize	Madhya Pradesh	49.3
	Karnataka	45.0
	Maharashtra	14.4
	Rajasthan	18.1
	Uttar Pradesh	18.3
	All India	227.2
Jowar	Rajasthan	5.3
	Uttar Pradesh	4.6
	Madhya Pradesh	1.6
	Tamil Nadu	1.3
	Maharashtra	0.9
	All India	15.5
Bajra	Rajasthan	42.8
	Uttar Pradesh	22.0
	Haryana	11.7
	Madhya Pradesh	9.6
	Maharashtra	2.0
	All India	95.3
Ragi	Karnataka	8.7
	Tamil Nadu	1.9
	Uttarakhand	1.0
	Maharashtra	0.9
	Odisha	0.4
	All India	13.9
Small Millets	Madhya Pradesh	1.5
	Uttarakhand	0.6
	Odisha	0.3
	Maharashtra	0.2
	Karnataka	0.2
	All India	4.3
Tur	Maharashtra	8.8

Crop	State	Production (Lakh Tonnes)
	Karnataka	9.5
	Uttar Pradesh	3.8
	Gujarat	2.7
	Jharkhand	2.1
	All India	33.4
Urad	Madhya Pradesh	4.7
	Uttar Pradesh	4.4
	Maharashtra	1.1
	Rajasthan	1.7
	Jharkhand	0.9
	All India	15.5
Moong	Rajasthan	11.0
	Karnataka	0.7
	Maharashtra	0.7
	Gujarat	0.3
	Odisha	0.3
	All India	14.1
Other Pulses	Rajasthan	4.6
	Odisha	0.9
	Maharashtra	0.5
	Tamil Nadu	0.4
	Karnataka	0.6
	All India	8.2

Oilseeds:

Crop	State	Production (Lakh Tonnes)
Groundnut	Gujarat	36.7
	Rajasthan	20.9
	Madhya Pradesh	9.1
	Tamil Nadu	4.3
	Andhra Pradesh	1.6
	All India	79.1
Castorseed	Gujarat	15.1
	Rajasthan	3.3
	Andhra Pradesh	0.2
	Telangana	0.0
	Odisha	0.1
	All India	18.8
Sesamum	Madhya Pradesh	1.2
	Uttar Pradesh	1.2
	Rajasthan	0.9
	Gujarat	0.3
	Karnataka	0.1
	All India	4.0
Nigerseed	Odisha	0.2
	Chhattisgarh	0.1
	Madhya Pradesh	0.0
	Assam	0.0
	Maharashtra	0.0
	All India	0.3
Soybean	Maharashtra	52.7
	Madhya Pradesh	51.3

	Rajasthan	10.5
	Karnataka	4.4
	Gujarat	3.0
	All India	125.6
Sunflower	Karnataka	0.6
	Andhra Pradesh	0.0
	Maharashtra	0.0
	Tamil Nadu	0.0
	Bihar	0.0
	All India	0.7

Commercial:

Crop	State	Production (Lakh Tonnes)
Sugarcane	Uttar Pradesh	2,056.3
	Maharashtra	1,060.0
	Karnataka	531.9
	Tamil Nadu	144.1
	Gujarat	133.6
	All India	4,464.3
Cotton	Gujarat	89.7
	Maharashtra	82.4
	Telangana	48.1
	Rajasthan	27.4
	Karnataka	16.9
	All India	323.1
Jute	West Bengal	74.9
	Assam	6.7
	Bihar	9.5
	Odisha	0.5
	All India	92.2
Mesta	West Bengal	1.6
	Bihar	1.6
	Assam	0.2
	Odisha	0.2
	All India	4.2

Source: Department of Agriculture & Farmers Welfare (DA&FW)
Note: 1. Data for the year 2023-24 is of 2nd Advance Estimates
2. Cotton Production in Bales, 1Bale=170 Kg
3. Jute & Mesta Production in Bales, 1Bale=180 Kg

7 Pesticides Industry

7.1 Overview of the Global Pesticides Industry

7.1.1 Segments and Structure of the Global Pesticides Industry

The global pesticide industry is dominated by the herbicides segment followed by the fungicides and insecticides segments. Of the global market size of around USD 69,570 million, herbicides accounts for nearly half of the crop protection industry globally, however it is on the lower side for India which is around 17% of the total consumption.

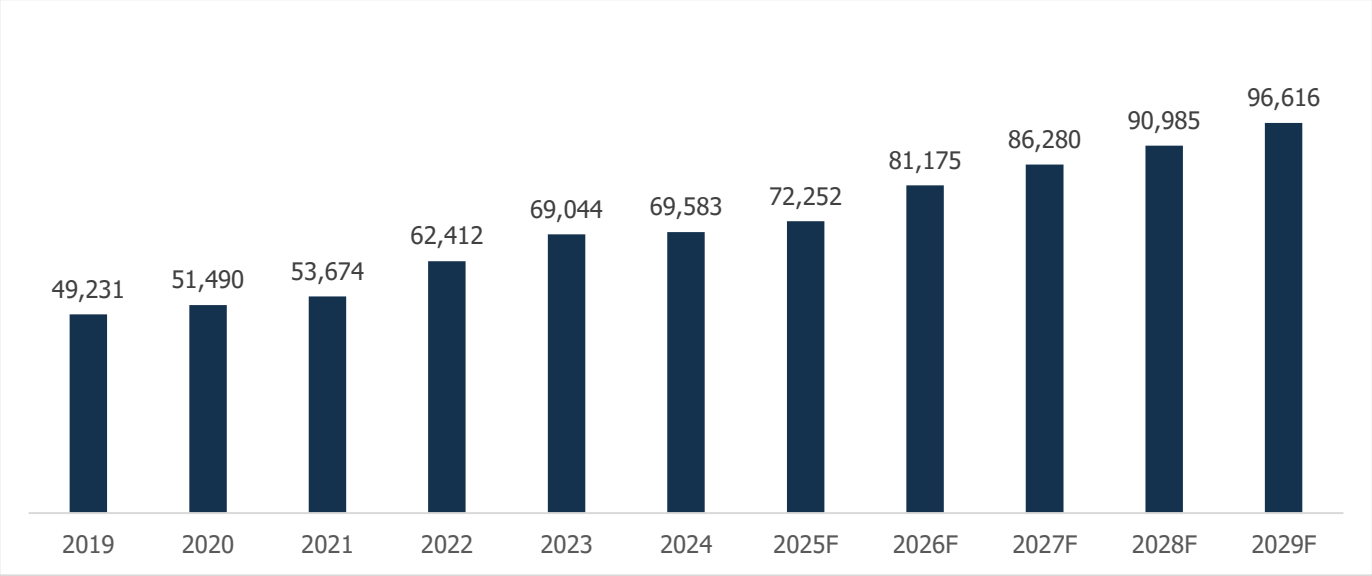
Apart from the crop market, another segment that has contributed to the global pesticides market includes the non-crop market. This segment had a market size of around USD 11.5 billion in 2024. These pesticides find their application in homes & gardens, turfs & ornamentals, pest control operations, industrial vegetation management, forestry, public health, and aquatics, among others. They are used for the control of weeds, diseases, insects, and other pests. Also, they are used for plant growth regulation.

With the expected increase in the application of these pesticides on account of the benefits offered by them, the crop market is estimated to grow at a faster CAGR compared to that of global non-crop. Accordingly, the global non-crop market is expected to rise to a CAGR of about 4-5% by 2029 and is estimated to reach the level of approximately USD 14.7 billion.

7.1.2 Trends in Global Pesticides Industry

During 2019-2024, the global pesticides market grew at a CAGR of 7.2% from USD 49,231 million in 2019 to USD 69,583 million in 2024. The demand in the market has grown despite the geopolitical tensions and global supply chain issues due to which the prices of raw material prices rose high. In 2023, the global pesticide market faced headwinds from supply chain disruptions and regulatory tightening, especially in China leading to sharp rise in prices. By 2024, the market inched up to USD 69,583 million, as China stabilized production and led a shift toward eco-friendly formulations amid global pressure for sustainable agriculture.

Chart 30: Trend in the Global Pesticides Market (USD million)



Source: CareEdge Research, Maia Research; F: Forecast
Note: Pesticides data includes formulation grade

Pesticides, also called agrochemicals, are used in agriculture to support the growth and safety of plants, protect crops from pests, and increase the yields of crops. They also protect crops from insects, diseases, and weeds. The mentioned benefits are the primary reasons that have supported the growth of this industry globally over the years. In addition to this, the sufficiency of global food production in the world to meet the requirements of the increasing world population has also been supporting the market of the pesticides industry globally.

Moreover, the above-mentioned factors are expected to continue to provide support to the global pesticides industry. Thus, this market is expected to register a growth of around 6.8% during 2024-2029 and is likely to reach approximately USD 96,616 million by 2029.

7.2 Evolution of the Pesticides Industry in India

The evolution of pesticides in India was led by the Green Revolution. In 1943, India saw one of the worst food disasters during the Bengal famine. Food shortages have resulted in the death of around 40 lakh people in the eastern part of India. The problem of food shortage in India continued even after independence during different time periods and the frequent food scarcity issue led to the beginning of the Green Revolution in India.

The Green Revolution

- The Green Revolution started around the world in several countries between the 1950s and the late 1960s. This resulted in various research technology transfer initiatives throughout the world, which in turn, focused on increasing agricultural production. The revolution started with Norman Borlaug's genetic testing. A hybrid wheat plant that could withstand diseases and fungi (in addition to high yield) was created by him. He is also known as the father of the Green Revolution.

- Around the 1960s the Green Revolution was launched by the Government of India with the support of M.S. Swaminathan, a geneticist, who is now referred to as the father of India's Green Revolution. The revolution started in 1967 and continued till 1978.

- The Green Revolution in India resulted in growth in agricultural production, primarily in the states of Haryana, Punjab, and Uttar Pradesh. The main achievement in this revolution was the development of a high-yielding variety of seeds of wheat and rust-resistant strains of wheat.

Aspects of Green Revolution in India

- High Yielding Varieties (HYV)
- Mechanization of Agriculture
- Use of Chemical Fertilizers and Pesticides
- Irrigation

- The Green Revolution that engaged agricultural production with the usage of modern tools and techniques involved the aspect of pesticides and chemical fertilizers. This revolution resulted in the conversion of agricultural systems into industrial systems. This further required the utilization of modern methodologies like high-yielding variety seeds, tractors, pesticides, fertilizers, and irrigation facilities. Until 1967, the government primarily focused on augmenting the farming areas. However, the rapid growth in population compared to food production demanded a major and immediate requirement to raise yield, which resulted in the evolution of the Green Revolution.

7.3 Classification of Pesticides - By Types & Application

The Indian agrochemicals industry can be primarily divided into the following types:

- Insecticides
- Fungicides
- Herbicides

- **Insecticides**

Insecticides enable protection of the crops from insects by either preventing their attack or destroying them. They help in controlling the population below a desired threshold level.

They can be further classified based on their mode of action:

- **Contact Insecticides:** Insects get killed on direct contact with these insecticides and they leave marginal residual activity which affects the environment minimally.

- **Systemic Insecticides:** Plant tissues absorb these insecticides and destroy insects when the insects feed on plants. These are generally related to long-term residual activity.

- **Fungicides**

Fungicides are used to prevent fungi attacks on crops and to tackle crop diseases. Protectants and eradicants are two types of fungicides. Protectants protect or hinder fungal growth and eradicants destroy the diseases on usage. This results in better productivity, contraction in crop blemishes, and increased storage life.

- **Herbicides**

Herbicides, also known as weedicides, are used to destroy unwanted plants. The unavailability of cheap labour leads to the major usage of herbicides in rice and wheat crops. The demand for herbicides is seasonal as they develop in damp, warm climates, and perish in cold spells. They are of two types depending on the way of action, selective and non-selective. Selective herbicides destroy specific weeds not harming the desired crop and non-selective herbicides are used for widespread ground clearance to handle weeds pre-crop planting.

Based on the usage, there are three types of herbicides:

1. Application prior to sowing of the crop (pre-planting)
2. Application post-development of weeds (pre-emergence)
3. Application right away subsequent to sowing (post-emergence)

- **Bio-Pesticides**

These are the new-age chemicals produced from substances of nature like plants, animal waste, bacteria, and minerals. Bio-pesticides have a small share in the agrochemicals market in India, which is expected to grow, backed by government support and increased awareness about pesticides that are eco-friendly. These pesticides are environmentally friendly and easy to use.

- **Others**

This others segment comprises fumigants, biostimulants, nematicides, rodenticides, and plant growth regulators (PGR). Plant growth regulators are chemicals used to modify and enhance plant growth such as increasing branching, suppressing shoot growth, increasing return bloom, removing excess fruit, or altering fruit maturity. Various factors such as how well the chemical is absorbed by the plant, tree vigour, and age, dose, timing, and weather conditions before, during, and after application affect the PGR performance. They prevent cops from attacking pests at the time of crop storage.

7.4 Overview of Pesticide Value Chain

The value chain of the pesticide industry involves five stages as shown in the chart below. The chain starts with intermediates moves to technical grades, formulations, and distributors and concludes at end-users.

The intermediates consist of petrochemical derivatives, natural feedstock, and chemicals that go into the making of technical grades. Once the technical grade or active ingredient is synthesized, the process moves to formulations.

Chemical synthesis is the method of transforming a reactant or starting material into a product or several products by one or more chemical reactions. The active ingredient controls pests and gives controlling action to the pesticides. This ingredient repels, destroys, or alleviates pests. It is also known as technical grade. The active ingredient is the technical grade of pure pesticide.

Figure 1: Pesticide Value Chain

Pesticides are generally not applied in their pure form. It is usually formulated by adding inert ingredients that improve storage, handling, application, effectiveness, or safety. The inert ingredients, which involve solvents, adjuvants, and fillers aid in the handling, application, storage, effectiveness, or safety of the pesticides. This is the formulation process of pesticides.

While the active ingredient destroys the pest, the inert ingredient facilitates ease of handling, spraying, and coating on plants. Following this, formulations are available to distributors who sell them to the end-users like farmers.

Enhanced Supply Chain Efficiency in the Agrochemical Space

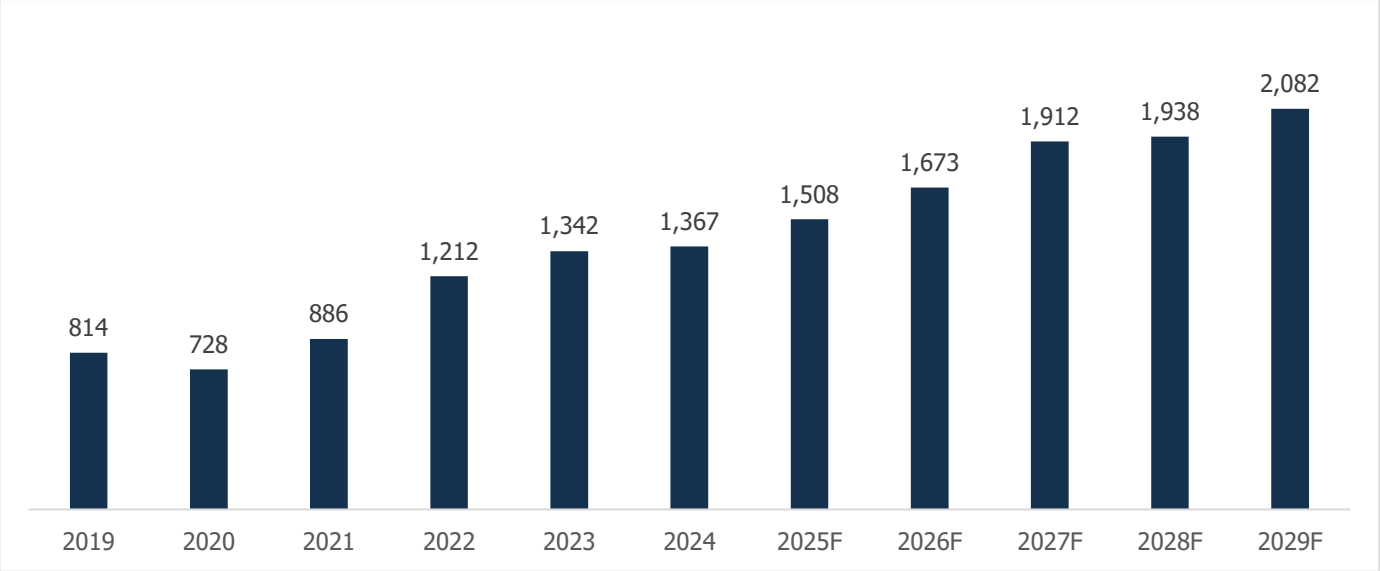
The Agrochemical supply chain has been considered as one of the most complex activities due to factors like seasonal demand, unpredictability of pest attacks, and high dependency on monsoons, which hinder the inventory and distribution of products. The Indian Agrochemical supply chain entails technical grade manufacturers, formulators producing end products, distributors, dealers, and retailers. An effective distribution channel plays a critical role in determining the growth of players in the industry.

While distributors are a large portion of the system, the trend is shifting, and manufacturers are moving to deal directly with dealers. This is further expected to make the supply chain more effective going forward as it will reduce time as well as cost for the players.

7.5 Review of Domestic Pesticide Industry

The overall Indian pesticides market grew at a CAGR of 10.9% from USD 814 million in 2019 to USD 1,367 million in 2024. It is projected to grow with a strong CAGR of 8.8% over the forecast period 2024-2029.

Chart 31: Indian Pesticides Industry (USD million)



Source: CareEdge Research, Maia Research; F: Forecast
Note: Pesticides data includes formulation grade

The Indian pesticide industry can be primarily divided into the following types:

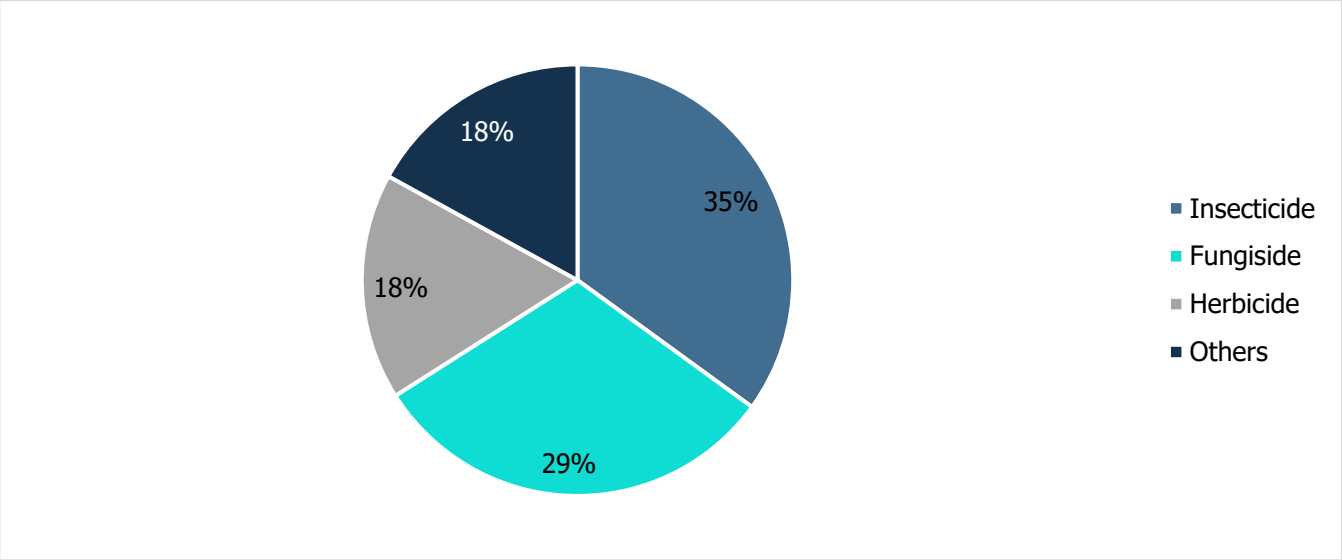
a. Insecticides

b. Fungicides

c. Herbicides

Insecticides account for a major share of around 35% followed by fungicides and herbicides, with an approximate share of 29% and 18%, respectively.

Chart 32: Segment-Wise Share of Agrochemicals in Indian Market in 2024 (in %)

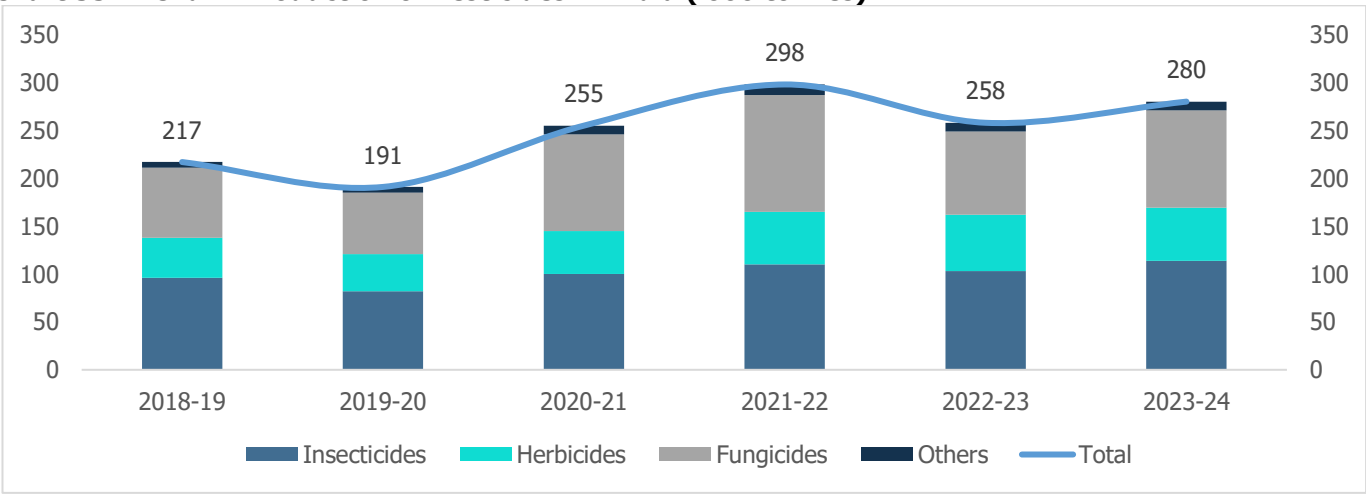


Source: Based on Industry sources, CareEdge Research estimates, Directorate of Plant Protection, Quarantine & Storage
Note: Others include- Rodenticides, PGR and Bio- Pesticide.

7.5.1 Production of Pesticides in India

The output of pesticides in India (which includes 42 technical grades) increased at a CAGR of 4.5% from 217 thousand tonnes in 2018-19 to 280 thousand tonnes in 2023-24.

Chart 33: Trend in Production of Pesticides in India ('000 tonnes)



Source: Directorate of Plant Protection, Quarantine & Storage; Segmental numbers for FY24 considered on average basis
Note: The production data includes the quantity of technical grades only. Others include plant growth regulators, fumigants, bio stimulants, rodenticides and nematicides.

During 2023-24, the production of pesticides increased by 9% y-o-y to 280 thousand tonnes. Stability in prices owing to destocking inventory supported the rise in production of pesticides.

Outlook

The overall Indian pesticide industry is estimated to increase at a CAGR of around 8% during the period 2023-2029. on account of an upward growth expected in the international market and a likely increase in domestic usage of pesticides in India.

While the demand for India's pesticides is likely to remain high, India aims to strengthen the process of backward integration for industry. This is because India is dependent on China for some of the technical insecticides, and thus, any disruptions at this source destination (like a chemical plant shutdown in China to reduce pollution) have the potential to affect India's supply chain. While such situations also provide an opportunity for India to increase the exports of pesticides, it does impact the supply chain of the industry. To avoid such instances, the Indian government said that it is considering increasing the scope of the Production Linked Incentive (PLI) scheme to include the domestic manufacturing of agrochemicals.

If implemented, the scheme will result in increased competitiveness of domestic producers, and given the reliance on exports, benefits will help India increase its market share in the global agrochemicals markets. The scheme will also help the industry become self-sufficient and will be able to integrate backwards to produce its own technical-grade ingredients instead of relying on China for supplies.

Moreover, many countries across the world are looking forward to a 'China plus one strategy' to avoid excess dependence on China. The adoption of this strategy internationally will benefit India, as the countries that import pesticides from China may now opt for India, which is the 4th largest producer and 13th largest exporter of agrochemicals globally.

While the above-mentioned factors will support the Indian pesticide industry going forward, it is worth mentioning that the Indian pesticide industry remained resilient even during the pandemic year (2021-22) as exports from the Indian pesticide industry increased by a healthy 22% to 648 thousand tonnes and grew by 37.7% to Rs.365 billion on a y-o-y basis.

In addition, India has a competitive edge in terms of low labour costs and has support towards chemical clusters, which will also aid the growth of the agrochemical industry in the coming years.

7.6 Overview of Generic and Premium Products in the Market

The Indian pesticides market is primarily dominated by generics that account for almost 75%-80% of the total market with specialty or premium pesticides accounting for the remaining share. Generic pesticides are sold at a cheaper price compared to specialty pesticides that offer higher effectiveness.

Further, generic pesticides are manufactured with the availability of molecules that go off-patent since this enables the commercial development of generic pesticides. A patent is an exclusive right granted by the government for an invention, which is a product or a process that provides, in general, a new way of doing something, or offers a new technical solution to a problem.

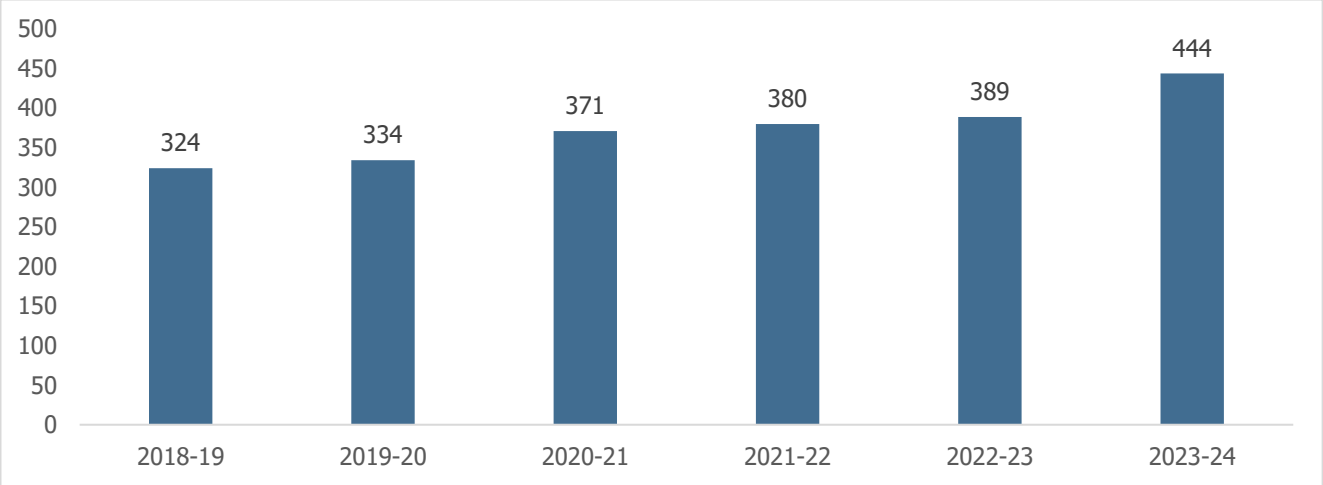
In addition, a patent grants its owner the legal right to prevent others from manufacturing, using, selling, or importing the patented product without the owner's permission, for a duration of 20 years. As per government guidelines, the term of all patents after 2002 was uniformly set at 20 years. The period of 20 years commences from the date of the filing of the relevant patent application. The patent protection period of 20 long years gives the patentee ample opportunity to recoup the money spent on initial research and subsequent commercial introduction. The patent rights are territorial and limited to the country where they have been granted.

7.7 Production Capacity of Pesticides in India

The pesticide production capacity in India meets the domestic and export requirements of the nation. Over the years, the production capacity in India has increased at a CAGR of 6%. It has increased from 324 thousand tonnes in 2018-19 to 444 thousand tonnes in 2023-24.

The pesticide production capacity has grown in each of the years for the period 2018-2022 except for 2018-19, where the capacity declined by a marginal 0.3% to 324 thousand tonnes. It is important to note that the industry's capacity utilisation on average has been around 65% in these last five years.

Chart 34: Trend in Production Capacity of Pesticides in India (`000 tonnes)

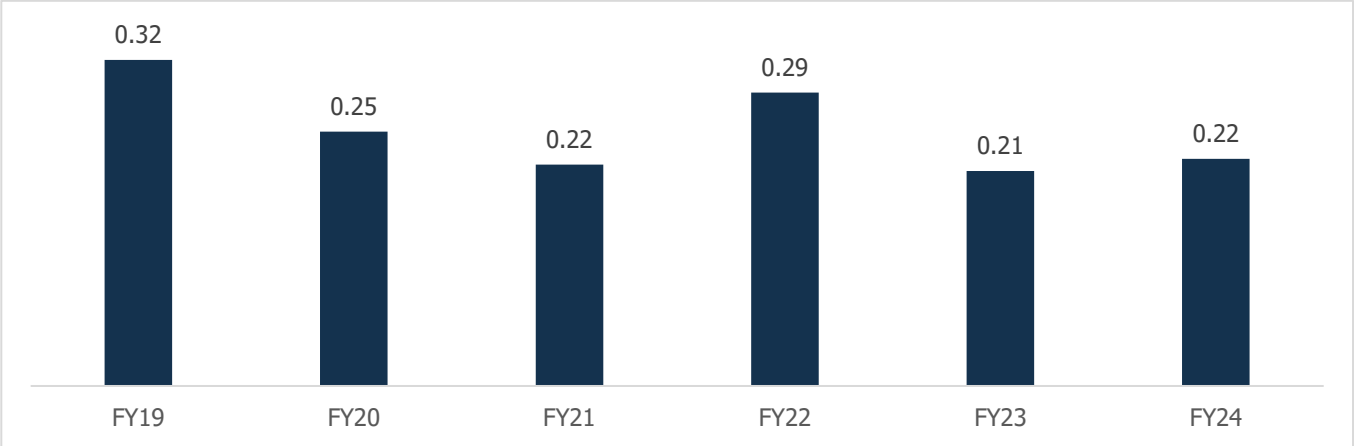


Source: Department of Chemicals and Petrochemicals
Note: The capacity refers only to technical grade

7.8 Low Per Hectare Pesticides Consumption in India

Of the total pesticides produced in India, the average per hectare chemical pesticides consumption accounted to around 0.25 kg/hectare during the period FY19 to FY24. In FY24, the per hectare pesticide consumption in India was 0.22 kg/hectare. India's share is the smallest compared to all other nations. India's per hectare consumption is even lower than the world average of 2.6 kg per hectare and that of Asia which stood at 3.7 kg per hectare.

Chart 35: Per-Hectare Pesticide Consumption in India (Kg/Hectare)



Source: Directorate of Plant Protection, Quarantine & Storage

India's per hectare consumption is lower than the world average of 2.6 kg per hectare and of Asia at 3.7 kg per hectare. The per hectare consumption of pesticides in India is minimal at 0.2 kg compared to the per hectare consumption of 13 kg and 12 kg in China and Japan, respectively. The low consumption at home has made India the net exporter of pesticides and India has emerged as the 13th largest exporter of pesticides globally which is discussed later in the report. [1]

[1] The data is taken from FICCI – Overview of Agrochemicals Report 2021.

Table 7: Country-Wise Consumption of Pesticides

Countries	Consumption (in '000 Tonnes)	World Share (in %)
China	1763	43%
USA	407	10%
Brazil	377	9%
Argentina	172	4%
Canada	90	2%
France	85	2%
Russia	76	2%
Australia	63	2%
Spain	61	2%
Ecuador	60	1%
Turkey	60	1%
India	58	1%
Italy	54	1%
Others	796	20%

Source: Lok Sabha Documents

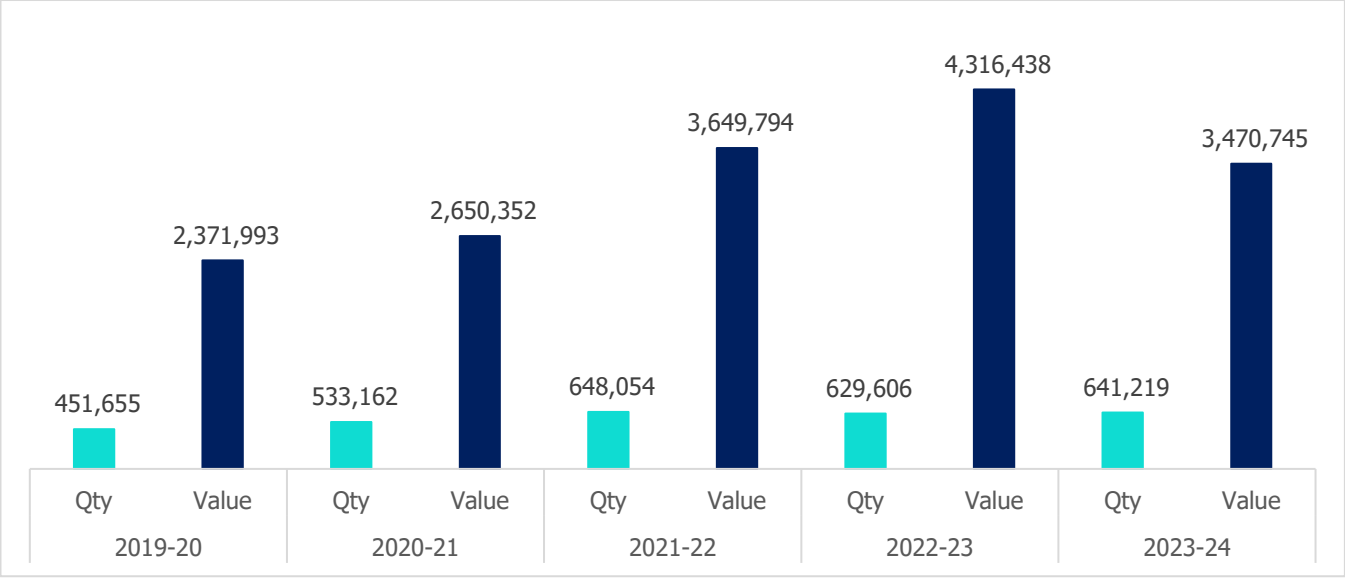
China has the highest share in terms of consumption of pesticides at 43% followed by the USA (10%) and Brazil (9%). As aforementioned, India's share is significantly low at 1%.

7.9 Trade Scenario of Pesticides in India

7.9.1 Trend in Pesticides Exports by India

India is a net exporter of pesticides, and the outbound shipments account for a significant share of the total market size of the Indian agrochemicals industry. Exports of pesticides (technical and formulations both) grew at a CAGR of 8.1% from 461 thousand tonnes in 2018-19 to 630 thousand tonnes in 2023-24. It is to be noted that exports CAGR increased at a faster pace compared to that of production, which grew at a CAGR of 4.5%.

Chart 36: Trend in Pesticides Export by India



Source: Directorate of Plant Protection, Quarantine & Storage
Note: This includes data on both technical and formulations; Value in Rs Lakhs, Qty in MT

Moreover, the export value of pesticides grew at a relatively higher CAGR of 18.2% from Rs. 23,71,993 million in 2019-20 to Rs. 34,70,745 million in 2023-24.

Table 8: Volume-Wise Top 10 Export-Destinations of Pesticides for India 2023-24

Country	Share	Country	Share
Brazil	22.6%	Indonesia	2.4%
USA	9.4%	Bangladesh	7.4%
China	3.0%	Colombia	2.6%
Vietnam	5.4%	Thailand	1.9%
France	1.3%	UK	0.7%

Source: CMIE

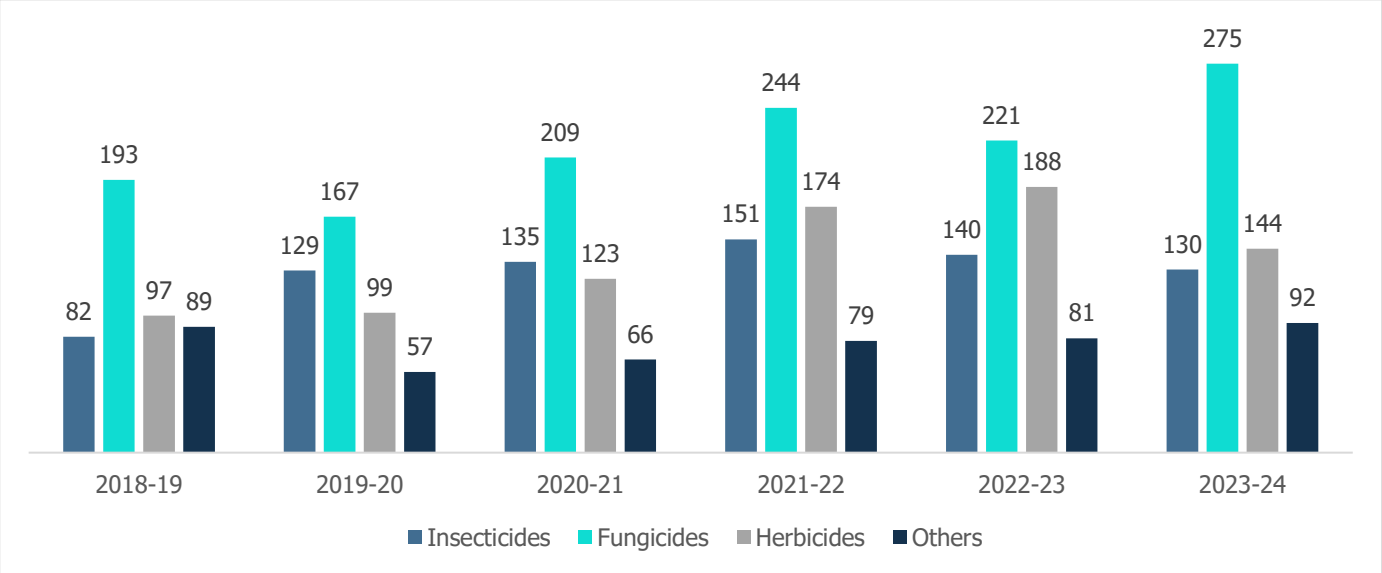
Trends in Segment-Wise Exports Volume

- **Segment-Wise Export Volume**

Of all the pesticide segments, fungicides accounted for the largest share of about 35% on average over the five-year period 2018-19 to 2023-24 in terms of volume. This was followed by herbicides, insecticides, and others that contributed 23%, 20% and 14%, respectively, towards total pesticide exports.

In terms of CAGR, the largest segment – fungicides, increased at a CAGR of 3.4%, which was slower than the CAGR of herbicides (18.1%) and insecticides (14.1%) segments in 2019-23. The remaining segment, others, declined to a CAGR of 2.4% during the same period.

Chart 37: Segment-Wise Pesticides Export Volume ('000 tonnes)



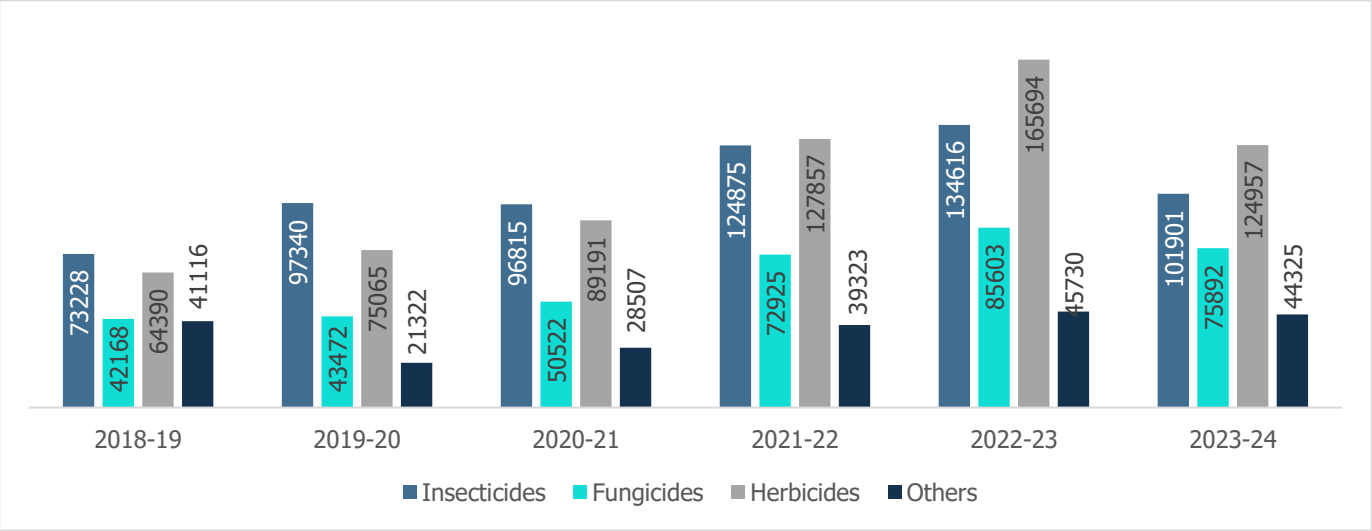
Source: Directorate of Plant Protection, Quarantine & Storage
Note: This includes data on both technical and formulations

- **Segment-Wise Export Value**

The scenario of segments in terms of contribution towards pesticides export value however is different with the insecticides segment accounting for the highest share of 35% on an average during 2018-19 to 2023-24. This was followed by the herbicides segment, which contributed 34% of total pesticide export value. The fungicides segment that had the largest share in terms of volume accounted for a smaller share of 19% in outbound shipments. The remaining segment, others, contributed 12% on average during the five years.

Further, in terms of CAGR, the herbicides segment reported the fastest CAGR of 14% during 2018-19 to 2023-24 followed by fungicides and insecticides which increased at a CAGR of 12% and 7%, respectively. The other segment, on the other hand, increased at a CAGR of 2% during the five-year period.

Chart 38: Segment-Wise Pesticides Export Value (in Rs. Million)

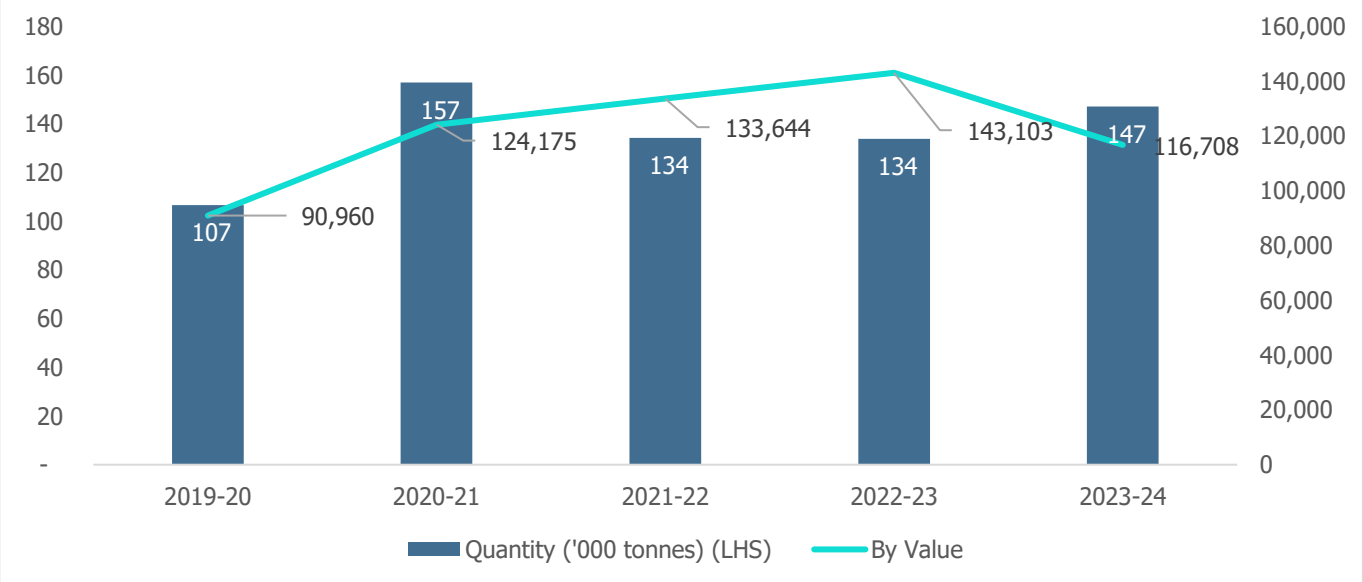


Source: Directorate of Plant Protection, Quarantine & Storage
Note: This includes data on both technical and formulations

7.9.2 Trend in Pesticides Imports by India

The quantity of pesticides imported by India is quite less compared to that of the pesticide exports. However, the quantity of pesticides imported by India has increased at a CAGR of 8.4% during the period 2020-24. The imports increased to 147 thousand tonnes in 2023-24 from 107 thousand tonnes in 2019-20. The value of imports grew at a higher CAGR of 6.4% from Rs. 90,960 million in 2019-20 to Rs. 116,708 million in 2023-24.

Chart 39: Trend in Imports of Key Pesticides by India (Rs million)



Source: Directorate of Plant Protection, Quarantine & Storage
Note: This includes data on both technical and formulations

China is the major source of pesticide imports and accounted for more than half of India's total imports with a share of 60.8% during 2023-24. This was followed by the USA, Taiwan and Israel contributing 10.6%, 5.9%, and 5.1%, respectively.

Table 9: Volume-Wise Top Source of Pesticides Imports for India 2023-24

Country	Share
China	60.8%
USA	10.6%
Taiwan	5.9%
Israel	5.1%

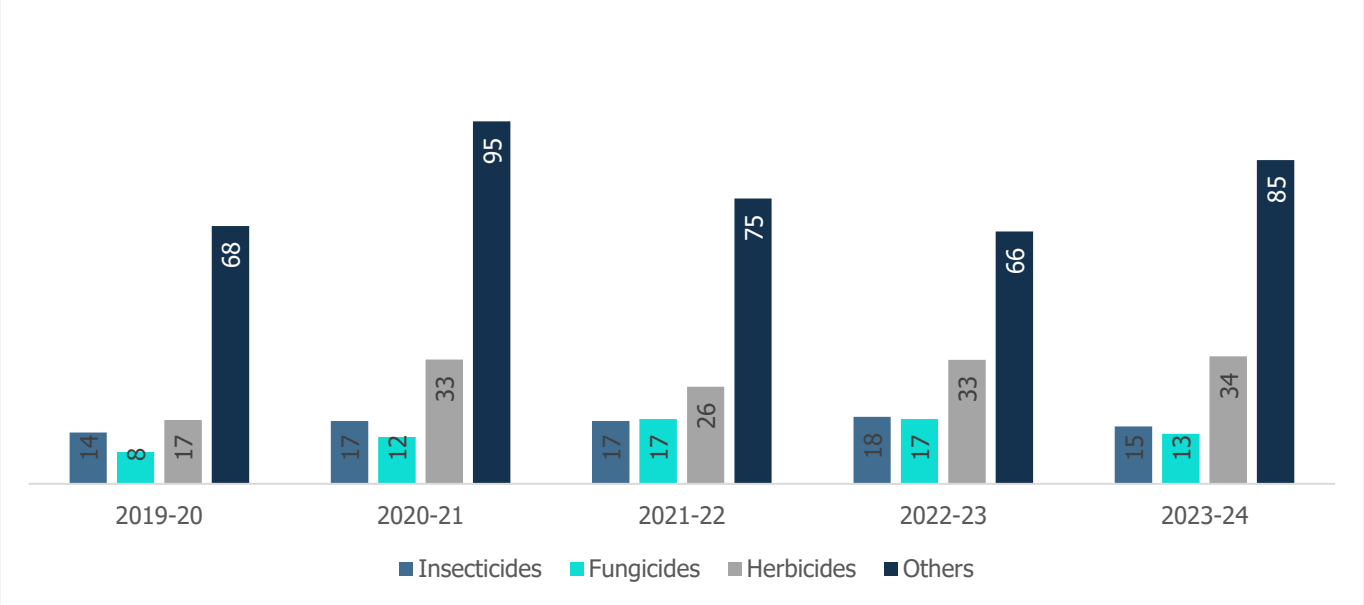
Source: CMIE

Trend in Segment-Wise Imports

- **Segment-Wise Import Volume**

Of all the pesticides segment imported by India, herbicides accounted for 20.6% followed by insecticides and fungicides with a share of 11.8% and 10.0%, respectively, on an average during 2019-20 to 2023-24. In terms of CAGR, while herbicides and fungicides grew in the range of around 10%-20%, the quantity of insecticides imported was at a CAGR of 2.8% during 2019-20 to 2023-24.

Chart 40: Segment-Wise Pesticides Import Volume ('000 Tonnes)



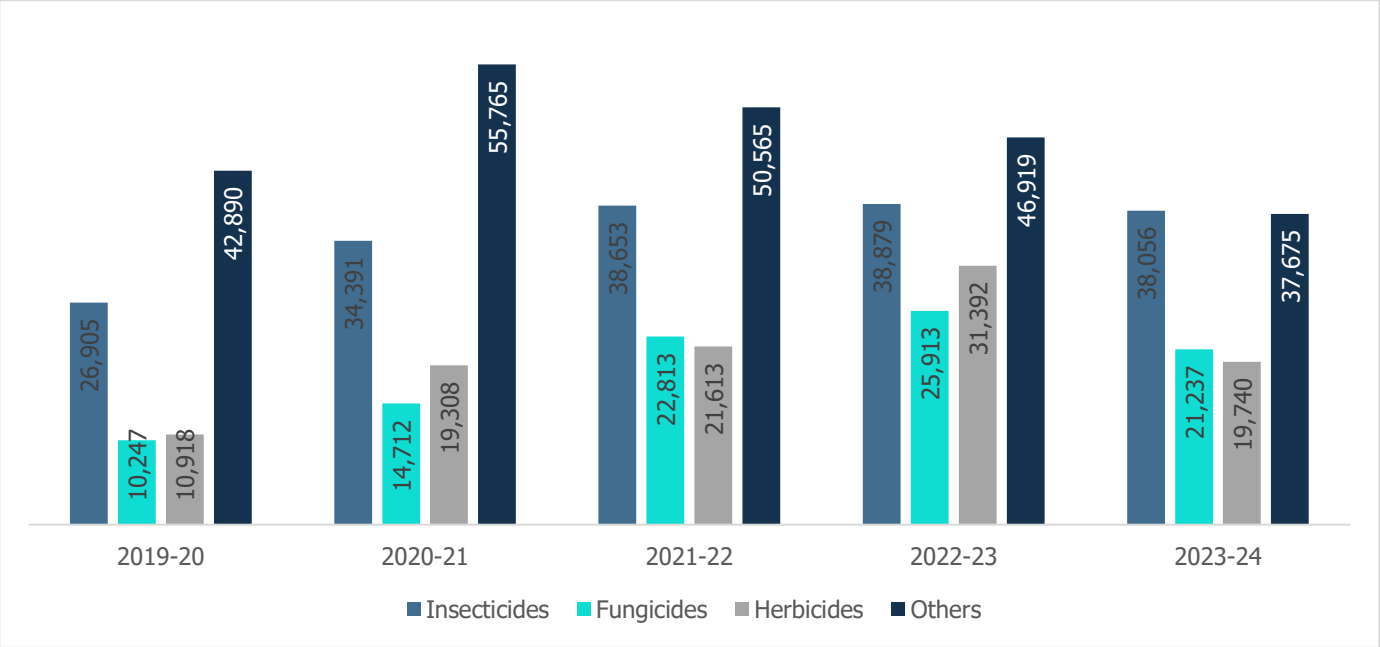
Source: Directorate of Plant Protection, Quarantine & Storage
Note: Others include fumigants, plant growth regulators and miscellaneous (where miscellaneous comprises disinfectants, paper impregnated, repellent for insect, weedicides and weed killing agents, etc.)

Apart from this, imports also include fumigants, plant growth regulators, and miscellaneous (where miscellaneous includes disinfectants, paper impregnated, repellent for insects, weedicides, weed killing agents, etc.) covered under the other segment. Others accounted for the remaining share of 57.6% on an average during the period 2018-19 to 2023-24. It largely remained flat at 66 thousand tonnes in FY23 vs 69 thousand tonnes in FY19.

- **Segment-Wise Import Value**

During the five-year period 2019-20 to 2023-24, insecticides, herbicides, and fungicides contributed about 29.2%, 16.5%, and 15.3%, respectively, in the overall import value of pesticides. Others accounted for the remaining share of 39.0% on average in terms of import value.

Chart 41: Segment-Wise Pesticides Import Value (in Rs. Million)



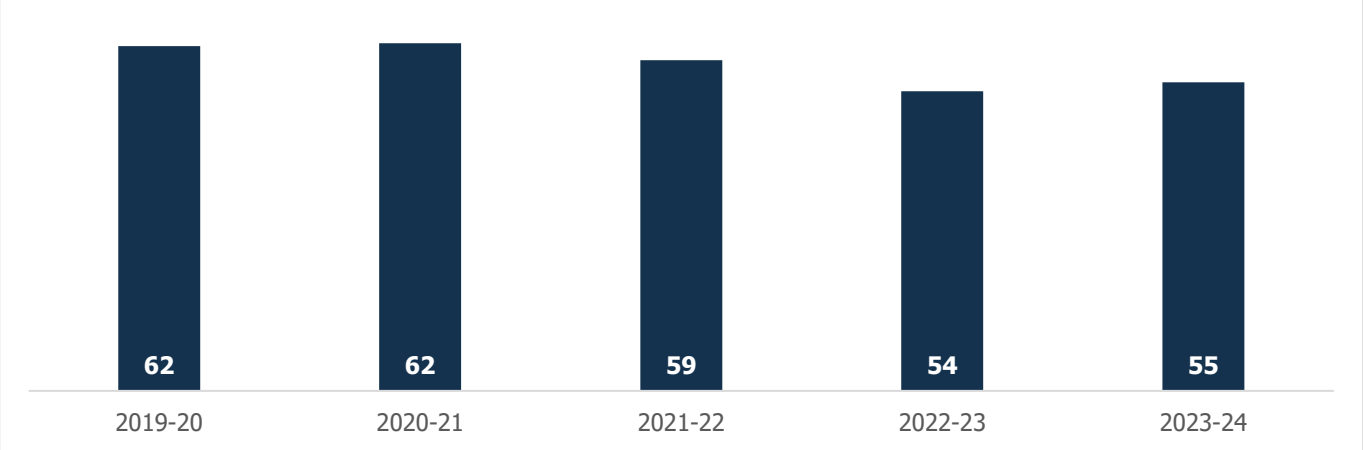
Source: Directorate of Plant Protection, Quarantine & Storage
Note: Others include fumigants, plant growth regulators and miscellaneous (where miscellaneous comprises disinfectants, paper impregnated, repellent for insect, weedicides and weed killing agents etc.)

7.10 Review of Pesticide Usage Dynamics in India

7.10.1 Trend in Chemical Pesticides Consumption

The domestic consumption of chemical pesticides declined at a CAGR of 2.7% from 62 thousand tonnes in 2019-20 to 55 thousand tonnes in 2023-24. This was due to the impact of new-age agrochemicals where the active ingredient or formulation was at a lower dosage per acre.

Chart 42: Trend in Chemical Pesticides Consumption in India (technical grade) ('000 tonnes)



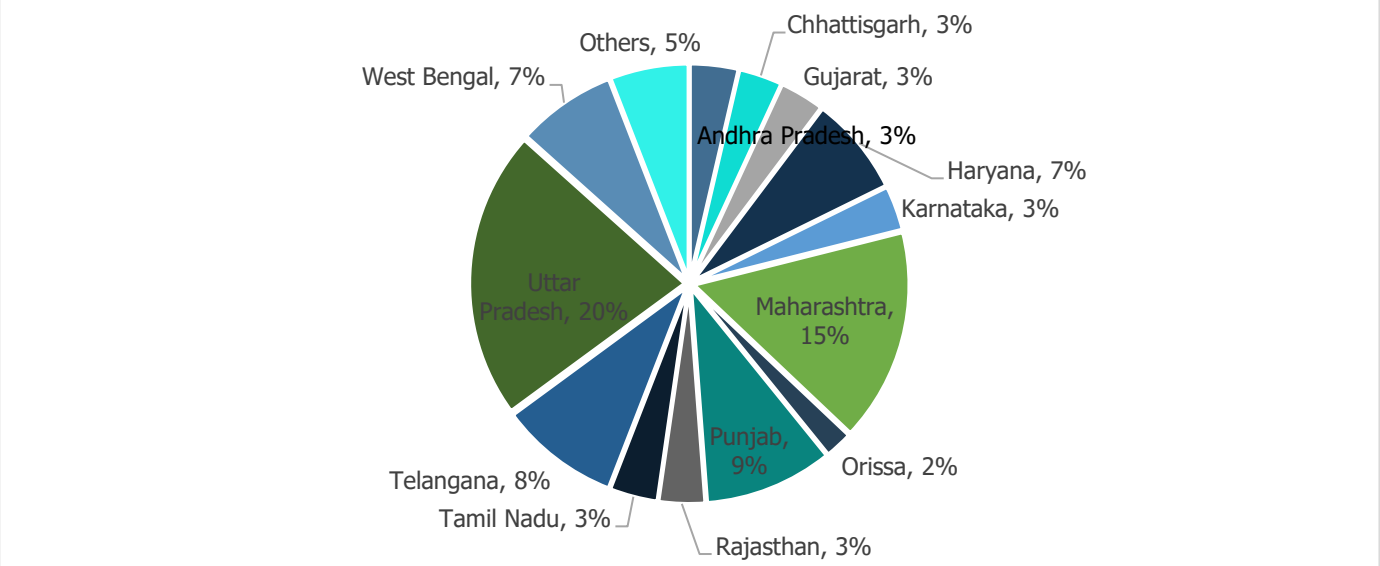
Source: Directorate of Plant Protection, Quarantine & Storage
Note: This does not include data on the states/UTs that have not reported pesticides consumption. Also, figures for 2019-20 for Haryana, Jammu and Kashmir, Tripura, Pondicherry, Goa and Nagaland have been taken from inputs provided by the States/UTs during the Zonal Conference (PP) for Rabi, 2020-21 Season.

7.10.2 State-Wise Consumption of Chemical Pesticides in India

The top ten states and UTs that reported chemical pesticide consumption accounted for around 83% of the total chemical pesticide domestic consumption in India during 2023-24.

Of the total, Uttar Pradesh and Maharashtra contributed a significant share of 2% and 15%, respectively. Telangana accounted for around 8% of overall chemical pesticide consumption. Following this, Haryana, West Bengal, Rajasthan, Andhra Pradesh, Karnataka, Tamil Nadu, and Gujarat contributed to the range of around 3%-8%. Others (which include remaining states and UTs) accounted for 5% of the total chemical pesticide consumption during 2023-24.

Chart 43: State-Wise Consumption of Chemical Pesticides in India during 2023-24 (technical grade) (in %)



Source: Directorate of Plant Protection, Quarantine & Storage

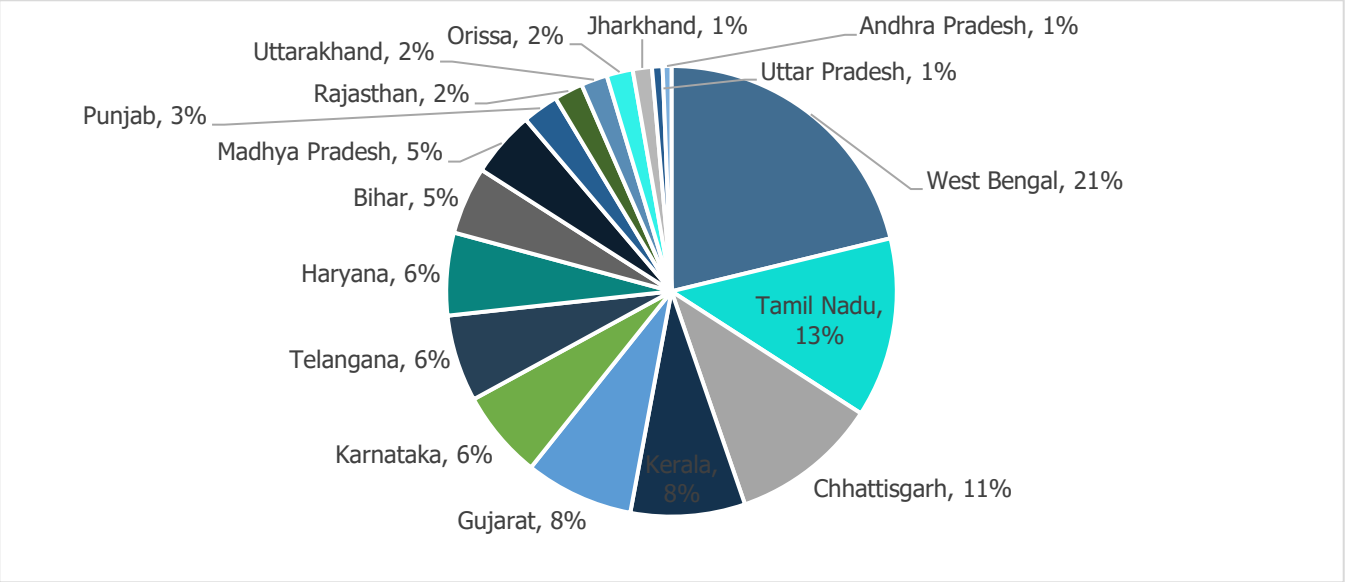
7.10.3 State-Wise Consumption of Bio-Pesticides in India

The top ten states and UTs' bio-pesticide consumption accounted for around 86% of the total bio-pesticide domestic consumption in India during 2024-24.

Of these, West Bengal, Tamil Nadu, and Chhattisgarh contributed to a significant share of 21%, 13%, and 11%, respectively. Kerala accounted for around 8% of overall bio-pesticide consumption. Following this, Gujarat, Telangana, Haryana, Madhya Pradesh, Karnataka, Bihar, and Assam contributed to the range of around 3%-8%. Others (which include remaining states and UTs) accounted for around 6% of the total bio-pesticide consumption during 2023-24.

Due to warmer weather, the infestation by pests increases, thereby leading to increased consumption of bio-pesticides majorly in the top states.

Chart 44: State-Wise Consumption of Bio-pesticides in India during 2023-24 (in %)



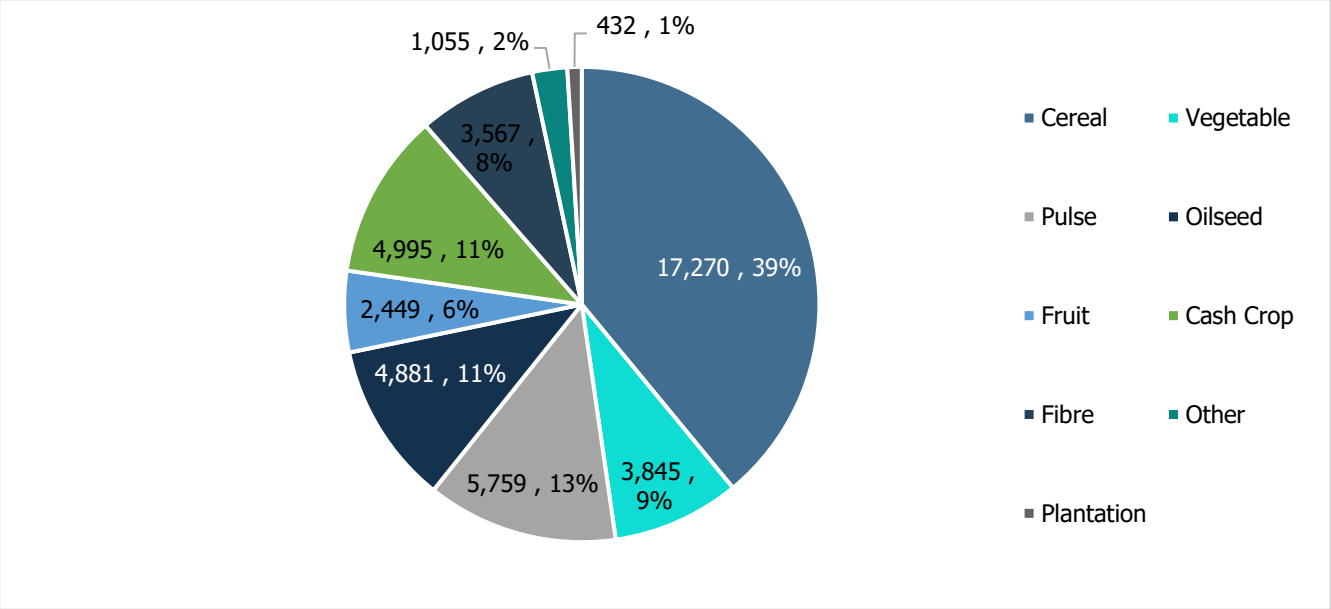
Source: Directorate of Plant Protection, Quarantine & Storage

7.10.4 Commodity-Wise Consumption of Chemical Pesticides in India

Pesticides are used and applied across a variety of commodities which include cereals, vegetables, pulses, oilseeds, fruits, plantation, cash crops, fibre, and others.

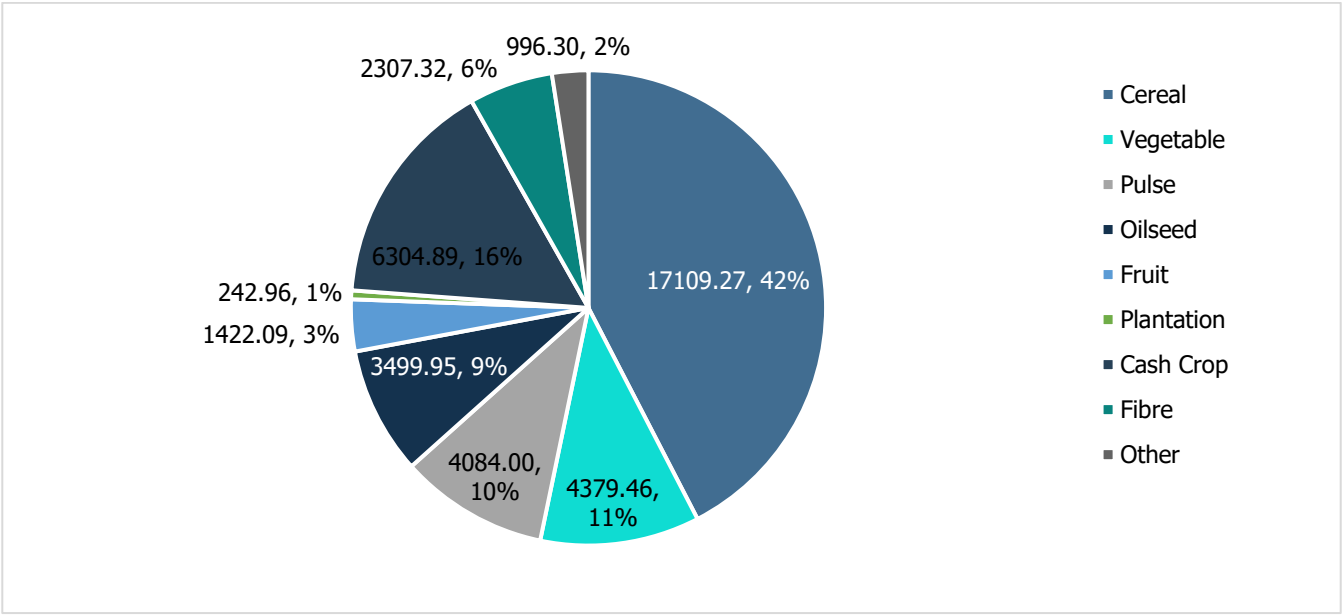
Chart 45: Commodity-Wise Consumption of Chemical Pesticides (Technical Grade) (`Metric Tonnes)

2018-19



Source: Directorate of Plant Protection, Quarantine & Storage

2023-24



Source: Directorate of Plant Protection, Quarantine & Storage

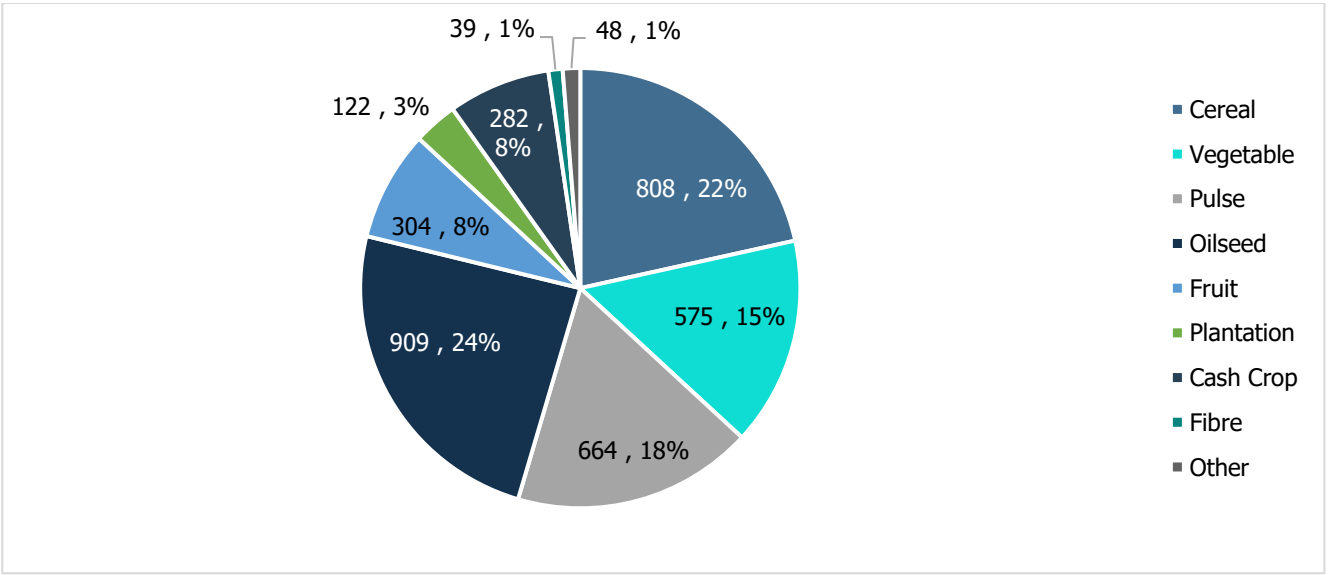
Of the total commodities covered by chemical pesticides, cereals account for the majority of the share, contributing around 42% on average during the five-year period 2019-20 to 2023-24. Following this, pulses, cash crops, oilseeds, vegetables, and fibres contributed in the range of about 8%-13% on average. The other commodities that have a small share include fruits (4%), plantations (1%), and others (2%).

7.10.5 Commodity-Wise Consumption of Bio- Pesticides in India

Among bio-pesticides, cereals account for the largest share with 29% on average during the five-year period 2019-20 to 2023-24. Following this, pulses, vegetables and oilseeds contributed to the range of about 11%-16% on average. The use of bio-pesticides in cash crops accounted for about 9%. The other commodities that have a relatively smaller share include fruits with 5%, plantations with 4% and fibres with 2%.

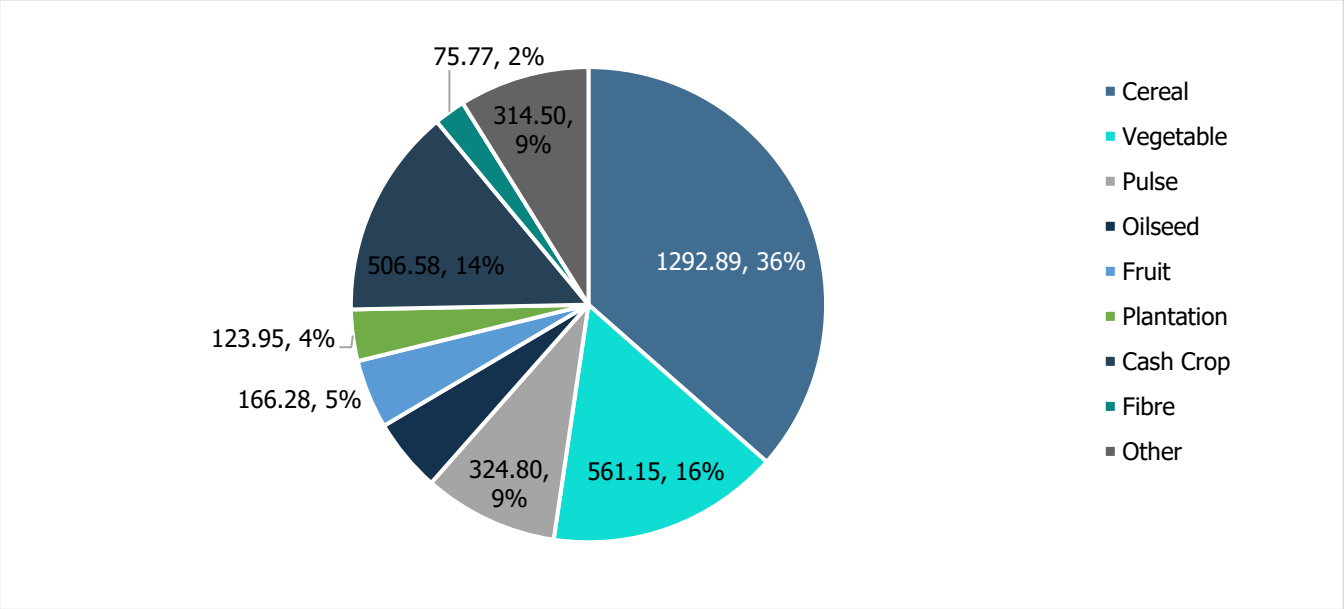
Chart 46: Commodity-Wise Consumption of Bio-Pesticides (Technical Grade) (`Metric Tonnes)

2018-19



Source: Directorate of Plant Protection, Quarantine & Storage

2023-24



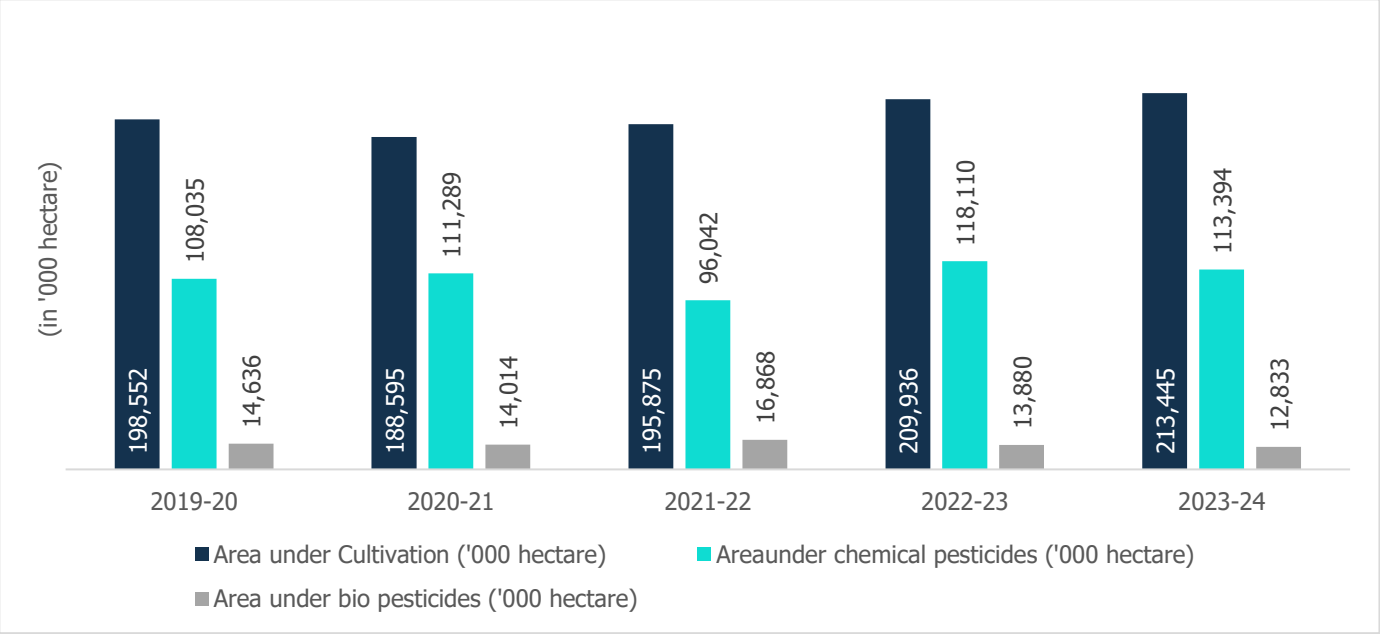
Source: Directorate of Plant Protection, Quarantine & Storage

7.10.6 Areas under Cultivation and Use of Chemical and Bio-Pesticides

The area available for agriculture largely is the same, catering to the growing population and rising demand. There was a dire need over the years to improve the crop yield and increase efficiency. Consequently, from 2019 to 2023, the area under cultivation has increased at a CAGR of 10%. Whereas the area under cultivation using bio-pesticides has increased at a faster CAGR of 21.7% during the same period. The usage of bio-pesticides has increased significantly on account of the various advantages it holds for the soil as well as crop yield.

Furthermore, the area under cultivation using chemical pesticides has increased at a slower pace exhibiting a CAGR of 7.5% from 2019 to 2023. The government's thrust towards increasing the usage of organic pesticides is expected to augur well for bio-pesticides compared to chemical pesticides.

Chart 47: Areas under Cultivation and Use of Chemical and Bio-Pesticides



Source: Directorate of Plant Protection, Quarantine & Storage

7.11 Key Growth Drivers

• **Agriculture**

Agriculture is the primary source of livelihood for about 58% of India's population. As a result, the share of agriculture and allied sectors to the total economy's Gross Value Added (GVA) has been significant and has increased over the years.

As of 2022-23, the sector is the largest employer of the workforce and accounted for a sizeable 15.1% in Gross Value Added (GVA) of the country. Growth in allied sectors including livestock, dairying and fisheries has also been the major drivers of overall growth in the sector.

The expansion in the share of agriculture and the allied sector's GVA is backed by an upward trend in the GVA of agriculture activities. The growth in agriculture GVA has been supported by various measures on credit, market reforms, and food processing. Moreover, in addition to several measures aimed at increasing productivity and improving the marketing of agricultural produce, the government also carries out a large food management programme with significant financial implications in terms of food subsidies.

The growth in the agriculture sector is expected to result in more demand for agrochemicals in India thus aiding its overall production and consumption.

• **Government Support**:

The government provides aid to the rural economy through various budget announcements that aim at reviving rural areas and raising farmers' income. In addition, growth in credit facilities to farmers through institutional credit mechanisms and low-interest rate farm loans are likely to motivate farmers towards usage of pesticides that help increase the productivity and yields of crops. Besides, the increased minimum support price (MSP) of crops also may contribute to pesticide usage. Moreover, in the recent Union Budget 2022-23, the government promoted the concept of natural and organic farming, thereby encouraging the usage of environmentally friendly agrochemicals.

• **Growth in Food Demand:**

With the expected increase in population, the demand for food grain in India is likely to rise. Accordingly, the growing consumption needs are to be met with almost the same arable land. Thus, raising farm productivity becomes important and this can be done with optimal usage of products like agrochemicals. It is to be noted that per hectare consumption of pesticides in India is one of the lowest in the world.

• **Increasing Demand for Horticulture and Floriculture:**

Fruits and vegetables have a significant share of around 90% of the Indian horticulture output. With increased consumption of healthy and nutritive foods, the demand for fruits and vegetables is likely to increase. This, in turn, is expected to support higher consumption of fungicides, which helps in contracting post-harvest losses in fruits and vegetables.

• **Growing Awareness of Bio-Pesticides:**

The rising awareness with respect to the environment-friendly usage of agrochemicals and the use of integrated pest management (IPM) mechanisms are expected to encourage the application of biopesticides. The biopesticides market in India constitutes a small proportion, offering growth opportunities for the segment.

• **Off-Patent Molecules:**

Any pesticide that goes off-patent provides an opportunity for the Indian industry to develop generic molecules. Such an event thus opens up opportunities for Indian manufacturers to increase their exports. An opportunity amounting to around USD 5 billion is estimated to go off-patent by FY27. This is likely to support pesticide exports from India going forward.

• **Export Markets:**

The outbound shipments account for a major share of the Indian agrochemicals market and have grown at a CAGR of around 8.1% over the five-year period 2018-19 to 2023-24, thus driving the overall agrochemicals industry. These exports have not just supported the agrochemicals industry but also the overall chemical exports from India as the contribution of pesticides has been significant. To support the ambition of making India a USD 5 trillion economy by 2025, the Indian agrochemical industry is estimated to make outbound shipments of around Rs.385 billion by 2025. This target is also likely to encourage agrochemical/pesticide exports from India.

7.12 Key Government Regulations

Proposed Pesticide Management Bill 2020

The Insecticides Act, 1968 (the Act) was enacted to regulate the import, manufacture, sale, transport, distribution and use of insecticides with a view to preventing risk to human beings or animals. In the said Act, there is a lack of sufficient deterrence against violations and there is no stricter penalty to safeguard the farmers' interest. There is also no mechanism to regulate pricing and disposal in an environmentally sound manner. Further, the Act is more than fifty years old, and its provisions are inadequate to meet the multi-dimensional management and administration of pesticides in present times. It is also important to align India's obligations with various international forums.

In view of the above, stricter penalties are required to safeguard the interest of farmers, which is jeopardized by the rampant availability of pesticides which are of dubious and deceptive identity, composition and source. In this background, a need was felt to bring new legislation providing better management of pesticides. With this in view, it is proposed to replace the Insecticides Act, 1968, with new legislation, namely, the Pesticide Management Bill, 2020.

The proposed bill will ensure transparency and effective implementation of the provisions of the proposed legislation and also enable the central government to make rules relating to the manner in which the powers and functions of the Registration Committee would be exercised. The provision is also made to encourage indigenous manufacturing and to promote pesticides that are biological and based on traditional knowledge. While registering a pesticide, the Registration Committee, apart from evaluating its safety and efficacy, would also be guided by factors like necessity, end use, risk involved and availability of safer alternatives. The provision has been made to constitute an authority to exercise such powers and perform such functions relating to regulating the price of pesticides.

Proposal to Ban Certain Molecules in India

The government considering the demands of nations that import from India has banned certain pesticides to avoid the loss of exports from India. For example, pesticide residue problems affected the exports of Basmati rice to the European Union (EU) following strict rules imposed by the EU on the usage of chemicals. Similarly, Saudi Arabia also insisted on tightening norms on the minimum residue levels of pesticides on Basmati rice imported from India. Punjab, which accounts for close to half of the exported rice from India, then announced a ban on the usage of 9 chemicals during the kharif season 2020.

The Union government also reviewed 66 contentious pesticides for their toxicity. While 18 of these were banned in 2018, the government, in January 2021, had appointed an expert panel to review the agrochemicals industry's objections to the proposed ban on 27 widely used pesticides.

The list of 18 pesticides that were banned in 2018 and the list of 27 pesticides for the proposed ban is given below.

List of 18 Pesticides

S.No.	Pesticides	S.No.	Pesticides	S.No.	Pesticides
1	Alachlor	7	Fenthion	13	Sodium Cyanide
2	Benomyl	8	Linuron	14	Thiometon

3	Carbaryl	9	Methoxy Ethyl Mercury Chloride	15	Triazophos
4	Diazinon	10	Methyl Parathion	16	Tridemorph
5	Dichlorvos	11	Phorate	17	Trichlorfon
6	Fenarimol	12	Phosphamidon	18	Trifluralin

Source: Government notifications and releases

List of 27 Pesticides

S.No.	Pesticides	S.No.	Pesticides	S.No.	Pesticides
1	Acephate	10	Deltamethrin	19	Oxyfluorfen
2	Atrazine	11	Dicofol	20	Pendimethalin
3	Benfuracarb	12	Dimethoate	21	Quinalphos
4	Butachlor	13	Dinocap	22	Sulfosulfuron
5	Captan	14	Diuron	23	Thiodicarb
6	Carbendazim	15	Malathion	24	Thiophanat emethyl
7	Carbofuran	16	Mancozeb	25	Thiram
8	Chlorpyriphos	17	Methomyl	26	Zineb
9	2,4-D	18	Monocrotophos	27	Ziram

Source: Government notifications and releases

The ban on these products will cause a significant amount of disruption in the market. Major players like UPL Ltd, despite having a wide portfolio, will suffer an impact. Rallis India and Insecticides India would further be affected by the ban of pendimethalin, atrazine and captan. Considering India is one of the major exporters of some molecules listed in the draft order, the ban will lead to an adverse impact on the global supply chain.

Regulation of Pesticides Awaiting to undergo Modifications

The Government of India regulates the manufacture, sale, transport, export/import etc. of pesticides under the guidelines of the Insecticides Act, 1968. The Insecticide Act, 1968 is administered through the Ministry of Agriculture, Department of Agriculture and Cooperation (DAC). Central Insecticides Board and the Registration Committee are the agencies under the Department to regulate the manufacture, distribution, export, import, ban and usage of pesticides. The Insecticide Act is enforced by the State Governments.

As per this act, no pesticide is allowed for production/import without registration. Compulsory registration is needed for the product at the central level and licenses for manufacture, formulation and sale at the state level. This creates hindrances as various state governments have different sets of rules. Also, the government has proposed a steep hike in registration fees for pesticides. The price hike proposed is Rs. 5000 to Rs. 4,50,000.

The government is in the process of replacing the old legislation with the proposed Pesticides Management Bill, 2020.

Central Insecticides Board - Established Under Section 4 of the Insecticides Act, 1968

Objectives

a. The Central Insecticides Board advises the Central Government and State Governments on technical matters arising out of the administration of this Act and to carry out the other functions assigned to the Board by or under this Act.

b. The matters on which the Board may advise include:

• The risk to human beings or animals involved in the use of insecticides and the safety measures necessary to prevent such risk.

• the manufacture, sale, storage, transport and distribution of insecticides with a view to ensuring the safety of human beings or animals.

Functions

a. Advise the Central Government on the manufacture of insecticides under the industries (Development and Regulation) Act, 1951 (65 of 1951).

b. Specify the uses of the classification of insecticides on the basis of their toxicity as well as their suitability for aerial application.

c. Advise tolerance limits for insecticide residues and establishment of minimum intervals between the application of insecticides and harvest with respect to various commodities.

d. Specify the shelf-life of insecticides.

e. Suggest colourization, including colouring matter which may be mixed with concentrates of insecticides, particularly those of a highly toxic nature.

f. Carry out such other functions as are supplemental, incidental or consequential to any of the functions conferred by the Act or the Rules.

By-laws have been framed by the Central Insecticides Board. The by-laws require the Central Insecticides Board to meet at least once in 6 months.

7.13 Key Government Initiatives

Agriculture being a state subject, the state government is primarily responsible for the growth and development of the agriculture sector developing perspective plans for their respective states and ensuring effective implementation of the programmes/schemes. However, the Government of India supplements the efforts of the State Governments through various schemes/programmes.

The details of various schemes, reforms and policies are given below:

A. Agri Infrastructure Fund
B. Agricultural Mechanization
C. Changes in Disaster Relief Standards
D. Creation of a Start-up Ecosystem in agriculture and allied sector
E. Fixing MSP at one-and-a-half times the cost of production
F. Improvement in farm produce logistics, Introduction of Kisan Rail
G. Income support to farmers through PM KISAN
H. Increase in procurement from farmers
I. Institutional credit for the agriculture sector
J. Micro Irrigation Fund
K. National Bee and Honey Mission (NBHM)
L. Neem Coating of Urea
M. Pradhan Mantri Fasal BimaYojana (PMFBY)
N. Pradhan Mantri Krishi Sinchai Yojana (PMKSY)
O. Promotion of FPOs Scheme
P. Promotion of organic farming in the country
Q. Providing Soil Health Cards to farmers
R. Setting up of E-NAM extension Platform
S. Unprecedented enhancement in budget allocation

The government has taken several steps to increase investment in the agriculture sector such as enhanced institutional credit to farmers; promotion of scientific warehousing infrastructure for increasing shelf life of agricultural produce; setting up of Agri-tech Infrastructure Fund for making farming competitive and profitable; developing commercial organic farming etc.

The government is implementing various schemes for the supply of farm inputs, like seeds, fertilizers, agricultural machinery and equipment, irrigation facilities, institutional credit, etc., at subsidized rates to the farmers in the country. The government has recently taken several steps to increase investment and growth in the agriculture sector which include the creation of the Long-Term Irrigation Fund (LTIF), the Micro Irrigation Fund for water use efficiency, the promotion of organic commercial farming, etc. The details of such major schemes /steps are given below.

The government of India has launched the Central Sector Scheme of financing facility under the Agriculture Infrastructure Fund (AIF) to boost Agriculture Infrastructure relating to post-harvest management and community farming assets. Under this scheme entities such as farmers, agri entrepreneurs, start-ups, Central/ State agencies or local body-sponsored public-private partnership projects, etc., can take benefit for setting up eligible infrastructure projects.

Some of the schemes are:

- **Rashtriya Krishi Vikas Yojana (RKVY):** Under the Rashtriya Krishi Vikas Yojana (RKVY) Scheme of the Ministry of Agriculture, grants-in-aid are given to state governments on the basis of the projects approved in State Level Sanctioning Committee Meeting (SLSC). States can take up projects for the development of Agriculture and allied sectors in Public Private Partnership (PPP) for the Integrated Agriculture Component.

- **Mission for Integrated Development of Horticulture (MIDH):** Under the Mission for Integrated Development of Horticulture (MIDH) of this Ministry financial assistance in the range of 35% to 55% of the eligible project cost is available in the form of credit-linked back-ended for creation of Post-Harvest management infrastructure like Pack Houses, Pre-cooling units, Integrated pack houses, Refrigerator van, Primary/mobile Processing unit, cold storage etc farm gate level to consumption level.

- **Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) Scheme:** The Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) Scheme is being implemented with a view to provide income support to all landholding farmer families across the country, to enable them to take care of expenses related to agriculture and allied activities as well as domestic needs. The Scheme, effective from 1.12.2018, aims to provide a payment of Rs.6000/- per year for the farmers' families with cultivable land holding, subject to certain exclusions. The financial benefit of Rs.6000/- is being released by the Central Government in three 4-monthly instalments of Rs.2000/- over the year directly into the bank accounts of the eligible farmers under the Direct Benefit Transfer mode.

Impact of Schemes and Initiatives by the Government of India

The efforts from the Government of India are very crucial to uplift the agricultural segment of the rapidly advancing country. The budgetary allocation to this segment is Rs. 7.27 lakh crore in FY25 which is 5 times more than that of FY07-FY14 duration.

Infrastructure near farms is key to farmers' welfare. Since the inception of the Agriculture Infrastructure Fund, ₹35,262 crore have been sanctioned for 48,352 projects. Major projects include 11,165 warehouses, 10,307 primary processing units, 10,948 custom hiring centers, 2,420 sorting and grading units, 1,486 cold storage projects, 169 assaying units, and around 11,857 other post-harvest management projects and community farming assets.

The introduction of 100% neem coated urea and the rise in urea production to 310 lakh metric tonnes from 225 lakh metric tonnes in 2014 highlight significant progress. Under the Paramparagat Krishi Vikas Yojana, Rs 1,980.88 crore have been released since FY16, benefiting 16.19 lakh farmers across 8.13 lakh hectares.

Agricultural mechanization has been boosted by Rs 8,006 crore till December 2024. The Sub-Mission on Agricultural Mechanization (SMAM) includes Rs 141.41 crore for Kisan drone promotion, facilitating the purchase of 317 drones for demonstration across 79,070 hectares and supplying 527 drones to farmers on subsidy.

Recognizing the invaluable role farmers play in driving the economy, the Government of India has extended support through numerous policies and schemes. These policies provide financial aid to farmers, alleviating hardships and enabling them to sustain their families while contributing to the nation's welfare. Agriculture constitutes an estimated 18% of India's GVA in FY24, which is very import for the nation's economy. Despite challenges like the global health crisis and climate variability, the sector has shown remarkable resilience, significantly contributing to India's economic recovery and development.

The total food grains production for FY24 was 309.3 million tonnes. Production of rice, wheat, pulses, coarse cereals, and oilseeds saw record increases, making India a global leader in the production of milk, pulses, and spices, and the second-largest producer of fruits, vegetables, tea, farmed fish, sugarcane, wheat, rice, cotton, and sugar. With appropriate policies, India's farmers have demonstrated their ability to meet global food demands.

The government's initiatives, such as Pradhan Mantri Kisan Maandhan Yojana (PM-KMY), Pradhan Mantri Kisan Samman Nidhi (PM-KISAN), and PMFBY, have been instrumental in providing financial and income support to farmers. Every year, under PM-KISAN, direct financial assistance is provided to 11.8 crore farmers with over Rs 2.80 lakh crore disbursed so far.

The government has introduced various initiatives for digital inclusion and mechanization to foster productivity. The launch of the digital platform e-NAM (National Agriculture Market) in 2016 has facilitated the integration of Agriculture Produce Marketing Committees (APMC) mandis to provide a wide range of benefits to farmers, farmer-producer organizations (FPOs), buyers, and traders. The number of markets linked to the e-NAM platform has increased from 250 in 2016 to 1,389 in 2023, facilitating the online trading of 209 agriculture and horticulture commodities.

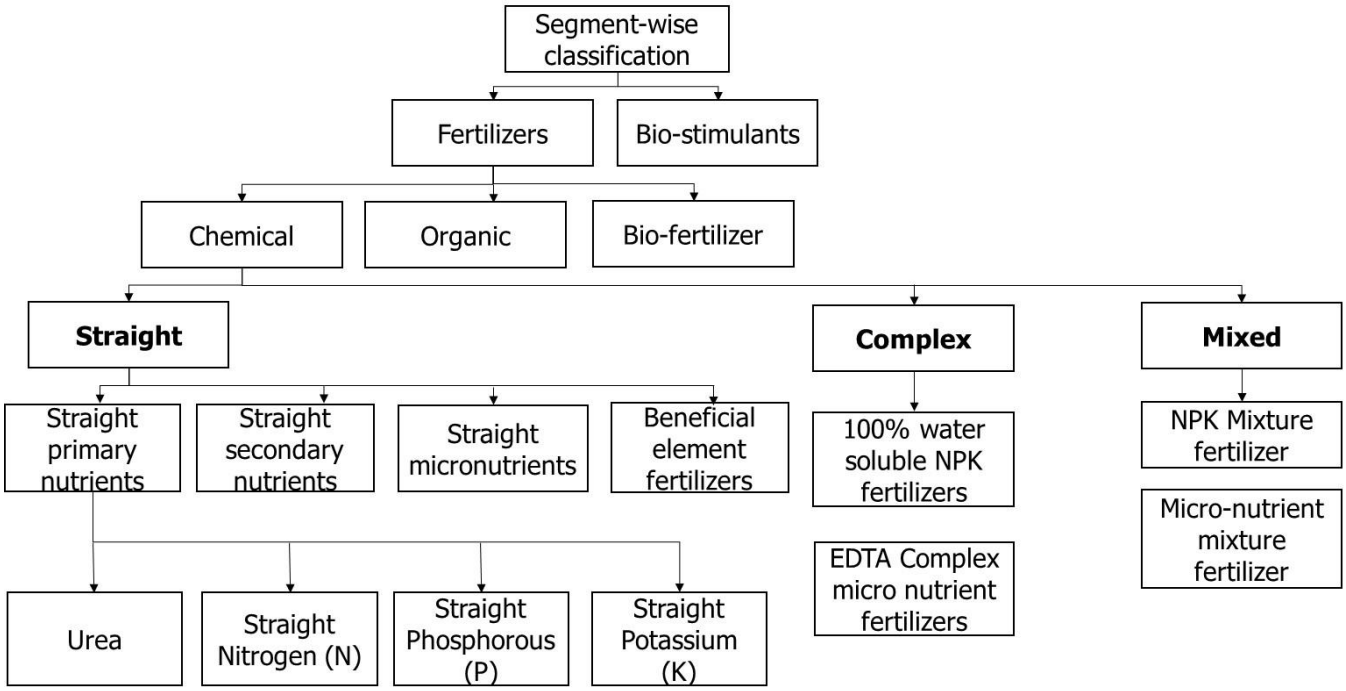
Apart from the above schemes, the government has also introduced the Agricultural Export Policy which has led the export reaching over Rs 4.2 lakh crore in FY23. Ministry of Cooperation has been established under which the world’s largest Grain Storage Plan has been launched. 2 lakhs societies are also being established in the villages under the Ministry. To ensure the momentum, the government is also promoting private and public investment in the post-harvest activities.

8 Overview and Types of Fertilizers

Fertilizer is any material of natural or synthetic origin that is applied to plant tissues or soil to supply plant nutrients. For most modern agricultural practices, fertilization focuses on three main macronutrients: Nitrogen (N), Phosphorous (P), and Potassium (K).

Fertilizers are mainly classified as:
a. Chemical fertilizers
b. Organic fertilizers
c. Bio-fertilizers

Figure 2: Classification of Fertilizers



Source: CareEdge Research based on Industry Sources

Chemical fertilizers are the artificial fertilizers manufactured in the industries. Some examples of chemical fertilizers are ammonium phosphate and potassium sulphate. Chemical fertilizers are further classified into urea and non-urea fertilizers. During FY24, fertilizers production in India increased by 3% to 50.4 million tonnes driven by 11% growth in urea output to 31.4 million tonnes. The fertilizers production is primarily divided into broad categories, urea and non-urea fertilizers where urea dominates the total output with an average share of 62% and non-urea contributing the remaining 38% on average. Over the years, while the production of urea grew at a CAGR of 5.5%, the output of non-urea fertilizers increased at a slower CAGR of 1.4%.

Bio-fertilizers are substances containing microbes that enhance plant nutrition or increase nutrient availability in soils. For example, azospirillum and rhizobium.

Organic fertilizers are natural products used by farmers to provide plant nutrients for crops. They increase the organic matter in the soil, which further releases plant food in the available form for the use of crops.

A. Bio-fertilizers

8.1 Overview and Key Types of Bio-Fertilizers

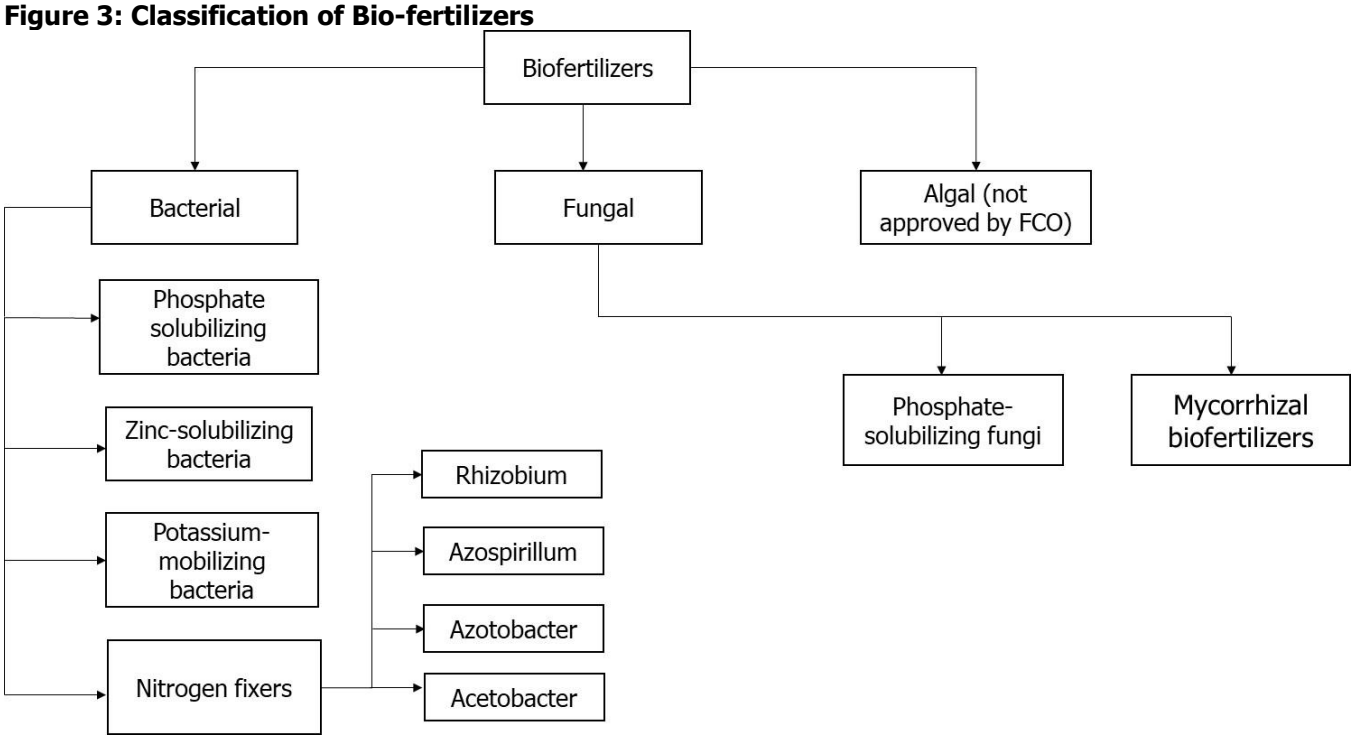
As per several studies conducted by Centre of Science & Environment, crops no longer respond to chemical fertilizers as they used to. The fertilizer response ratio used to be 13.4 in 1970 which further reduced to 2.7 by 2015. Due to heavy subsidies provided for nitrogen, the nitrogen-phosphorous-potassium ratio has been skewed toward nitrogen. However, the continuous use of nitrogenous fertilizers adversely affected the soil health in India. The crops displayed symptoms of deficiencies in macro and micronutrients. This became a growing concern and led to the search for alternative non-chemical choices, which included bio-fertilizers and organic fertilizers.

Bio-fertilizers contain microbes that enhance plant nutrition or increase nutrient availability in soils. E.g. azospirillum, rhizobium, etc. They are regulated under the Fertilizer Control Order (FCO).

Bio-fertilizers are primarily classified into two types:

- Bacterial Bio-fertilizers
- Fungal Bio-fertilizers

Figure 3: Classification of Bio-fertilizers



Source: CareEdge Research

Bacterial Bio-fertilizers

Of the two types of bio-fertilizers, bacterial bio-fertilizers account for a major share while fungal bio-fertilizers account for a relatively smaller share. This is because bacterial bio-fertilizers include nitrogen fixers that are used largely to fix the nitrogen levels of plants. As nitrogen fixers are used in large quantities, their application is made convenient with two physical forms – carrier-based and liquid-based. This is explained in detail later in the chapter.

Apart from nitrogen fixers, bacterial bio-fertilizers include phosphate-solubilizing, zinc-solubilizing, and potassium-mobilizing bio-fertilizers. The application of these bio-fertilizers, however, is low compared to that of nitrogen fixers.

Some of the types of bacterial bio-fertilizers are:

1. Nitrogen Fixers

- **Rhizobium**:

○ This belongs to a bacterial group and a classic example is symbiotic nitrogen fixation. The bacteria infect the legume root and form root nodules within which they reduce molecular nitrogen to ammonia further utilized by the plant to produce valuable vitamins, proteins, and other nitrogen-containing compounds.

○ It is a relatively more effective and widely used biofertilizer. The rhizobium population in the soil is dependent on the presence of legume crops in the field. When there is an absence of legumes, the population of rhizobium in the soil diminishes.

- **Azotobacter**:

○ It is a common soil bacterium. Soil organic matter is an important factor that decides the growth of this bacteria.

○ It is well known as a free-living nitrogen-fixing aerobic bacterium and is used as a biofertilizer for all non-leguminous plants, especially rice, cotton, vegetables, etc.

- **Azospirillum**:

○ This is known to have a close associative symbiosis with the higher plant system.

○ It is known to fix the considerable quantity of nitrogen in the rhizosphere in non-leguminous plants such as cereals, millets, oilseeds, cotton, and other minor millets and fodder grasses.

2. Phosphate Solubilizing Bacteria (PSB)

These bacteria are beneficial in solubilizing inorganic phosphorous from insoluble compounds. One of the most important traits associated with plant phosphate nutrition is the solubilization ability of rhizosphere microorganisms. Phosphorous is a major essential macronutrient for plants, and hence, is applied to soil in the form of phosphate fertilizers. The main purpose of managing soil phosphorous is to optimize crop production and minimize the loss of phosphorous from soils.

The other types of bacterial bio-fertilizers are zinc-solubilizing bacteria and potassium-mobilizing bacteria. However, these are not as widely used as the aforementioned.

Fungal Bio-fertilizers

Fungal bio-fertilizers are of two types, phosphate solubilizing and mycorrhizal. Both are essential for plants as phosphorous is a major essential macronutrient. These bio-fertilizers manage phosphorous soil to optimize crop production, minimize loss of phosphorous, and protect plants from nematodes or worms.

- **Vesicular Arbuscular Mycorrhiza (VAM)**:

○ VAM associates symbiotically with the roots of the plants and helps in increased absorption of phosphorous. It is an effective soil inoculant. Mycorrhizae in nature are obligate and require a living host for its survival.

○ Further, it protects the plants from nematodes or worms and pathogenic fungi and acts as an accessory to the root hairs in the process of nutrient absorption and mobilization. VAM is used as a biofertilizer for fibre and sugar crops, cereals, millets, pulses, fruits, vegetables, etc.

Another type of fungal biofertilizers used is phosphate-solubilizing fungal bacteria.

Furthermore, bio-fertilizers are disseminated through two modes –

a) Carrier-Based Fertilizers

In this category of fertilizers, bio-fertilizers are supplied as carrier-based microbial inoculants to the soil to provide extra immunity and/or enrich soil fertility. The carrier is a medium that under specified conditions carries microorganisms in sufficient quantities and keeps them viable. One crucial factor for the production of good-quality bio-fertilizers is ensuring that the ideal carrier material is used.

An ideal carrier material should have the following characteristics:

- It should be highly absorptive and easy to process
- Non-toxic to microorganisms
- Should be easily sterilizable
- Available in low-cost and ample amounts
- Provide good adhesion to seeds
- Should have a good buffering capacity
- Should have high organic matter content and a water-holding capacity of more than 50%

Bio-fertilizers are supplied to the soil by seed inoculation in which the bacteria-carrier mixture is mixed with water to make a slurry and then mixed with seeds or by soil inoculation, wherein it is spread over the field during cultivation.

b) Liquid Bio-fertilizers

In this category of fertilizers, as the name suggests the formulation is liquid and contains the dormant form of desired microorganisms and their nutrients alongside a few other substances that enable the formation of cysts or resting spores for longer shelf-life and tolerance to adverse conditions.

On reaching the soil, the dormant forms germinate to produce a fresh batch of active cells. Further, with the help of a carbon source in the soil or root exudates, the cells grow and multiply. These bio-fertilizers are more advantageous compared to conventional carrier-based bio-fertilizers.

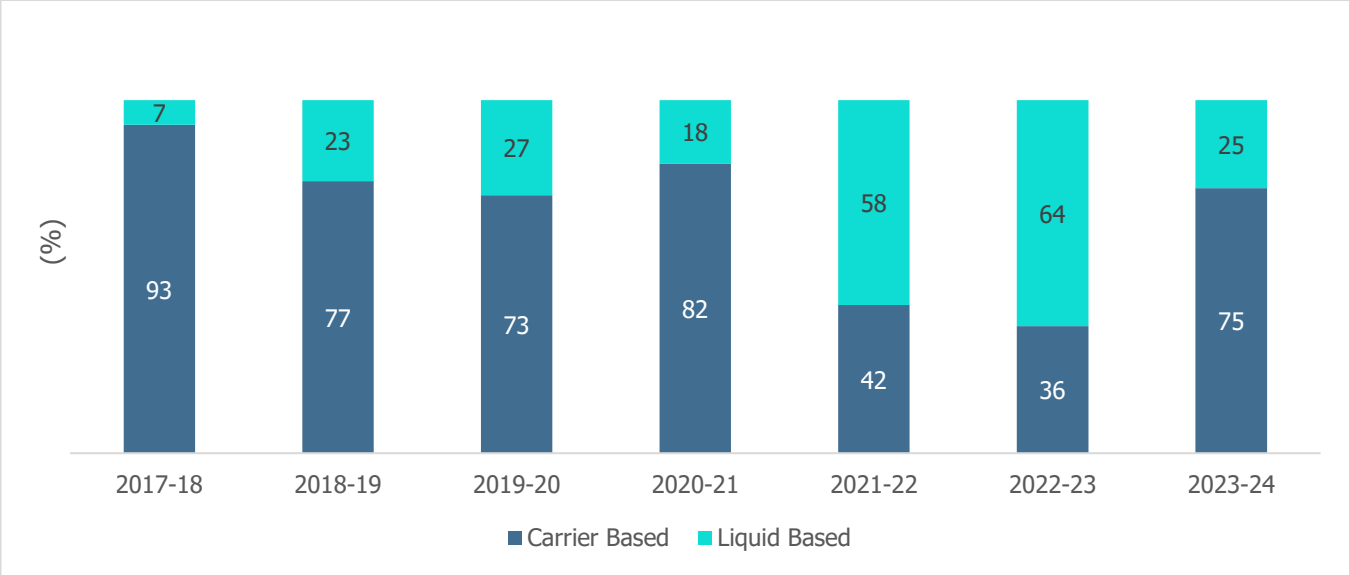
Some of the advantages of liquid bio-fertilizers over conventional carrier-based bio-fertilizers are:

- Longer shelf life, typically 12-24 months
- No contamination
- No loss of properties takes place as the storage is up to 45 degrees Celsius
- Can be identified easily as it has a typical fermented smell
- A lot of cost is saved on carrier material, pulverization, neutralization, sterilization, packing, and support
- Quality control protocols are easy and quick
- Can be easily used by the farmer
- High commercial revenues and export potential

❖ Different kinds of carrier-based and liquid bio-fertilizers are listed below. These are the most commonly used bio-fertilizers in the country.

8.1.1. Share of Liquid and Carrier Bio-Fertilizers

Chart 48: Share of Liquid and Carrier-Based Bio-Fertilizers



Source: Ministry Sources, Fertilizer Association of India, Department of Agriculture & Farmers Welfare

The production trend of bio-fertilizers in India over the last seven years reflects a structural shift in the type of formulations being favored. While carrier-based bio-fertilizers dominated production volumes up until 2020-21, a notable transition toward liquid-based formulations began in 2021-22 and intensified in 2022-23.

From 2017-18 to 2020-21, carrier-based fertilizers consistently accounted for the majority share of total bio-fertilizer production, suggesting their wide acceptance and lower cost of adoption. However, starting 2021-22, the share of carrier-based products declined sharply, with liquid-based variants taking the lead for two consecutive years. This shift may be attributed to the superior shelf life, higher microbial counts, and easier application of liquid bio-fertilizer factors that are increasingly valued by modern and commercial farming operations.

By 2023-24, production of carrier-based fertilizers partially recovered but remained below earlier levels, while liquid-based production continued to hold a significant share. This rebound may reflect a balancing act between traditional affordability and modern efficacy, especially as government schemes push for wider adoption of organic and bio-inputs.

Moreover, the other major growth driver of the liquid fertilizer market is the need for micro-nutrients, investment by government and private players, and increasing research & development activities. The handling and storage costs of liquid fertilizers are higher compared to carrier-based fertilizers, and hence, during the pandemic, the production and demand for liquid fertilizers were reduced.

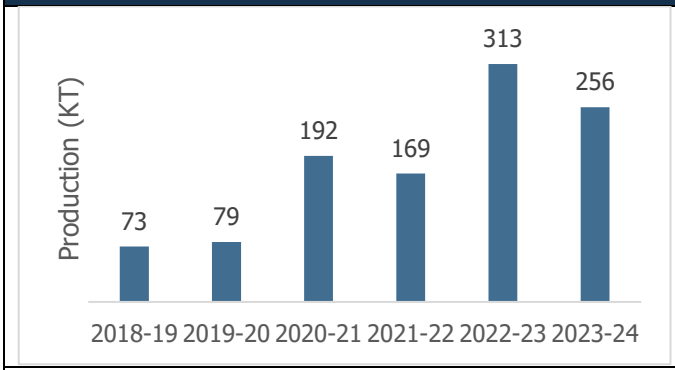
India's bio-fertilizer production is expected to grow steadily, with liquid-based variants likely to dominate due to their longer shelf life and ease of application. By 2026-27, liquid formulations may account for over 60% of total production, driven by sustainable farming policies and rising mechanization.

8.1.2 Trend in Bio-Fertilizer Production and Outlook

The total production in 2023-24 of carrier-based solid bio-fertilizers in India was 256 thousand tonnes. This marked a four-fold growth from 2018-19. It increased at a CAGR of 29% during 2018-19 to 2023-24.

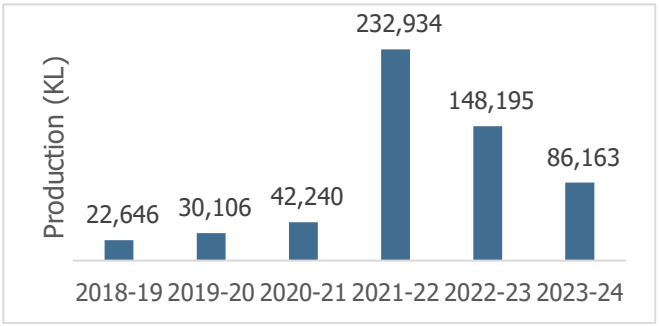
In the case of liquid fertilizers, India produced about 86,163 kiloliters of liquid bio-fertilizers in 2023-24. The production grew from 22,646 KL in 2018-19 to 86,163 KL in 2023-24, registering robust growth at a CAGR of 31% during the same period.

Chart 49: Trend in Carrier-Based Fertilizer (In Thousand Tonnes)



Source: Ministry Sources, Fertilizer Association of India, Department of Agriculture & Farmers Welfare

Chart 50: Trend in Liquid Fertilizers (In Kilolitres)



Source: Ministry Sources, Fertilizer Association of India, Department of Agriculture & Farmers Welfare

The following reasons are attributed to the growth in the production of carrier-based fertilizers as well as liquid fertilizers:

1. Development of New Eco-Friendly Technologies for Production:

Development of new technologies like the development of mixed inoculants has taken place. This is considered an important approach as different microbial strains facilitate combined biofertilization effect and help plants to promote better uptake of nutrients.

Such technologies will overcome the shortcomings of conventional chemical-based farming and have a positive influence on both soil sustainability and plant growth.

2. Rising Government Support to Promote Bio-fertilizers:

The government has taken various initiatives and programmes such as the National Food Security Mission (NFSM), which assists of up to Rs.300 per hectare for the promotion of various bio-fertilizers such as rhizobium, azospirillum, azotobacter, phosphate-solubilizing bacteria, potash-mobilizing bacteria, zinc-solubilizing bacteria, and mycorrhiza culture.

Under the Capital Investment Subsidy Scheme (CISS) of Soil Health Management Scheme (SHM) of National Mission of Sustainable Agriculture (NMSA), Government is aiding for setting up of state of art liquid/ carrier-based bio-fertilizer/ bio-pesticide units of 200 Ton Per Annum (TPA) capacity. 100% assistance is provided to State Government / Government agencies up to a maximum limit of Rs.160.00 lakh/unit. Similarly, for individuals/ private agencies assistance up to 25% of cost limited to Rs.40 lakh/unit as capital investment is provided through NABARD.

3. Increasing Emphasis on Organic Culture:

The excessive use of synthetic fertilizers has led to the contamination of soil and the destruction of microorganisms. To reduce the increasing pollution of soil, organic farming is being adopted.

The rising demand for organic food is further motivating farmers to adopt bio-fertilizers. Also, the general population is increasingly concerned about the quality of food they consume and are willing to pay for the same. Thus, farmers too consider investing in bio-fertilizers.

4. Increased Demand for Cereals and Grains:

The demand for cereals and grains has increased and rhizobium is widely used as a biofertilizer and crop enhancer for cereal. It has been found that rhizobia can make an association with gramineous plants without forming nodule-like structures or any disease symptoms.

Outlook:
The market for bio-fertilizers is expected to continue to grow in the coming years. This will be backed by a higher understanding of environmental hazards caused by the use of synthetic agrichemicals, primarily the pollution and contamination of the soil, and growing health concerns that come along with it. As evidenced by past trends, liquid-based bio-fertilizers are expected to increase at a faster rate than carrier-based bio-fertilizers.

Also, there is an urgent need for a shift to more sustainable agricultural production methods with a greater focus on promoting sustainable mechanisms. Accordingly, bio-fertilizers are considered one of the best strategies and a possible solution to meet the parallel challenges of global food security and environmental stability.

Similarly, factors like increased plant nutrient absorption, improved soil fertility, and lower human health risks associated with the product are some of the factors that will help in augmenting the biofertilizer industry market growth.

8.1.3 Region-Wise Split of Bio-Fertilizer Production for the year 2023-24

The production of carrier-based and liquid fertilizers can be looked at zone wise as given below:

❖ **South Zone**: In the south, Tamil Nadu and Kerala produced most of the carrier-based fertilizers and Tamil Nadu and Karnataka were responsible for the highest production of liquid fertilizers.

Table 10: Zone-Wise Production of Fertilizers (South)

Types of Bio-Fertilizers (2023-24)	States					
	Andhra Pradesh	Karnataka	Kerala	Puducherry	Tamil Nadu	Telangana
Carrier-based fertilizers (in tonnes)	92	1,687	2,293	-	2,334	-
Liquid fertilizers (in kiloliters)	91	1,787	-	-	1,237	-

Source: Ministry Of Agriculture and Farmers Welfare, CareEdge Research

❖ **West Zone:** In the west, Gujarat produced most of the carrier-based fertilizers whereas Maharashtra was the highest liquid fertilizers producing state.

Table 11: Zone-Wise Production of Fertilizers (West)

Types of Bio-Fertilizers (2023-24)	States					
	Chhattisgarh	Gujarat	Goa	Madhya Pradesh	Maharashtra	Rajasthan
Carrier-based fertilizers (in tonnes)	271	138,617	-	32,011	7,331	24,219
Liquid fertilizers (in kiloliters)	132	-	-	-	11,818	3,807

Source: Ministry Of Agriculture and Farmers Welfare, CareEdge Research

❖ **North Zone**: In the north, Uttar Pradesh was responsible for the highest production of carrier-based fertilizers and Uttarakhand was responsible for the highest production of liquid fertilizers.

Table 12: Zone-Wise Production of Fertilizers (North)

Types of Bio-Fertilizers (2023-24)	Haryana	Himachal Pradesh	Punjab	Uttar Pradesh	Uttarakhand
Carrier-based fertilizers (in tonnes)	10,337	55	15,200	14,869	3,352
Liquid fertilizers (in kiloliters)	1,925	31	315	496	756

Source: Ministry Of Agriculture and Farmers Welfare, CareEdge Research

❖ **East Zone**: In the east, Bihar was the highest carrier-based fertilizers producing state.

Table 13: Zone-Wise Production of Fertilizers (East)

Types of Bio-Fertilizers (2023-24)	States			
	Bihar	Jharkhand	Odisha	West Bengal
Carrier-based fertilizers (in tonnes)	2,816	3	-	-
Liquid fertilizers (in kiloliters)	-	-	-	-

Source: Ministry Of Agriculture and Farmers Welfare, CareEdge Research

❖ **North-East Zone**: For the north-east, according to the past year data, Assam and Tripura are the highest carrier-based fertilizer producing states whereas Assam are the highest liquid fertilizer producing states.

8.1.4 Usage of Bio-Fertilizers in Crops and Plantations

Bio-fertilizers like bacterial bio-fertilizers include nitrogen fixers that are used largely to fix the nitrogen levels of plants which is generally low in Indian states. Despite India holding a prominent position in the production of crops like rice and cotton, the level of nitrogen for these crops continues to be a barrier. The usage of bio-fertilizers helps in improving the crop yield, aids in nutrition absorption, and is environment-friendly unlike chemical fertilizers (which are also used to fix the nitrogen levels).

1. Rice

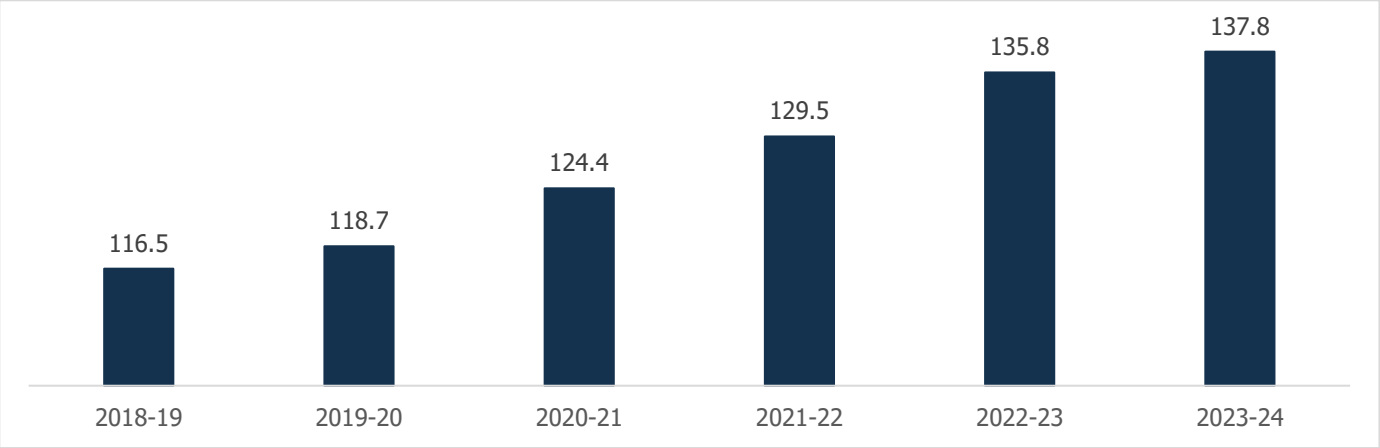
Application of Bio-fertilizers in Rice

Symbiotic systems such as the Azolla and Anabaena complex and that of leguminous green manures with rhizobium and azo rhizobium association are of value to wetland rice crops and supplement inorganic nitrogen for cereals.

Further, Azotobacter can be applied to rice through seed or seedling or soil to fix the nitrogen in the soil. Inoculation with Azospirillum promotes early tillering and growth of rice. It also significantly increases the filling rate of grain and the grain per weight per plant at harvest.

The production of rice as of 2023-24 is 137.8 million tonnes as per the Ministry of Agriculture and Farmers Welfare. Andhra Pradesh accounts for around 8% of the total rice production in India.

Chart 51: Production Trend of Rice in India (million tonnes)



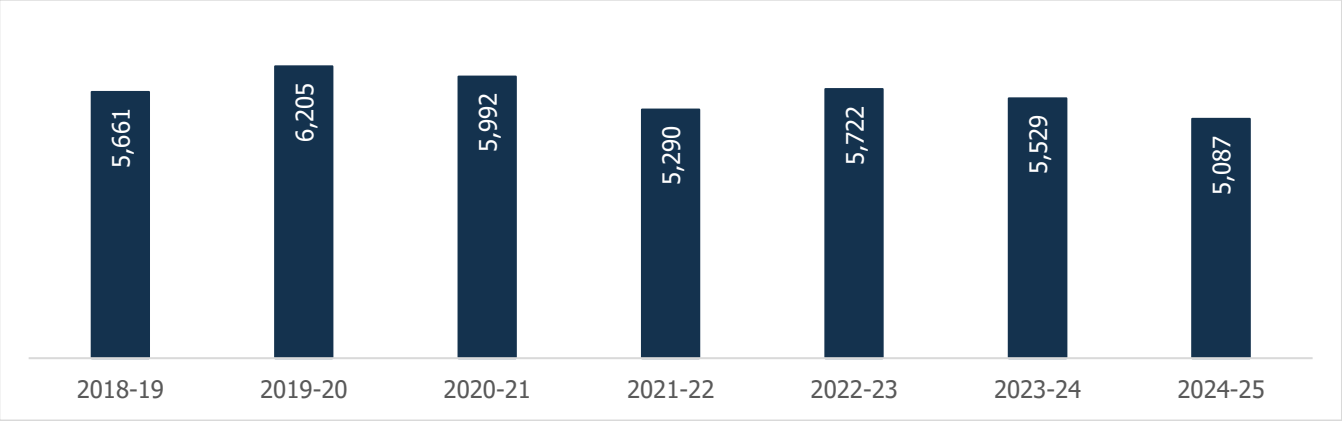
Source: National Food Security Mission, Ministry of Agriculture & Farmers' Welfare
Note: * As per 2nd Advance Estimates

2. Cotton

Application of Bio-fertilizers in Cotton

When the crop preceding cotton is heavily fertilized, it reduces the nitrogen recommendation by 25%. The seeds are treated with 600g/ha of azospirillum and 600g/ha of phosphobacteria or 1200g/ha of azophos. Additionally, 2000g/ha of azospirillum and phoshphobacteria or azophos (4000g/ha) each is mixed with 25kg of farmyard manure and 25kg of soil on the seed line. This saves 25% nitrogen and also increases the yield. Whereas to increase the germination and vigour, the seeds are coated with arappu leaf powder, DAP, micronutrient mixture, azospirillum, phosphobacteria, azophos, and maida solution or gruel as an adhesive.

Chart 52: Production Trend of Cotton in India (in '000 tonnes)



Source: Cotton Association of India; 2024-25 figures are estimates

The production of cotton was 5,529 thousand tonnes in 2023-24 and 5,087 thousand tonnes in 2024-25.

In addition to crops like rice and cotton, chilli also requires high levels of nitrogen for its growth.

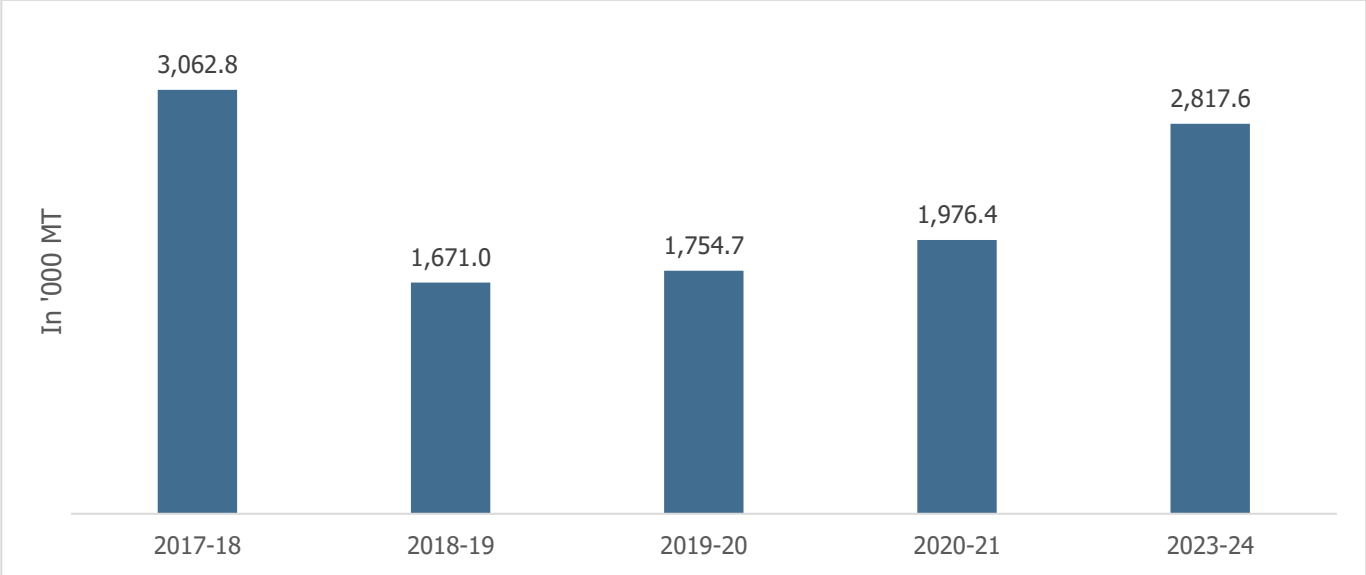
3. Chilli

Application of Bio-fertilizers in chilli

Earlier, minimal fertilizer was used on chillies but the development of early maturing varieties with high yield potential and growing chillies under irrigated conditions resulted in increased use of fertilizers. Chillies heavily use Nitrogen (N),

Phosphorous (P) and Potassium (K). When nitrogen is applied heavily, there is an increase in vegetative growth and maturity is delayed. It also delays flowering by 5 days while application of phosphorous reduces flowering days to 13 days.

Chart 53: Production Trend of Chilli in India



Source: APEDA (Agricultural and Processes food products Export Development Authority)

India's chilli production has shown a remarkable recovery, climbing from 1.97 million tonnes in 2020-21 to 2.82 million tonnes in 2023-24 a growth of over 43%. This rebound is largely attributed to Southern states, led by Andhra Pradesh, which nearly doubled its output to 1.21 million tonnes. Key drivers include the adoption of high-yielding hybrid varieties, improved irrigation infrastructure (like drip systems and Mission Kakatiya in Telangana), and state-specific horticulture subsidies that incentivized chilli farming.

Telangana and Karnataka also saw steady gains due to better rainfall patterns, technological support, and a shift toward commercial cultivation with export potential. In contrast, West Bengal's production fell sharply from 105.8 in 2018-19 to 16.4 thousand tonnes in 2023-24, likely due to a shift to alternative crops, erratic monsoons, or pest outbreaks that affected farmer preferences. Similarly, states like Gujarat and Assam showed marginal or inconsistent output due to limited irrigation coverage and lower market access.

State-wise production trend:

States	2017-18	2018-19	2019-20	2020-21	2023-24
Andhra Pradesh	992.9	630.0	805.0	796.7	1,212.9
Telangana	681.6	369.0	436.4	536.5	794.4
Karnataka	520.3	194.8	129.2	147.1	280.6
Madhya Pradesh	489.1	217.7	208.6	315.6	301.6
Odisha	138.3	69.3	69.3	69.3	89.0
West Bengal	100.3	105.8	8.6	7.8	16.4
Gujarat	44.1	21.4	18.9	23.4	36.1
Assam	41.2	19.0	21.9	20.2	21.7
Punjab	28.2	1.8	17.0	17.6	23.1
Uttar Pradesh	25.2	24.0	11.8	12.1	29.6
Total	**3,062.8**	**1,671.0**	**1,754.7**	**1,976.4**	**2,817.6**

Source: APEDA (Agricultural and Processes food products Export Development Authority); Top common states considered

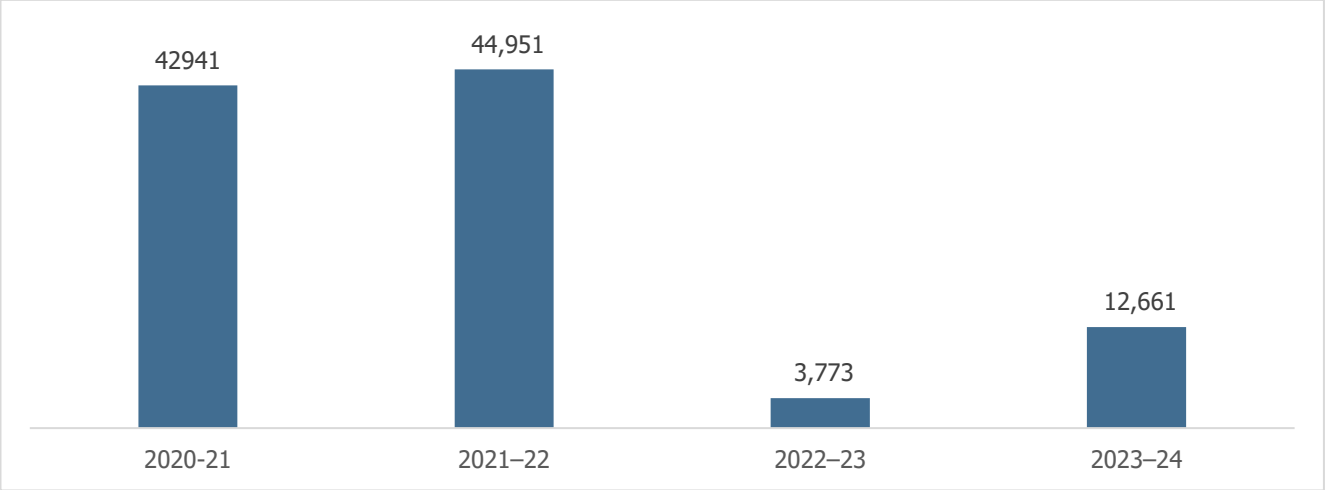
B. Organic Fertilizers

8.2 Overview of Organic fertilizers

Organic fertilizers are natural products used by farmers to provide plant nutrients for crops. They increase the organic matter in soil which in turn releases plant food in available form for the use of crops. They also enable the soil to hold more water and help in improving the drainage in clay soil.

Organic Fertilizer Production in India

Chart 54: Organic Fertilizer Production in India (in '000 MT)



Source: National Centre for Organic and Natural Farming

The production trend of organic fertilizers in India over the last four years reflects significant fluctuations, indicating challenges in sustaining consistent growth. From 42,941 metric tonnes in 2020-21, production marginally increased to 44,951 metric tonnes in 2021-22. However, a sharp decline followed in 2022-23, with output declining to just 3,773 metric tonnes, a nearly 92% drop. This dramatic fall may be attributed to reduced demand, logistical issues, or policy bottlenecks.

The production rebounded slightly in 2023-24 to 12,661 metric tonnes, yet it still remains well below earlier levels. The erratic pattern suggests a need for better policy push, improved supply chain mechanisms, and awareness programs to promote organic fertilizer usage among farmers. Stabilizing this sector is crucial for promoting sustainable agricultural practices in India.

Some of the organic fertilizers are:

- **Farmyard Manure**

It refers to the decomposed mixture of dung and urine of farm animals alongside litter and left-over material from roughages or fodder fed to the cattle. Several vegetable crops like potato, tomato, sweet potato, carrot, radish, onion, etc., respond well to farmyard manure.

- **Vermicompost**

In this process, earthworms are used for composting organic residues. Earthworms are capable of consuming practically all kinds of organic matter and they can eat as much as their own body weight per day. The excreta or casting of earthworms is rich in nutrients such as nitrogen, phosphorous, potassium, and manganese alongside bacterial and actinomycetes populations. This whole process of collecting vermicast along with microbially degraded organic compost is known as vermicompost.

- **Phosphate Rich Organic Manure (PROM)**

PROM is enriching manure with phosphate minerals that improve the level of nutrient elements in them. It is produced by co-composting organic manure with high-grade (32% phosphorous pentoxide) rock phosphate mineral in fine (min 80% finer than 74 microns) size.
The addition of phosphate-solubilizing microorganisms enhances the effect. Usage of PROM reduces the cost of fertilization to the farmers and also leads to the conservation of phosphate minerals, a non-renewable resource, due to the high residual effect.

Some of the benefits of using PROM are:
- Cheaper than chemical fertilizers
- Enriches the soil to its natural cultivable source
- Saves soil from becoming dead due to inorganic fertilizer utilization
- Helps in soil rejuvenation and is sustainable
- Suitable to neutral and alkaline soils, which is proving to be a boon to Indian farmers

8.2.1 Organic Manure
Organic manure is a well-decomposed material used in organic agriculture. It is free from chemicals, harmful chemicals, organisms, and weed seeds and the origin is from either plant or animal. Organic manure increases the organic matter in the soil, and in turn, releases the plant food available for the use of crops.

- **Phospho-Compost**

It is produced from crop residues, cattle dung, urine and other similar organic matter. Phosphorous-rich rock phosphates or pyrite enriched with phosphate solubilising microbes are mixed with the organic residues. This enables the non-solubilised nutritional factors like phosphorous to get solubilised, which can easily be taken up by plants from the soil. Traditionally prepared compost is very low in nitrogen and phosphorous but phospho-compost contains these ingredients 2-8 times more.

- **Oil Cakes**

After extracting oil from oilseeds, the remaining solid portion is dried as a cake which can then be used as manure. After mineralization, the nutrients present in oil cakes are made available to crops 7 to 10 days after application. It is very important for the oil cakes to be well powdered before application to ensure even distribution and quicker decomposition.

There are two types of oil cakes:
- Edible Oil Cakes - These oil cakes can be safely fed to the livestock. Examples include Groundnut cake and coconut cake.
- Non-Edible Oil Cakes - These oil cakes are not fit for feeding livestock. Examples include Castor cake and mahua cake. They are used as manures for horticultural crops.

- **Enriched Composting**

In this type of composting, recycled green materials such as garden cuttings are used. It is a kind of soil improver suitable for mixing with soil but can also be used as topdressing, a mulch or in 'no-dig' approaches.

Some of the key benefits of using enriched composting are:
- Improves soil structure
- Weed free
- Suitable for organic growing
- Easy to work with and spread
- Reduces the risk of plant failure
- Improves soil drought resistance

- **Green Manuring**

The practice of ploughing or turning the soil into undecomposed green plant tissues for the purpose of improving the soil's physical, chemical, and biological environment is known as green manuring.

According to suitable soil and climatic conditions of a particular area, green manuring is performed in different ways.

Broadly, the practice of green manuring in India can be divided into two types:

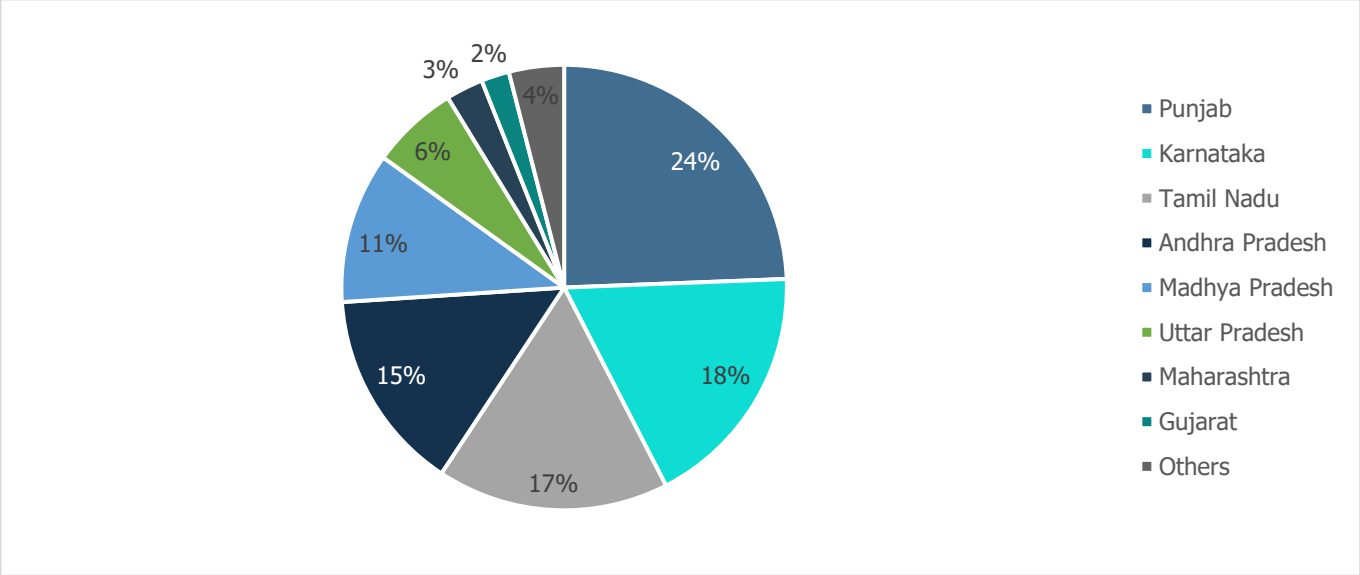
- **Green Manuring in Situ**: It is a system in which green manure crops are grown and incorporated into the soil of the same field that is to be green manured, either as a pure crop or an intercrop with the main crop. Common green manure crops in this system are sun hemp, dhaincha, guar, etc.
- **Green Manuring through a Collection of Green Plant Tissues from Other Places**: It refers to turning into the soil green leaves and tender green twigs collected from outside the shrubs and trees grown on bunds, wastelands, and nearby forest areas. E.g. Glyricidia, karanj.

The advantages of green manuring include the addition of organic matter to the soil and simulating soil micro-organisms, improving the structure of the soil, decreasing run-off and erosion caused by rain, and increasing the availability of certain plant nutrients like calcium, manganese, iron, etc.

All India Production of Organic Fertilizer

In 2023-24, Punjab was the highest organic fertilizer producing state. It had a share of 24% of the total production. After Punjab, Karnataka is the second-highest organic fertilizer-producing state, it holds a share of 18% and the third-highest organic manure-producing state is Tamil Nadu with a share of 17%. These three states cumulatively account for almost 60% of the organic production. Accordingly, it can be inferred that organic fertilizer production is the highest in the southern part of India.

Chart 55: All India Production of Organic Fertilizer



Source: Ministry of Agriculture and Farmers' Welfare, CareEdge Research
(Note: The 'others' category of the state comprises of the following states: Assam, Jammu & Kashmir, Chhattisgarh, Rajasthan, Jharkhand, Bihar, Ladakh and Haryana)

8.2.2 Rise in Exports for Organic Production

The total exports stood at 3,12,800 metric tonnes in 2022-23 and 2,61,029 MT in 2023-24. During 2022-23, there was a significant degrowth of 17% in exports. India exported 2,61,029 MT of organic products during 2023-24 for a value of Rs 4007.91 Crore (494.80 million USD) to more than 50 destinations. The major export destinations included U.S.A, European Union, Canada, Great Britain, Sri Lanka, Switzerland, Vietnam, etc.

8.2.3 Key Growth Drivers for Bio-fertilizers and Organic Fertilizers Industry

➢ **Introduction and promotion of new technologies such as usage of drones**

- The necessity of increasing food production to meet the demand of the ever-increasing population in India needs no emphasis but doing so while maintaining soil nutrients and fertility is more crucial.
- The use of conventional methods for application of fertilizer has its own limitations and challenges of labour shortage, energy, and low input use efficiency. Furthermore, the conventional machines used for crop nutrient spraying are heavy and may compact the soil along with mechanical damage to the crop.
- This is when Unmanned Aerial Vehicles (UAVs) which are usually known as drones become a vital alternative to overcome these challenges. Drones can be used for targeted input application, timely diagnosis of nutrient deficiency, crop health monitoring, rapid assessment of crop yield and crop losses. There is a variety of imaging technologies which include multi spectral, hyper spectral and thermal imaging, with the help of which farmers are able to get a better picture of farms and fields.

- Crop nutrient spraying through drone ensures rapid application and can be used to treat large areas quickly. The drones also have the capability to fly at low height (1-3m) over the canopy of the crop and this makes them even more suitable for spraying crop nutrients and is more viable compared to aerial spray. This also saves input cost and environment.
- Drones use multiple batteries, and it is very beneficial for farmers as it helps in saving effort, time and dependencies on labour. It is also helpful for tall crops like sugarcane, bushy crops like cotton and fields like paddy.
- Drones can be more effectively used in hilly regions where it is difficult for another farm equipment to reach. Drones not only encourage farmers to solve other problems and receive plenty of benefits through precision agriculture but enhances the overall performance of the farmers, crop and soil.
- Drones with special features like lasers, sensors, reservoirs can be filled with fertilizer and pesticide for spraying on the crops and for planting seedlings since they have flexibility and can maneuver over the desired locations. Further, drones can also provide accurate information, quantify and identify risks faster and safely. Hence it is used in insurance to assess the extent of damage based on visuals provided by the drones and in monitoring for timely harvest, aversion of pest attacks etc. Drones can prove to be vital for agriculture as they provide real time information which can improve the health of crops.

➢ **Other Key Growth Drivers:**

Changing Perception

There is an increased awareness about the harmful effects of chemical fertilizers on the environment in recent times. People are now more focused on their well-being and what goes into their food. They are willing to pay more alongside wanting to do better for the environment. Such aspects have led to the increased use of bio-fertilizers.

Farm Mechanization

Farm mechanization is the process of using agricultural machinery to mechanize the work of agriculture, which greatly increases farmer productivity. It helps in increasing farm labour efficiency and reducing workload. It is estimated that farm mechanization can help reduce time by approximately 15-20%.

Additionally, farm mechanization helps in improving the harvest and reducing post-harvest losses alongside improving the quality of cultivation. These benefits help in the reduction of production costs and allow farmers to earn more income. As of June 2019, the percentage of farmers accessing technical advice was 42% and the percentage of farmers who adopted the advice was 90%. This means farmers are willing to adopt technical advice and assistance for improving the crop yield, as well as their income.

Further, the cost of deploying labour is also increasing substantially and farm mechanization is the only way to reduce labour costs, and thus, the cost of cultivation. It also helps in the conversion of uncultivable land to agricultural land through advanced tilling techniques, improvement in the safety of farm practices, and helps encourage the youth to join farming, attracting more people to work and live in rural areas. However, the increasing levels of mechanization do not necessarily mean big investments.

Besides, women play an important role in farming-based communities and more percentage of total farm labour comprises women. This implies the power sources should be chosen accordingly (human, animal, or motor-based), depending on the work to be done. Accordingly, taking into consideration technologies that are apt to women's needs and improving their access to appropriate forms of farm power can reduce drudgery and lead to sustainable mechanization.

Government Initiatives

Declining soil quality due to overuse of chemical fertilizers and their ill effects on human health is a rising concern, and thus, has encouraged the government to opt for various plans, schemes, and other initiatives to encourage the adoption of bio-based fertilizers among farmers. For instance, regular training courses and frontline demonstrations are organized by the National Center for Organic Farming (NCOF) and the Indian Council of Agricultural Research (ICAR) to educate farmers about biological fertilizers.

Surging Demand for Cereals and Grains

Bio-fertilizers help to fix atmospheric nitrogen in the soil and root nodules of legume crops. Rhizobium is used as a biofertilizers and crop enhancer for increased cereal production. It has been found that rhizobia can make an association with gramineous plants such as wheat, rice, maize, barley, and other cereals without forming any nodule-like structure or causing any disease symptoms. Hence, the increase in demand for cereals and grains will also result in increasing use of bio-fertilizers.

Increasing Farm Incomes

The National Statistical Office (NSO) has conducted a survey twice since 2003 and the farmer's average monthly income has increased over a period of time. In 2013, income increased from Rs.969 to Rs.6,426 and as of 2019, income stood at Rs.10,218.

Average Monthly Income of Farmers in India (in Rs.)

Year	2003	2013	2019
Income (Rs.)	969	6,426	10,218

Source: National Statistical Office (NSO)

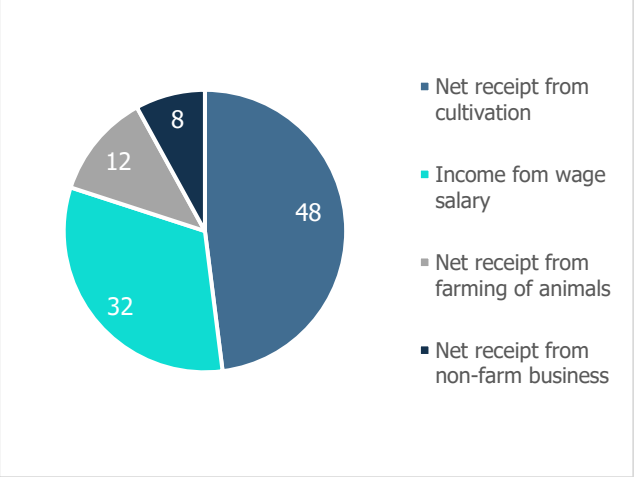
Similarly, the income of agricultural households has increased over the years backed by growth in income from farm activities and farm-allied activities as shown in the chart below and MSP fixed by the government has been supporting farmer's income over the years. The MSPs are primarily linked to market prices and have been very important in passing better prices to farmers.

MSP has also encouraged farmers to move towards crops that provide better yield and value. Apart from this, agricultural marketing, food management practices, and encouragement of the food processing sector coupled with various initiatives by the government have been aiding the income of agricultural households.

Strong brand presence with wide variety of ranging products

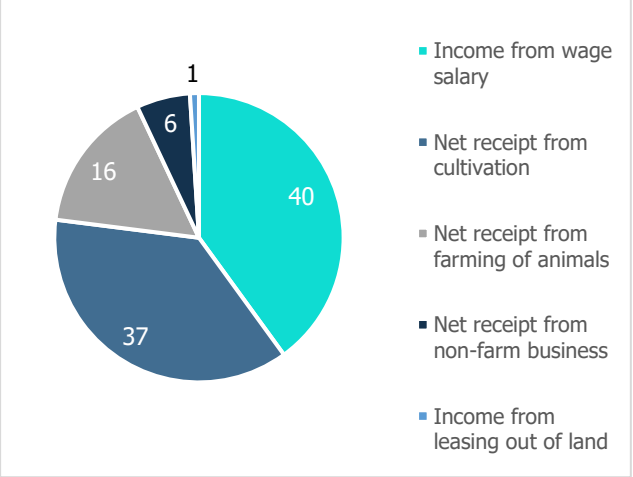
Strong and recognizable brands are crucial in the industry, as they enhance customer trust and credibility. The brands not only instill confidence in product quality but also significantly influence purchase decisions, giving companies with well-established brands a competitive edge as well as wide choices for customers to choose between products.

Chart 56: Composition of Average Monthly Income of Agricultural Households in % (2013)



Source: Economic Survey 2021-22

Chart 57: Composition of Average Monthly Income of Agricultural Households in % (2019)



Source: Economic Survey 2021-22

The above charts show class-wise distribution of sources of income among agricultural households and depicts that there is a visible diversification in the sources of income of the farmers. The net receipts from cultivation (crop production) continued to account for a major share of agricultural household income and contributed 37% of the agricultural household income. The income from cultivation increased by 22.6% to Rs.3,781 in 2019 from Rs.3,084 in 2013. The net receipts from other sources (excluding income from cultivation) increased by 92.6% where total income grew by 59%. However, the income still remains very low due to which usage of pesticides also remains lower compared to developed nations. Government's support and impetus to improve the situation of farmer income, is likely to help the industry.

Kisan Programmes

There are several business segments of companies wherein the aim is to create a bridge between the point of research to farmer fields to attain its objective of generating revenue by adding more satisfied loyal customers by providing need-based solutions with production, technologies, and usage skills. With the help of such applications, data related to farmers are collected, which can be used to connect and provide support further.

The role of people involved is to provide information about a product, help in identifying the problem, and help in solving it. The problem is fed into the system, identification is done and the solution is provided accordingly. Furthermore, feedback is taken if the problem still persists. It is addressed again.

Some of the companies that have such initiatives are:
Indian Farmers Fertilizer Cooperative (IFFCO Kisan Sanchar Ltd)
Nova Agri Tech Limited (Nova Kisan Seva Kendra)

Increasing Emphasis on Organic Agriculture

One of the fastest-growing agricultural methods is organic farming. The excessive use of synthetic fertilizers has led to the contamination of soil and the destruction of microorganisms. To reduce the increasing pollution of soil, organic farming is being adopted. Besides, the rising demand for organic food is further motivating farmers to adopt bio-fertilizers.

C. Bio-Stimulants

Bio-stimulants are compounds or products that include microorganisms, whose function when applied to plants/seeds/ rhizosphere is to enhance and regulate the crop's physiological process to improve input use efficiency, growth, yield, quality, and stress tolerance. These bio-stimulants may include products of plants/ animals or microbial origin.

It not only enhances plant immunity but is also effective in the management of pests and withstanding abiotic as well as biotic stress. It shows an immense effect on pests like leaf-eating caterpillars and borers that last for a long time. There are many categories of bio-stimulants.

Some of the widely used bio-stimulants are:

- Humic and Fulvic Acids: This has parts of soil organic matter resulting from the decomposition of plant, animal, and microbial residues.

- Seaweed Extracts: These are insoluble powder or liquid form and are derived through different extraction processes.

Amino-Chelated Fertilizers

Amino-chelated fertilizers contain micronutrients based on key amino acids that increase nitrogen using efficiency and optimize overall plant metabolism by improving crop production. These helps accelerate the growth of the plant by inducing stress resistance and tolerance and significantly enhancing seedling growth, postponing plant deterioration with age and increasing plant canopy.

Further, amino-chelated fertilizers help in increasing the pollen germination rate and length of the pollen tube. It focuses on crops like chilli, cotton, tomato, paddy, tobacco, cereals, pulses, creeper vegetables, etc. In addition, these act as a deficiency corrector and assist in the rapid and healthy growth of plants, which results in good quality high yields. These fertilizers focus on crops like chilli, jasmine, rose, rice, sugarcane, red gram, melon, etc.

8 Threats and Challenges

For pesticides-

- **Research & Development (R&D) Costs:**

Companies are required to invest in R&D to develop new molecules, which usually involves high costs. Also, developing a new molecule takes around 9 years on average. While R&D is important to introduce innovation, the investment and time it demands restricts the development of R&D.

- **Distribution Systems:**

The weak distribution system hinders the reach of agrochemicals to each and every remote area of the country. This, in turn, restricts its availability to the users that are spread at the remotest location in India. The industry requires efficient distribution through retailers to enhance its availability.

- **Spurious Products:**

The unavailability of pesticides at different locations gives an opportunity for spurious products to make their way. The usage of these counterfeit products, in turn, may also affect the crops, thus harming the honour of the agrochemicals industry and its sales. Besides, the unawareness among farmers contributes towards the growth of such products.

- **Lack of Awareness:**

There is a lack of awareness among farmers with respect to the optimum and proper application of pesticides, which is affecting the growth of the agrochemicals industry. The companies, however, have been working toward increasing awareness about the usage of pesticides by farmers. They are educating the farmers about the benefits of agrochemicals and their safe usage. This is further expected to increase the demand for pesticides.

Further, companies are also educating farmers on aspects such as the right quantity, right use, and right application method for the usage of pesticides. Besides, farmers are trained with respect to appropriate chemicals that are to be used for identified pest problems.

- **Genetically Modified (GM) Seeds:**

GM seeds have the potential to decrease the application of pesticides. These seeds introduce pest avoidance qualities in high-yielding crops. GM seeds, thus, have immunity developed in them, which tends to prevent them from the vagaries of nature. Accordingly, this quality of GM seeds has the potential to affect the demand for agrochemicals.

- **Organic Farming:**

With growing health consciousness among people, there has been an increase in demand for organic food, and thus, organic farming. Thus, there is a need for the agrochemicals industry to consider and work toward these concerns to prevent their impact on industry growth.

- **Competition:**

The pesticides market is fiercely competitive with several domestic and international players. Companies face challenges with regulatory compliance including obtaining approvals and meeting safety standards. There is an increasing demand for innovation in environmentally friendly products. The companies must also ensure their products meet the specific needs of various crops and regions. Additionally, establishing efficient distribution networks is crucial for gaining a competitive edge.

- **High entry barriers**

Entry barriers include the high cost, complex regulatory approvals, intricacy of product development and manufacturing, lead time, expenditure required for R&D, building customer confidence and relationships which play a crucial role in shaping the business.

For bio-fertilizers and organic fertilizers industries-

- **Lack of Awareness and Low Adoption Rates due to High Production Costs**

Farmers are not aware of the usefulness of bio-fertilizers and how they increase crop yields sustainably. Their lack of awareness about the concentration, time, and method of biofertilizer application and the efficacy of bio-fertilizers compared to their familiarity with the use of conventional fertilizers is a serious challenge of their wide-scale application and adoption. Also, specific machinery and equipment are needed for the production and storage of bio-fertilizers, which, in turn, increases production costs. This further leads to a lower adoption rate, limiting the growth of the biofertilizer market.

- **Poor Infrastructure**

Non-availability of suitable facilities for production is a major infrastructural constraint. In addition to this, inadequate availability of inputs and unavailability of inputs at appropriate times is another problem. Also, the shortage of essential equipment, power supply and less space availability for the laboratory is also a major constraint.

- **Staff Competence**

The lack of technically qualified staff in production units is a serious problem and this constraint is in direct connection with the lack of proper training and the adoption of technical qualifications for the production of bio-fertilizers. Improving the technical and human capacity for quality control of bio-fertilizers also has been identified as critical for adequate biofertilizer market realization.

- **Lack of Regulations**

The lack of effective regulation on bio-fertilizers is among the greatest contributors to the low availability and adoption of the products. Due to the absence of a supportive regulatory and policy framework the research to improve the agricultural application of bio-fertilizers is often disrupted. Whereas effective regulatory environments can significantly reveal the potential of biofertilizer use.

In addition, the lack of such an environment leads to poor facilitation of production, distribution, and use of bio-fertilizers. Poor management of fertilizers and supplements registration further raises more problems, leading to low accessibility to novel products.

- **Low Shelf Life**

To increase the shelf-life of bio-fertilizers there are other processes to be followed adding to an extra cost to the farmer. For storing bio-fertilizers, a cool place is required. In areas where temperatures are hot and proper care of storage is not taken; the quality gets reduced as microbial count decreases.

- **Seasonal Demand for Bio-Fertilizers**

Bio-fertilizer demands are seasonal in nature and so are the requirements of its supply. Hence, the production and distribution are done only a few months in a year. The bio-fertilizer producers thus face a challenge to design improved formulations tailored to local conditions and supply them in a way that satisfies the variability of crop responses. Thus, extensive research on technology to develop formulations that can satisfy these requirements is necessary and without this research, the producers will not benefit from the full potential of bio-fertilizers.

9 Competitive Landscape

Competition in the Agrochemical Market

The agrochemical market in India faces strong competition from both domestic and international players. The intensity of competition varies across market segments, geographic regions, and product categories. To remain competitive, companies in this sector must continuously focus on reducing operating costs and improving overall efficiency to sustain their market position.

- **Aries Agro Limited**

Incorporated in 1969, Aries Agro Ltd. manufactures micronutrients and other customized nutritional products for plants and animals. It also offers equipment like soil testing kits and drones. It has total installed capacity of 95,400 MTPA in India. The company has 25 branches across 27 Indian states and around 6,400+ registered distributors and dealers. It also has a manufacturing unit at Fujairah, UAE, which produces 1,888.75 MT of Sulphur bentonite and other value-added Sulphur products for sale in India and globally.

Aries Agro Limited				
Financial indicators	**FY22**	**FY23**	**FY24**	**9MFY25**
Net Sales (Rs. Million)	4,323.69	4,722.36	5,164.58	4,952.02
Operating profit (EBITDA) (Rs. Million)	505.37	565.84	584.01	713.19
Operating margin (in %)	11.69%	11.98%	11.31%	14.40%
Net profit (Rs. Million)	116.05	159.30	183.99	374.05
Net profit margin (in %)	2.68%	3.37%	3.56%	7.55%
Total debt (Rs. Million)	1,059.00	955.38	703.45	344.05
Debt -to- Equity	0.46	0.39	0.27	0.12
Return on Capital Employed (ROCE) (in %)	17.35%	17.28%	16.62%	19.38%
Interest coverage (in times)	1.83	2.08	2.27	4.14
Return on Equity (ROE) (in %)	5.05%	6.45%	6.95%	13.12%
Asset Turnover Ratio (in times)	0.85	0.91	1.00	0.87

Source: Company disclosures, CareEdge Research

- **Basant Agrotech India Limited**

The company was incorporated in 1990. Its wide product portfolio includes various grades of fertilizer, seeds, agriculture plastics, organic products, and chemicals. The company has its three Single Super Phosphate (SSP) manufacturing plants located at Akola and Jalgaon in Maharashtra and Neemuch in Madhya Pradesh. The Company has three manufacturing plants at Akola and Sangli in Maharashtra and Hospet in Karnataka. Its fertilizer division has a total plant capacity of 454075 MTPA. The company provides warehousing and is into renewable energy generation with four windmills, three in Maharashtra and one in Gujarat with installed capacity of 3.050MW. Warehouses and cold storage units of the company are located at Shivni, Dalambi, Bramhandari, Kumbhari in Maharashtra.

Basant Agrotech India Limited				
Financial indicators	**FY22**	**FY23**	**FY24**	**9MFY25**
Net Sales (Rs. Million)	4481.56	5492.60	4047.52	3302.21
Operating profit (EBITDA) (Rs. Million)	303.33	359.26	247.69	194.54
Operating margin (in %)	6.77%	6.54%	6.12%	5.89%
Net profit (Rs. Million)	189.94	183.85	39.57	30.14
Net profit margin (in %)	4.24%	3.35%	0.98%	0.91%
Total debt (Rs. Million)	720.93	1238.87	1536.83	1311.60
Debt -to- Equity	0.47	0.72	0.88	0.74

Basant Agrotech India Limited				
Financial indicators	**FY22**	**FY23**	**FY24**	**9MFY25**
Return on Capital Employed (ROCE) (in %)	14.40%	15.00%	9.33%	6.69%
Interest coverage (in times)	4.24	2.87	1.33	1.31
Return on Equity (ROE) (in %)	12.39%	10.76%	2.27%	1.70%
Asset Turnover Ratio (in times)	1.20	1.32	0.98	0.94

Source: Company disclosures, CareEdge Research

- **Best Agrolife Limited**

The company was incorporated in 1992. It offers technical, intermediate, and novel formulations specializing in insecticides, herbicides, fungicides, plant-growth regulators, and public health products. It has 52,000+ distribution networks. It has a technical manufacturing capacity of 7,000 MTPA & formulations manufacturing capacity of 30,000 MTPA with plants located in Gajraula (UP), Jammu, and Greater Noida. The company has presence in 19 Indian states, 23 countries, and 5 continents.

Best Agrolife Limited				
Financial indicators	**FY22**	**FY23**	**FY24**	**9MFY25**
Net Sales (Rs. Million)	12,107.95	17,456.78	18,733.19	15,399.70
Operating profit (EBITDA) (Rs. Million)	1,658.14	3,136.58	2,255.89	1,958.80
Operating margin (in %)	13.69%	17.97%	12.04%	12.72%
Net profit (Rs. Million)	1,047.62	1,921.46	1,062.67	917.80
Net profit margin (in %)	8.65%	11.01%	5.67%	5.96%
Total debt (Rs. Million)	2,644.07	5,576.46	6,277.24	5,700.61
Debt -to- Equity	0.80	1.06	0.97	0.75
Return on Capital Employed (ROCE) (in %)	39.01%	50.04%	27.67%	20.79%
Interest coverage (in times)	10.32	7.51	3.14	3.50
Return on Equity (ROE) (in %)	31.75%	36.44%	16.42%	12.14%
Asset Turnover Ratio (in times)	1.23	1.18	0.93	0.64

Source: Company disclosures, CareEdge Research

- **Bhagiradha Chemicals & Industries Limited**

The agrochemical manufacturing company was incorporated in 1992 and is based at Hyderabad. It manufactures various technical-grade insecticides, herbicides, and fungicides. The company has an annual capacity of 3,250 tonnes. It has presence in 23 countries.

Bhagiradha Chemicals & Industries Limited				
Financial indicators	**FY22**	**FY23**	**FY24**	**9MFY25**
Net Sales (Rs. Million)	4,356.67	5,020.91	4,076.48	3,178.52
Operating profit (EBITDA) (Rs. Million)	682.77	773.25	429.13	308.72
Operating margin (in %)	15.67%	15.40%	10.53%	9.71%
Net profit (Rs. Million)	357.48	451.52	182.21	147.42
Net profit margin (in %)	8.21%	8.99%	4.47%	4.64%
Total debt (Rs. Million)	805.45	499.72	614.21	874.34
Debt -to- Equity	0.42	0.16	0.15	0.14
Return on Capital Employed (ROCE) (in %)	28.85%	19.87%	7.68%	4.22%
Interest coverage (in times)	6.65	13.77	4.50	5.14
Return on Equity (ROE) (in %)	18.83%	14.41%	4.40%	2.35%
Asset Turnover Ratio (in times)	1.27	1.12	0.71	0.38

Source: Company disclosures, CareEdge Research

- **Heranba Industries Limited**

Present across 70+ countries, the company was incorporated in 1992. It manufactures pesticides including insecticides, herbicides, fungicides, and public health products. The company has four manufacturing facilities across Gujarat with an aggregate plant capacity of 16,224 MTPA. It has 10,000 dealers across 19 states and union territory.

Heranba Industries Limited				
Financial indicators	**FY22**	**FY23**	**FY24**	**9MFY25**
Net Sales (Rs. Million)	14,503.70	13,188.20	12,570.70	7,336.70
Operating profit (EBITDA) (Rs. Million)	2,597.50	1,560.30	768.70	998.70
Operating margin (in %)	17.91%	11.83%	6.12%	13.61%
Net profit (Rs. Million)	1,890.60	1,043.70	177.40	122.90
Net profit margin (in %)	13.04%	7.91%	1.41%	1.68%
Total debt (Rs. Million)	529.63	890.10	1,609.50	2,330.40
Debt -to- Equity	0.07	0.11	0.19	0.26
Return on Capital Employed (ROCE) (in %)	35.52%	17.68%	7.27%	8.02%
Interest coverage (in times)	63.71	18.33	5.23	7.35
Return on Equity (ROE) (in %)	26.46%	12.88%	2.08%	1.36%
Asset Turnover Ratio (in times)	1.36	1.13	0.85	0.42

Source: Company disclosures, CareEdge Research
Note: Standalone financials have been considered for FY21 & FY22

- **India Pesticides Limited**

The company was incorporated in 1984 and globally operates chemical manufactures in India. It is in the manufacturing of both technicals & formulations in agro-chemicals and active pharma ingredients for the pharma industry. It exports its products to 29 countries. The company has 26 branches, 18 warehouses, and 5,112 dealers. The technical capacity of the company is 24,000 MTPA and formulations capacity is 6,500 MTPA.

India Pesticides Ltd				
Financial indicators	**FY22**	**FY23**	**FY24**	**9MFY25**
Net Sales (Rs. Million)	7,161.43	8,849.40	6,804.10	6,213.70
Operating profit (EBITDA) (Rs. Million)	2,137.72	1,969.40	866.10	887.10
Operating margin (in %)	29.85%	22.25%	12.73%	14.28%
Net profit (Rs. Million)	2,115.68	1,432.40	601.70	620.10
Net profit margin (in %)	29.54%	16.19%	8.84%	9.98%
Total debt (Rs. Million)	143.51	35.90	184.00	201.80
Debt -to- Equity	0.02	0.00	0.02	0.02
Return on Capital Employed (ROCE) (in %)	33.16%	25.01%	10.19%	9.80%
Interest coverage (in times)	31.87	27.80	19.79	28.08
Return on Equity (ROE) (in %)	33.17%	18.53%	7.29%	7.18%
Asset Turnover Ratio (in times)	0.90	0.96	0.68	0.55

Source: Company disclosures, CareEdge Research

- **Dharmaj Crop Guard Limited**

The company was incorporated in 2015 and manufactures, distributes, and markets a wide range of agro chemical formulations, such as insecticides, fungicides, herbicides, plant growth regulators, micro fertilizers and antibiotics. The company's installed manufacturing capacity is 25,500 TPA and exports its products to around 20 countries. It also manufactures and sells general insect and pest control chemicals for public health and animal health protection with 13,500 retail touchpoints. It has a network of 4,500+ dealers and distributors across 26 countries and 20 Indian states.

Dharmaj Crop Guard Limited				
Financial indicators	**FY22**	**FY23**	**FY24**	**9MFY25**
Net Sales (Rs. Million)	3,942.08	5,242.97	6,541.03	7,411.16
Operating profit (EBITDA) (Rs. Million)	443.37	411.27	629.42	709.33
Operating margin (in %)	11.25%	7.84%	9.62%	9.57%
Net profit (Rs. Million)	286.90	268.60	443.76	372.76
Net profit margin (in %)	7.28%	5.12%	6.78%	5.03%
Total debt (Rs. Million)	369.28	524.17	1,118.87	1,367.14
Debt -to- Equity	0.43	0.17	0.31	0.35
Return on Capital Employed (ROCE) (in %)	37.19%	11.61%	13.93%	12.31%
Interest coverage (in times)	15.73	17.39	17.69	6.48
Return on Equity (ROE) (in %)	33.79%	8.52%	12.35%	9.43%
Asset Turnover Ratio (in times)	1.80	1.21	1.16	0.92

Source: Company disclosures, CareEdge Research

- **Indogulf Cropsciences Limited**

The company is focused in field research, manufacturing, R&D and branding. They manufacture and market products, such as biostimulants, crop protection, public health and veterinary, and plant supplements. The company exports their products to 34+ countries. Besides this, the company has been recognized with 'Two Star Export House' in 2021 for delivering higher export performance.

The company also manufactures both technical and formulation products. The company is amongst the first few manufacturers of Pyrazosulfuron Ethyl. Technical products are concentrated chemicals, which form the base of pesticides; however, they are not yet suited for direct application to the crops. Formulation products are made by adding various solvents etc. called formulants to the technical pesticides to make them ready for application on crops.

Indogulf Cropsciences Limited (Consolidated)				
Financial indicators	**FY22**	**FY23**	**FY24**	**9MFY25**
Net Sales (Rs. Million)	4872.10	5496.56	5522.34	4641.88
Operating profit (EBITDA) (Rs. Million)	471.65	488.76	594.09	434.41
Operating margin (in %)	9.68%	8.89%	10.76%	9.36%
Net profit (Rs. Million)	263.63	224.23	282.33	216.77
Net profit margin (in %)	5.41%	4.08%	5.11%	4.67%
Total debt (Rs. Million)	1013.78	1892.18	1545.62	2063.04
Debt -to- Equity	0.56	0.93	0.67	0.78
Return on Capital Employed (ROCE) (in %)	20.26%	17.77%	18.82%	12.96%
Interest coverage (in times)	6.91	3.60	3.78	3.83
Return on Equity (ROE) (in %)	14.60%	11.03%	12.19%	8.17%
Asset Turnover Ratio (in times)	1.18	1.06	1.02	0.78

Source: Company disclosures, CareEdge Research

Benchmarking Based on Financial Parameters

1. Operating Profit Margin

The operating profit margins fluctuate for companies in these industries. While a few companies have witnessed significant fluctuations in their margins, Indogulf Cropsciences has consistently remained stable over the past three years. This steady improvement is driven by a gradual rise in revenue and increased operational efficiency.

Operating Margin	FY22	FY23	FY24
Basant Agrotech India Limited	6.77%	6.54%	6.12%
Aries Agro Limited	11.69%	11.98%	11.31%
Best Agrolife Limited	13.69%	17.97%	12.04%
Bhagiradha Chemicals & Industries Limited	15.67%	15.40%	10.53%
Dharmaj Crop Guard Limited	11.25%	7.84%	9.62%
Heranba Industries Limited	17.91%	11.83%	6.12%
India Pesticides Ltd	29.85%	22.25%	12.73%
Indogulf Cropsciences Limited	9.68%	8.89%	10.76%

Source: Company disclosures, CareEdge Research

2. Net Profit Margin

While many companies have experienced significant volatility in net profit margins, Indogulf Cropsciences has consistently maintained stable profit margins over the past three years.

Net Profit Margin	FY22	FY23	FY24
Basant Agrotech India Limited	4.24%	3.35%	0.98%
Aries Agro Limited	2.68%	3.37%	3.56%
Best Agrolife Limited	8.65%	11.01%	5.67%
Bhagiradha Chemicals & Industries Limited	8.21%	8.99%	4.47%
Dharmaj Crop Guard Limited	7.28%	5.12%	6.78%
Heranba Industries Limited	13.04%	7.91%	1.41%
India Pesticides Ltd	29.54%	16.19%	8.84%
Indogulf Cropsciences Limited	5.41%	4.08%	5.11%

Source: Company disclosures, CareEdge Research

3. Debt to Equity Ratio

This ratio measures the company's financial leverage. The debt-to-equity ratio for major agrochemical players is currently below 1, indicating a conservative financial structure with lower reliance on debt financing. With a D/E ratio below 1, these companies face lower financial risk, reduced interest obligations, and greater flexibility to invest in growth and innovation without becoming overleveraged. This conservative approach provides stability, positioning them well to navigate market volatility.

Debt-to-Equity Ratio	FY22	FY23	FY24
Basant Agrotech India Limited	0.47	0.72	0.88
Aries Agro Limited	0.46	0.39	0.27
Best Agrolife Limited	0.80	1.06	0.97
Bhagiradha Chemicals & Industries Limited	0.42	0.16	0.15
Dharmaj Crop Guard Limited	0.43	0.17	0.31
Heranba Industries Limited	0.07	0.11	0.19
India Pesticides Ltd	0.02	0.00	0.02
Indogulf Cropsciences Limited	0.56	0.93	0.67

Source: Company disclosures, CareEdge Research

4. Return on Capital Employed

Return on Capital Employed (ROCE) measures a company's efficiency at generating profits. Indogulf Cropsciences has demonstrated resilience keeping ROCE ranging between 19–21% over the last three years.

Return on Capital Employed (%)	FY22	FY23	FY24
Basant Agrotech India Limited	14.40%	15.00%	9.33%
Aries Agro Limited	17.35%	17.28%	16.62%
Best Agrolife Limited	39.01%	50.04%	27.67%
Bhagiradha Chemicals & Industries Limited	28.85%	19.87%	7.68%
Dharmaj Crop Guard Limited	37.19%	11.61%	13.93%
Heranba Industries Limited	35.52%	17.68%	7.27%
India Pesticides Ltd	33.16%	25.01%	10.19%
Indogulf Cropsciences Limited	20.26%	17.77%	18.82%

Source: Company disclosures, CareEdge Research

5. Interest Coverage Ratio

The Interest Coverage Ratio is a key indicator of a company's ability to meet its interest obligations, reflecting financial stability. In agrochemical industry, this ratio varies peers to peers indicating diverse capital structure and debt management strategies. For FY24, Indogulf Cropsciences' interest coverage ratio stands at 3.8x.

Interest Coverage Ratio	FY22	FY23	FY24
Basant Agrotech India Limited	4.24	2.87	1.33
Aries Agro Limited	1.83	2.08	2.27
Best Agrolife Limited	10.32	7.51	3.14
Bhagiradha Chemicals & Industries Limited	6.65	13.77	4.50
Dharmaj Crop Guard Limited	15.73	17.39	17.69
Heranba Industries Limited	63.71	18.33	5.23
India Pesticides Ltd	31.87	27.80	19.79
Indogulf Cropsciences Limited	6.91	3.60	3.78

Source: Company disclosures, CareEdge Research

6. Return on Equity

Return on Equity (ROE) assesses a company's efficiency in generating profits for its shareholders. Although ROE varies across companies due to differing capital structure, many industry players have experienced significant fluctuations. While several players have seen sharp declines in ROE in FY24, whereas Indogulf Cropsciences has maintained a stable yet moderate ROE.

Return on Equity (%)	FY22	FY23	FY24
Basant Agrotech India Limited	12.39%	10.76%	2.27%
Aries Agro Limited	5.05%	6.45%	6.95%
Best Agrolife Limited	31.75%	36.44%	16.42%
Bhagiradha Chemicals & Industries Limited	18.83%	14.41%	4.40%
Dharmaj Crop Guard Limited	33.79%	8.52%	12.35%
Heranba Industries Limited	26.46%	12.88%	2.08%
India Pesticides Ltd	33.17%	18.53%	7.29%
Indogulf Cropsciences Limited	14.60%	11.03%	12.19%

Source: Company disclosures, CareEdge Research

7. Asset Turnover Ratio

The Asset Turnover Ratio reflects how efficiently a company utilizes its assets to generate revenue. Indogulf Cropsciences has maintained stable ratio. For FY24, the ratio stood at 1.0x.

Asset Turnover Ratio	FY22	FY23	FY24
Basant Agrotech India Limited	1.20	1.32	0.98
Aries Agro Limited	0.85	0.91	1.00
Best Agrolife Limited	1.23	1.18	0.93
Bhagiradha Chemicals & Industries Limited	1.27	1.12	0.71
Dharmaj Crop Guard Limited	1.80	1.21	1.16
Heranba Industries Limited	1.36	1.13	0.85
India Pesticides Ltd	0.90	0.96	0.68
Indogulf Cropsciences Limited	1.18	1.06	1.02

Source: Company disclosures, CareEdge Research

Contact

Tanvi Shah	Director – Advisory & Research	tanvi.shah@careedge.in	022 6837 4470
Vikram Thirani	Director – Business Development	vikram.thirani@careedge.in	022 6837 4434

CARE Analytics and Advisory Private Limited
(Wholly-owned subsidiary of CARE Ratings Ltd.)
Office No. 602, 6th Floor, Rustomjee Aspiree, Off Eastern Express Highway, Sion East, NA, Mumbai, 400022, Maharashtra, India
Phone: +91-22-68374400

Connect :

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