CropLife INDIA

YES BANK

TOWARDS A FOOD SECURE FUTURE

The Pivotal Role of Crop Protection Solutions in Boosting Sustainable Growth of Indian Agriculture

September 2023

CropLife India is a leading industry association of both Indian and Global R & D driven crop science organizations. CropLife India jointly represents around 70% of the Indian crop protection market and are responsible for 95% of the molecules introduced in the country. Our member companies have an annual global R & D spend of over INR 50,000 crores.

Our member companies were established in India as far back as the 1950s. We continue to work hand-in-hand with the Government to build the agriculture sector – from introduction of several newer and safer molecules, direct investment of building factories, jobs creation, bringing in agriculture innovation and working endlessly over the years with multi-stakeholders to enhance agriculture productivity. All member companies are firmly committed to engage with the farming community to enable Safe, Secure and Sustainable Food Supply.

CropLife India members enable farmers adopt new technologies in agriculture, while providing in depth farmer trainings on good farming practices, including responsible use of crop protection products, container management and spraying techniques promotion of safe, responsible & judicious use of crop protection products under Integrated Pest Management approach.

CropLife India extensively engages with the farming community including dealers and traders for growing safe, secured and nutritious food committed to responsible crop care and crop production for sustainable development of Indian Agriculture.

CropLife India is a not for profit organization, (registered under Section 8 company) wholly funded by membership. CropLife India is a part of the CropLife International Network; and works closely with CropLife Asia & CropLife International, spread across 91 countries while engaging with diverse stakeholders to drive programs on Anti-Counterfeiting, Product Stewardship, Progressive Regulations, IPR/Data Protection, Policy & Advocacy, Communications & Outreach.

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YES BANK operates its Investment banking, Merchant banking & Brokerage businesses through YES SECURITIES and its Mutual Fund business through YES Asset Management (India) Limited, both wholly owned subsidiaries of the Bank. Headquartered in Mumbai, it has a pan-India presence across all 28 states and 8 Union Territories in India including an IBU at GIFT City, and a Representative Office in Abu Dhabi.

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Chairman Message

The year 2023 has been momentous as we've made significant strides during India's Presidency of the G20. " India's G20 Presidency, themed One Earth, One Family, One Future," draws inspiration from our ancient Sanskrit text of the Maha Upanishad "Vasudhaiva Kutumbakam" meaning "The Whole World is One Family". The New Delhi Leaders' Declaration is also a testament to India's diplomatic prowess and the G20's commitment to addressing global issues collectively and with zeal, prominently recognizes the future path for agriculture also.

The Declaration committing to eliminate Hunger and Malnutrition stresses on accelerating innovations and investment focused on increasing agricultural productivity, reducing food loss and waste across the value chain, and improving marketing and storage, to build more sustainable and climate-resilient agriculture and food systems. Equally critical and essential for our industry is the acknowledgment of agriculture inputs. The Declaration, while committing to enhance global food security and nutrition for all underscores "the importance of increasing access to, availability, and efficient use of fertilizer and agricultural inputs, including strengthening local fertilizer production, and improving soil health."

Implicit in this statement is the pivotal role of the crop protection industry. Our industry is contributing to the significant achievements in agriculture food production and more significantly exports. From a mere 50 million tonnes of exports at the dawn of independence, our agricultural exports have grown exponentially, reaching a value of over USD 50 billion in 2021-22. The introduction of High Yielding Variety (HYV) seeds, high-quality fertilizer and crop protection products has fueled this momentum.

Also it is worthy of note that according to the latest data from the WTO, India has emerged as the second-largest exporter of agrochemicals globally. In the financial year 2022-23, agrochemical exports from India reached US$ 5.4 billion (Rs. 43,223 crores), up from US$ 4.9 billion (Rs. 36,521 crores) in the financial year 2021-2022. The government identified the agrochemical industry as one of the 12 champion industries where India can play a significant role in the global supply chain, and the industry is proving its resilience.

The 'Amrit Kaal' is poised to be a transformative phase in Indian agriculture. The consistent focus on the digitization of farming, in line with Prime Minister Narendra Modi's vision to empower our 'Annadatas,' will revolutionize Indian agriculture over the next 25 years, easing the toil of our farmers and creating new opportunities for rural youth and farm workers.

The Centre's plan to build a digital public infrastructure for the agriculture sector is set to be a game-changer. This open-source digital public good will support the growth of the agri-tech industry and startups, enabling an inclusive farmer-centric ecosystem with relevant information services for crop planning and improving access to farm input, credit, insurance, crop estimation, market intelligence, and the growth of agri-tech industry and startups. The Government of India's Digital Agriculture Mission 2021-25 underscores the importance of projects predicated on technologies such as artificial intelligence, block-chain, remote sensing, GIS technology, drones, and robots to galvanize agricultural transformation. There are immense opportunities to promote Public-Private Partnerships as industry also is deploying cutting edge technologies to address the various challenges of the farmers.

Digital technology is pivotal in supporting innovation, boosting productivity and profitability, and endorsing sustainable farming practices. Increasingly, farmers can harness digital tools to manage farms efficiently, reduce production costs through judicious input utilization, detect pests, access weather and market information, and streamline waste management. The convergence of AI and IoT with big data, sensors, drones, and computer imaging, bolstered by analytical tools, furnishes actionable insights that drive progress.

However, we recognize that rural-to-urban migration has hindered the supply of agricultural labor, and this trend must be reversed. This can only happen if farmers are equipped with the latest and a wider range of technologies to tackle the increasing challenges posed by pests, diseases, and climate change. CropLife India has been at the forefront of advocating for the use of drones in spraying crop protection products. We provided inputs, suggestions, and shared best practices during the deliberation process for the expeditious release of SOP and Guidelines for spraying agrochemicals through Kisan Drones.

CropLife India continued to prioritize safety as the key driver for resilient and sustainable agriculture throughout the last year. Recognizing our efforts, CropLife India was honored at the India Public Relations and Corporate Communications Conference and Awards (IPRCCA) 2022 under the Corporate Communications category.

CropLife India will continue to collaborate with all stakeholders to ensure a predictable, science-based policy and regulatory regime that enhances the crop protection sector's ability to make Indian agriculture sustainable—this remains our ongoing agenda. As always, the Secretariat has been at the forefront of all our activities. A big thank you and compliments to the entire team who worked tirelessly to implement all the initiatives during the year. I am thankful for the leadership and guidance of all Committees and Groups, making the year highly productive for our industry.

I would also like to take this opportunity to thank my Co-Chairs Shri. Anil Kakkar and Shri. Srinivasa Karavadi for their continued support during the year. I thank our Board of Directors for their contribution in implementing the learnings of the pandemic, which highlighted the vulnerability of supply chains and brought the focus back to strengthening Indian manufacturing. It is heartening to note that the CropLife India Board meetings, various Committee meetings, seminars, and meetings with external stakeholders saw record participation. I wish all members continued success and prosperity as we work together to leverage CropLife India's platform for nation-building.

Dr. K. C. Ravi
Chairman, CropLife India

Foreword

The role of the crop protection industry in safeguarding global food security is indispensable. The world grapples with the critical issue of pre-harvest crop losses, which not only jeopardize food security but also has far-reaching implications on socioeconomic progress. Globally, the leading cause of these losses is the prevalence of crop pests. FAO estimates that annually, as much as 40% of the world's crop production succumbs to these pests. Estimates indicate that, globally, plant diseases and invasive insects together account for an annual loss exceeding USD 290 billion. Innovative products and technologies developed by the crop protection industry empower farmers to shield their crops from this diverse array of pests. These advancements are pivotal, as without them, mankind's ability to sustainably produce food for an ever-growing global population would be significantly compromised.

Within India, the crop protection sector has witnessed a profound evolution in recent times. The landscape of crop protection is being redefined through the strides made in science and technology, where green chemistry, biologicals, precision agriculture, and digital tools are opening new vistas to elevate both productivity and sustainability. While embracing these innovations, the industry remains steadfast in its commitment to the responsible application of crop protection solutions. This unwavering dedication stems from the industry's overarching mission—to harmonize the pursuit of high agricultural yields with the goals of ensuring safety and minimizing environmental impact.

YES BANK is sincerely committed to playing a catalytic role in the development of the Indian agriculture sector, not just by serving as a banking partner but also by working alongside private sector, multilateral institutions, government and industry associations for assimilating and propagating knowledge that contributes to sustainable growth of this sector. Towards this, YES BANK is privileged to knowledge partner with CropLife India to develop this report titled "Towards a Food Secure Future: The Pivotal Role of Crop Protection Solutions in Boosting Sustainable Growth of Indian Agriculture". This report explores the dynamic landscape of the crop protection industry, identifies critical challenges that the industry is currently facing and puts forth select initiatives that could boost crop protection industry's contribution towards sustainable growth of Indian agriculture. We hope that this report will foster a deeper understanding of the industry's complexities and lead to a larger conversation on potential pathways for responsible innovation and sustainable growth.

Prashant Kumar
MD & CEO
YES BANK

Executive Summary

Pre-harvest and post-harvest crop losses are serious global challenges that impact food security and have far-reaching socio-economic implications. Pre-harvest losses are primarily caused by crop pests. FAO estimates suggest that annually up to 40% of global crop production is lost to pests. Plant diseases alone cost the global economy more than USD 220 Bn each year, while invasive insects account for at least USD 70 Bn in economic losses annually. In India, estimates suggest that about INR 2 lakh crores worth of crop yield is lost annually due to pests.

Crop loss remains a complex issue with significant implications for farmers, agri value chain stakeholders, food security and the economy at large. It thus becomes essential to understand the root cause, foresee the impact and explore various solutions that can work towards reducing this problem on a sustainable basis. The crop protection solutions industry has been contributing significantly to mitigate the risks arising due to pests and diseases and has been able to effectively confront numerous national emergencies while demonstrating its strong commitment towards enabling Safe, Secure and Sustainable food production and supply.

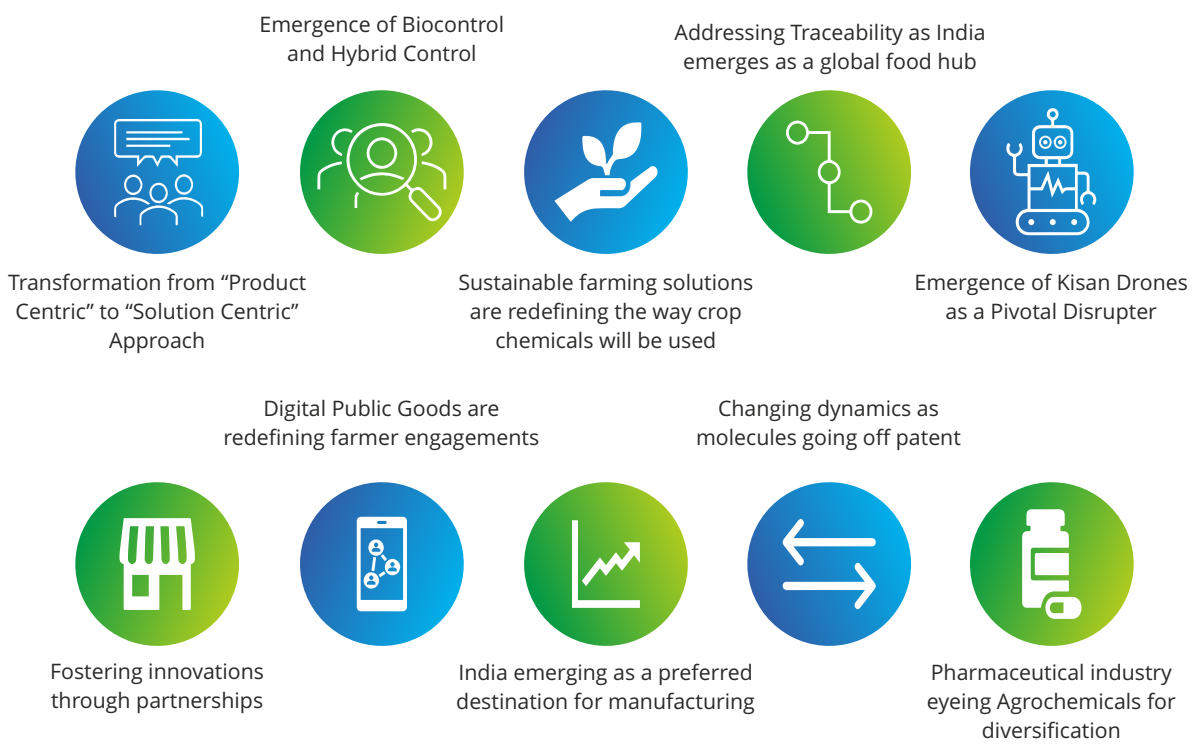
The Indian crop protection industry has been evolving over the years, giving way to some significant shifts driven by climate change, global geo-political issues, technology and its adoption by farmers, evolving consumer preferences and greater farmer centric policies. Some of the key shifts in the crop protection sector include:

- Transformation from a product-centric to a sustainable solution-centric approach, wherein "beyond-crop protection" offerings are being provided to farmers.
- Through innovative research, development, partnerships and collaborations, companies are reimagining their products, solutions and practices to reduce their ecological footprint. There is increased interest amongst industry players to introduce and popularize bio-controls, hybrid and holistic control measures.
- Agtechs (including dronetechs) are changing the way agri-inputs are delivered to farmers, the way agri-inputs are applied in the farm as well as the way farmers are linked to markets. Usage of drones is a big game changer not only for the way that crop protection solutions are applied on field, but also for providing additional income generating activities in rural areas by promoting

entrepreneurship. The initiative to create "Lakhpati Didis" in rural areas harmonizes effectively with the emerging drone tech in agriculture. This synergy is not only a step towards women empowerment but also towards enhancing agricultural productivity, diversifying income sources, technological inclusivity and community development.

- As concerns over sustainability increase, concepts such as Direct Seeded Rice (DSR) and Sustainable Sugarcane Initiative are being widely promoted. The crop protection industry has a significant role to play in this changing scenario as initiatives such as DSR warrant smart weed-management strategies that integrate various approaches, including, preventive, cultural, mechanical, and chemical solutions.
- Continuing their pursuit towards sustainability, R&D backed crop protection industry has been launching new molecules with increased efficiency and reduced per acre application rates.
- As India emerges as a global food hub, addressing traceability becomes crucial for enhancing the efficiency, quality and competitiveness of its agricultural and food production system. Quality remains one of the major pillars for making a mark in the global food supply chain. The crop protection industry is partnering with food companies and other like-minded stakeholders to engage with farmers and create platforms that ensure food safety, quality, sustainability and traceability.
- By 2030, additional 22 crop production products will go off patent. This opens up significant opportunity for generics companies to introduce new molecules into India. In addition to this, protection of regulatory data is one of the best means to attract the entry of new molecules in the Indian Market.

Graphical Representation of the Changing Landscape in the Crop Protection Industry



Source: Stakeholder Discussion, Croplife India & YES BANK Analysis

The role of agriculture in achieving SDGs for India is vital as the sector provides livelihoods to about 50% of the population on one hand while it is amongst the largest users of natural resources on the other. It is estimated that the sector accounts for more than 80% of India's total water usage and about 60% of land use. The crop protection industry at large is adopting sustainability as a core business principle and towards this many initiatives have been taken that impact one or more SDGs. Select sustainability focused initiatives taken up by the industry include:

- Introduction of innovative, greener and eco-friendly solutions for crop protection.
- Stewardship programs on judicious usage of solutions and safe measures to yield safe and nutritious food.
- Building capacities and developing entrepreneurial skills among women in agriculture in India to empower them to take larger roles in the sector.
- Encouraging growers to adopt conservation agricultural practices, helping them optimize water use, increase soil water holding capacity, reduce water runoff and build crop resilience to changing weather patterns.
- Stewardship programs for container management for reducing waste and improving overall environmental footprint of packaging.
- Promoting trainings on ending child labor, workers' rights, and issues of health and safety amongst other.
- Helping growers connect directly to market to get remunerative prices.
- Initiatives that promote traceability of produce
- Increased focus on digitalization, mechanization and collectivization through several collaborations and partnerships.

Case studies of diverse sustainability focused initiatives taken by various industry players have been captured in this report.

The government of India has identified Agrochemicals as a champion sector, which reiterates the importance and contribution of this industry. The role of industry as well the Government remain critical for boosting the crop protection industry's contribution towards Sustainable Growth of Indian Agriculture and its production system. The need is for the industry, regulators, producers, extension services experts and research and development organizations to come together to work on innovations, policy reforms, public awareness and creation of an enabling business environment such that the industry can further contribute to the growth of the agriculture sector. A snapshot of select initiatives that could boost the contribution of the crop protection industry is captured below:

Initiatives to be taken up by Industry

Adopting Farmer Centric Solutions

- Focus on holistic approach that factors in the crop diversity, sustainability, and economic viability to provide “beyond crop protection” solutions to farmers, that addresses challenges faced by the farmer right from sourcing of farm inputs to sale of farm produce.
- Focus on promoting and providing cost effective and accessible IPM solutions to the farmers such that farming practices remain viable and yield good returns.

- Create an effective feedback mechanism such that specific challenges are identified, and customized solutions are delivered at farm.

Embracing Sustainability to the Core

- Prioritize innovations towards greener chemistries, biologicals and hybrid control. Increase the share of green portfolio.
- Invest in packaging that reduces environmental impact.
- Advocate for the adoption of Integrated Pest Management solutions and work with framers to develop effective IPM strategies that go beyond the use of crop protection chemicals.
- Invest in collaborative initiatives that boost farm level carbon sequestration and mitigate farm level carbon emission.

Creating Awareness that Goes Beyond Product Use

- Increasing efforts on creating awareness on MRLs, application techniques, container disposal, safety measures, market dynamics, weather forecasts, pest advisory etc.
- Increase the outreach and diversify the delivery mechanisms of awareness campaigns such that farmers can derive inferences and take decisions in a timely manner.

Initiatives to be taken up by Government

Paving a "Public-Private Pathway" for Capacity Building and Awareness Creation

- There is a need to develop a common platform to collaborate and co-create interventions between like-minded private players as well as between private sector and governments.
- There are numerous myths and misconceptions related to crop protection industry, which need to be effectively tackled through comprehensive awareness campaigns targeted at all stakeholders- right from the farmers to the end consumer. The government and the industry need to collaboratively work towards this national campaign.

Enabling Ease of Doing Business and Ease of Doing Agriculture

- Provision of Data Protection Rights- Considering best practices globally, molecules being introduced for the first time in the country could be given a minimum of 5 years data protection from the date of registration in India. Other countries such as USA, EU, China, Japan, Indonesia, Malaysia, Philippines, Thailand, and Brazil, provide data protection for 6-15 years for molecules being introduced for the first time. Protection of regulatory data is one of the best means to attract the entry of new molecules in the Indian Market. CropLife India is in the favor of providing data protection for new molecules introduced for the first time in the country for a minimum period of 5 years from the date of registration in India.

The government of India has identified Agrochemicals as a champion sector, which reiterates the importance and contribution of this industry.

- There is need to review the process and timelines required for registration and align them to international norms while ensuring safety, efficacy, and sustainable aspects.
- To ease out the registration process, regulatory bodies may induct independent scientists and experts to guide on pesticide registrations and related matters. The supporting staff need to be augmented with requisite upskilling to effectively evaluate product registration data in time bound manner. Government owned universities could play a key role in capabilities augmentation. In addition, the toxicology studies which are time consuming may be outsourced to designated government institutions.
- Criminalization of offences in PMB 2020 needs to be reviewed as this could significantly impact conducive business environment.
- A single window system may be created, that is used as a common platform to apply for licenses across different states. This will save on resources to fill in multiple applications with similar data sets.
- Central as well as State Governments need to carefully evaluate the impact of decisions to ban or restrict the use and introduction of new molecules, on the future of crop protection solutions, morale of industry participants and perceived attractiveness for industry to invest in introduction of new molecules.
- Ease of doing agriculture requires action on several fronts involving central and state governments. A well-coordinated action and strategy between the two levels of government is needed to ensure that agriculture moves to the next stage of development.

Unlocking Opportunities through Investment Incentives

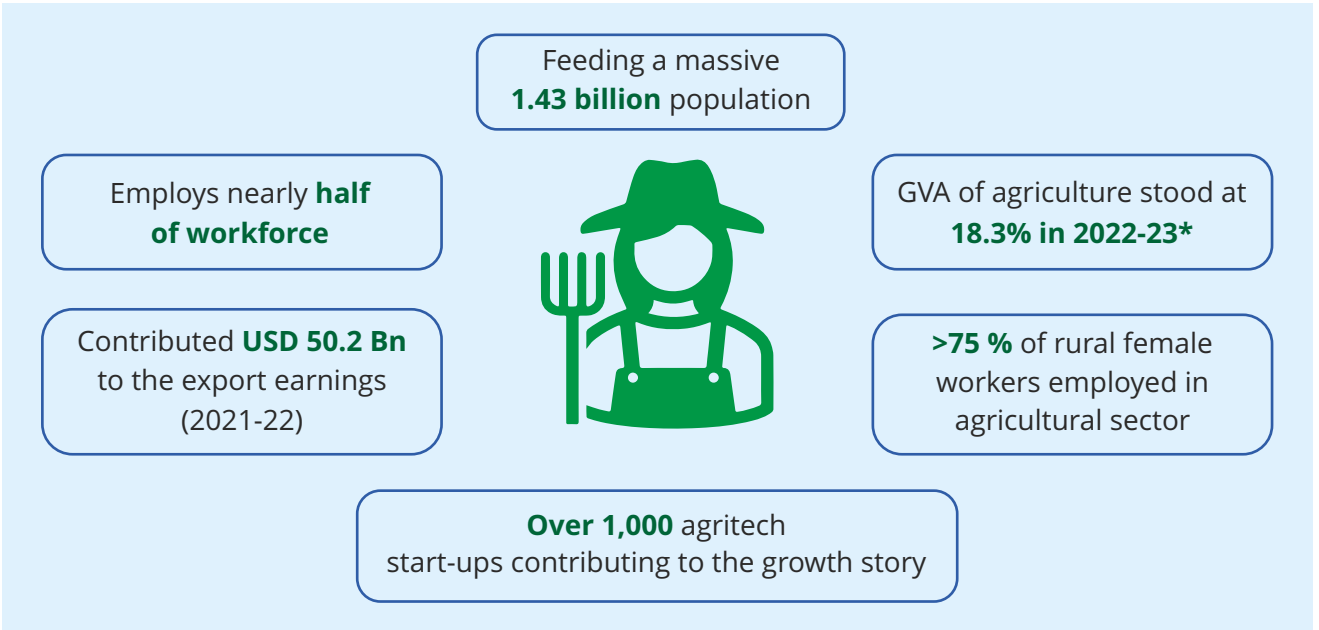
- To reduce dependence on external sourcing of raw materials specially adjuvants, incentive structure may be rolled out for companies to produce raw material and intermediates that can be utilized by the crop protection industry.

Striking a balance between the production of safe, healthy, quality and environmentally sustainable food on one hand and ensuring food security for the increasing population, is a difficult task. Towards this, the role of crop protection industry remains critically important. While the Indian government is championing the cause of sustainable agriculture, unprecedented efforts from the private sector are complementing these efforts to build a safe and sustainable future for India. The crop protection industry is taking swift strides in promoting sustainable agricultural practices and is playing a critical role in paving the way for India to build a sustainable and food secure future.

1 Introduction

Agriculture lies at the heart of India's thriving economy, serving as a cornerstone that sustains the nation's progress and prosperity. The sector is fundamental to ensuring food and nutritional security of the nation, is a vehicle of inclusive growth, a primary medium for enhancing rural income and a critical sector for ensuring sustainability. In the last few decades, India's agriculture sector has witnessed spectacular advances in terms of production, diversification, value addition and exports. A new era of agriculture has dawned upon India with young entrepreneurs building solutions for the sector on one hand and the farmers rapidly adopting these new technologies on the other. As we embark on this new epoch of agriculture, the pathways to produce more food from less resources take centerstage.

Exhibit 1: Snapshot of Indian Agriculture



United Nations Population Dashboard; PIB; Economic Survey 2022-23
**of the total economy (%) at current prices*

By 2050, India will need to meet the food and nutritional requirements of 1.7 Bn people.[1] In addition, India will have a critical role to play in fulfilling the food and nutritional security of resource-constrained nations globally, as well as bridging the demand-supply gap for high value and value-added products in growing economies. Increasing productivity and minimizing crop loss will play a pivotal role in actualizing this goal. The crop protection industry will have a very significant role to play in achieving these aspirations.

Pre-harvest and post-harvest crop losses are serious global concerns, not only posing as a threat to food and nutritional security, but also to the overall socio-economic development. Globally, the major causes of loss at pre-harvest stage are the incidences of crop pests, including insects, diseases, fungi, rodents and weeds. Food plants of the world are known to be damaged by more than 10,000 species of insects, 30,000 species of weeds, 1,00,000 disease causing agents and 1,000 species of nematodes[2]. Food and Agriculture Organization (FAO) estimates that annually up to 40% of global crop production is lost to pests. Each year, plant diseases cost the global economy over USD 220 Bn, and invasive insects at least USD 70 Bn.[3] This together surpasses the Gross Domestic Product (GDP) of many countries including New Zealand, Peru, and Portugal. A technical paper published by Directorate of Weed Research, Indian Council of Agricultural Research (ICAR), suggests that the crop yield loss due to weeds alone is to the tune of USD 11 Bn per annum. The study indicates that weeds contribute to about 37% of yield loss due to pests while insects contribute to 29%, diseases contribute to 22% and other pests (such as rodents) contribute to 12%[4]. Estimates suggest that about INR 2 lakh crores worth of crop yield is lost in India annually due to infestation of such crop pests.[5]

India's agro climatic diversity provides the wherewithal for the nation to extensively cultivate a diverse basket of crops. This diverse crop universe, to thrive, needs to compete with numerous species of weeds, pests and insects, the incidences of which have been growing, impacting diverse crops across the country. Exhibit 2 highlights some of the major incidences of pest attacks in India over the last few years.

[1] *National Academy of Agriculture Sciences*

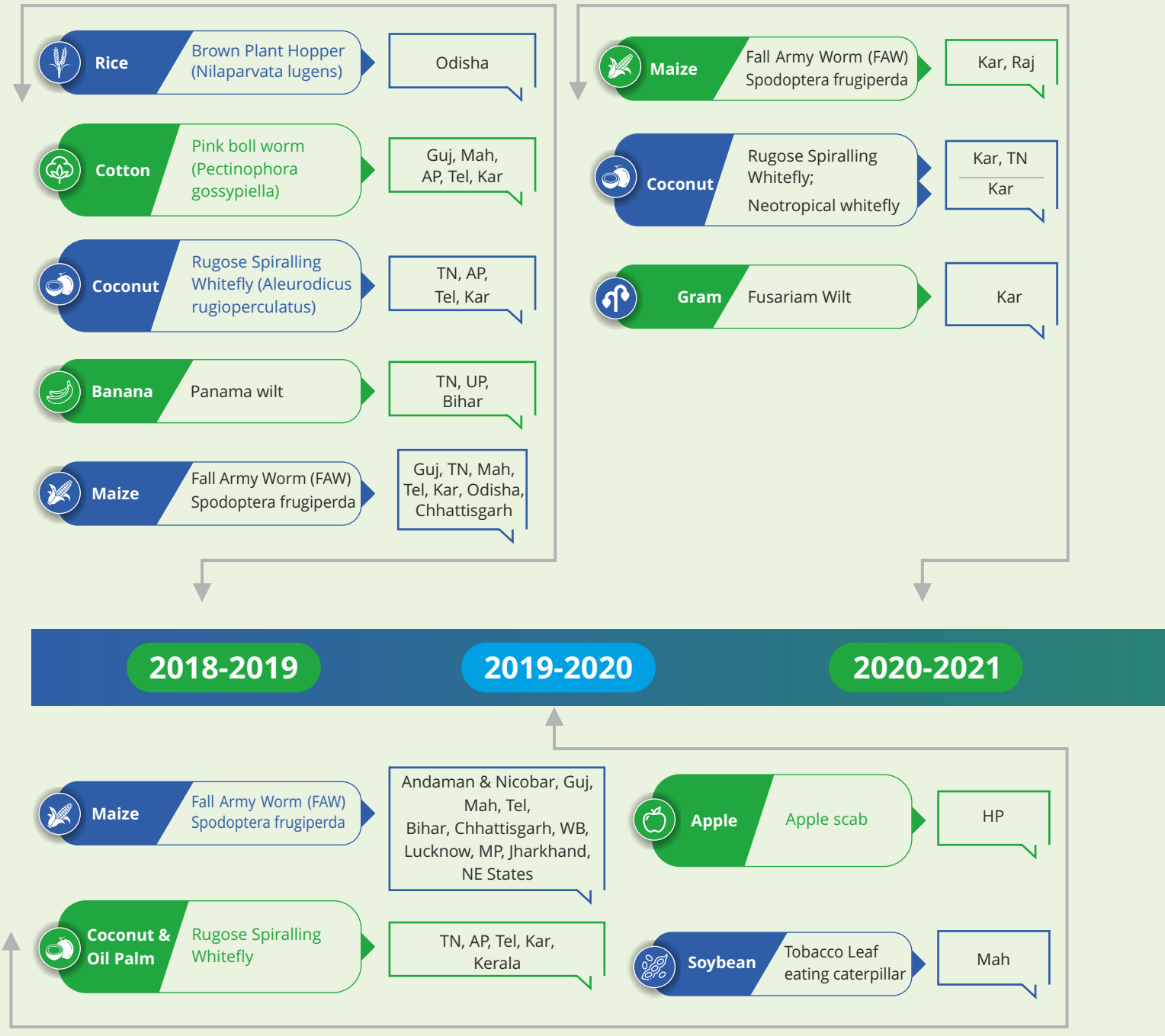
[2] *https://cashew.icar.gov.in/wp-content/uploads/2019/08/Insect-Pests-final.pdf*

[3] *https://www.fao.org/news/story/en/item/1402920/icode*

[4] *ICAR (A.Jamaludheen, Singh P.K, ChoudharyV.K., Gharde Yogits and Mishra J.S 2023. Herbicides Vis-à-vis other pesticides: Trend analysis and economic impact. Technical Bulletin No. 23, ICAR- Directorate of Weed Research, Jabalpur. 32p.) estimates yield loss due to weeds to be USD 11 Bn annually (Gharde et al 2018). It further estimates that yield loss due to weeds is 37%, due to insects is 29%, due to diseases is 22% and due to other pests is 12%.*

[5] *The loss due to weeds (USD 11 Bn) when converted to INR at 2018 rates (1 USD=INR 70) amounts 0.77 lakh crores and this translates to ~ INR 2 lakh crores on overall yield losses due to pests.*

Exhibit 2: Major Incidences of Pests and Diseases in India during the Last 5 Years



Source: Directorate of Plant Protection, Quarantine & Storage

Wheat	Yellow rust (Puccinia stiirformis)	Haryana, HP, Punjab
Maize	Fall Army Worm (FAW) Spodoptera frugiperda	Mah, UP, Haryana,Kar, Punjab, TN, Raj
Chilli	Invasive chilli thrips (Thrips parvispinus)	AP, Tel, Mah
Cotton	Pink boll worm (Pectinophora gossypiella); Whitefly; Thrips & Jassids	Punjab, Mah, TN, Haryana, Raj
Coconut, Areca nut	Rugose Spiralling Whitefly	AP, Kerala, Andaman & Nicobars
Sugarcane	White grub	Mah
Banana	Sigatoka Disease; Cucumber Mosaic Virus	TN, Kerala, Mah
Rice	Southern Rice Black Streaked Dwarf Virus; Brown Plant & White Backed Plant Hopper; Yellow stem Borer; Leaf Folder	Haryana, Punjab, Bihar, Odisha, Uttarakhand, Mah

2021-2022

2022-2023

Wheat	Yellow rust (Puccinia stiirformis)	Haryana, Punjab, Mah, Raj, Chhattisgarh, Uttarakhand
Rice	Gandhi Bug; Bacterial streak	Kar, Meghalaya, Kerala, TN
Maize	Fall Army Worm (FAW) Spodoptera frugiperda	Mah, UP, Haryana, Kar, MP, Tel, Punjab, Bihar, Jharkhand, TN, Raj, Sikkim, Nagaland, Meghalaya
Chilli	Invasive chilli thrips (Thrips parvispinus); White fly, leaf curl, fruit rot	AP, Tel, Mah, Kar, TN
Cotton	Pink boll worm (Pectinophora gossypiella); Whitefly	Punjab, Mah, Kar, Guj, Haryana
Cassava	Cassava mealy bug	TN
Coconut, Areca nut	Rugose Spiralling Whitefly	Kar, TN, AP

Crop loss remains a complex issue with significant implications for farmers, agri value chain stakeholders and the economy at large. It thus becomes essential to understand the root cause, foresee the impact and explore various solutions that can work towards reducing this problem.

The crop protection solutions industry has been contributing significantly to mitigate the risks arising due to pests and diseases and has been able to effectively confront numerous national emergencies, including the control of Phalaris minor weed in wheat, Helicoverpa armigera bollworm in cotton and brown plant hopper insect pest in rice over the years. During 2017-18 alone, rice Kharif area of 1.2 lakh ha was affected by Brown Plant Hopper leading to yield loss of 33% in Odisha. For the same, Govt of Odisha had provided around INR 137 crores as input subsidy to farmers for procurement of crop protection solutions. Exhibit 3 captures the loss due to select pest incidences.

Exhibit 3: Damage to Crops Due to Various Pest and Disease Incidences in India

LOSS OF ABOUT USD 11 BILLION DUE TO WEEDS	Loss estimated as per All India Coordinated Research Project on Weed Management
40-80% LOSSES IN YIELD OF RAPESEED-MUSTARD	Loss due to Sclerotinia rot in Haryana
40-80% DAMAGE TO CHILLI	Damage due to Thrips parvispinus (Karny) in Andhra Pradesh and Telangana during 2022
YIELD LOSS OF 35% IN MAIZE IN KARNATAKA	In 2018, damage intensity of fall army worm was 9 to 62% with the yield loss of 35% in maize
90% PADDY PLANT DAMAGE	Damage in about 1.25 million hectares due to swarming catterpillar in Odisha during kharif 2009 alone
64.16-89.42% COCONUT INFESTATION	In 2014, invasive pest, coconut eriophyid mite, Aceria gurrreronis Keiffer caused nut infestation in Thane, Maharashtra
DEVASTATION OF COTTON IN ABOUT 1.5 MILLION HA	A whitefly epidemic occurred in 2015 in North India
34% YIELD LOSS OF RAW COTTON IN PUNJAB	Loss due to pink bollworm during 2021 with over 54% of the 3 lakh ha cotton area infested

Source: ICAR, Indian Journal of Entomology (Emerging Insect Pests in Indian Agriculture; and Occurrence and Spread of Invasive Thrips Thrips Parvispinus (Karny) In North India), Cotton Association of India (weekly publication), Integrated whitefly [Bemisia tabaci (Gennadius)] management in Bt-cotton in North India: an agroecosystem-wide community-based approach, Current Science, industry sources

The Indian crop protection industry has demonstrated its strong commitment towards enabling Safe, Secure and Sustainable food production and supply. Towards this, the industry has enhanced the focus on innovative and greener chemistries and has undertaken stewardship programs, enabling farmers to adopt new technologies, providing in-depth trainings on responsible use of crop protection products, promoting safe container management systems and promoting safer spraying techniques. Aligned to the goal of improving farmers' income and building the rural economy, the crop protection industry has been working towards upskilling of farmers in general and women folks in particular.

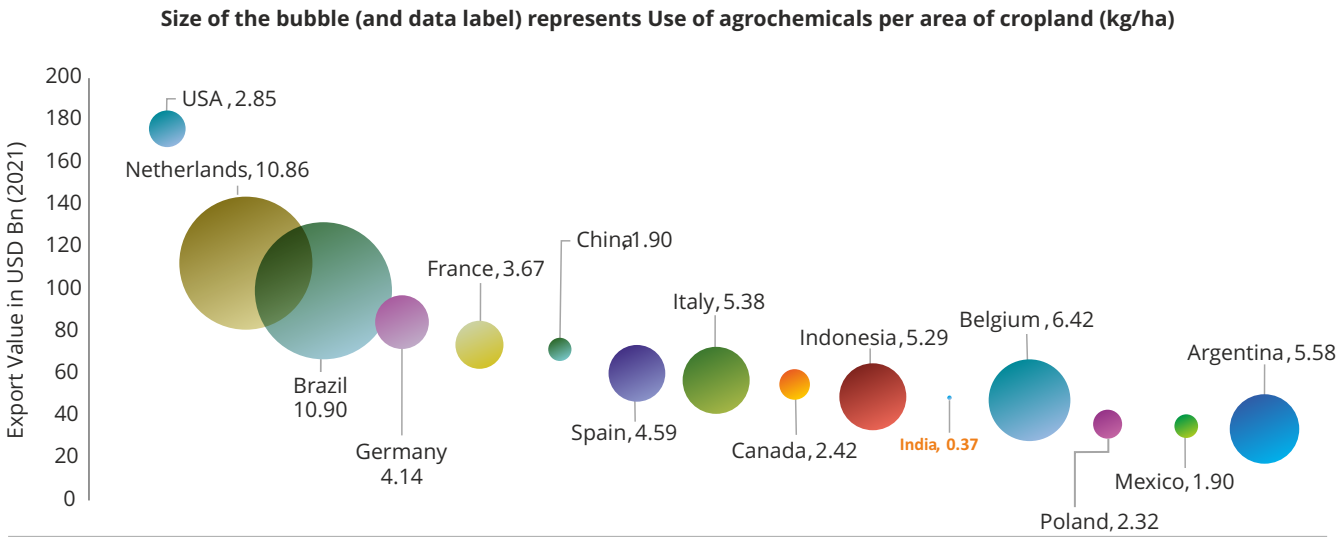
Upskilling of rural women has empowered them to take up entrepreneurship roles, resulting not only in income enhancement of the family but also contributing to increased share of women workforce in the country. Training to farmers on aspects such as good agriculture practices, judicious use of resources and climate smart agriculture has aided in increasing productivity and enhanced income levels.

India now stands as the second largest exporter of agrochemicals globally, after China, making it a key participant in the global crop protection industry.

The contribution of this sector to India's export basket has also been noteworthy. This has two aspects to it. Firstly, the sector itself is a forex earner for the country and secondly, the sector is a very important enabler for exports of food and agricultural products from India.

With exports amounting to USD 5.38 Bn[6] (2022-23 provisional), India now stands as the second largest exporter of agrochemicals globally[7], after China, making it a key participant in the global crop protection industry. The crop protection industry has also enabled the agricultural sector to produce exportable surplus through means of enhanced productivity and training farmers on practices that make crops export ready. Contrary to the belief that use of agrochemicals adversely impact agricultural exports, the top exporters of food and agri commodities also remain the largest consumers of crop protection solutions. Exhibit 4 compares the standing of various countries on food and agricultural exports and usage of crop protection chemicals.

Exhibit 4: Mapping of Top Food and Agri Exporters Against Usage of Agrochemicals per Unit of Cropped Area (2021)



Country	USA	Netherlands	Brazil	Germany	France	China	Spain	Italy	Canada	Indonesia	India	Belgium	Poland	Mexico	Argentina
Agri Exports in USD Bn	176.49	114.67	102.20	87.39	77.05	74.87	63.91	60.26	59.09	53.13	52.18	51.34	40.53	39.40	38.02

Source: FAOSTAT and YES Bank Analysis

Size of circles depict the usage of pesticides per unit of cropped area

[6] *Chemexil, DGCI&S*
[7] *WTO*

2 Overview of Crop Protection Solutions Sector

The global population crossed the 8 billion mark in 2022 from an estimated 2.5 billion people in 1950. This population is expected to increase by nearly 2 billion in the next 30 years, to 9.7 billion in 2050 and could peak at nearly 10.4 billion in the mid-2080s[8]. Supplying food to this exponentially growing population has become a global concern that warrants enhanced yields and minimum food loss. Crop protection solutions are used for shielding crops against insects, diseases, weeds, rodents, and other pests. Their use has globally been recognized as an effective means to secure the food requirements of an ever-increasing population.

Exhibit 5: Types of Crop Protection Solutions

Insecticides
Control harmful insects damaging the crops

Herbicides/ Weedicides
Reduce/control the density of weeds

Others
Bio-pesticides/ fumigants/ rodenticides/ plant growth regulators

Fungicides
Control disease and fungi attack on crops

Source: Industry Discussions

[8] *United Nations*

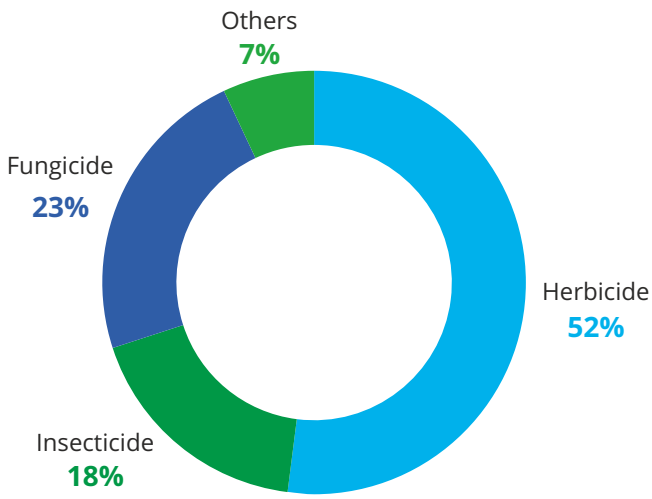
2.1 Global Overview

At the global level, total use of crop protection chemicals[9] was estimated to be about 2.7 Mn MT of active ingredients, while the global average for application of pesticides per unit of cropland was estimated to be about 2.3 kg/ha[10] in 2020.

Herbicides are the largest category of crop protection chemicals used globally, contributing to 52% of global agrochemical usage, followed by fungicides (23%) and insecticides (18%)[11] (refer exhibit 6).

USA is the largest user of crop protection solutions, followed by Brazil, China, Argentina, and Russian Federation. India ranks 11th in total crop protection products' usage.[12]

Exhibit 6: Segmentation of Crop Protection Solutions (% Share by Volume) - Global



Source: FAO-2020

The usage of crop protection solutions per unit of cropland area also varies across the countries, with Brunei being the highest user of agrochemicals per hectare of crop (33.91 kg/ha). India has a comparatively low usage of crop protection chemicals (kg/ha) vis-à-vis a number of other nations. In the year 2021, consumption of crop protection chemicals in India was reported at 0.37 kg/ha compared 11.24 kg/ha in Japan and 10.90 kg/ha in Brazil and 5.58 kg/ha in Argentina. Exhibit 7 depicts the consumption of crop protection solutions per unit area for select countries.

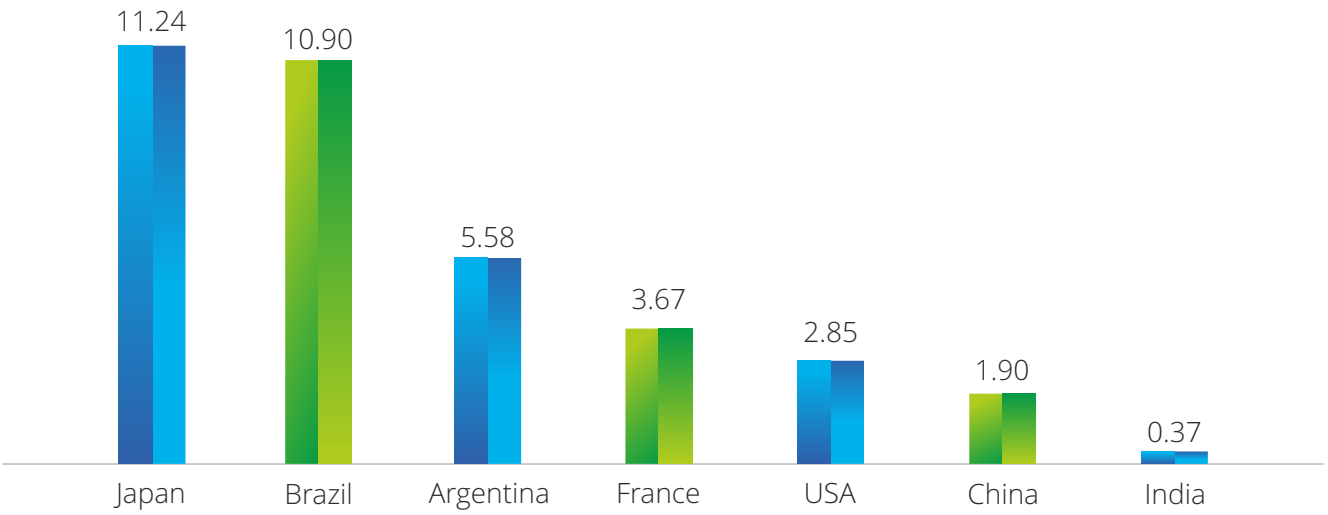
[9] *Includes insecticides, fungicides, herbicides, disinfectants, rodenticides, plant growth regulators, seed treatment solutions etc.*

[10] *FAOSTAT*

[11] *https://www.fao.org/3/cc0918en/cc0918en.pdf*

[12] *FAOSTAT*

Exhibit 7: Consumption of Crop Protection Chemicals of Select Countries in 2021 (kg/ha)



Source: FAO

The global crop protection industry is dominated by players such as Syngenta, Sinochem, Bayer BASF, Corteva, FMC, UPL, Sumitomo and Nufarm among others. Over the recent past, there has been a significant increase in mergers & acquisitions in this industry, driven by the need to expand geographical reach, address rise in spending on Research and Development (R&D) of new active ingredients, manage regressive margins and boost product offerings. Some of the major global corporate consolidations that have taken place in the recent years are indicated in exhibit 8.

Exhibit 8: Major Corporate Mergers in Crop Protection Segment

Major Products
- Animal Health
- Consumer Health
- Crop Science
- Pharmaceuticals

BAYER + MONSANTO

Major Products
- Agrochemical
- Crop Protection
- Data Science
- Seeds (GM)

DEAL WORTH APPROX. $ 63 BILLION

Major Products
- Agrochemical
- Automotive
- Electronic Materials
- Energy & Water

CORTEVA agriscience (• Seeds • Crop protection) + Dow + DUPONT

Major Products
- Agrochemical
- Automotive
- Building & Construction
- Industrial Biotech

DEAL WORTH APPROX. $ 130 BILLION

Major Products
- Agrochemical
- Chemical Material
- Petrochemical Processing

CHEMCHINA 中国化工集团公司 China National Chemical Corporation + syngenta

Major Products
- Agrochemical
- Biotechnology
- Seeds (GM)

DEAL WORTH APPROX. $ 43 BILLION

M&A: Global

Major Products
- Agrochemical
- Crop Protection

Excel Crop Care Limited — SUMITOMO CHEMICAL

Major Products
- Health & Crop Science
- Chemicals & Plastics
- Energy & Functional Materials
- Pharmaceuticals

DEAL WORTH APPROX. $ 75.2 MILLION

Major Products
- Agrochemical
- Crop Protection
- Crop Science
- Public Health
- Data Science

UPL OpenAg™ — Arysta LifeScience

Major Products
- Agrochemical
- Crop Protection

DEAL WORTH APPROX. $ 4.2 BILLION

Major Products
- Agrochemical
- Crop Protection
- Animal Health
- Pharmaceuticals

NICHINO NIHON NOHYAKU CO., LTD. — Hyderabad Chemicals Limited

Major Products
- Agrochemical
- Crop Protection

DEAL WORTH APPROX. $ 60.3 MILLION

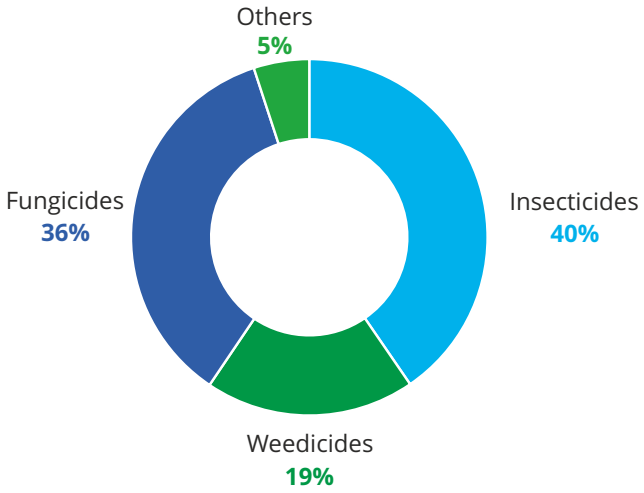
Source: Elsadig Elsheikh and Hossein Ayazi. "The Era of Corporate Consolidation and The End of Competition: Bayer-Monsanto, Dow-DuPont, and ChemChinaSyngenta." Haas Institute for a Fair and Inclusive Society at the University of California, Berkeley, CA. October 2018. haasinstitute.berkeley.edu/ shahidi, Industry sources

2.2 Indian Overview

In last five years the crop protection market in India has grown at a Compounded Annual Growth Rate (CAGR) of 7.6% with the market growing to INR 264.8 Bn in 2022 from INR 197.4 Bn in 2018. The crop protection industry is expected to reach to INR 355 Bn by 2027.[13]

The consumption of technical grade chemical pesticides in India was estimated to be 52,000 MT in 2022-23, a 17% decline from the previous year (decline in volume terms).[14]

Exhibit 9: Segment-wise Contribution of Crop Protection Solutions in India (volume terms)



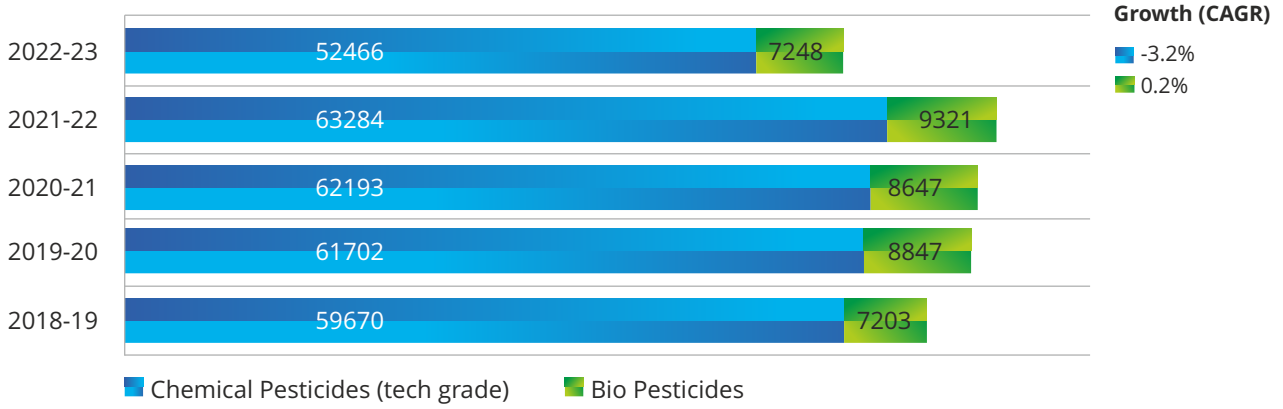
Source: Directorate of Plant Protection, Quarantine & Storage (PPQS) 2022-23 data

[13] *Croplife India*
[14] *This decline may partially be on account of provisional data coming in from select states*

Pesticide usage patterns in India differ from those prevalent worldwide. While herbicides account for major market share globally (~52%), the Indian crop protection market is dominated by insecticides. Insecticides contributed to about 40% of the crop protection market (by volume) , followed by Fungicides (36%) Weedicides (19%), and others (5%) (which includes plant growth regulators, rodenticides, seed treatment solutions etc.). Exhibit 9 depicts the segment wise contribution (in volume terms) of crop protection solutions in India.

Consumption of crop protection solutions witnessed a stagnant trend during the period from 2018-19 to 2021-22, with annual consumption ranging between 59,500 to 63,300 MT, followed by a steep decline between 2021-22 and 2022-23. The consumption of bio-pesticides also witnessed a decline of 22% compared to 2021-22[15]. Consumption decline was noticeable in the states of Maharashtra, Karnataka, Rajasthan, Gujarat, Uttarakhand and Jammu & Kashmir. Exhibit 10 depicts the consumption trend of chemical and bio-pesticides in the last 5 years.

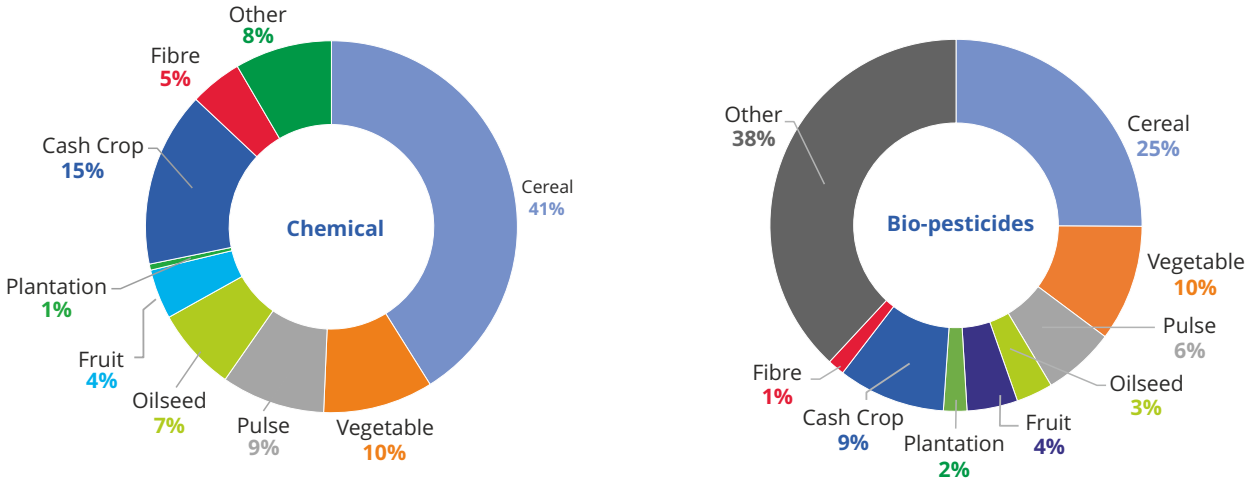
Exhibit 10: Consumption of Crop Protection Solutions Between 2018-19 to 2022-23 (in MT)



Source: Directorate of Plant Protection, Quarantine & Storage (PPQS)

At a crop category level, chemical pesticides usage is dominated by cereals (41%), followed by cash crops like sugarcane (15%), vegetables (10%), pulses (9%), fiber crops (7%), oilseeds (7%) and fruits (4%). Cereals are the largest consumers of bio-pesticides as well, with 25% share, followed by vegetables (10%), cash crops (9%), pulses (6%), fruits (4%), oilseeds (3%) and plantation crops (2%). Exhibit 11 depicts the crop category-wise share of usage of crop protection solutions in India.

Exhibit 11: Crop Category-Wise Share of Usage of Pesticides in India (Chemical and Bio)



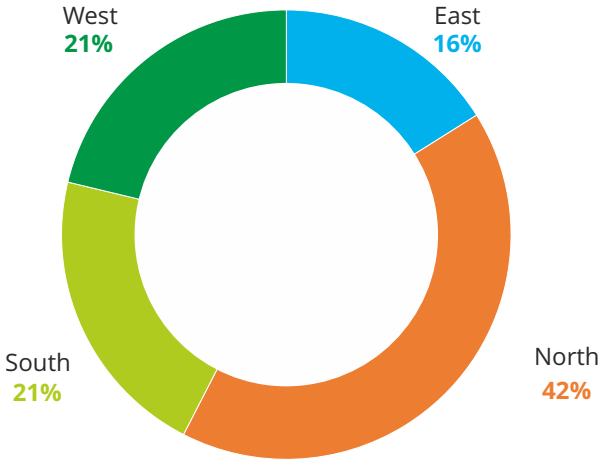
Source: Directorate of Plant Protection, Quarantine & Storage (PPQS)

[15] *PPQS*

Analysis of regional use of crop protection solutions (chemical-technical grade) indicates that northern region of India (including the six states of Punjab, Haryana, Uttar Pradesh, Uttarakhand, Himachal Pradesh and Jammu & Kashmir) contribute to ~42% of the total consumption, followed by the western and southern region with 21% share each (refer exhibit 12). The top 5 states in terms of usage of chemical pesticides (2022-23) are Uttar Pradesh, Maharashtra, Punjab, Telangana and Haryana. These 5 states together contribute to ~62% of India's total usage.

Growth in consumption of chemical pesticides (technical grade) between 2018-19 to 2022-23 (CAGR) has been higher in states of Assam, Himachal Pradesh, Goa, Mizoram, Andhra Pradesh and Bihar while consumption has been reducing in states/UTs of Kerala, Uttarakhand, Maharashtra, Jharkhand, Rajasthan and Jammu & Kashmir.

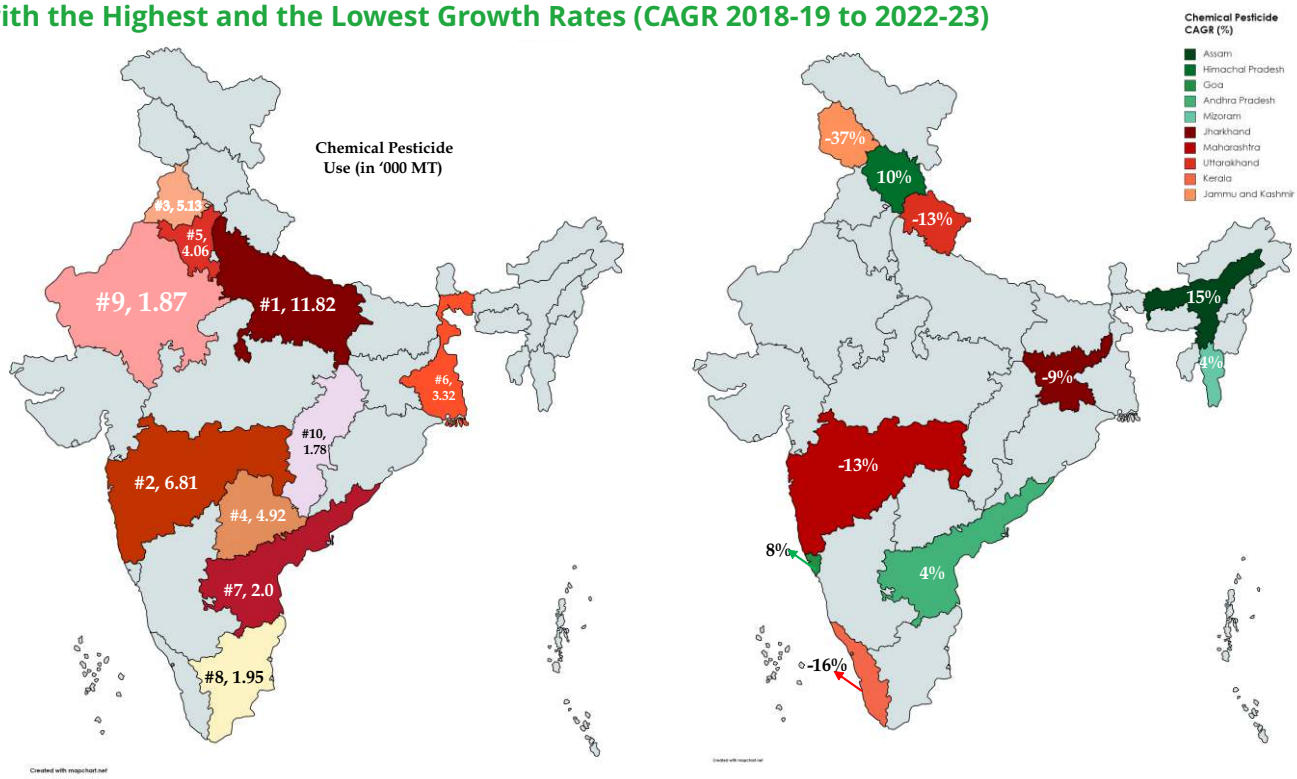
Exhibit 12: Regional Bifurcation of Pesticide Usage (Chemical) (Volume Share) 2022-23



Source: Directorate of Plant Protection, Quarantine & Storage

The top 10 states based on consumption of chemical pesticides and top 5 states with the highest and the lowest growth rates each (CAGR 2018-19 to 2022-23) are highlighted in Exhibit 13.

Exhibit 13: Top States Based on Consumption of Chemical Pesticides in 2022-23 and Top 5 States with the Highest and the Lowest Growth Rates (CAGR 2018-19 to 2022-23)

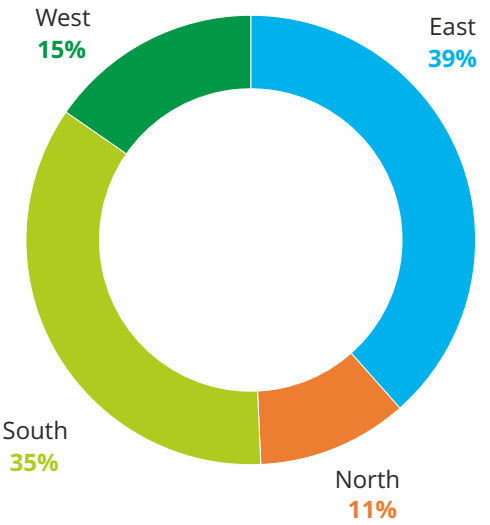


 # Ranking

Source: Directorate of Plant Protection, Quarantine & Storage, YES BANK Analysis

With regards to bio-pesticides, the eastern region (including Bihar, Chhattisgarh, Jharkhand, Odisha, West Bengal and the North Eastern Region (NER) is the largest consumer contributing 39% to the total consumption, followed by southern (35%), western (15%) and the northern region (11%) (refer exhibit 14) West Bengal, Tamil Nadu, Chhattisgarh, Kerala and Gujarat have emerged as the key consumer states, together contributing to ~56% of India's total consumption of bio-pesticides. In terms of growth, the highest growth in consumption of bio-pesticides (CAGR from 2018-19 to 2022-23) was witnessed in Rajasthan, Telangana, Andhra Pradesh, Uttarakhand and Jharkhand. A negative growth trend with respect to bio-pesticide consumption was witnessed in Maharashtra, Himachal Pradesh, Odisha, Jammu & Kashmir and Punjab.

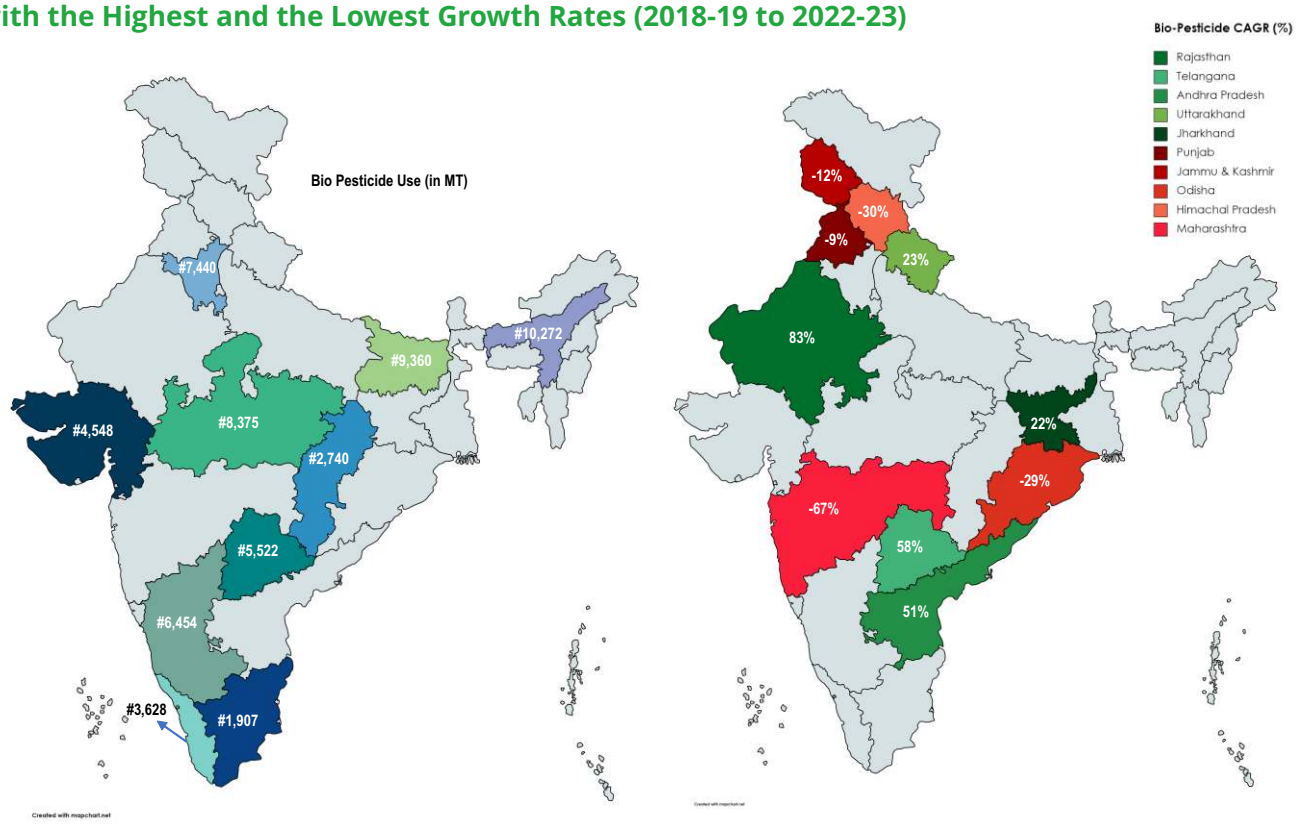
Exhibit 14: Regional Bifurcation of Bio-Pesticide Usage (MT) (Volume Share) 2022-23



Source: Directorate of Plant Protection, Quarantine & Storage

Top 10 states based on consumption of bio-pesticides and top 5 states with the highest and the lowest growth rates each (CAGR 2018-19 to 2022-23) are highlighted in Exhibit 15.

Exhibit 15: Top States Based on Consumption of Bio- Pesticides in 2022-23 and Top 5 States with the Highest and the Lowest Growth Rates (2018-19 to 2022-23)



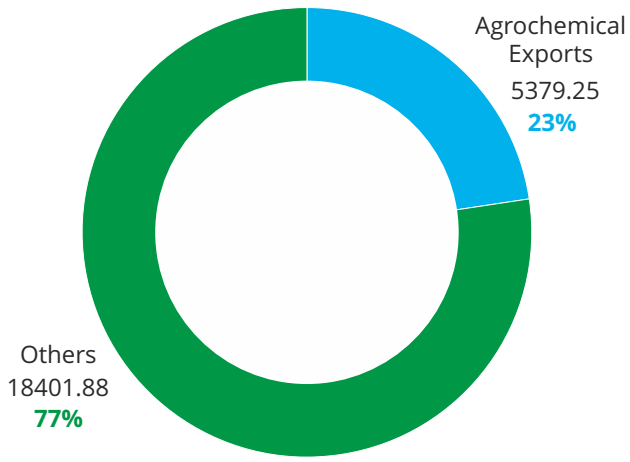
 # Ranking

Source: Directorate of Plant Protection, Quarantine & Storage, YES BANK analysis

2.2.1 Export Scenario

Export of agrochemicals from India have witnessed significant growth over the past few years, driven by a strong traction in the global market, and emergence of India as the preferred manufacturing destination. The nation has emerged as the second largest exporter of agrochemicals, (after China), surpassing USA and France in 2022. The total chemical (dyes, chemicals, essential oils, castor oil) exports from India was valued at about USD 23.8 Bn in 2022-23 (provisional). Of this, agrochemicals exports were valued at about USD 5.38 Bn, contributing to about 23% of India's chemicals exports (refer exhibit 16).[16]

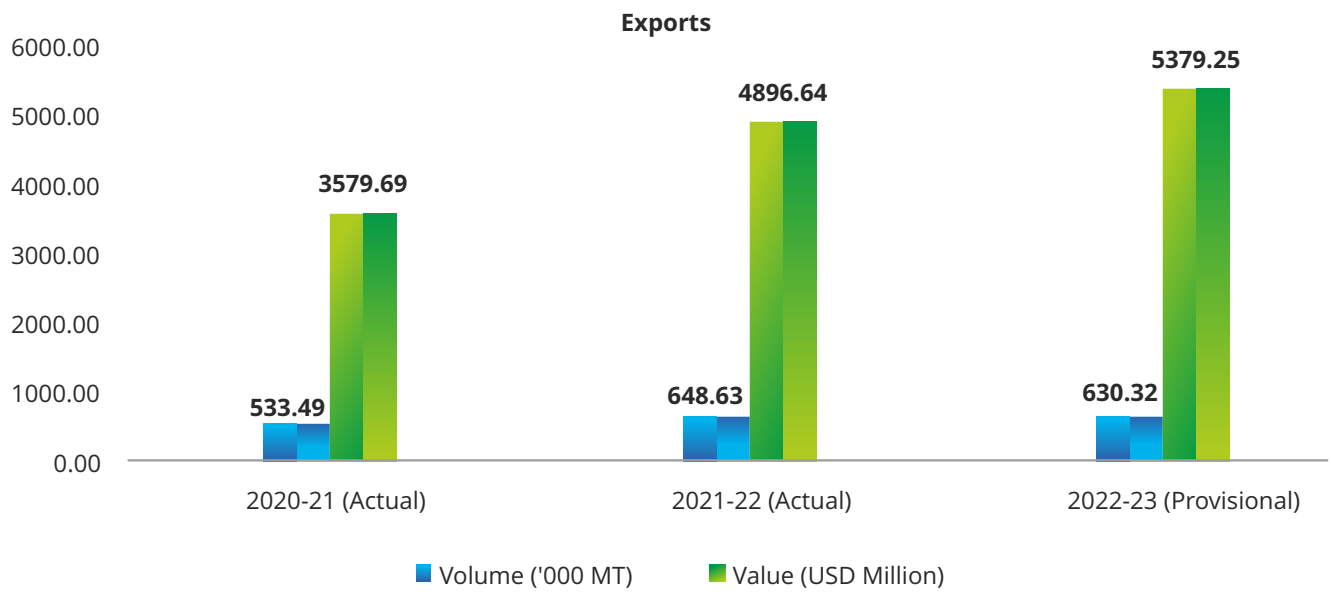
Exhibit 16: Share of Agrochemicals Exports in Total Chemical Exports (Value in USD Mn)



Source: CHEMEXIL Export Statistics; YES BANK Analysis

India exported about 533 thousand MT of agrochemicals in the year 2020-21, which increased to about 630 thousand MT in 2022-23 witnessing a growth (CAGR) of 8.70% (refer exhibit 17). The Indian agrochemicals exports value grew at 22.59% CAGR during the same period (2020-21 to 2022-23).

Exhibit 17: Agrochemicals Export from India in Terms of Value (USD Million) & Volume (000' MT)

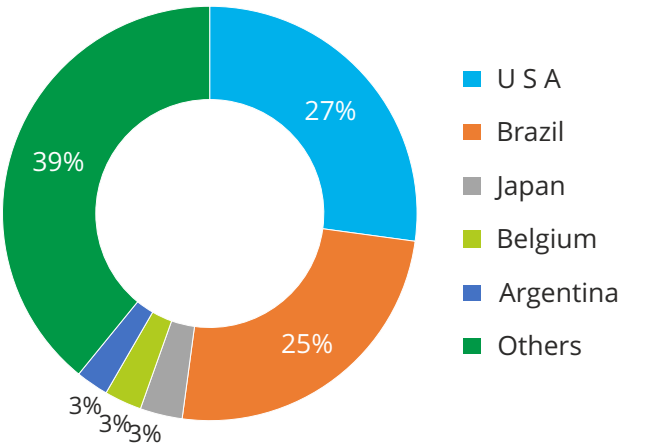


Source: CHEMEXIL Export Statistics

[16] *CHEMEXIL*

The top five countries to which India exports agrochemicals are USA (27%), Brazil (25%), Japan (3%), Belgium (3%) and Argentina (3%). Together they contribute to nearly 61% of agrochemicals' exports from India (in value terms). The other key importing countries include Australia, France, Vietnam, China, Indonesia and Bangladesh (refer exhibit 18).

Exhibit 18: % Share of India's Exports of Agrochemicals (Value Terms) (2022-23 Provisional)

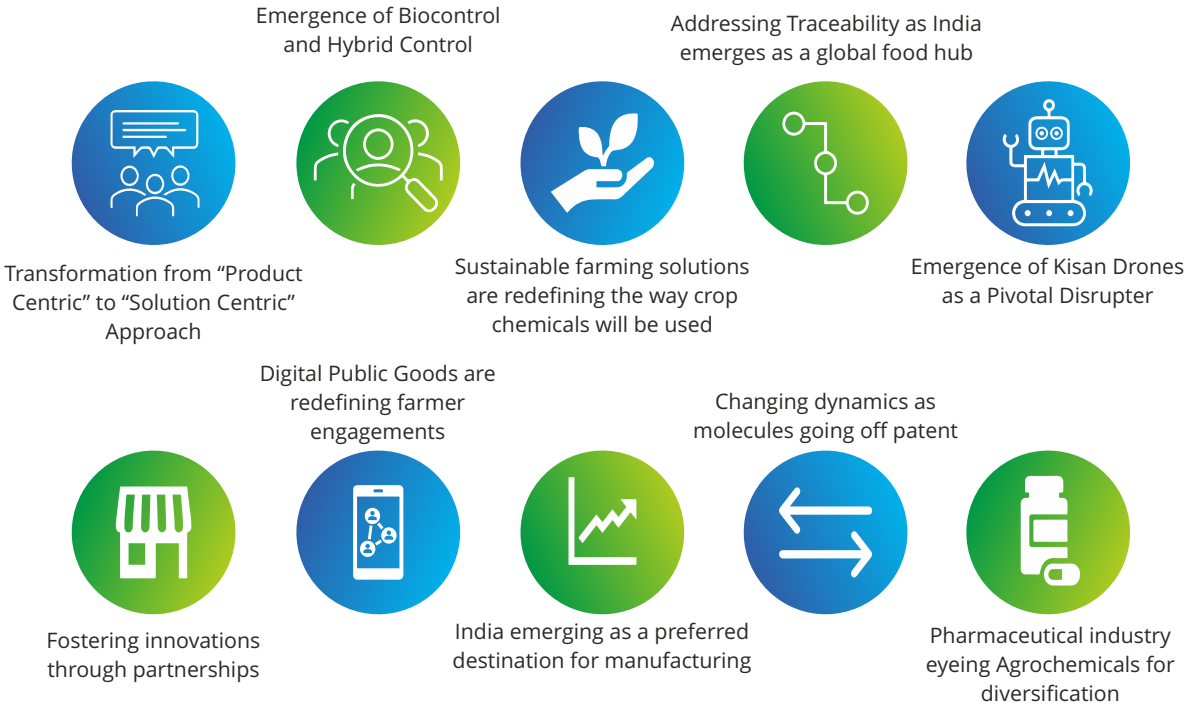


Source: CHEMEXIL Export Statistics; YES BANK Analysis

3 Winds of Change

The Indian crop protection industry has been evolving over the years, giving way to some significant shifts driven by climate change, global geo-political issues, technology and its adoption by farmers, evolving consumer preferences and greater farmer centric policies. Traditional products and processes have been revolutionized to align with sustainable practices and the circular economy leading to solution driven approach, novel products, greater utilization of technology and greater sustainability driven activities. Together, these are bringing a change towards a more inclusive and sustainable growth story. Some of the key shifts are captured in exhibit 19 below.

Exhibit 19: Changing Landscape of the Crop Protection Industry



Source: Stakeholder Discussion, CropLife, YES BANK Analysis

3.1 Transformation from "Product Centric" to "Solution Centric" Approach

Progressive rural entrepreneurs / channel partners are being promoted to act as drone operators which ensures timely application specially during times of labor shortage, ensure appropriate dosage and ensure farmer safety.

The agrochemicals industry is undergoing a profound transformation, shifting its focus from a product-centric to a sustainable solution-centric approach, wherein "beyond-crop protection" offerings are being provided to farmers. The industry is augmenting their products with value-added services, such as agronomic advice, data analytics, linking farmers to markets, and provision of extension services that are beyond crop-protection related farm activities. This paradigm shift is an indication that industry recognizes the need and importance to address the complex challenges that farmers face holistically and address the challenge of "sustainable farming" rather than just focus on addressing the challenge of pest attack. These comprehensive solutions integrate technologies, sustainable practices, application techniques, and market linkages to provide customized strategies for improving farmer income.

3.2 Emergence of Biocontrol and Hybrid Control

The crop protection industry is embracing sustainability with a determined stride, safeguarding both - agricultural productivity and the environment. Through innovative research, development and collaborations, companies are reimagining their products, solutions and practices to reduce their ecological footprint. From formulating innovative, greener and eco-friendly solutions to promoting precision agricultural techniques that optimize resource utilization, the industry is aligning its goals with the broader mission of global sustainability. Such proactive initiatives by the crop protection sector to blend science, technology, and environmental consciousness, demonstrates its commitment to nurturing planet-friendly agricultural development.

Exponential interest is being witnessed amongst the crop protection industry players towards biocontrols which is an emerging and growing market in India. The market growth is influenced by a combination of environmental, social, consumer driven factors including:

- Increasing awareness on sustainable agriculture & impact of climate change is leading to an increased usage of next generation climate adaptive agbiologicals in India.
- Government Initiatives to promote natural and organic farming
- Crop diversity and increasing horticulture production- Horticulture finds significant application of biologicals especially during sowing (seed treatment) as well as to boost vegetative growth and flowering.
- The emergence of pesticide-resistant pests has driven the need for alternative pest management strategies, with biocontrol being an effective option.
- A more health-conscious and eco-friendly consumer base
- Investments in research and development of biocontrol products and technologies have led to more effective and commercially viable solutions for Indian farmers.
- Efforts to educate farmers about the benefits and proper use of biocontrol agents have played a crucial role in market growth.

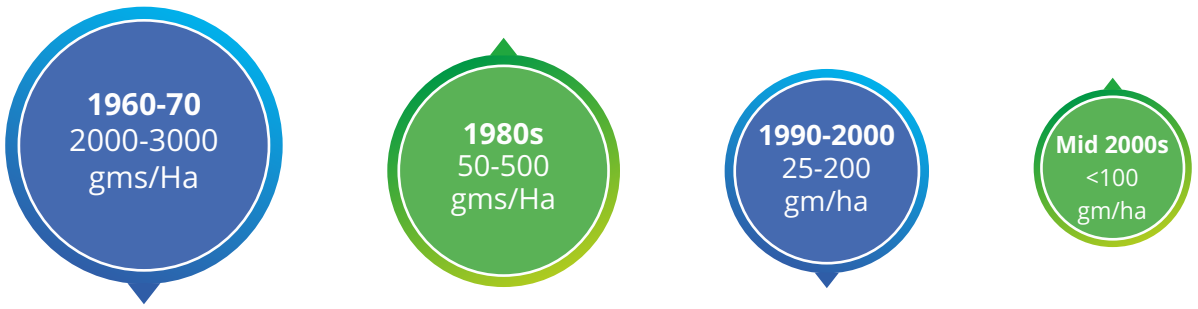
Another emerging area is hybrid control which indeed represents an exciting development in agriculture- blending the strengths of natural products and traditional synthetic crop protection chemicals. Hybrid products are an effective combination of a natural product mostly with broad-spectrum activity and a traditional site-specific synthetic product. Hybrid products offer multiple benefits including providing growers with different modes of action of a botanical-based active ingredient and an effective chemical pesticide, a reduced environmental impact and an entry point for growers who have never previously tried a biopesticide. Historically, biopesticides have been used largely on high-value crops, such as fruits and vegetables, while these hybrid products are expected to be cost-effective for field crops as well. This approach aligns well with the growing interest in eco-friendly and integrated pest management strategies for modern agriculture.

3.3 Sustainable farming solutions are redefining the way crop chemicals will be used

Water usage in crop production remains a key concern and there has been vocal activism on high water use in crops, which traditionally, have been key users of crop protection solutions as well (for instance: paddy and sugarcane). As concerns over sustainability strengthen, concepts such as Direct Seeded Rice (DSR) and Sustainable Sugarcane Initiative are being widely promoted. Such shifts have the potential to impact the profile of crop chemicals used and their delivery mechanisms. The crop protection industry has a significant role to play in the changing scenario as initiatives such as DSR warrant smart weed-management strategies that integrate various approaches, including, prevention, cultural, mechanical, and chemical.

Continuing the pursuit towards sustainability, the R&D based crop protection industry has been launching new molecules with increased efficiency and reduced application rates over time. The application rates in the case of insecticides such as organophosphates and carbonates during the

1960s and 1970s were as high as 2000 - 3000 grams of active ingredient per hectare. By the 80s with the advent of Cartap and synthetic pyrethroids, the rates came down to 50 - 500 grams per hectare. From the 90s to the early 2000s there was further advancement through moderate toxicity chemicals like triazoles and neonicotinoids, having dosages of 25-200 grams per hectare. Since the mid 2000s the active ingredient application has fallen to well below 100 grams in some cases such as sulfonylureas and diamides- it is less than 4 grams per hectare.[17]



3.4 Addressing Traceability as India Emerges as a Global Food Hub

As India emerges as a global food hub, addressing traceability becomes crucial for enhancing the efficiency, quality and competitiveness of its agricultural and food production system. Quality remains one of the major pillars for making a mark in the global food supply chain. The crop protection industry, along with food companies is partnering on multifaceted aspects aimed at ensuring food safety, quality, sustainability and traceability. These include developing and implementing effective pesticide management practices (on application, safe handling, and storage), monitoring pesticide residues in food products to ensure compliance with safety standards, identifying emerging challenges and developing innovative solutions (new crop protection technologies, improved formulations etc.).

3.5 Emergence of Kisan Drones as a Pivotal Disrupter

A key technological innovation that could have a significant impact on crop protection industry is the use of drones in agriculture. Usage of drones is a big game changer not only for changing the way that crop protection chemicals are applied on field, but also for providing additional income generating activities in rural areas by promoting entrepreneurship as drone pilots. The Government of India is driving the use of drones in agriculture and has not only framed conducive regulations for use in agriculture but is also providing incentives like PLI for drones. Numerous crop protection industry players are actively promoting this technology by forming partnerships with drone start-ups.

*The initiative to create **"Lakhpati Didis"** in rural areas also harmonizes effectively with the emerging drone tech in agriculture. This synergy is not only a step towards women empowerment but also towards enhancing agricultural productivity, diversifying income sources, technological inclusivity and community development.*

[17] *Croplife India*

A snapshot of select initiatives and partnerships taken by the crop protection industry that are boosting tech-enablement in the Indian agriculture sector:

FMC Ventures

Participated as a principal in Series "A" round of the India based mini robotics for farm named Niqo Robotics (formerly Tartan Sense)

Rallis India

Signed an MoU with Garuda aerospace to conduct demonstrations on approximately 1,000 acres of land on crops such as paddy, onion, Bengal gram, wheat and vegetables.

Dhanuka Agritech

Minority stake in IoTech Avigation – a dronetech startup; and separately has invested in a startup that develops IoT- and AI-based equipment for the farm sector, specifically soil sensors.

Other Drone Companies

Drone companies like ioTech Avigation; Marut Drones; Garuda; Ideaforge are working with a host of crop protection companies for crop spraying by aggregation of demand hours and passing on to entrepreneurs/ drone pilots.

3.6 Fostering Innovations through Partnerships

The agrochemicals industry is fostering innovations through a dual commitment to internal excellence and strategic partnerships. By forging alliances with research & educational institutions, agritechs, food industry pioneers, and other agricultural stakeholders, agrochemical companies are disseminating specialized knowledge and resources. By integrating advanced technologies such as precision agriculture tools, data analytics, remote sensing, drone tech and robotics crop protection solutions' companies are equipping farmers with precise insights into their crops' health, soil conditions, and pest management. This data-driven approach is enabling farmers to take informed decisions, optimize resources, enhance crop productivity and minimize environmental impact.

Probably, the biggest transition is happening due to the growth of agtechs in India and partnerships therein. They are changing the way agri-inputs are delivered to farmers, the way agri-inputs are applied in the farm as well as the way farmers are linked to markets. Pure play agtechs in specific segments are turning to full-stack offering. Also, they are forming 'platform-of-platforms' by acquisitions or by partnerships. Indian crop protection sector has been actively involved in accelerating growth and service delivery of such tech-enabled start-ups, by investing in or partnering with them. This has helped the industry in evolving its go-to-market models, reshaping the way products reach farmers and stakeholders. Traditionally, agrochemicals have been distributed through a linear supply chain, with manufacturers selling to distributors who, in turn, supply to retailers and eventually farmers. However, the industry is shifting towards more direct and dynamic approaches. Direct-to-farmer models are gaining prominence, enabled by digital platforms and e-commerce, allowing manufacturers to engage with farmers directly, provide tailored solutions, and gather valuable feedback.

Some of the partnership engagements are listed below:

Bayer Crop Science

Partnership with Agrostar to sell farm inputs; and with Waycool to offer optimal services to smallholder farmers.

Bayer India and PI Industries

Partnered with Sahyadri Farms at Nasik to accelerate sustainability by setting up several empty container collection bins (ECCB). Aim is to reduce environmental impact of farm based plastic by collection and recycling

Syngenta Group Ventures

Invested in Indian agritechs like Ninjacart and Jai Kisan

BASF Ventures

Acquired a minority stake in two agritechs in India namely Sea6 Energy (large scale mechanized ocean farming) and Urban Kisaan (urban hydroponics)

Corteva Agriscience

Creating synergies with FPOs by collaborating with ITCMAARS platform and strengthening B2C e commerce with FPOS in partnership with DeHaat. Corteva Agriscience also works with Plantix in B2B model.

3.7 Digital Public Goods are Redefining Farmer Engagements

The Government of India has unleashed a plethora of large-scale digitalization products which are expected to transform the Indian agriculture and will have significant lessons for crop protection sector to connect with farmers and also expand their markets.

Some of these are:

- Unified Portal for Agricultural Statistics.
- Agristack as a part of "India Digital Ecosystem of Agriculture (IDEA)".
- eNAM platform of platforms where "Agri Inputs" too are a part of the dashboard.
- Open Network for Digital Commerce (ONDC) which is onboarding Farmer Producer Company (FPC)/ Farmer Producer Organisations (FPOs) to sell their produce to consumers; and this platform can be used for reaching out to farmers for their requirement of farm inputs. ONDC will go on to become a big B2B / B2C play as they are partnering with many players across agribusiness value chain.
- Usage of GeM (Government Electronic Marketplace) for institutional sales of agrochemicals.

- It is expected that by the use of innovative finance models such as embedded finance in apps and ecommerce websites; the ease of payment to crop protection companies from farmers via digital-sales channel will improve.
- Usage of TReDS platform by Micro, Small & Medium Enterprises (MSME) vendors of crop chemical companies will facilitate discounting of trade receivables and help in their working capital cycle.

3.8 India Emerging as a Preferred Destination for Manufacturing

India has emerged as a preferred destination for many agribusinesses. With its diverse agro-climatic zones and abundant natural resources, skilled labor force and progressive policies, India offers a fertile ground for manufacturing. For agrochemicals, as global supply chains diversify geographically, looking for a China plus one strategy, India is presented with the opportunity to become a preferred destination in the global crop protection value chains. However, countries such as Vietnam, Korea, Malaysia and Philippines are posing a stiff competition to the nation. India has, to a large extent, successfully positioned itself as a reliable alternative for agrochemical production, on the back of established chemical manufacturing capabilities and rapidly improving infrastructure to meet the growing demand for agrochemicals worldwide. Indian manufacturers have efficiently backward integrated in the production of organophosphate compounds and pyrethroids and have recently overtaken China in pyridine and many other newer chemistries, not only in costings but also in technology wherein they have greener production processes compared to those adopted in China.

3.9 Changing Dynamics as Molecules Going Off Patent

The term "off-patenting molecules" refers to the expiration of patent protection for specific chemical compounds or molecules. When a patent expires, it allows other companies to produce and market generic versions of the product without infringing on the original patent holder's rights. By 2030, additional 22 crop protection products will go off patent[18], bringing in many companies to offer the product at lower prices. This opens up significant opportunity for generics companies to introduce new molecules into India. In addition to this, protection of regulatory data is one of the best means to attract the entry of new molecules in the Indian Market. CropLife India is in the favor of providing data protection for new molecules introduced for the first time in the country for a minimum period of 5 years from the date of registration in India.

3.10 Pharmaceutical Industry Eyeing Crop Protection for Diversification

Pharmaceutical companies are actively exploring crop protection as a strategic avenue for diversification. These companies are trying to leverage their scientific acumen and research capabilities to develop innovative solutions for crop protection, soil health and sustainable farming practices.

- Mankind Pharma has set up a new subsidiary Mankind Agritech.
- NATCO Pharma has launched Crop Sciences Division with product portfolio of a range biological pest management solutions and plant growth stimulants.
- The custom manufactured chemicals division of Chemplast Sanmar Limited has signed a letter of intent with a global agrochemical innovator to manufacture an advanced intermediate.

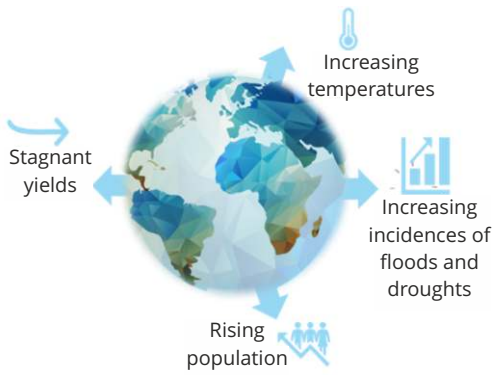
[18] *Croplife India*

4 Industry's Strides Towards Sustainability

4.1 Need for Sustainable Agriculture

While agriculture continues to fulfill the food and nutritional security of the country, the sector battles several inherent challenges including those of small and marginal farmlands, fragmented landholdings, inadequate irrigation, limited farm mechanization any many more. Compounding these challenges, is the vulnerability of the sector to climate change related weather events such as floods, droughts and natural hazards- which are becoming frequent and more intense, impacting several parts of the country.

According to International Panel on Climate Change (IPCC) report, the predicted temperature rise for India is in the range of 0.88–3.16°C by 2050 and 1.56–5.44°C by the year 2080. Studies show significant negative impacts of climate change, predicting yield reduction by 4.5% to 9.0%, depending on the magnitude and distribution of warming.[19] An Indian Agricultural Research Institute (IARI) study suggests that for every one-degree change in temperature, wheat production loss will average at 4-5 Mn MT. Depending on the modeling techniques, it has been estimated that rice yields can be impacted by up to 40% while that of wheat could be up to 52%.[20]



While agricultural supply chains face multidimensional challenges, the food demand is on a constant rise. Indian agriculture needs to feed about 1.7 Bn people by 2050. Rapid growth in the Indian economy is expected to increase incomes and expand the middle class significantly. This

[19] *Intergovernmental Panel on Climate Change Report (IPCC), 4th Assessment report*
[20] *Climate Change and Indian Agriculture: Impact, Adaptation and Vulnerability – Salient Achievements from ICAR Network Project, 2012, Eds. S. Naresh Kumar, Anil Kumar Singh, P.K. Aggarwal, V.U.M. Rao and B. Venkateswarlu. IARI Publication*

financially empowered middle class will demand higher quantity and quality of food, including more protein. Clearly, sustainable growth and development of agriculture – that focuses on balancing the requirements of people, planet, and environment - is no longer an option- but a pressing priority.

Exhibit 20: Sustainability – An Imperative for India

India- World's Most Populous Country

By 2050, India's population is expected to reach 1.7 Bn.

Higher agriculture output is required to ensure food & nutritional security.

Changing Food Habits

It is estimated that by 2050, demand for meat & meat products would increase by 3 times, milk demand projected at >400 Mn MT and calorie requirement (Kcal/ capita) will increase from 2500 to 3000+.

Shift from Rural to Urban

In India, the level of urbanization is expected to increase to more than 50% by 2050 from 31% presently.

Shrinkage of Farm Sizes

The horizontal expansion of land is limited, and per capita availability of land is shrinking. The average land holding is expected to drop to 0.30 Ha by 2050 from ~1.08 Ha presently

Decrease in Productivity

India's crop yield is expected to fall by 7.2 to 23.6% by end-century (2061–2080). Higher losses are projected in rainfed conditions

Water Scarcity

By 2050, the per capita water availability in India is projected to decline to the level of 1,140 m3/person/year

Global Warming

Average temperature of India is projected to rise by 4.4°C & heatwaves to increase by 3x-4x by the end of 21st century

Rising Emissions

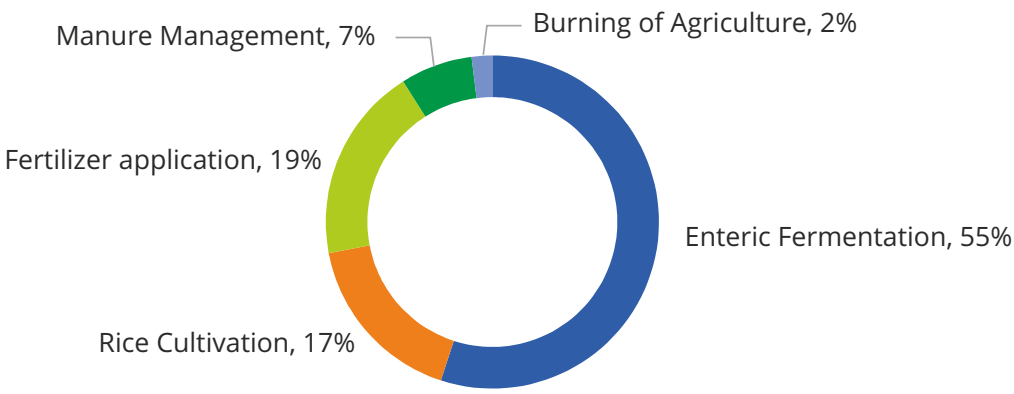
With emissions of about 2.6 giga tonne per annum (gtpa), India is the 3rd largest emitter of CO_2 in the world

Source: National Academy of Agriculture Sciences, ICAR Vision Document, Report of the Technical Group on Population Projections, July 2020, Global food policy report: Climate change and food systems by International Food Policy Research Institute (IFPRI); UN, Carbon Capture Utilization and Storage (CCUS) – Policy Framework and Deployment Mechanism in India by NITI Aayog, IIT Delhi- CERCA

4.2 Role of Agriculture in Achieving Sustainable Development Goals (SDGs)

The role of agriculture in achieving SDGs for India remains vital as the sector is amongst the largest users of natural resources. It is estimated that the sector accounts for more than 80% of India's total water usage and about 60% of land use.[21] Moreover, it remains a significant contributor to India's total Green House Gases (GHG) emissions (contributing about 21%[22]) and one of the sectors most affected by it. Within the sector, 55% of GHG emissions are expected to be linked to enteric fermentation, 17% to rice cultivation, 19% to fertilizer applied to agricultural soils, 7% to manure management, and 2% to field burning of agricultural residues[23] (Refer Exhibit 21).

Exhibit 21: Sources of GHG Emissions within Agriculture Sector in India



Source: India BUR-3, YES BANK Analysis

Initiatives and interventions in the agriculture sector have a direct or indirect impact on all the 17 SDGs albeit at varying degrees. While SDG 2, which aims to "End Hunger, achieve food security and improve nutrition and promote sustainable agriculture" remains one of the key SDGs impacted directly through agriculture, sustainability initiatives in agriculture and its allied sectors have direct implications on many other SGDs.

[21] *Paper by India on National Dialogue Action Track 4: Advance Equitable Livelihoods, United Nations Food Systems Summit 2021*
[22] *Carbon Capture, Utilization and Storage: Policy Framework and its Deployment Mechanism in India, NITI AAYOG*
[23] *https://www.downtoearth.org.in/blog/climate-change/indian-agriculture-the-route-post-cop-26-81154*

An overview of the relevance and role that initiatives in agriculture play in achieving these select sustainable development goals is captured in exhibit 22.

Exhibit 22: Overview of Role of Agriculture in Achieving Select SDGs

End Poverty in all its forms everywhere

Interventions across the agriculture value chain can contribute to reducing poverty primarily by increasing incomes, creating employment opportunities and mobilizing economic activities (including agriculture dependent non-agricultural activities) in rural communities.

End hunger, achieve food security and improved nutrition and promote sustainable agriculture

This SDG is the most relevant and directly related to agriculture. Interventions towards enhanced productivity (through improved varieties, crop protection solutions, capacity building, R&D, technology etc.), reducing food losses (through Integrated Pest Management (IPM), creation of pre- and post-harvest infrastructure, value addition, constructive policies etc.) and timely interventions to avoid extreme volatility in food prices contribute significantly towards this SDG.

To ensure healthy lives and promote well-being for all at all ages

Interventions in Agricultural value chains including those on crop diversification, safe input usage, fortification, value addition and others targeted towards providing safe, hygienic and nutritious food contribute to this SDG.

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Interventions in agriculture done towards trainings, awareness programs, extension services on modern, scientific, improved, and sustainable agriculture practices, capacity building of the rural youth and promotion of agripreneurship promote lifelong learning opportunities and contribute to the SDG of Quality Education.

Achieve gender equality and empower all women and girls

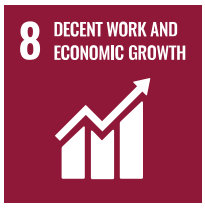
Initiatives and reforms (like women-oriented training/entrepreneurship programs, promotion of SHGs, financial literacy, equal remuneration etc.) that specifically provide women farmers and women workforce equal rights and opportunities to access economic resources, financial services, ownership and control over land/property, inheritance and natural resource auger well for achievement of this SDG.

Ensure availability and sustainable management of water and sanitation for all

Adoption of policies and practices which optimize water use (more crop for drop), increase water holding capacity of soil, ensure sustainable withdrawal of groundwater, facilitate in integrated water resource management and protect or restore related ecosystems have a direct impact on ensuring availability and sustainable management of water resources.

Ensure access to affordable, reliable, sustainable and modern energy for all

Interventions in agriculture that utilize renewable source (biomass, solar, wind) of energy for growing crops, food processing, storage, distribution, and transportation, improved access to climate smart agriculture (e.g., solar powered pumps) and increased investments in agricultural projects to meet the increasing demand from agriculture for production of biofuel contribute towards ensuring affordable and clean energy.



Promote sustained, inclusive, and sustainable economic growth, full and productive employment and decent for all

Interventions for adoption/promotion of innovative and technological advancement in the agriculture and food processing sector to increase the revenue contribution to the economy of the country and encouraging entrepreneurship, empowering women farmers, creating farm and off farm employment opportunities contribute meaningfully to this SDG.

Ensure sustainable consumption and production patterns

Initiatives that reduce food waste across the agriculture value chain (including at production, post-harvest, retailer and consumer level), adoption and implementation of sustainable agriculture practices, promotion of climate smart agricultural practices and sustainable use of resources contribute to achieving this SDG.

Take urgent action to combat climate change and its impact

This SDG encompasses all initiatives that strengthen resilience and adaptive capacity of agriculture to the impact of climate change like adoption of renewable sources of energy, practices related to climate resilient agriculture, controlling GHG emissions from the agriculture sector and better handling and decomposition of waste generated through agriculture practices.

Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Interventions contributing towards adoption of sustainable fishing practices keeping in view both the livelihood creation and resource conservation, and providing small scale fishers, the access to marine resources and market contribute to this SDG.

Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Promotion of agroforestry and initiatives that conserve soil and water contribute to achieving this SDG.

Source: UN, FAO, YES BANK Analysis

4.3 Role of Crop Protection Industry in Achieving SDGs

The implications of varying temperatures, altering precipitation patterns and extreme weather events are increasingly evident in agricultural ecosystems. These changing weather patterns, coupled with unsustainable production practices, directly influence crop health and can change pest and disease dynamics in agriculture, as a result of which, farmers are confronted with the onerous tasks of consistently updating and upgrading their pest management and disease control techniques. Further, with changing resource dynamics, the suitability of certain crops in specific regions change, prompting farmers to reassess their planting choices and crop management practices. Such shifts in crop suitability will have large implications for agricultural production, trade patterns and nutritional security.

Buoyed by the initiatives being taken by the Government of India towards developing sustainable value chains, many crop protection companies have embraced the concept of triple bottom line of people-planet-profit and have brought sustainability to the core of their businesses. Their efforts towards upskilling of farmers, bringing greener chemistry, promoting circular economy, women empowerment, and technology upgradation to reduce carbon emissions are going a long way in complimenting the efforts of the Government of India to deliver on a wider range of sustainable development goals. In addition, the industry has also been supporting rural development through activities in the areas of education, drinking water, health, hygiene and sanitation, rural infrastructure, and tree plantations.

Some of the key contributions by the crop protection industry that are contributing to achievement of SDGs are highlighted in Exhibit 23.

Exhibit 23: Role of Crop Protection Industry in Achieving Select SDGs

About 60%[24] of rural Indian households are dependent on agriculture and allied sectors for their livelihood making it one of the key sectors to be linked to the goal of reducing poverty in the country.

Crop protection solutions have an important role to play in increased productivity, ensuring minimum crop loss through pests and maintaining a stable food supply. This leads to higher income for the farmers, stable food prices and improved access to food for the vulnerable population. Other interventions that are being carried out by the industry, such as upskilling the stakeholders, empowering women, helping growers connect directly to market to get remunerative prices and generating employment have contributed to this SDG.

In India, 34.7% children aged under 5 are stunted, 40.5% children between 6 to 59 months are anemic and 33.40% of the children aged under 4 years are underweight. Further, by 2032-33, India's foodgrain requirement is projected to increase to 334-350 million to adequately feed the population[25].

Crop protection solutions focus on maximizing productivity for farmers by reducing crop losses through sustainable measures, thus ensuring safe, nutritious and abundant food for all.

The crop protection industry has been driving the progress of agricultural sector through stewardship programs on judicious usage of solutions and safe measures to yield safe and nutritious food for all. Many forward-looking corporates in this industry have committed to provide a safe, healthy, and fair working environment to all employees and for the farm workers associated with them.

The Indian farming community (85% of which is small and marginal), needs to take decisions on an everyday basis. Providing them with quality education not only empowers them to take informed decisions, but also brings them closer to technology, financial inclusion, and sustainable profits

To ensure that crop protection products are used ethically, safely and judiciously, the industry regularly undertakes training programs for all stakeholders including farmers, dealers, medical practitioners, spray operators and applicators on the best practices for usage, purchase practices, maintenance of the application equipment, label reading and container disposal. The industry also promotes training on ending child labor, workers' rights, and issues of health and safety to all stakeholders in the value chain.

[24] *https://agricoop.nic.in/Documents/Intensive%20Agriculture%20April%20-%20June,%202022%20issue%20(1)_repaired.pdf*
[25] *https://www.niti.gov.in/sites/default/files/SDG-India-Index-2.0_27-Dec.pdf*

In India, about 75% of rural women workers are engaged in agriculture but women's operational landholding is only 13.96%[26]. This inequality in land ownership limits their access to inputs, seeds, fertilizers, credit, and agricultural extension services.

The crop protection industry has been implementing programs to build capacities and develop entrepreneurial skills among women in agriculture in India to empower them and take larger roles in the sector.

India has 4% of global freshwater resources & supports 19% of the world's population. Nearly 80% of water in India goes to agriculture, primarily from groundwater sources. The demand for water in the country is projected to be twice the available supply by 2030 which may lead to severe water scarcity.

The industry has been encouraging growers to adopt conservation agricultural practices, which help them optimize water use, increase soil water holding capacity, reduce water runoff and build crop resilience to changing weather patterns. The industry has also invested in infrastructure creation like check dams to conserve water.

The agricultural sector constitutes nearly 18.5% of India's total energy consumption. Consumption is expected to rise by nearly 54% between 2015 and 2022[27].

By utilizing the renewable sources (solar, wind) of energy in their business operations, the industry is embracing the concept of triple bottom line of people-planet-profit and are contributing towards achieving the SDG of affordable and clean energy.

Agriculture continues to be the largest employer by sector in India- engaging nearly half of the population. Indian economy during 2022-23 showed a growth of 6.6% (Gross Value Added (GVA) at basic process) while agriculture, forestry & fishing showed a growth of 3.3% during the same year[28].

Farming is one of the largest employment generators for India. Cognizant of the fact that improving farmers' access to agricultural technologies is an important aspect to spur growth, the crop protection industry has been innovating and transferring technology to the fields to enhance the prosperity of farmers and communities. The industry has established demonstration farms, centers of excellence and learning centers to make knowledge and technology more accessible. They have also partnered with various tech-enabled start-ups to accelerate transfer of technology, access to right inputs and access to markets for farmers.

[26] *https://www.niti.gov.in/sites/default/files/SDG-India-Index-2.0_27-Dec.pdf*

[27] *Third Biennial Update Report submitted by the Government of India in 2021 to the United Nations Framework Convention on Climate Change (UNFCCC)*

[28] *https://www.mospi.gov.in/sites/default/files/press_release/PressNoteNAD_28feb23final.pdf*

India generates about 350 Mn MT of agricultural waste every year[29]. As the global population is increasing, there is a need for responsible and sustainable consumption of all resources.

The industry is investing in innovations that sustainably control weeds, pests and diseases and help improve plant health. Stewardship programs for container management is one of the initiatives for reducing waste and improving overall environmental footprint of packaging.

Take urgent action to combat climate change and its impact

The effects of climate change are being felt across the globe. During the recent years, India has witnessed floods, droughts as well as the risk from tsunamis and cyclones in coastal areas owing to climate change. Indian agriculture is highly vulnerable to climate change. According to Economic Survey, 2018, India faces annual loss of USD 9-10 billion due to the adverse effects of climate change - with small and marginal farmers being the most affected segment.

The crop protection industry is making contributions towards tackling the climate change by encouraging the farmers to adopt climate-smart practices and helping farmers to mitigate greenhouse gas emissions. The industry is also working towards transfer of knowledge regarding the eco-friendly growing techniques and better handling of rejected plastic containers.

With about 17% of the world's total population, sustainable management of the terrain ecosystem is a priority in India.

Being committed to enhance biodiversity and soil health, the industry is providing trainings, advisory and technologies to farmers and are contributing towards re-vitalization and restoration of cultivable land.

The crop protection industry has been actively engaging in partnerships with growers, industry peers, research institutions, agricultural universities, innovators, and technology providers to scale innovation capabilities, improve efficiency and help mobilize action towards sustainable agriculture.

The crop protection industry has explored application of sustainable solutions to several aspects of the agriculture sector and in achieving the sustainable development goals. Some such initiatives include introduction of greener molecules and product development with latest technologies to reduce the GHG emissions, empowering women by enhancing their skills and upskilling of farmers through trainings, advisory and extension services resulting in increase of productivity leading to income enhancement. These sustainable solutions by industry helps in overall development and growth of rural India. Specific sustainable initiatives undertaken by the companies are highlighted in the section below:

[29] *https://icar.org.in/sites/default/files/Creating-Wealth-From-Agricultural-Waste.pdf*

Case Studies

ADAMA: Moving towards greener chemistries and encouraging gender diversity

TORMOSTM - In 2022, ADAMA entered into an agreement with Groundwork BioAg to offer a sustainable, cost-effective alternative to synthetic fertilizers to help Indian farmers increase yield. Based on naturally robust strains of mycorrhizal fungi that are symbiotic with 90% of plant species, the solution helps farmers enhance their soil health and increases the plants' resilience to climate challenges.

ADAMA places great importance on encouraging the employment of women in all roles across the company and recognizes the need to increase the percentage of women in the workforce. As a result, the percentage of women in their workforce in India increased from 6% in 2021 to 13% in 2022, with 100% job satisfaction and retention. ADAMA's goal is to reach 25% representation by 2025.

In India, as part of an industry task force, ADAMA led a broad study of residues in different areas of the country to determine safe application rates and methods for a commonly used insecticide for rice. Based on the results of this study, the company establishing training sessions for farmers to ensure that everyone understands and follows safe use guidelines.

BASF: Project Pragati

Over 80% of the world's castor beans are produced in India, mainly by smallholders. As part of Pragati, smallholder farmers receive training on cultivation methods, efficient water use, health and safe use of crop protection products based on a specially developed sustainability code, SuCCESS. Since the project was initiated, more than 6,200 smallholders and over 19,000 hectares of land have been certified for sustainable castor cultivation. Yields from this land were 22% higher than average amounts for the region published by the local government for the 2021/2022 harvest cycle. In addition to SuCCESS, the Sustainable Castor Association (SCA), which was launched in 2019 by the founders of the Pragati initiative, has also developed a sustainability code for the wider supply chain. This will allow castor beans obtained from the program to be further processed into certified castor oil and derivatives and to be introduced into the downstream supply chain. In 2022, BASF again sourced certified sustainable castor oil from the program and became the first chemical company in the world to successfully complete the certification process at the Düsseldorf-Holthausen site in Germany. The site supplies customers with the first certified products based on certified sustainable castor oil.

Other Focus Areas for India

Innovation

140

Patents filed by BASF researchers in India in last 5 years

30%

of the above filed patents were developed by female researchers

Sustainability

40%

Energy savings realized by vehicle manufacturing plant with use of Oxsilan® technology

50,000 tons

Of certified castor seeds cultivated in Project Pragati in India

People

21

Scholarship recipients hailing from 14 districts of Maharashtra were selected under the WEnyan Scholarship program – a CSR initiative

awards & recognition

Avtar & Seramount – 100 Best Companies for Women in India

Economic Times – Best Manufacturing Plants

Marksmen Daily – Most Preferred Workplaces

Dun & Bradstreet – One of the top performers in Indian Chemical Sector

Safety

10 million

Accident-free working hours at BASF Dahej since it started operations in 2014

2,500 tons/annum

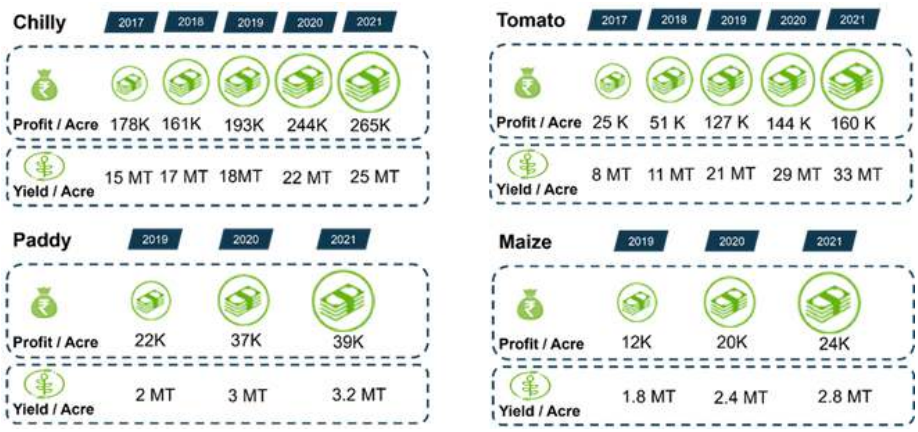
Reduction in green house gas emissions by the use of a biomass bioler installed at the company's Mangalore site

BASF_in_India_Factsheet_2022.pdf

Bayer: Better Life Farming Initiative

Better Life Farming (BLF) is an alliance consisting of private and public partners working together to improve the livelihoods of rural smallholders and their communities. The smallholder farming interventions started in 2016 by Bayer and the alliance was founded in 2018 by Bayer, International Finance Cooperation (IFC / a member of the World Bank) and Netafim. BLF acts as last-mile delivery solution to provide rural farmers with access to high-quality agricultural inputs, services and trainings needed to enable farmers' capacity building.

BLF creates ecosystems that enable numerous smallholders to build commercially viable and sustainable farming businesses. The project was set-up with a dedicated focus on increasing productivity and improving price realizations with special focus on last-mile delivery to improve initially limited access to essential agricultural services – with the roll-out potential to other areas such as healthcare and nutrition. The access, market linkage, and knowledge gained through the centers have up to doubled yields and almost tripled incomes respectively, as for green chili in Uttar Pradesh & Tomato in Jharkhand



Corteva Agriscience: Aligned to UN SDGs

Corteva strives to be a catalyst for farmers to deliver safe, affordable sustainable solutions that are efficient, environmentally friendly, and effective in optimizing output increasing global food security. Each new product from Corteva's pipeline meets the stringent baseline requirements and delivers at least one notable sustainability advantage aligned with the United Nations Sustainable Development Goals "UN SDGs". Corteva is focused on delivering naturally derived and sustainably advantaged crop protection and plant health products, and other technologies and solutions that protect water, soil, and biodiversity while enhancing farm productivity and profitability. The company is committed to taking steps to reduce their greenhouse gas footprint through a 65% intensity reduction for Scope 1 and 2 emissions by 2030, consistent with the 1.5°C pathway identified in the Paris Agreement.

India specific projects:

1. Corteva's Climate Positive Leaders Program - is a nomination-based recognition program designed to showcase early adopter producers who are successfully implementing, scaling, and sharing climate-positive practices. The Program honors farmers who have made a measurable impact in advancing climate-positive agriculture. The program also gives global and regional recipients opportunities to broadly share their experiences and accelerate the adoption of climate-positive practices. This year one Indian farmer from Tamil Nadu, doing agriculture on 45 acres for last 35 years, has received this prestigious global leader award under the Corteva Positive Leader program.

2. Multi stakeholder partnership with Water Resource Group is implemented in Uttar Pradesh to convert 40,000-acres of rice farmland towards DSR in 3 years. This will result in 30% reduction in water utilization, GHG emissions and labor requirement making rice farming sustainable and higher ROI for rice farmers.

3. Women Empowerment

Empowering rural women: Understanding the need to empower rural women farmers, Corteva has been conducting on-ground interventions to empower rural women and has programs that holistically address challenges faced by rural women by providing agronomy training, agri inputs, access to the end-to-end value chain and more to maximize the opportunities for them in agriculture. Corteva is leading several programs to empower women smallholder farmers to realize higher yields and increase profits. Corteva recognizes the contribution of women farmers of the Farmers-Producer Organization (FPOs). As part of company's Pravakta program various women farmers become the local ambassadors, 'Pravakta', who guide fellow farmers on preferred agricultural practices, enabling them to implement good agronomic practices and establishing market linkages of the crop. In this program women are also benefitted from solutions to financial situations and best practices around manual harvesting etc.

Women's Inclusion Network (WIN): Connects women across Corteva and enables them to collaborate and develop leadership skills, ultimately supporting the women in agriculture who work to support its customers.

Scholarship Program: In 2023, to mark 50 years of Pioneer in India, Corteva launched pan-India annual scholarship for 100 Female students pursuing masters & Ph.D. courses in agriculture.

Fellowship programme: Corteva is industry partner for “Prime Minister's Fellowship for Doctoral Research”. This is a unique PPP initiative of Science & Engineering Research Board, Department of Science and Technology and Confederation of Indian Industries. The scheme aims at encouraging young, talented, enthusiastic and result-oriented scholars to take up industry-relevant research.

Crystal- Committed to serve the Farmers

Crystal Group conducts several Agri-care programs that are beneficial to the farming community. Farmers are educated on issues like correct and judicious use of plant protection agro- chemicals, proper and balanced use of fertilizers, proper seed treatment methods. The company conducts crop pest orientation programs where numerous scientists and industry experts from the company interact with the farming community. Methods to overcome the problems by appropriate use of science and technology are discussed and taught to the farmers for better yield and results.

Dhanuka Agritech- Transforming India through Agriculture

Dhanuka Agritech Limited under its aspiration “Transforming India through Agriculture” is highlighting their approach of DKKNT (Dhanuka Kheti Ki Nai Takneek), which is focused on providing end-to-end farming solutions through training and educating farmers. Under this approach, the company aims to minimize the crop losses and improve crop yield. Dhanuka Agritech is also distributing safety kits to farmers for personal protection and encourage good agricultural practices during their farmers meetings and other programs.

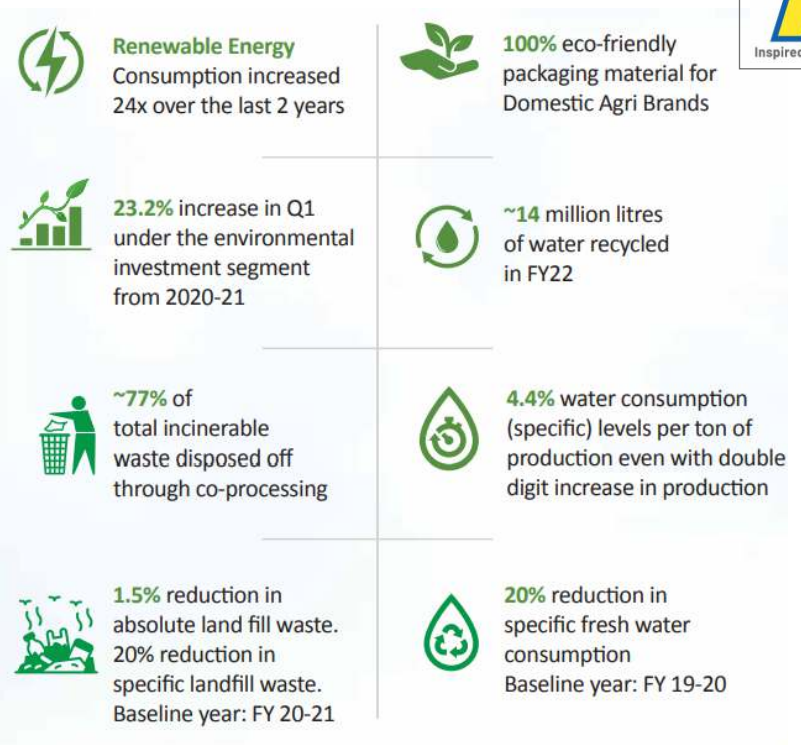
To work towards the greater cause of water conservation, Dhanuka has come up with a massive campaign "Gaon Ka Pani Gaon Mein, Aur Khet Ka Pani Khet Mein" to create mass awareness about conservation and judicious use of water. The Company has constructed five check dams in Jugalpura, Devipura (District Sikar), Mainpura ki Dhani, Sankotra and Kothputli (Jaipur district), Rajasthan. These dams are expected to benefit approximately 10,000 households having a population of over 50,000.

Indofil- Crop Care Concept

Indofil is promoting "Crop Care Concept" throughout the crop districts, where the needs and problems of the crops are identified, and an attempt is made to meet the same by existing solutions or procuring new/right solutions. The basic market potentials are worked out by a systematic approach called Market Potential System, which helps to determine market share on every important crop in the district. This also helps to identify new avenues and understand customer's requirements better. The field staff is in constant touch with the market and customers to achieve this objective.

PI: Sustainable Value Creation for People & Planet

PI remains focused on protecting the health and safety of people while continuing to support the commitments towards SDG 2025. PI have been able to sustain their progress towards various commitments and, with planned projects, the company expects to achieve these commitments by 2025. Below is an overview of the company's progression towards different elements of sustainability



Rallis: Initiatives towards Drone Tech

Rallis started UAV-Drone application activities since 2016 India along GTIO (Group Technology Innovation office) Tata group. Standardization of water volume, height, speed, penetration, coverage & other parameters with respect to validation of efficacy on key crops viz., rice, Bengal gram, red gram.

1. Large scale demonstration was carried out on Bengal gram pod borer with Rallis key Insecticide in 400 acres at Karnataka & Madhya Pradesh.
2. Demonstration was also done with UAS' Dharwad during 2018 on Bengal gram pod borer & these were witnessed by State Agriculture Minister, VC etc. before the release of guide line by CIB &RC.
3. Validation of Rallis key CIB & RC approved pesticides on key crops pests.
4. Sponsored the Rallis key pesticides on phytotoxicity study for label approval at SAU's as per the guide line which are due for submission.
5. Explored few service provider on demonstration on key crops to create awareness at market place.

FMC: Science Driven People Focused Solutions for Agriculture

FMC is a global agricultural sciences company that advances farming through innovative and sustainable crop protection technologies. The company is constantly bringing new solutions to growers across crop nutrition, modern biological products, precision agriculture and unique application solutions.

FMC aims to support farmers around the world with sustainable technologies that will protect their crops and contribute to food security, while building resiliency to climate impact. FMC is committed to agroeconomic growth in India, through innovative solutions to sustainably increase productivity and prosperity for farmers. FMC also encourages the responsible use of their products, while imparting a positive impact on local communities where they live and work. Reflecting upon its commitment, FMC has set sustainability goals to make the world a better place, by creating meaningful partnership with its important stakeholders. Some of the key themes are as follows:

SWAL: Strides towards ecological farming

SWAL Corporation has been working on product innovations and has recently launched a cost-effective, sustainable, and innovative solution, specifically designed for soybean and cotton crops. This product eliminates the risks associated with spillage, drift or dust formation during application. The safety of applicators is prioritized, making it an ecologically safe choice.

Bharat Certis: Driving Rural prosperity

Bharat Certis AgriScience Ltd. (BCA) aims to bring "Smiles with AgriScience" and continue to be an innovative platform to deliver solutions and spread awareness among farmers for best practices for sustainable farming. Few initiatives are highlighted below

BCA provides free soil testing facility with a mission to sensitise farmers with soil health and for balanced use of fertilisers based on recommendations in Soil Health Cards. The company has installed 37 Soil testing minilabs all over the country for Soil testing. These are operated by trained Agricultural graduates. The Soil Health card provides information on 14 parameter and includes all macro and micronutrients, pH, EC and soil amendments recommendation. We have so far benefited over 15000 farmers with this service in the past two years.

Farmer Education and Awareness Campaigns: BCA trains farmers with best package of practices and guides them with demonstrations from seed to harvest by organising various trainings and field days. Additionally, the company spreads awareness among farmers for safe use of pesticides by educating them through one to one interaction and organised programmes. **BCA has** educated more than 60,000 farmers and provided safety Kits to them in the past 5 years all over the country.

Syngenta-Promoting Sustainable Agriculture and Rural Prosperity through

I-CLEAN (Inculcating Cleanliness, Learning, Education, Awareness and New Habits)

I-CLEAN primarily addresses the challenge of inadequate infrastructure and unhygienic conditions in rural vegetable markets, which kept the rural women away from market yards. The initiative has brought about long-term improvement in socio-economic conditions of the rural communities vide 25 projects in 4 states. According to an independent study, the project has achieved substantive measurable gains such as 42% increase in the income of rural vendors and farmers. Syngenta evaluated the on-ground conditions and created enabling holistic infrastructure and facilities such as market sheds with platforms, storage facilities, separate toilet blocks for men and women, solar lights, functional hand pumps & RO drinking water, rainwater harvesting, garbage disposal system, creche and day care facilities for children, and canteen.

Syngenta I-SAFE (Inculcating Safety Awareness for Farmer Empowerment):

As a responsible corporate citizen, Syngenta integrates awareness of safety tools and procedures as pertinent component of product stewardship to effectively minimize environmental impact and mitigate adverse health risks and incidents, during use of crop protection products. Going one step further, Syngenta initiated the I-SAFE programme, to collaborate with Government and NGOs to provide health and safety education and service to 150,000 farmers and 10,000 farm labours, trained and certified 4,000 spray-man, conducted doctor awareness program on recognition and treatment of pesticide exposure cases for 1,400 doctors and public awareness campaigns on hygiene and safe use practices in 3,000 villages and mobile health service to 200,000 people in more than 15 districts across 5 states - Maharashtra, Andhra Pradesh, Telangana, Punjab and Haryana.

SoilCare

Syngenta's **SoilCare** program supports farmers by providing personalized soil reports and recommendations on better soil management by making farmers understand how to optimize their fertilizer application and other best practices like crop rotation. In North India, SoilCare has benefited 5,425 farmers, 10525 acres in 133 villages. Farmers were able to reduce their cost by 15% and increase their yields by 10%.

Climate Smart Agri- India Basmati Rice

Syngenta's solutions support growers to cultivate rice with less climate impact. This includes-Soil health Analysis, Crop Residue Management, Water Management, Syngenta Crop protocol, Practical Stewardship and support the producers to grow rice sustainably and reduce GHG emissions. The company piloted the initiative in 2022 and expanded the project by covering 10200 acres in Punjab and Haryana states of India in 2023.

Sumitomo Chemical India Limited: Paving the way to Greener Future

SCIL recognises it's responsibility in promoting sustainable development and places a strong emphasis on minimising it's environmental impact. Embracing a resilient sustainability model, the Company diminishes greenhouse gas emissions by focussing on renewable energy generation and reducing reliance on thermal power. Thereby, paving the way towards a more environmentally conscious and sustainable future.

The Company is committed to making a positive impact on the society with a focus on conserving natural resources, promoting rural development, fostering community education, and enhancing healthcare initiatives.

SCIL supports conservation efforts for community development near its manufacturing facilities' like Bhavnagar, Gajod, and Tarapur through a host of initiatives. These include improving provision of drinking water, green belt development, tree planting, garden development, rainwater harvesting, and renewable energy use.

SCIL's unwavering commitment to healthcare is shown through innovative programmes, health camps, and financial aid for surgeries, animal health support, diagnostic centres, kidney disease treatment, paediatric heart surgeries, and autism care. The Company is involved in fostering healthier communities in Mumbai, Bhavnagar, Gajod, Bhuj, and beyond.

Another very significant milestone for SCIL towards sustainable agriculture is its foray into alternative pest control methods including biologicals, driven by pest resistance and challenges in pest monitoring. Government is promoting Integrated Pest Management, which takes a comprehensive approach to pest control while minimizing the usage of chemical agrochemicals. Taking this mandate forward, SCIL has recently acquired major stakes in Barrix Agro Sciences, a Bangalore based firm mainly involved in pheromones and chromatic sheets.

To know SCIL's sustainability initiatives in detail, kindly visit www.sumichem.co.in

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Nisso India

Nisso Chemical India LLP (Nisso India), incepted in 2017, is a wholly owned subsidiary of Nippon Soda Co., Ltd. (Nisso) based in Tokyo, Japan. The parent company's core businesses comprise of high-performance and versatile fine chemicals and pharmaceuticals, as well as the authorization and distribution of safe, sustainable and effective agrochemical products. These include proprietary active ingredients, as well as plant protection products formulated with world-class technology.

The company is on a mission to Contribute to sustainable growth of Indian Agriculture and Pharmaceutical Industry by rendering Proprietary Technologies of World Class Nisso Products.

In order to fulfil the mission, Nisso India is working towards newer and sustainable crop protection solutions. The broad categories being explored are –

a) New Chemistry Agrochemicals recently introduced and under development in India are:
   - Fungicide: Picarbutrazox; Ipflufenoquin; Triflumizole and Cyflufenamid

- Acaricide & Insect Growth Regulator: Acynonapyr and Tebufenozide
- Herbicide: Sethoxydim

The above segment of crop protection solutions were worth about INR 2,26,401 Mn in the year 2022 and have an Year on Year growth of 7.1%.

Apart from the above, various formulations with these new chemistries are being developed keeping in backdrop the pest profile of India.

b) Pharmaceuticals: Hydroxy Propyl Cellulose (HPC) - a pharma excipient used as Tablet binder and Topical pharmaceutical applications.

Nisso India, currently does not sell products directly, but offers services in market research, evaluation and development, technical services, marketing strategies, regulatory support, product promotional support and outreach to the customers.

Stanes- Giving back to the society

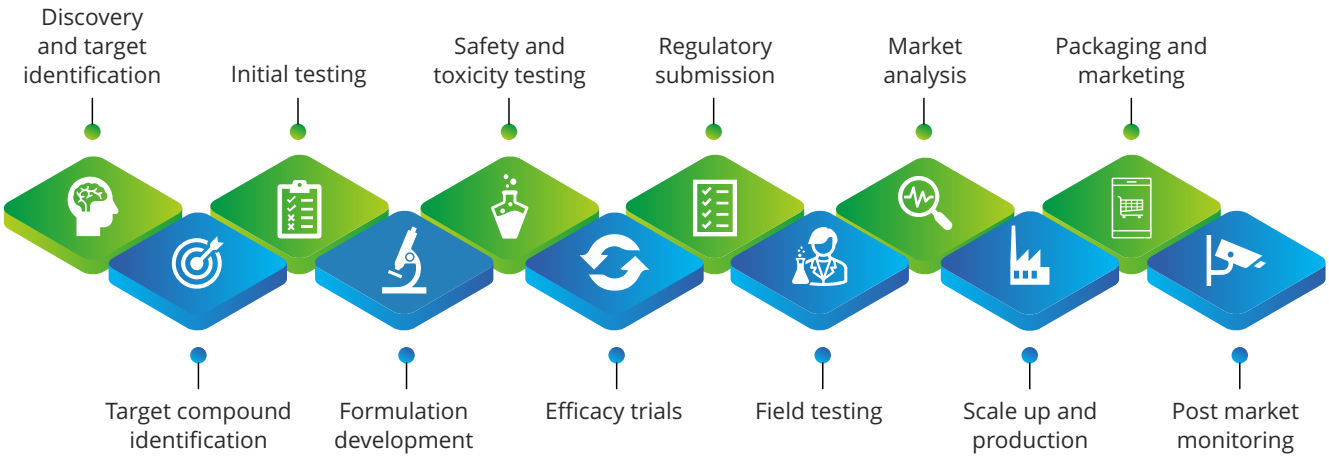
Stanes embraces the philosophy for giving back to the society and lays down the guidelines and mechanism for undertaking socially useful programs for the transformation and sustainable development of the rural communities at large. It also supports to empower India's rural poor through awareness, skills and training programs that are sustainable in the areas ranging from economic development, infrastructure to healthcare and education.

5

Overview of Policy and Regulatory Scenario

The process of introducing a new molecule to the market takes over 10- 12 years with an average investment of around INR 2,000 crore. A snapshot of market entry process of a typical crop protection solution is captured in exhibit 24.

Exhibit 24: Life Cycle of a Typical Crop Protection Solution



Source: Industry Discussion, YES BANK Analysis

The Indian crop protection industry is governed by specific policies and regulations that are aimed at ensuring safe use of pesticides, protecting the environment and safeguarding public health. Key regulations that govern this sector include - The Insecticides Act, 1968 and Insecticide Rules, 1971 (which is an addendum to the Act).

5.1 The Insecticides Act, 1968 and Insecticide Rules, 1971

5.1.1 Objectives

The agrochemicals registration process in India (imports, Indigenous manufacture, and sales) is regulated under the Insecticides Act 1968. This act regulates the import, manufacture, sale, transport, distribution and use of insecticides with a view to prevent risk to human beings or animals and for matters connected therewith. Under the Act, there is a compulsory registration of pesticides at central level and license of their manufacture, import and sales are dealt at state levels. The Pesticide regulations in India is governed by two Govt. bodies: Central Insecticides Board & Registration Committee (CIBRC) and Food Safety and Standard Authority of India (FSSAI).

The agrochemicals registration process in India (imports, Indigenous manufacture, and sales) is regulated under the Insecticides Act 1968. This act regulates the import, manufacture, sale, transport, distribution and use of insecticides with a view to prevent risk to human beings or animals and for matters connected therewith.

The Central Insecticides Board (CIB) advices on matters relating to a) the risk to human beings or animals involved in the use of insecticides and the safety measures necessary to prevent such risk b) The manufacture, sale, storage, transport, distribution of insecticides with a view to ensure safety to human beings and animals. The role of the Registration Committee (RC) is to register insecticides after scrutinizing them with regard to efficacy and safety. Technical grade product registrations can be obtained in three ways:

- Registration u/s 9(3b)- for new molecule introduced for the first time in India (usually granted for a period of 3-4 years).
- Regular registration u/s 9(3)- subject to submission of complete data.
- “Me-Too' registration u/s 9(4)- after 9(3) registration of a molecule, any other applicant can apply for the registration. If technical is being registered for the first time in India, the applicant has to obtain registration under section 9(3); while if the product to be registered are identical in its use or already marketed/registered with any other applicant earlier in the country, then the applicant needs to get the product registered under section 9(4).

After Registration Committee approves the product, registration certificate is issued and only then can the product be marketed in India. The entire registration process takes 6-36 months depending on type of registration applied, number of crops applied for etc. Cost of registration varies on the type of technical to be registered i.e., higher for 9(3) molecules and lower for the Me-Too 9(4) molecules.

5.1.2 Salient Features of The Insecticides Act, 1968:

- Compulsory registration of the product at the Central level and licenses for manufacture, formulation and sale at the State level.
- The high level advisory board 'Central Insecticides Board' is drawn from various field having expert knowledge of the subject to pursue the registration of pesticides.
- Registration Committee to look after the registration aspects of all insecticides.
- Establishment of machinery or system like insecticide analysts and insecticide inspectors by the Central or State Government.
- Establishment of Central laboratory.
- Power to prohibit the import, manufacture and sale of pesticides and also confiscate the stocks. The offences are punishable and size and other penalties are prescribed.
- Both the Central and State Governments are empowered to make rules, prescribe forms and fees.

There are nine chapters in The Insecticide Rule, 1971 relating to the functions of CIBRC, Central Insecticide Laboratory (CIL), grant of licenses, packing, labelling, first aid, protective clothing's etc. and are presented below:

Chapter	Coverage
Functions of Central Insecticide Board, Registration Committee and Laboratory	• Functions of Board • Functions of Registration Committee • Functions of Laboratory
Registration of Insecticides	• Manner and Issue of Certificate of Registration • Issue of duplicate certificate of registration • Addition, deletion or alteration on the Certificate of Registration including labels and leaflets • Appeal • Manner of publication of refusal to register or cancellation of certificate of registration
Grant of Licenses	• Application for the grant or renewal of a license to manufacture any insecticide • Applications for the grant or renewal of a license to sell, stock or exhibit for sale or distribute insecticides • License for Pest Control Operators - Any person who desires to undertake pest control operations, with the use of Aluminum Phosphide, Methyl bromide. Ethylene dibromide or as notified • Segregation and disposal of date-expired pesticides • Special provision with regard to Sulphur and its formulations • Prohibition against sale or storage of insecticides in certain places • Durations, Conditions, Amendment and Transfer of Licenses • Issuing cash memo and maintenance of records
Packing and Labelling	• Prohibition of sale or distribution unless packed and labelled • Packaging of insecticides • Leaflet to be contained in a package • Manner of labelling

Chapter	Coverage
Insecticide Analysts and Insecticide Inspectors	• Qualifications, Powers, Duties of Insecticide Analyst • Procedure on receipt of sample • Fees payable for testing or analysis • Qualifications & Duties of Insecticide Inspectors • Duties of Inspectors specially authorized to inspect manufacture of Insecticides • Prohibition of disclosure of information • Form of order not to dispose of stock • Prohibition of sale • Form of receipt for seized insecticides • Form of intimation for purposes of taking samples • Dispatch of samples for test or analysis
Transport and Storage of Insecticides in Transit by Rail, Road or Water	• Manner of packing, storage while in transit by rail • Conditions to be specified for storage of insecticides
Provisions regarding protective clothing, equipment and other facilities for workers during manufacture of insecticides	• Medical Examination • First aid measures • Protective clothing • Respiratory devices • Manufacturers, etc. to keep sufficient quantities of antidotes and first-aid medicines • Training of workers • Aerial spraying operations • Disposal of used packages, surplus materials and washings of insecticides
Miscellaneous	• Places at which the insecticides may be imported • Traveling and other allowances payable to the members of the Board, etc.

Source: Directorate of Plant Protection, Quarantine and Storage, Ministry of Agriculture & Farmers Welfare, Department of Agriculture and Farmers Welfare, Government of India

5.2 New Pesticide Management Bill, 2020

Pesticide Management Bill (PMB) – 2020 was introduced in Rajya Sabha by the Minister of Agriculture and Farmers Welfare, Shri Narendra Singh Tomar, on March 23, 2020, and later it was referred to the Standing Committee on June 3, 2021. The Bill, if passed in the Parliament, will replace the 53-year-old Insecticides Act, 1968. CropLife India was the first association to be invited by the Parliamentary Standing Committee; to present its views on PMB 2020.

5.2.1 Salient Features of PMB-2020

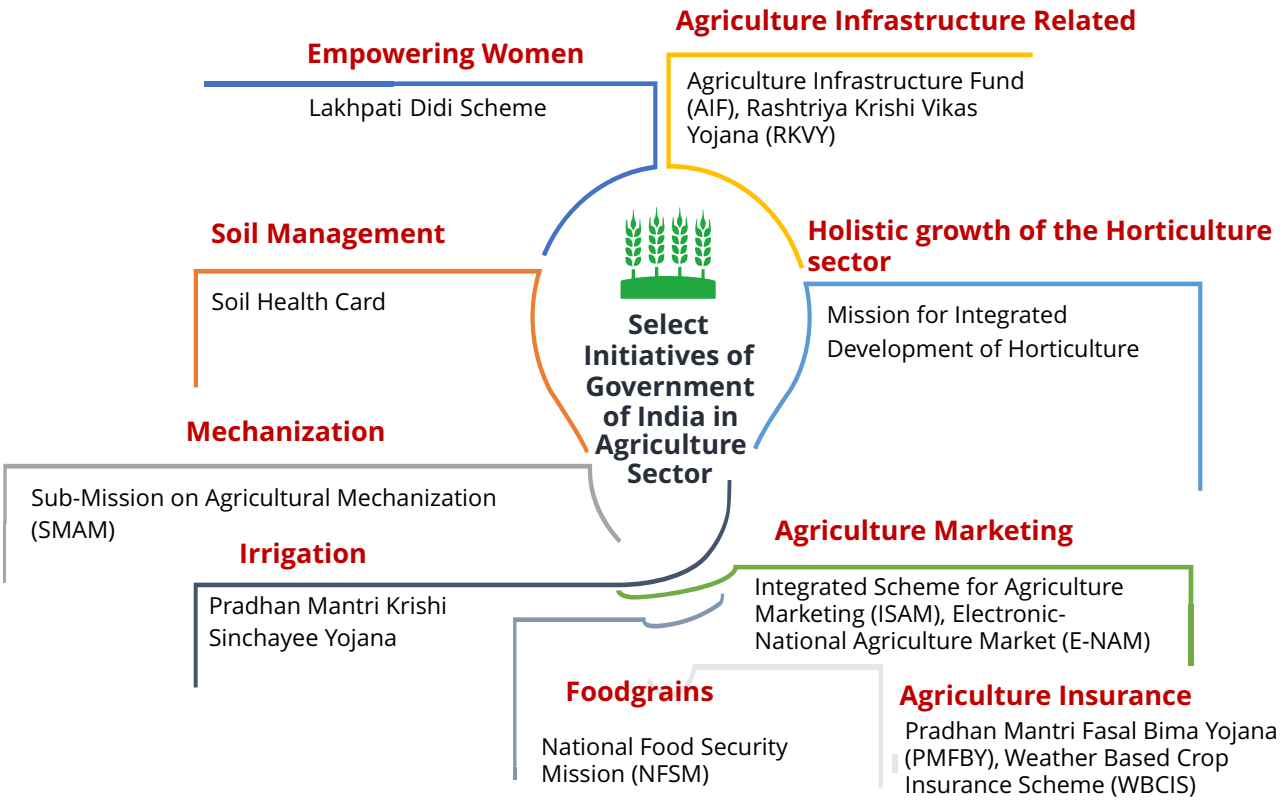
- The Pesticides Management Bill seeks to replace the Insecticides Act, 1968.
- The draft bill proposes an increase in penalties on sale of spurious, substandard and misbranded pesticides and gives State Governments more power to deal with the issue and take action against them.
- The draft contains clauses relating to allowance of provisional registration of new pesticides in India in case of "national exigency" for a period of 2 years.
- The draft provides for punishment to anyone who 'uses' a pesticide in contravention to the provisions of this Act.
- The proposed Bill provides for paying of compensation to the affected farmers or users under the provisions of Consumer Protection Act, 1986.
- The Bill contains detailed clauses for registration of new molecules.
- It has also tightened the guidelines for registration and licensing of new molecules.
- It includes a broader category of offences and provisions for paying compensation to the farmers.

5.3 Initiatives by the Government to Boost Growth of Agriculture and the Crop Protection Industry

Agriculture remains a priority sector for the Government of India. Several initiatives have been taken to boost the growth of this sector and sectors impacting agriculture directly or indirectly. Efforts have been made to implement farmer centric policies, enhance investments in R&D, infrastructure development, promoting sustainable agriculture, support through incentives, and providing

diversified marketing avenues. Select Initiatives by Government of India for augmenting farm productivity and farmers' incomes are captured in Exhibit 25.

Exhibit 25: Select Initiatives by Government of India for Augmenting Farm Productivity and Farmers' Incomes



Source: Various Government Websites

The Government of India has identified agrochemical industry as one of the 12 champion industries for India. Some select initiative that have been taken to boost the growth of the sector are captured in the section below.

5.3.1 Kisan Drones

The use of Unmanned Aerial Vehicles (UAVs) commonly known as drones has great potential to revolutionize Indian agriculture and ensure country's food security. The use of drone in agriculture is helpful to farmers owing to its distinct advantages such as high field capacity and efficiency, less turnaround time and other field operational delays, wastage reduction of pesticide and fertilizers due to high degree of atomization, water saving due to ultra-low volume spraying technology in comparison to traditional spraying methods, reduction in cost of spraying and fertilizer application in comparison to conventional methods etc. besides reduction of human exposure to hazardous chemicals.

The National drone policy has been notified and the Drone Rules 2021 have been made significantly easier for people and companies in the country to now own and operate drones. The requisite fees for permissions have also been reduced to nominal levels.

Considering the advantages of drone technologies in agriculture, the Department of Agriculture & Farmers Welfare (DA&FW) has released the Standard Operating Procedures (SOPs) which provide concise instructions for effective and safe operations of drones for pesticide and nutrient application. CIB &RC has prescribed the guidelines/protocols for registration requirements of pesticides for drone application. It has also finalized the test protocols for Phyto-toxicity evaluation and for bio-efficacy evaluation of pesticide formulation. In order to promote the use of drone technology in agriculture, the following provisions have been made under the guidelines of Sub-Mission on Agricultural Mechanization (SMAM) being implemented by DA&FW:

Exhibit 26: Financial Assistance to Promote the Use of Drones for Pesticide and Nutrient Application

Sr No	Component for Financial Assistance	Financial Assistance
1.	Purchase of Agriculture drone by institutes under Indian Council of Agricultural Research, Krishi Vigyan Kendras (KVKs), State Agriculture Universities (SAUs), State and other Central Government Agricultural Institutions/ Departments and Public Sector Undertakings (PSUs) of Government of India engaged in agricultural activities	100 % up to maximum of INR 10.00 lakhs per drone. The Farmers Producers Organizations (FPOs) are provided grants up to 75% of the cost of agriculture drone for its demonstrations on the farmers' fields.
2.	A contingency expenditure is provided to implementing agencies that do not want to purchase drones but will hire drones for demonstrations from Custom Hiring Centres, Hi-tech Hubs, Drone Manufacturers and Start-Ups. The contingent expenditure to implementing agencies that purchases drones for drone demonstrations.	INR 6,000 per hectare INR 3,000 per hectare
3.	Drone services to farmers on rental basis	@ 40% up to a maximum of INR 4.00 lakhs are provided for purchase of drones by Custom Hiring Centers under Cooperative Society of Farmers, FPOs and Rural entrepreneurs.
4.	Financial assistance Agriculture graduates establishing Custom Hiring Centers	Financial assistance @ 50% of the cost of drone up to a maximum of INR 5.00 lakhs per drone.
5.	For individual purchase of drones, the Small and Marginal, Scheduled Caste/Scheduled Tribe, Women and North Eastern State farmers	Financial assistance @ 50% of the cost up to a maximum of INR 5.00 lakhs and other farmers @ 40% up to a maximum of INR 4.00 lakhs.

Source: Press Information Bureau, Government of India vide release dated 16th Dec 2022

CropLife India, as the largest among all Indian agrochemical industry associations; has been advocating the need for fast tracking drone's application for spraying of agrochemicals for quite some time. The discussions held during the Virtual Conference on Drones Application Technology in Spraying for Crop Protection was organized on 29th July 2020 and the Technical Discussion Paper on Drone Usage for Agrochemical Spraying was greatly appreciated in the consultation process. CropLife India was part of the Expert Committee formed by the Government of India for drafting of SOP for applying pesticides for crop protection and soil nutrients using drones. CropLife Asia helped draft the Technical Discussion Paper and with help from Japan's Drone Guidelines.

Moreover CropLife Asia had organised **Virtual Drone Pesticide Application Forum**, involving stakeholders from the entire food supply chain of all Asian countries for exchange of knowledge and best practices across Asia. CropLife India team invited the Ministry of Civil Aviation, Government of India to deliver an address on "How is civil aviation collaborating with other sectors to allow drones to benefit smallholder farming in India" for the benefit of participants from all countries.

CropLife India shared the agrochemical industry perspective during the National Conference on "Promotion of Kisan drones: issues, challenges and way forward" on 2nd May, 2022. CropLife India members also provided crucial inputs in drafting the Crop Specific Standard Operating Procedure (SOP) For The Application of Pesticides with Drones to the Government of India. Additionally, the Crop wise SOP on Drone application was released in April 2023 by the Government of India.

5.3.2 Agriculture Infrastructure Fund (AIF) for Drones

Agriculture Infrastructure Fund (AIF) scheme is a financing facility started on 08 July 2020. Benefits under the scheme include 3% interest subvention and credit guarantee support. Under the eligible component, Infrastructure for smart and precision agriculture, purchase of drones, and putting up specialized sensors on field, Blockchain and AI in agriculture etc. have also been included. Under this scheme, all loans under this financing facility will have interest subvention of 3% per annum up to a limit of INR 2 crore. This subvention will be available for a maximum period of 7 years. In case of loans beyond INR 2 crore, the interest subvention will be limited up to INR 2 crore. The extent and percentage of funding to private entrepreneurs out of the total financing facility may be fixed by the National Monitoring Committee.

Credit guarantee coverage will be available for eligible borrowers from this financing facility under Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE) scheme for a loan up to INR 2 crore. The fee for this coverage will be paid by the Government. In case of FPOs, the credit guarantee may be availed from the facility created under FPO promotion scheme of DA&FW.

5.3.2 PLI Scheme for Agrochemicals

The government has identified the agrochemical industry as one of the 12 champion industries where India can play a significant role in the global supply chain. Recognizing the sector's potential, the central government may soon finalize the Production Linked Incentive (PLI) scheme for agrochemicals. Once announced, agrochemicals will be the 15th sector that will be covered by the PLI scheme. Going by the overall thrust given for PLI schemes, the agrochemical products for PLI scheme will be selected on the basis of the global market size of the products and the scope for Indian exports. The scheme would pave the way for India to become a global champion in agrochemicals manufacturing with right kind of incentives.

Some agrochemicals were among the list of 100 chemicals identified by the Department of Chemicals and Petrochemicals (DCPC) to be supported through a PLI for the chemicals sector. The list submitted by a technical committee of the department in November 2020 consisted of 100 chemicals, and its key raw materials used in agrochemicals, dyes and pharmaceuticals.

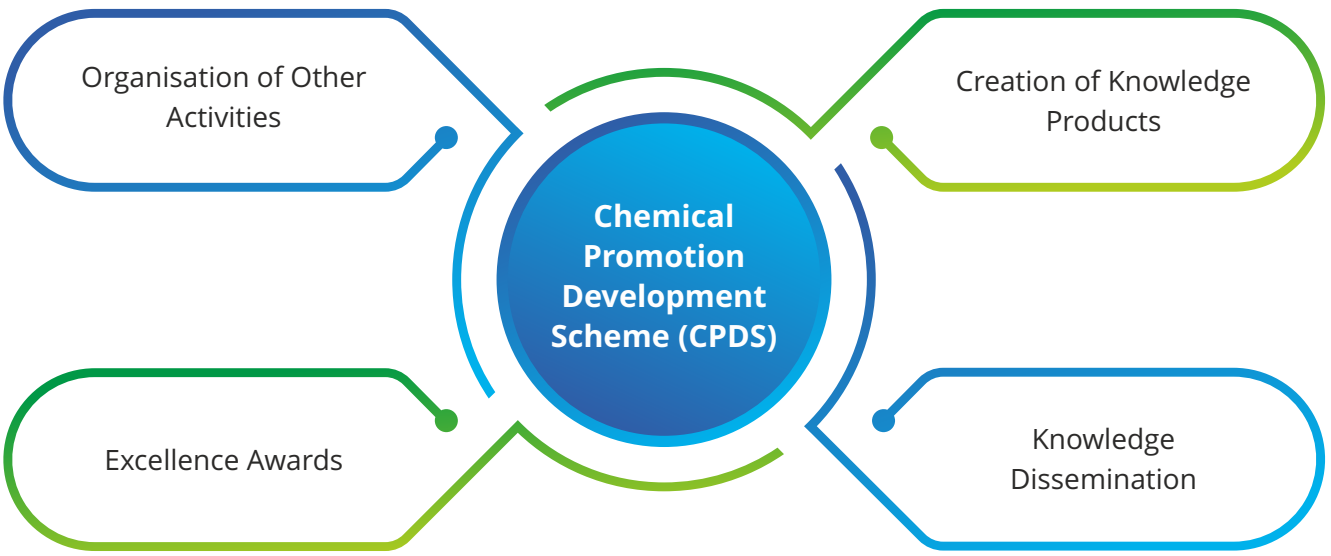
5.3.4 Chemical Promotion Development Scheme (CPDS)

Chemical Promotion Development Scheme (CPDS) is being implemented since 1997 in the Chemical Division of Department of Chemicals and Petrochemicals (DCPC) under Plan Head of Account. The aim of the scheme is to extend soft support in the form of Grants-in-Aid (General) to various organisations/industry associations, etc. to conduct workshops, seminars, studies, etc. to obtain necessary inputs for enabling the Department to firm its views on various policy matters relating to the Chemical and Petrochemical sector. The objectives of the scheme are:

- To facilitate growth and development of chemicals and petrochemicals Industry by creation of knowledge products through studies, survey, data banks, promotional material etc.
- To disseminate knowledge through seminars, conferences, exhibition etc. to facilitate development of these sectors.
- To incentivize research and innovation by awarding outstanding efforts in the field of chemicals and petrochemicals.

The Scheme has the following four components as given in Exhibit 27 below:

Exhibit 27: Components of CPDS Scheme



Source: Department of Chemicals and Petrochemicals, Government of India

6 Key Challenges Faced by the Crop Protection Industry

The crop protection industry faces several challenges that impact its operations, sustainability, and reputation. The industry strives hard to overcome the underlying challenges to maintain the delicate equilibrium of productivity enhancement and environmental sustainability. One of the primary obstacles encountered by the crop protection industry in India pertains to the myths and misconceptions that revolve around it, causing disruption to the substantial industry endeavors aimed at the development of the agriculture sector. In addition, the industry faces specific challenges that could be bucketed into five areas, namely

1) Farm Level
2) Product Level
3) Supply Chain Management
4) Manpower Skillings
5) Regulatory

This chapter highlights the key challenges including the key myths around the crop protection solutions.

6.1 Myths and Misconceptions About Crop Protection Solutions

Myth

Pesticide usage in India is very high

Fact

India is the second largest producer of agricultural commodities after China, however, the nation ranks 11th in terms of total pesticide usage. The pesticide use per unit of cropland in India was estimated to be 0.37 kg/Ha (2021) which is amongst the lowest globally; way below countries like USA (11 kg/ha), Japan (11.24 kg/ha), Brazil (5.7 kg/ha), France (3.7kg/ha), UK (2.8 kg/ha), Indonesia (5.7 kg/ha) and Vietnam (5.7 kg/ha).[30]

Use of pesticides per unit value of agricultural production in India is amongst the lowest globally (0.13 kg/1000 Int. $), compared to countries like USA (1.19kg/1000 Int. $), Japan (1.80 kg/1000 Int. $), Brazil (2.86 kg/1000 Int. $), France (1.20 kg/1000 Int. $), UK (0.53 kg/1000 Int. $), Indonesia (2.74 kg/ 1000 Int. $) and Vietnam (0.96 / 1000 Int. $)[31].

[30] *FAOSTAT*
[31] *FAOSTAT*

Myth	Fact
Use of pesticides limit exports	Contrary to the belief that use of agrochemicals adversely impacts agricultural exports, analysis of data on country wise export of agricultural produce and use of agrochemicals reveals that the top exporting nations of food and agri commodities are also the largest consumers of crop protection solutions. The top 10 agri exporters (including USA, Netherlands, Brazil China, Germany, France, Spain, Italy, Canada, Indonesia (refer exhibit 4)) use pesticides much more than those used in Indian farmlands. India ranks 11th in agricultural exports while is amongst the lowest users of pesticide use per unit of cropland.
Pesticides are generic chemicals that anyone can manufacture	Development of a new product/molecule takes over INR 2,000 crore worth of investment in R&D with over 10-12 years for commercialization. CropLife India member companies have an annual global R&D spend of approx USD 6 billion (nearly 7.5% of their revenues)[32] that lead to newer and safer innovations for the farmers worldwide.
India has a very high number of pesticides registered in the country	India has ~330[33] registered insecticides/pesticides as against 681 in China, 583 in Japan, 561 in Australia, 481 in USA and 477 in Brazil. There are about 1175 registered molecules across the world.[34] The farmers need for new pesticides is triggered by the ever-evolving nature of pests and crop diseases.
Agri commodities in India carry high pesticide residues	Government body AINP-PR (All India Network Project on Pesticide Residues) routinely checks samples of all types of agricultural commodities. Its study of data over the 14 years suggests that, on average, 98% of India's agricultural commodities have maximum residue limit[35].
Chemical use always harms the environment	While some chemicals can have detrimental impact on the environment, modern crop protection products are rigorously and regularly tested for safety and environmental impact.

[32] *Croplife India*
[33] *PPQS- As on 01.06.2023*
[34] *Croplife India*
[35] *https://aicrp.icar.gov.in/pesticide/monitoring-of-pesticide-residues/*

Myth	Fact
Organic means chemical free	Organic or natural farming often warrants use of natural pesticides, which are also chemicals. Thus, the distinction lies in the type of chemicals used and not in the presence or absence or them. All pesticides whether organic, bio or synthetic undergo toxicity, safety, and efficacy assessments before allowed for commercial use.
Crop protection industry only focusses on synthetic solutions	Crop protection industry offers a variety of crop protection products including organic, bio, synthetic and hybrids enabling a diverse product choice for the farmers. The industry is committed to offer a balanced portfolio of solutions that cater to various farming practices and environmental concerns. As the industry is evolving its focus on sustainable and responsible pest management solutions continues to expand beyond synthetic solutions.

6.2 Other Challenges

Farm Level Challenges

- High diversity of crops, seasons and geography in the country result in high diversity in pest species. However, the number of registered molecules available in the nation are comparatively lower than other nations and do not address pest management requirements of all pest species- leading to limited choices available for farmers and use of crop protection chemicals on specific pests even though there is no label claim for that pest.
- Varying levels of awareness amongst the farmers, combined with the fear of crop failure leads to non-judicious usage in terms of the appropriate crop protection solution, its quantity and application technique, leading to adverse impact on the crop, farm economics, environment, safety and health.
- Conventional delivery mechanisms require significant labor/ manhours. Labor shortage, especially during the peak season hinders efficient operations and timely application of crop protection solutions leading to crop loss.
- Changing weather patterns influence the efficacy of crop protection solutions impacting their overall effectiveness.

Product Level Challenges

- Creating new molecules involves significant cost and time for R&D, regulatory approvals, field trials, environmental and toxicology testing, and quality control. This complex process requires substantial financial resources, expertise and a long-term commitment to bring innovative crop protection solutions to the market. A new product or molecule takes over INR 2,000 crore of investment in R&D and over 10-12 years for commercialization.[36]

[36] *CropLife*

Supply Chain Challenges

- Agriculture is highly seasonal due to which balancing the demand and supply of crop protection solution during short windows of demand across different crop seasons and regi ons becomes challenging. Also, accurate information about ground level progress on progress of area covered under the crop, possibility of pest attack and estimated demand for crop protection solutions is lacking which increases the risk of inventory pile up, leading to working capital management challenges.
- Crop protection inputs require specialized storage conditions to maintain their efficacy and safety. Ensuring proper storage and handling practices in the remote locations is a challenge. Also, lack of proper transportation and infrastructure leads to logistics issues in rural areas.
- Adjuvants play a crucial role in enhancing the performance, stability, and coverage on target plants. At present, many adjuvants need to be imported due to absence of the manufacturers in India or non-competitive pricing. Imports put forth challenges related to supply chain disruptions, heavy reliance on foreign vendors, cost fluctuations, regulatory compliances, and vulnerability to geo-political situations.

Manpower Skilling Related Challenges

- The complex nature of pesticide production and application requires a skilled workforce. Developing and maintaining a pool of qualified technicians, chemists and agronomists is essential but can be challenging to recruit due to specialized knowledge required.
- The crop protection industry is continuously evolving with new formulations, applications and regulations. Training programs need to keep up with these advancements to ensure that workforce remains updated.
- Crop protection industry is subject to strict regulations and compliances. The entire supply chain stakeholders need to be well versed with these regulations to ensure compliance, avoid penalties, and maintain product quality.
- Training programs need to be accessible to a diverse range of stakeholders including those with different levels of proficiency and languages.

Regulatory Challenges

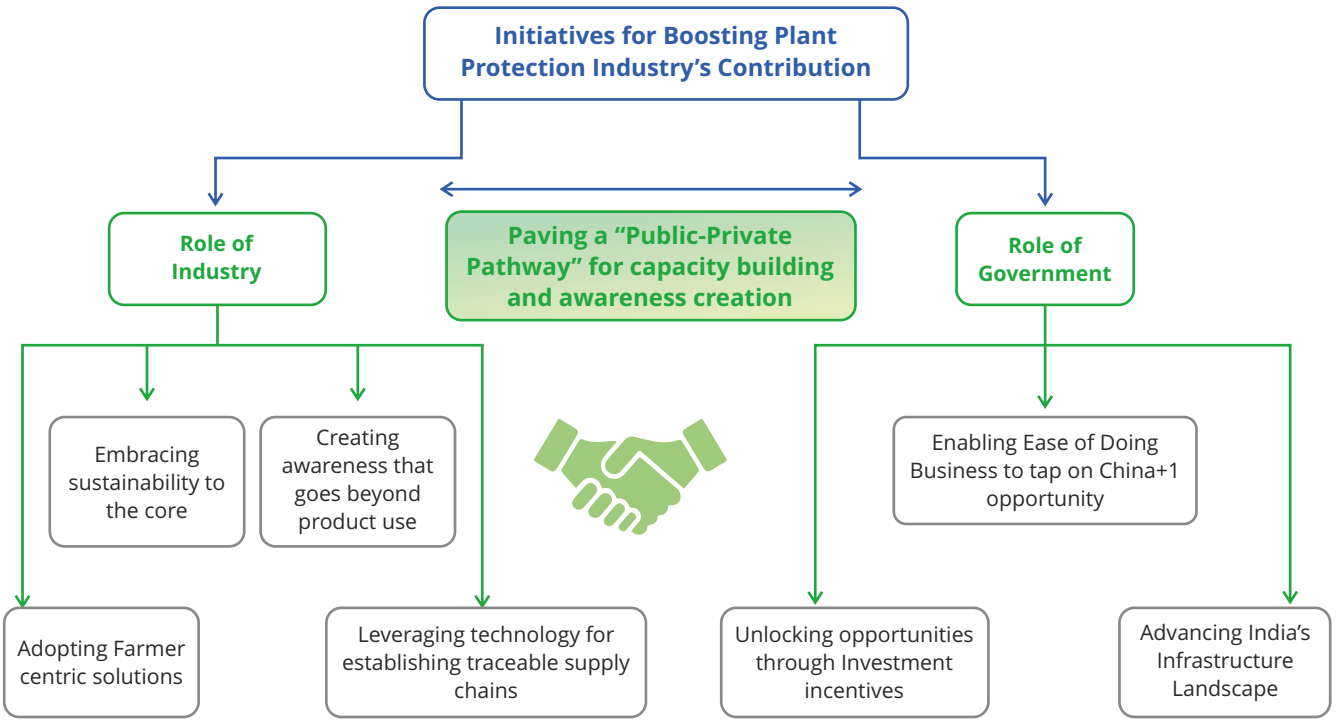
- Registration process for a new product is stringent and complex, involving multiple government agencies. In India, sometimes it takes more than 3 years for registration of a molecule against the prescribed duration of about 18 months, which may be due to involvement of multiple departments, limitation on resources, infrastructure, skills etc.
- The central license is not valid for the state and companies must apply for sale in each state for operations separately, through different portals which warrants a lot of time and cost.
- Crop protection solutions are subject to stringent regulations related to production, transportation, labeling and storage. Ensuring compliance with various regulatory standards can be complex at times. Also, underlying regulations in India can change frequently requiring manufacturers to stay updated and adapt their products and practices accordingly.
- Crop protection companies put in a lot of resources and efforts to educate the farmers on the precise use of approved products on the right crops. Ad hoc bans (specifically at the onset of cropping season) or restriction on usage of specific products or adjuvants restrains ease of doing business for these companies and leaves best practices training redundant.
- Crop protection companies operate in global markets which can involve navigating complex international regulations, custom procedures, and trade restrictions.

7

Going Forward: Initiatives for Boosting Crop Protection Industry's Contribution Towards Sustainable Growth of Indian Agriculture

The Indian crop protection industry has been instrumental in boosting growth of the Indian agricultural sector by effectively confronting many national emergencies, augmenting productivity, enhancing livelihood generation, empowering rural women, and supporting upskilling at the ground level. The government of India has also identified Agrochemicals as a champion sector, which reiterates the importance and contribution of this industry. The role of industry as well the Government remain critical for boosting the crop protection industry's contribution towards Sustainable Growth of Indian Agriculture. The need is for the industry, regulators, producers, extension services experts and research & development organizations to come together to work on innovations, policy reforms, public awareness and creation of an enabling business environment such that the industry can further contribute to the growth of the agriculture sector. Key roles of the industry as well as the Government towards this are captured in Exhibit 28.

Exhibit 28: Key Roles of the Industry as well as the Government for Boosting Crop Protection Industry's Contribution Towards Sustainable Growth of Indian Agriculture



Source: Industry Discussions, YES BANK analysis

7.1 Role of Industry

Adopting Farmer Centric Solutions

Farmers are the primary harbingers of agricultural growth and development. Farm sustainability and farmer income enhancement needs to therefore be central to all extension activities taken up by the industry. Towards this, the industry may

- Take a holistic approach that factors in the crop diversity, sustainability, and economic viability to provide "beyond crop protection" solutions to farmers, that addresses challenges faced by the farmer right from sourcing of farm inputs to sale of farm produce. This may require collaborate with other industry players, agtechs, civil societies, research organizations etc.
- Focus on promoting and providing cost effective and accessible IPM solutions to the farmers such that farming practices remain viable and yield good returns.
- Create an effective feedback mechanism such that specific challenges are identified, and customized solutions are delivered at farm.
- Encourage, train and incentivize the farmers to adopt new technologies and solutions such as drones for spraying the crop protection products and crop nutrients.

Embracing Sustainability to the Core

The crop protection industry at large is adopting sustainability as a core business principle. To further align the business towards sustainability, the industry could further

- Prioritize innovations towards greener chemistries and look at a larger share of green portfolio.
- Invest in packaging that reduces environmental impact.
- Advocate for the adoption of Integrated Pest Management solutions and work with framers to develop effective IPM strategies that go beyond the use of crop protection chemicals.
- Invest in collaborative initiatives that boost farm level carbon sequestration and mitigate farm level carbon emission.

Creating Awareness that Goes Beyond Product Use

The crop protection industry has been investing significantly on creating awareness towards responsible usage of crop protection solutions. Industry players may consider further investing in:

- Increasing efforts on creating awareness on MRLs, application techniques, container disposal, safety measures, market dynamics, weather forecasts, pest advisory etc.
- Increase the outreach and diversify the delivery mechanisms of awareness campaigns such

Leveraging Technology for Establishing Traceable Supply Chains

Implementing technology for traceable supply chains fosters greater trust amongst stakeholders, enhances product safety, and reduces environmental and health risks. The industry could focus on partnering with like-minded stakeholders to promote technologies that drive traceability, such as

- Blockchain to create a transparent record of every step of the supply chain.
- RFID to provide access to product's origin, composition, and usage.
- IOT sensors to monitor temperature, humidity and other parameters that can impact efficacy.

7.2 Role of Government

Advancing India's Infrastructure Landscape

- Creation of a robust farmer information database is essential for the industry to make data-driven demand forecast and plan farmer extension based on data analytics. The recent launch of Unified Portal for Agricultural Statistics is a step towards this.
- As India emerges as a key supplier of crop protection solutions to the world, it is essential to streamline export infrastructure. Modernizing handling at ports to match international benchmarks will enable quick turn-around time and efficient quality management.
- With a view to address MRL issues, Government could establish a robust testing and sanitary management infrastructure, by inviting private players (that could be a consortium of agri-commodity exporters, food processors and crop protection companies) to set up an integrated quality assurance system with viability gap funding support from Government.

Enabling Ease of Doing Business and Ease of Doing Agriculture

- **Data Protection Rights** - One of the key missing elements in India is the lack of legal provisions to support innovation and new products registrations – such as Protection of Regulatory Data (PRD). Considering best practices globally, molecules being introduced for the first time in the country could be given a minimum of 5 years data protection from the date of registration in India. Other countries such as USA, EU, China, Japan, Indonesia, Malaysia, Philippines, Thailand, and Brazil, provide data protection for 6-15 years for molecules being introduced for the first time.[37]
- **Efficient use of agricultural inputs** - With the New Delhi Leaders Declaration, G20 participating leaders jointly committed to accelerate innovations and investment focused on increasing agricultural productivity & build more sustainable and climate-resilient agriculture and food systems. This calls for the central as well as state government to enhance thrust to promote responsible, sustainable and inclusive use of digital technology in agriculture and increase access, availability, and efficient use of agricultural inputs including the crop protection products.
- **Registration process and timelines** - There is an imminent need to review the process and timelines required for registration and align them to international norms while ensuring safety, efficacy, and sustainable aspects. To encourage new molecule registrations, all registration categories under section 9(3) for molecules to be introduced first time in the country could be given priority and their registration should be fast-tracked. Also, there is a need to create a level playing field for crop protection product imports especially for the new crop protection products, which are the need of the hour, as most of them are discovered, developed and originate outside India.
- **Reinforcement of requisite manpower**– To ease out the registration process, regulatory bodies may induct independent scientists and experts to guide on pesticide registrations and related matters. The supporting staff must be augmented with requisite upskilling to effectively evaluate product registration data in time bound manner. Government owned universities could play a key role in capabilities augmentation. In addition, the toxicology studies which are time consuming may be outsourced to designated government institutions.

[37] *CropLife India*

- There needs to be effective convergence among various Ministries and other Govt stakeholders to ensure that the policy issues are effectively addressed (For e.g., MRL limits fixation by FSSAI).
- **Decriminalization of offences under the Pesticide Management Bill 2020** – Criminalization of offences in PMB 2020 could significantly impact conducive business environment. This would rather be a deterrent for new registration of molecules and for companies looking at India for market entry or diversification.
- Implementation of International Best Practices like Crop Grouping, Creation of Guidelines for minor changes in the approved formulations, Harmonization of Registration Data requirements, OPEX model etc. will help further in ease of doing business. Fast track of the review and approval of the drone-use endorsement applications for the approved pesticide formulations.
- A single window system may be created to apply for licenses across different states. This will save on resources to fill in multiple applications with similar data sets.
- India could implement Organization for Economic Co-operation and Development (OECD) requirements and encourage data generation under Good Laboratory Practice (GLP). Peer review on toxicological data needs to be adopted by India similar to the pattern adopted by OECD member countries.
- Central as well as State Governments need to carefully evaluate the impact of decisions to ban or create a policy environment that restricts the use and introduction of new molecules on the future of crop protection solutions, morale of industry participants and perceived attractiveness for industry to invest in introduction of new molecules.
- Doubling Farmers Income is one of the key policy initiative of the govt. Hence, the import duties on crop protection products should remain stable. Any increase in import duties of crop protection products ultimately hurts the pocket of farmers.
- Ease of doing agriculture requires action on several fronts involving central and state governments. A well-coordinated action and strategy between the two levels of government is needed to ensure that agriculture moves to the next stage of development.

Unlocking Opportunities through Investment Incentives

- To reduce dependence on external sourcing of raw materials specially adjuvants, incentive structure may be rolled out for companies to produce raw material materials and intermediates that can be utilized by the crop protection industry.
- The PLI scheme for agrochemicals is a much-awaited initiative by the industry which could be implemented as soon as possible so as to further boost investments in this sector.

Paving a "Public-Private Pathway" for Capacity Building and Awareness Creation

- The crop protection industry carries out focused and extensive farm level interventions to generate awareness around responsible use of crop protection solutions, container disposal, application techniques etc. Various government agencies including Krishi Vikas Kendra (KVK) are designated to carry out similar activities. The industry and the

government agencies act independently and lack a common platform for co-creating and co-implementing their efforts collectively. There is a need to develop a common platform to collaborate and co-create interventions between like-minded private players as well as between private sector and governments.

- There are numerous myths and misconceptions related to crop protection industry, which need to be effectively tackled through comprehensive awareness campaigns targeted at all stakeholders- right from the farmers to the end consumer. The government and the industry need to collaboratively work towards this national campaign.

Striking a balance between the production of safe, healthy, quality and environmentally sustainable food on one hand and ensuring food security for the increasing population, is a difficult task. Towards this, the role of crop protection industry remains critically important. While the Indian government is championing the cause of sustainable agriculture, unprecedented efforts from the private sector are complementing these efforts to build a safe and sustainable future for India. The crop protection industry is taking swift strides in promoting sustainable agricultural practices and is playing a critical role in paving the way for India to build a sustainable and food secure future.

Abbreviations

AIF	Agriculture Infrastructure Fund
AINPR	All India Network Project on Pesticide Residues
ATMA	Agriculture Technology Management Agency
CAGR	Compounded Annual Growth Rate
CGTMSE	Credit Guarantee Fund Trust for Micro and Small Enterprises
CIB	Central Insecticides Board
CIBRC	Central Insecticides Board & Registration Committee
CIL	Central Insecticide Laboratory
CPDS	Chemical Promotion Development Scheme
DA&FW	Department of Agriculture & Farmers Welfare
DCPC	Department of Chemicals and Petrochemicals
DSR	Direct Seeded Rice
ECCB	Empty Container Collection Bins
E-NAM	Electronic- National Agriculture Market
FAO	Food and Agriculture Organization
FPC	Farmer Producer Company
FPO	Farmer Producer Organisation
FSSAI	Food Safety and Standard Authority of India
GDP	Gross Domestic Product
GeM	Government Electronic Marketplace
GHGs	Green House Gases
GLP	Good Laboratory Practice
GVA	Gross Value Added
IARI	Indian Agricultural Research Institute
ICAR	Indian Council of Agricultural Research
IDEA	India Digital Ecosystem of Agriculture
IPCC	International Panel on Climate Change
IPM	Integrated Pest Management
ISAM	Integrated Scheme for Agriculture Marketing

KVK	Krishi Vigyan Kendra
MRL	Maximum Residue Limit
MSME	Micro, Small & Medium Enterprises
NER	North Eastern Region
NFSM	National Food Security Mission
OECD	Organization for Economic Co-operation and Development
ONDC	Open Network for Digital Commerce
PLI	Production Linked Incentive
PMB	Pesticide Management Bill
PMFBY	Pradhan Mantri Fasal Bima Yojana
PPQS	Plant Protection, Quarantine & Storage
PSU	Public Sector Undertaking
R&D	Research and Development
RC	Registration Committee
RKVY	Rashtriya Krishi Vikas Yojana
SAU	State Agriculture Universities
SDG	Sustainable Development Goal
SMAM	Sub - Mission on Agricultural Mechanization
SOP	Standard Operating Procedure
UAV	Unmanned Aerial Vehicle
WBCIS	Weather Based Crop Insurance Scheme

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