Policy landscape for a flourishing agrochemicals industry

11th Agrochemicals Conference 2022

June 2022

pwc

FICCI

Message from FICCI

Sanjiv Mehta, President, FICCI

The agrochemicals industry plays an important role for the agriculture sector and works towards reducing yield loss. India is the world's fourth-largest agrochemicals producer. It has enormous potential for directly contributing to India's economic growth by becoming a global manufacturing and export hub, in addition to playing a critical role in ensuring the country's food security. Thus, it could go a long way towards realising the vision of ' Aatmanirbhar Bharat'.

We firmly believe that policy interventions in the areas of improving research and development (R&D) infrastructure, regulations, compliance-related issues and promotion of manufacturing and export of agrochemicals could bring significant transformation in this sector. This will help India achieve a robust position in the global agrochemicals landscape.

I am glad that FICCI, with the support of the Department of Chemicals and Petrochemicals, and the Department of Agriculture and Farmers' Welfare, Government of India, is organising the 11th Agrochemicals Conference with the theme 'Policy landscape for a flourishing agrochemicals industry' in New Delhi. I am sure that the conference will have deliberations on priority issues, possible solutions and the action agenda. I wish the event great success.

Message from FICCI

RG Agarwal
Chairman. FICCI Crop Protection Committee, and Chairman – Dhanuka Group

A healthy agriculture sector is essential and will continue to play an integral role in the Indian economy. Agriculture contributes significantly to India's GDP and around 58%[1] of our population depends on this sector for its livelihood as farming is its main profession. Considering the current global population scenario, it is extremely important to increase the production of crops within the present arable land to feed the global population. Agrochemicals are one of the most important agri inputs and play the role of insurance to Indian farmers against the perils of pests and pathogens, as medicine plays for the human health.

The Government of India has taken various initiatives for the growth of the sector. The national policies, thus, have been favourable by announcing the agrochemical sector amongst the 12 champion sectors. Further, India can play an important role in the global supply chain by increasing the export of not only crop protection chemicals but also food, thus earning foreign exchange.

With the Government and private sectors working towards intensification of agriculture, the usage of agrochemicals is expected to increase, especially in areas where the penetration of agrochemicals is less. I appreciate the Government of India's contribution towards improving India's ranking in the Ease of Doing Business index, believing in 'Sabka Saath, Sabka Vikas, Sabka Prayas, Sabka Vishwas,' and emphasising on 'vocal for local' to support its flagship programme Aatmanirbhar Bharat (self-reliant India), which will help boost the Indian economy.

The sector has some genuine issues where we seek the support of the Government to resolve them at the earliest. Addressing such issues will enable us to double our exports, for which we have the vast potential.

It is my pleasure to announce that FICCI, with the support of the Department of Agriculture and Farmers' Welfare, and the Department of Chemicals and Petrochemicals, Government of India, is organising the **11th edition of the Agrochemicals Conference on 23 June 2022 from 10am–5.30pm at Hotel Taj Palace, New Delhi, with the theme 'Policy landscape for a flourishing agrochemicals industry'.**

[1] India Brand Equity Foundation

Message from PwC

Ashok Varma
Partner, Agri and Social
Management Consulting, Advisory
PwC India

The Indian economy has progressed significantly from being a subsistence agriculture based economy in the post-independence era to becoming one of the largest economies in the world. Agriculture continues to be a dominant player in the Indian economy. Along with major economic reforms, Government programmes such as the Green Revolution have played a critical role in transforming the country's agriculture sector and supporting economic growth. The Indian agriculture sector also faces some major challenges such as small landholdings, decreasing arable land area, low productivity, inadequate awareness levels among farmers and limited penetration of technology. A significant portion of farm productivity is lost to pests, diseases, lack of irrigation facilities and overdependence on traditional methods of farming. The vision of doubling farmers' income by 2022 has given a strategic direction to policy and investment support by the Government and private sector to address challenges and boost sectoral growth.

The importance of agrochemicals needs to be viewed in the context of improving agricultural yields as their proper use may lead to an approximately 20–30% improvement in productivity. Currently, the usage of agrochemicals in the Indian agriculture sector is amongst the lowest in the world when compared to leading agricultural producers and even the global average. The Indian agrochemicals industry is the fourth largest in the world and has the potential to become a global agrochemicals production hub. The usage of agrochemicals in improving agricultural yields and increasing their production and exports will contribute significantly to the Indian economy. However, the industry currently faces major challenges in terms of low usage, inadequate awareness, non-scientific usage, low levels of technology interventions, and a stringent and complex regulatory framework.

This knowledge paper provides an overview of the Indian agriculture sector and policy interventions that led to its growth. It also offers insights into India's agrochemical industry and its impact on Indian agriculture. The paper also discusses the current policy landscape governing the agrochemicals sector and the areas in which policy interventions may lead to the growth of the agriculture and agrochemicals industries. It elaborates on the key areas of intervention, including improvements in the farming extension services, policy interventions related to agrochemicals industry, adoption of technology and mechanisation, and improvement of the agriculture marketing ecosystem.

Understanding the importance of the agrochemicals industry and the impact of the challenges it faces, and implementing the identified growth levers will ultimately enable the agriculture sector to fulfil its role in the country's growth story. With the above-mentioned interventions, there can be a multifold impact on the Indian economy driven by surplus production due to yield growth, increase in rural income resulting in rural spending, growth of the Indian agrochemicals sector in domestic and international markets, and creation of social entrepreneurs, generating more employment and value.

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Executive summary

The Indian agriculture sector plays an integral role in the Indian economy and is responsible for the livelihoods of more than half of India's population.[2] India is rich in agricultural resources, both in terms of size and diversity. The country is the largest producer of spices, pulses, milk, tea, cashew, jute and the second-largest producer of wheat, rice, fruits and vegetables.[3] The Green Revolution of the 1960s played a major role in initiating the shift from subsistence to commercialised agriculture. Various flagship Government programmes and policies like the National Food Security Mission and the Rashtriya Krishi Vikas Yojana (RKVY) further led to the sector's growth. However, despite the vast scale of Indian agriculture and several efforts by Government and private institutions, the sector faces challenges like fragmented landholding, low productivity, lack of irrigation facilities and inadequate awareness among stakeholders that limit its potential to grow further.

Agricultural inputs like seeds, fertilisers and agrochemicals play a major role in improving agricultural output. The agrochemicals industry, in particular, can significantly help in improving agriculture yields by preventing losses incurred due to pests and diseases. The Indian agrochemicals industry is the fourth largest in the world, with nearly equal contributions from domestic consumption and exports. It has flourished with the rise in commercial agriculture. However, the industry faces challenges related to the agriculture sector as well as from the awareness and regulatory framework perspectives.

The agrochemicals industry has the potential to play a major role in terms of improving productivity through increased and scientific usage of agrochemicals while meeting the global standards of residue level required for agricultural exports. It can also directly contribute to the country's economic growth by becoming a global manufacturing and export hub. However, due to the challenges posed by the regulatory and policy landscape governing the Indian agrochemicals industry and the inherent problems related to extension services, poor penetration of technology and inefficient marketing systems are major hinderances in unlocking this growth.

This paper identifies the four major growth levers from the points of view of policy-, scheme- and investment-based interventions by the Government and private organisations that can contribute to the growth of the agrochemicals industry, the agriculture sector and, subsequently, the economy. The first lever stresses on making improvements in farming extension services in India to effectively promote scientific and proven package of practices and train progressive farmers. The second lever highlights regulatory policies governing the agrochemicals industry to promote research and development (R&D), new product launches, domestic manufacturing and exports. The third lever focuses on promoting adoption of technology and mechanisation in farming, and agrochemical application in order to improve the efficiency of farming activities while reducing costs and effort. The fourth lever discusses improvements in the agricultural marketing ecosystem to improve farmers' income. These growth levers can have a synergistic and multifold effect on the industry and the performance of the agriculture sector as a whole, contributing significantly towards achieving the target of making India a USD 5 trillion economy by 2025.

2 https://www.ibef.org/industry/agriculture-india.aspx
3 Ibid.

1. Overview of India's agriculture sector

Overview of India's agriculture sector

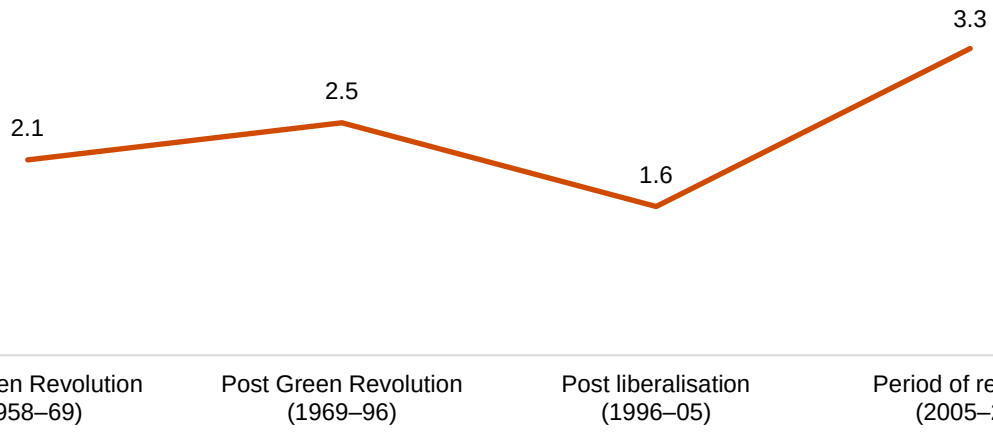
1.1. Evolution of Indian agriculture over the last few decades

Agriculture in post-independence India was largely practised as subsistence farming which was primarily rainfed and used dynamic sources of farm power and traditional tools and equipment. The agricultural productivity of staple crops was very low and more than 80% of the population living in rural areas was dependent on agriculture as a source of livelihood. In order to address the situation, India implemented revolutionary agricultural reforms with prime focus on achieving self-sufficiency of staple crops. Many special programmes such as the Grow More Food Campaign and Integrated Production Programme were implemented to improve the supply of food and cash crops. The Five-Year Plans formulated after the 1950s prioritised agriculture with significant investments planned for upliftment of farmers. The 1960s is characterised by the initiation of the Green Revolution which paved the way for similar initiatives in allied sectors such as Yellow Revolution (oilseeds), Blue Revolution (fisheries) and White Revolution (dairy) in the subsequent decades. The Green Revolution, especially in the pockets of north-western and coastal peninsular India, focused on the cultivation of high-yielding crop varieties through chemical inputs such as fertilisers and pesticides along with improved mechanisation and electrification. This revolution promoting the development of agriculture-oriented approaches instead of single actions led to the achievement of self-sufficiency of staple crops in just five years after a severe drought in 1967.

The introduction of economic reforms in India in 1991 had an indirect impact on the agriculture sector, thereby leading to significant structural adjustments. This change resulted in a marked shift from the consumption of staple-based crops to high-value agricultural products such as fruits, vegetables, meat and dairy due to increased standards of living of the middle-income people. The per-capita consumption of cereals declined from 192 kg to 152 kg from 1977–1999 while the consumption of fruits increased by 553%, vegetables by 167%, dairy products by 105% and meat by 85%.[4] Agricultural exports also experienced a significant improvement with an annual growth rate of more than 10%.

Though globalisation has had a significant effect on the growth of India's agricultural output, it has negatively impacted farmers due to higher input and lower output costs. Devaluation of the Indian rupee immediately after liberalisation made commercial crops affordable and attractive in the global market, leading to the increased usage of expensive chemical inputs where the global food prices remained stagnant, resulting in unpronounced losses for small-scale farmers. The scenario of reduction of commercial bank credit to agriculture in lieu of these reforms led to a reduction in agricultural investment and infrastructure development also got affected due to the lack of public expenditure in the wake of new policies of fiscal compression.[5] Liberalisation of open market operations enhanced competition in resource use, and agriculture marketing resulted in farmers adopting distress sale, thereby leading to agriculture becoming a loss-making profession.

Growth rate of Indian agriculture sector post independence (in %)



Source: Reserve Bank of India

[4] http://www.igntu.ac.in/eContent/IGNTU-eContent-375577792959-BA-AIHC-6-DrJanardhanaB-ScienceandTechnologyinAncientIndia-4.pdf

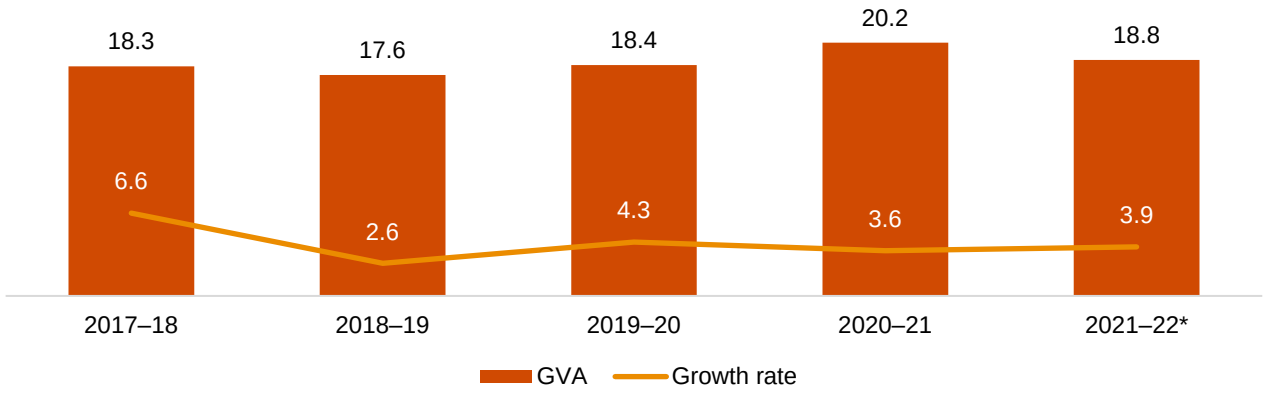
[5] https://www.ijrar.org/papers/IJRAR19D1148.pdf

The growth of agricultural production also remained stagnant during the post-liberalisation period from 1995–2006. This is attributed to increased input cost of production, lack of market value of food and commercial crops, adverse climatic conditions, and lack of infrastructure development due to more emphasis on the manufacturing and industrial sector. Since 2007, the agriculture sector grew steadily, making a remarkable contribution to the economy due to the introduction of various reforms in the country such as Rashtriya Krishi Vikas Yojana (RKVY), National Food Security Mission (NFSM), Pradhan Mantri Krishi Sinchayi Yojana (PMKSY), Pradhan Mantri Fasal Bima Yojana (PMFBY) and digital initiatives by the Government. Though the introduction of these policy reforms has paved the way to some remarkable developments in the sector, few significant challenges such as small and fragmented land holdings, lower productivity, lack of infrastructure etc., are present which is constraining the potential development of the agriculture sector in India. In order to address these challenges, a paradigm shift in the entire approach towards the agriculture sector is essential involving advancement in science-led technology, consolidation of holdings, enhanced private sector participation in pre and post-harvest phases will equip the sector to achieve new heights of development in line with other sectors.

1.2. Importance of the agriculture sector in the Indian economy

India witnessed an agricultural revolution, transitioning from a food-insecure and import-dependent nation to a global agricultural powerhouse, undergoing significant transformations since the early 1960s. Agriculture in India resonates closely with the socioeconomic growth with about 54.6% of the total workforce of the country engaged in agricultural and allied sector activities.[6] As per the provisional estimates of the Annual National Income released by the Central Statistics Office (CSO), the agriculture sector contributed approximately 20.2% of India's gross value added (GVA) at current prices during 2020–21, which is higher than 17.6% in 2018–19. The share of agriculture in gross domestic product (GDP) increased to 19.9% in 2020–21 from 18.4% in 2019–20.[7]

Percentage share of GVA to total GVA (at current prices) and growth rate of agriculture and allied sectors (percentage)

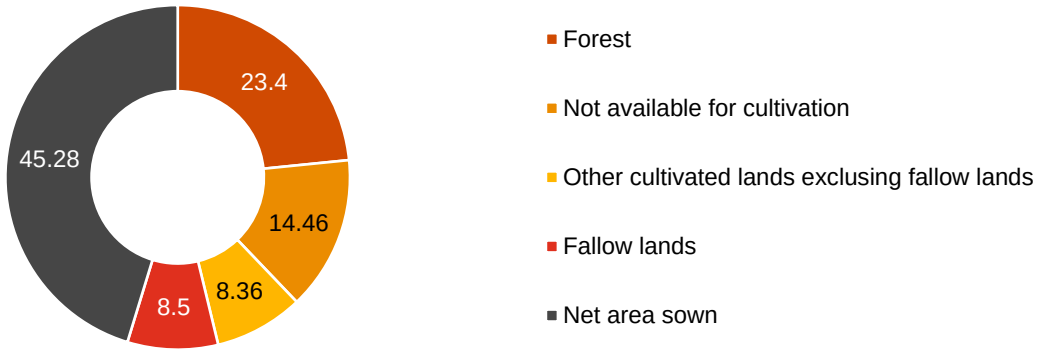


Source: Press Information Bureau

The agricultural and allied sector witnessed a growth rate of 3.9% during 2021–22 compared to that of 2.6% in 2018–19.[8] This became possible due to good monsoon and various Government measures to enhance credit availability, improve investments for creating market facilities, enhance the provision of quality inputs and promote infrastructure development in the sector. The country's inherent land use status and agroclimatic strength can also be termed as the bedrock of this vibrant scenario. As per the Land Use Statistics of 2017, the total geographical area of the country is 328.7 million hectares (ha), of which 139.35 million ha is the reported net sown area and 197.32 million ha is the gross cropped area with a cropping intensity of 141.60%. The net irrigated area is 71.55 million ha.[9]

6 https://agricoop.nic.in/sites/default/files/Web%20copy%20of%20AR%20%28Eng%29_7.pdf
7 https://www.pib.gov.in/PressReleasePage.aspx?PRID=1741942
8 https://www.indiabudget.gov.in/economicsurvey/doc/eschapter/echap07.pdf
9 https://eands.dacnet.nic.in/

Percentage of land use for agriculture in India



Source: Ministry of Agriculture and Farmers' Welfare

An overview of the Indian agriculture and allied sector

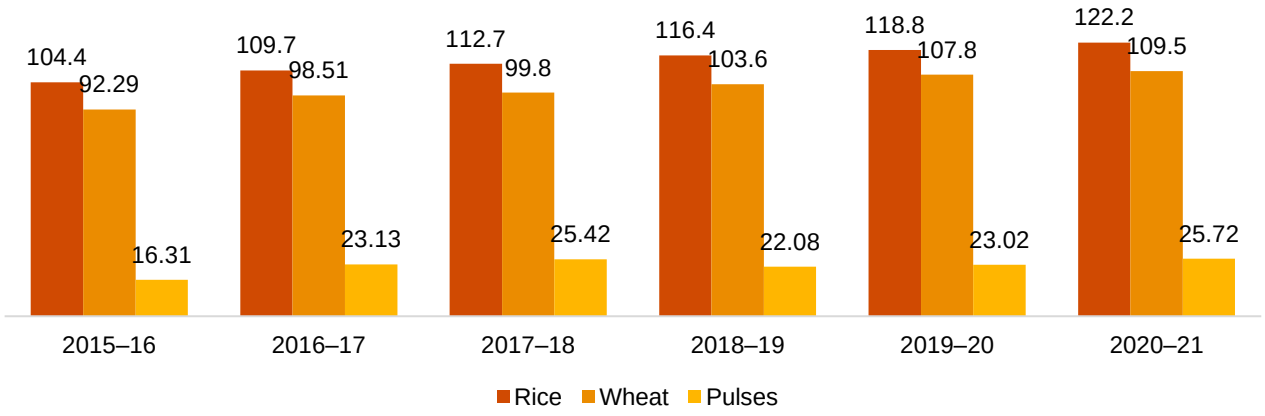
1. Agriculture is the primary source of livelihood for 54.6% of India's population and generates employment for 44% of the country's workforce.
2. The arable land resources of the country account for about 52.6% of the total geographical area.[9] The country has 46 out of 60 soil types in the world with 15 major agroclimatic regions.
3. India recorded significant foodgrain production of 308.65 million tonnes according to Fourth Advance Estimates of 2020–21, serving around 1.3 billion people in the country.
4. The food and non-alcoholic beverages category holds the highest share of consumer expenditure (private) which was approximately 28.3% in FY19 and is growing at a CAGR of 11.4% since 2012.[10]
5. India accounts for one-third of the world's tractor production and is the largest manufacturer of farm equipment like tractors, harvesters and tillers.
6. India is the ninth-largest exporter of agricultural products in the world with a share of around 2.2% of the global agri exports.[11]
7. Indian agriculture plays a predominant role in the development of important industries such as cotton and jute textiles, sugar manufacturing, edible oils and plantation as well as many agro-based cottage industries where agricultural produce is used as raw material.
8. Conducive policy environment favouring increased agri output and farmer economic status through schemes such as PMFBY, RKVY and other initiatives.

10 https://data.worldbank.org/indicator/AG.LND.ARBL.ZS
11 https://www.careratings.com/uploads/video/pdf/08032021045147_Consumption_Expenditure_Trends_.pdf
12 https://www.wto.org/english/res_e/statis_e/wts2021_e/wts2021_e.pdf

Globally, India ranks first in the production of pulses, spices, milk, tea, cashew and jute, and second in the production of wheat, rice, fruits, vegetables, sugarcane, cotton and oilseed. It ranks third in fisheries production and has the world's largest livestock population of about 535.5 million (31% of the global population).[13]

India's foodgrain production has been increasing year on year (YoY), recording a total of 308.65 million tonnes according to the Fourth Advance Estimates of 2020-21, which is 11.5 million tonnes higher than that during 2019–20. The production of rice, wheat and coarse cereals has increased at a compound annual growth rate (CAGR) of 2.7, 2.9 and 4.8% respectively in the last six years, i.e. 2015–16 to 2020–21. The CAGR for pulses, oilseeds and cotton has been 7.9, 6.1 and 2.8% respectively during the same period.[14] The table below depicts the trend of output of major crops over the past six years.

Trend in production (million tonnes) of major crops



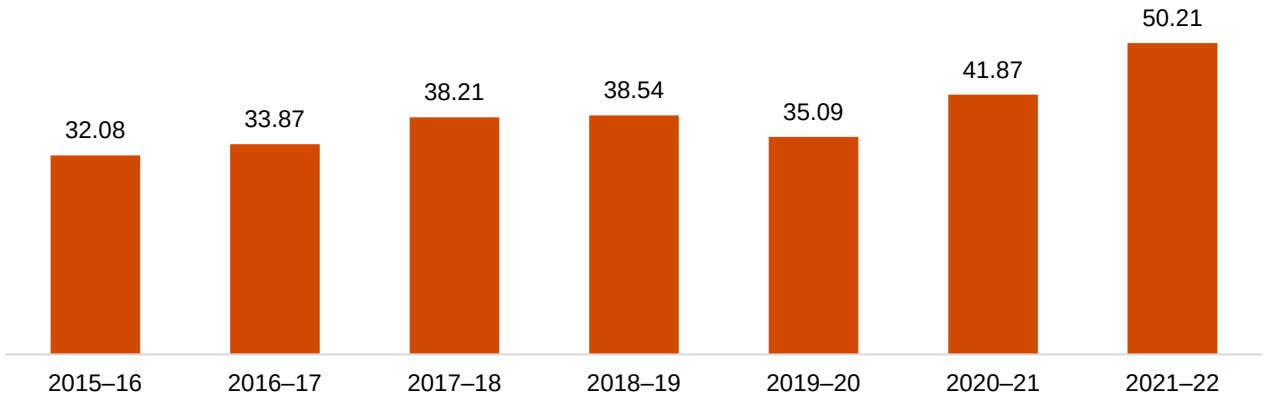
Source: Ministry of Agriculture and Farmers' Welfare

India produced 331.05 million metric tonnes (MT) of horticulture crops in 2020–21 (according to the Third Advance Estimates), an increase of around 3.27% from 2019–20.[15] The increase in the volume of horticulture crops is both attributed to increase in area and productivity. The area under horticulture is projected to rise by 2.7% in 2020–21.[16]

India is the ninth-largest exporter of agricultural products in the world. The total value of exports stood at USD 50.21 billion[17] in 2021–22 which is around 10% of the total export value of the country. Marine products, rice and spices are the largest agricultural export items in terms of value whereas the other major export items are buffalo meat, sugar, cotton and oil products.

13 https://agricoop.nic.in/sites/default/files/Web%20copy%20of%20AR%20%28Eng%29_7.pdf
14 https://www.indiabudget.gov.in/economicsurvey/doc/eschapter/echap07.pdf
15 https://agricoop.nic.in/sites/default/files/Web%20copy%20of%20AR%20%28Eng%29_7.pdf
16 https://www.ibef.org/industry/agriculture-india
17 https://pib.gov.in/PressReleasePage.aspx?PRID=1815164

Agriculture exports in India (in USD billion)



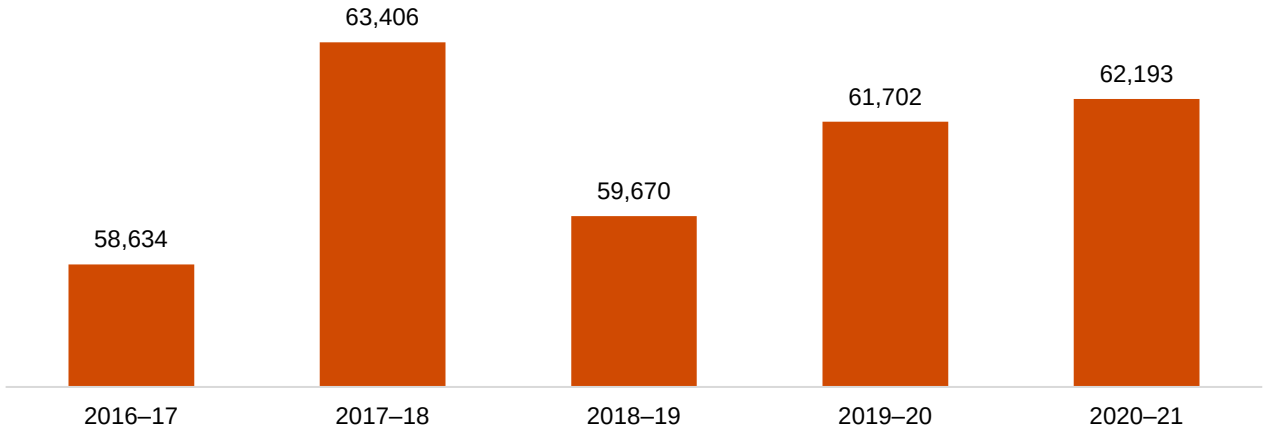
Source: India Brand Equity Foundation

As per a draft agriculture export policy, the Government of India (GoI) is aiming to achieve USD 60 billion in exports by 2022.[18] Reduced sanitary and phytosanitary (SPS) rejections and improved supply chain traceability can help India expand its share of agricultural exports, particularly to European markets. In order to streamline export supply chains and unlock development potential, digitisation and technological interventions can be transformative.

In the wake of Government initiatives such as PMKSY and investments worth USD 1 trillion in development infrastructure, the processed food market is projected to grow to become worth USD 470 billion by 2025 from USD 273 billion in 2020.[19] The sector which allows 100% FDI inflow on an automatic route employs around 1.77 million people over the country.[20]

The agrochemicals industry in India, being one of the largest producers in the world, is valued at around USD 6.4 billion dollars in 2021-22[21] and is expected to grow at a CAGR of around 8% till 2025.[22] As per the reports published by Directorate of Plant Protection, Quarantine and Storage, Ministry of Agriculture and Farmer's Welfare, around 78% of the cultivated land in India is covered by chemicals and biopesticides. The trend of consumption of technical-grade pesticides in India has been increasing as depicted in the graph below:

Quantity of consumption of technical grade pesticides (in MT)

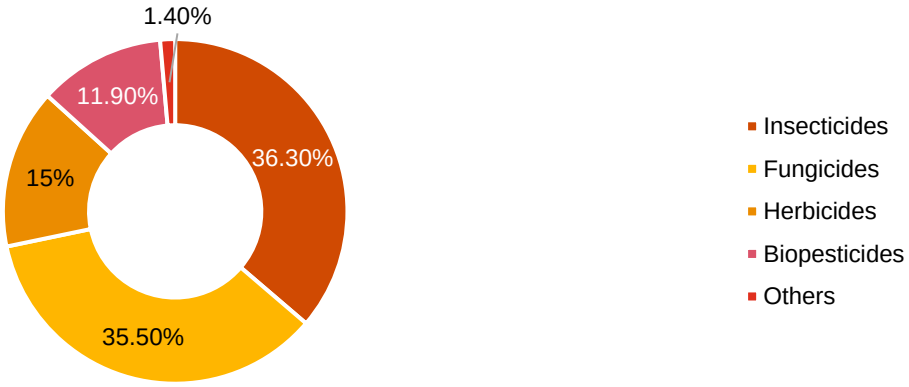


Source: Directorate of Plant Protection, Quarantine and Storage

18 https://commerce.gov.in/wp-content/uploads/2020/02/NTESCL636802085403925699_AGRI_EXPORT_POLICY.pdf
19 https://www.ibef.org/industry/agriculture-india
20 http://microdata.gov.in/nada43/index.php/catalog/145
21 PwC Research and Analysis
22 https://agrospectrumindia.com/2020/09/17/india-agrochemical-market-to-grow-fast-with-cagr-8.html

The Indian crop protection market experiences predominant use of insecticides and fungicides which contributes to almost 72% of the crop protection market.[23] The major applications of these chemicals are found in cereal and commercial crops such as rice, wheat and cotton. The sale of herbicides is seasonal owing to the seasonal growth patterns of weeds. In recent times, the demand for biopesticides is also increasing due to increasing concerns of safety and toxicity of pesticides, stringent regulations and Government support.

Share of different agrochemical products by volume of usage (FY19)



Source: Directorate of Plant Protection, Quarantine and Storage

Challenges

While the Indian agriculture sector enjoys massive production and steadily improving productivity, it also faces a set of inherent challenges that are limiting it to reach its full potential. Given below are some of the major challenges that need to be addressed through policy interventions, extension services, financial interventions, market infrastructure improvement and technological interventions.

- **Lower productivity limiting yield**

  India produces a significant amount of foodgrains but the country's crop productivity is much lower compared to China, Brazil, the US and global averages. The wide variation in crop productivity is attributed to factors such as rainfall dependency, imbalanced use of inputs, varying levels of mechanisation, lack of assured irrigation facilities and institutional credit, and uneven access to technology.

- **Small and fragmented landholdings**

  Indian agricultural landholdings are small and fragmented. The average landholdings of Indian farmers stand at 1.08 ha.[24] The farm areas of Europe and the US are approximately 30 and 150 times larger than that of India.[25]

- **Poor penetration of mechanisation**

  Though India ranks first in the manufacturing of farm equipment, adoption rates of the same amongst producers is comparatively low. The farm mechanisation level in India has been in the lower range of around 40–45% compared to other countries such as the US (95%), Brazil (75%) and China (57%).[26] Lack of farm power and mechanisation is highly pronounced among small and marginal farmers.

- **Low levels of irrigation uptake**

  A majority of Indian farmers practice rain-fed agriculture which accounts for a total of 52% of the country's cropped area.[27] Reliance on rainfall for yield can lead to high levels of unpredictability due to changing weather patterns.

23 http://ppqs.gov.in/statistical-database
24 https://agricoop.nic.in/sites/default/files/Web%20copy%20of%20AR%20%28Eng%29_7.pdf
25 https://ourworldindata.org/farm-size
26 https://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/02AR_170120226CD582783DB44FECB7A07AC238270E5F.PDF
27 https://agricoop.nic.in/sites/default/files/Web%20copy%20of%20AR%20%28Eng%29_7.pdf

- **Lack of proper storage and processing infrastructure**

  Though the production advantages in India are huge, the level of processing for the perishables continues to be miniscule at around 10% or even lower for fruits and vegetables (2%).[28]. Post-harvest losses in India are also significantly greater due to a dilapidated supply chain network, lack of storage and pack houses, warehousing infrastructure which are not developed in pace with the production increase in which transformation with digital and disruptive solutions can lead to amelioration.

- **Lack of access to market information and potential government schemes**

  Most smallholder farmers lack information about the market trends and demand patterns, resulting in lesser farmer share in consumer expenditure. They also have limited access to Government schemes. According to a survey conducted by a financial organisation in over eight states of India, it was found out that only 28.7% of the farmers know about PMFBY, the principal insurance scheme formulated to address crop losses.[29]

Drivers of Indian agriculture

India's agriculture sector has the potential to grow further in the years to come. The sector has huge demand in terms of primary consumption, processing, industrial uses and exports. Given below are some of the major demand drivers of the agriculture sector.

Demand

- **Increase in population and per capita income**

  In FY 2012, India's population stood at 1.23 billion which further increased to 1.38 billion in 2020.[30] This itself proves the growing demand of food consumption and the overall agriculture ecosystem in India. The per capita income has also recorded a remarkable growth from FY15–20 with an increase of around 55.35% impacting the food systems to record increased production.[31]

- **Growing urbanisation and change in consumption patterns**

  Around 34% of the Indian population lives in urban areas with a rising growth rate since 2010.[32] This scenario of rising income and a growing middle class contributes to changing consumption patterns from convenience foods to a diversified and balanced food basket.

- **Raising export demand for raw commodities and processed foods**

  India's agri exports grew significantly at a rate of 19.22% in 2021–22 to touch USD 50.21 billion over USD 41.87 billion in 2020–21.[33] Export of principal commodities like rice, wheat, sugar and marine products is yielding higher value. India's exports in food processing also account for a significant value of USD 4.98 billion, which include the share of products like gherkins and cucumbers, processed vegetables, and mango pulp.[34] The increasing demand for these high-value crops has the potential to create modern infrastructure facilities and better services in the sector.

- **Growing industrialisation**

  The growing demand of goods from cotton, jute textiles, rubber, and plantation industries, in which commercial agriculture commodities are used as raw materials, can be a potential driver of growth in the demand side, ultimately improving the price realised by farmers and sector performance.

28 https://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/02AR_110320207BF5BBAA459047E49DADA63E3E25BD95.PDF
29 https://economictimes.indiatimes.com/news/economy/agriculture/farmers-still-unaware-of-details-of-pmfby-survey/articleshow/65472194.cms
30 https://databank.worldbank.org/source/population-estimates-and-projections
31 https://data.worldbank.org/indicator/NY.GDP.PCAP.CD
32 https://nudm.mohua.gov.in/about/
33 https://pib.gov.in/PressReleasePage.aspx?PRID=1815164
34 https://apeda.gov.in/apedawebsite/six_head_product/PFV_OPF.htm

Supply

- **Diversified and surplus production base supporting the increased demand:**

  India's huge and surplus agricultural production volumes in diversified cereals and horticultural crops are making a significant impact on the growth of the agriculture sector in India. The production volume has been increasing YoY, recording a total of 308.65 million tonnes and 331.05 million tonnes in foodgrains and horticulture crops respectively for 2020–21.[35] This trend of increasing production volumes can pave the way for the development of better infrastructure addressing the ground-level problems.

- **Favourable climate for food production:**

  India has large arable land with 15 agroclimatic zones, 46 soil types and various weather conditions, making the country capable of growing a variety of crops.[36] This particular advantage favouring diversified crop bases with higher production volumes is the main driver for the agriculture sector's growth even in unprecedented situations like the COVID-19 pandemic.

- **Improved usage of farm inputs:**

  Increased usage and penetration of farm inputs like quality hybrid seeds, fertilisers and crop protection chemicals, advisory/extension services, and credit facilities being the key supply chain drivers indicates the sector's upgrade in the domain of economy and technology. There is also a significant increase in the number of farmers who are accessing institutional credit which can be attributed to interventions such as the Kisan Credit Card (KCC) scheme and prioritisation of agricultural lending.

- **Rise in digital technologies:**

  With Indian agriculture embracing digital transformation, the advancement of these technologies is having a significant impact on the efficiency of crops. The present market of agricultural digitisation is valued at USD 204 million and further expected to grow exponentially owing to the increased adoption of technologies like artificial intelligence (AI), internet of things (IoT) and remote sensing.[37] Over the years, the Government is taking major steps to aid and enhance the agricultural sector with proven digital technologies which will further accelerate growth by ensuring higher crop yields and enhancing sustainability.

35 https://agricoop.nic.in/sites/default/files/Web%20copy%20of%20AR%20%28Eng%29_7.pdf
36 https://aicrp.icar.gov.in/vc/Ach_Zonespecific.aspx
37 https://indiaai.gov.in/article/ai-impact-on-india-how-ai-will-transform-indian-agriculture

1.3. Role of policy interventions in shaping India's agriculture sector

From importing foodgrains to feeding the growing population in the 1950s to becoming a nation that produces and exports surplus foodgrains, India has traversed a long way. The transformation in the Indian agriculture sector since the 1950s is driven by several policies and reforms across different time periods which shaped the sector to reach its current state. The last five years, in particular, have witnessed the agriculture sector's transformation at an unprecedented pace and disruptive breakthrough through introduction of several schemes, policy changes and reforms which is set out to change the overall scenario of Indian agriculture.

1960–1980s

This phase in Indian agriculture witnessed the transition from food production stagnation to high-volume agricultural production. The India agriculture rose to new heights during the period of Green Revolution. High-yield variety of seeds, increased application of fertilisers and increase in irrigation facilities contributed significantly in increasing the production of agricultural produce, which aided in achieving the goals of food security as well as import reduction of food grains.

1980s–2000

This period was characterised by India attaining the status of a food-surplus nation as well as a net exporter of agricultural products. The Small Farmers' Agri-Business Consortium (SFAC) was established in 1994 to facilitate business ventures in agriculture. It worked to guide private investment in the agriculture sector, promote the development of small agribusinesses and aid the formation and growth of farmer producer organisations (FPOs) / farmer producer companies (FPCs) in India. Trade liberalisation in Indian agriculture was also a major step in which a series of policy measures were undertaken in 1991. Withdrawal of subsidies on the exports of a set of commercial crops and removal of quantitative restrictions on the imports of commodities like wheat and wheat products, rice, pulses and oilseeds, discontinuation of quotas as an instrument of trade policy, use of tariffs as the primary instrument of regulation were key highlights of such newly introduced reforms. Export controls on almost all the crops, due to a World Trade Organization (WTO) agreement in 1995, were gradually removed.

2000–2015

The twenty-first century marked a new era in Indian agriculture. The agriculture sector saw the onset of new supporting reforms and institutions, new policies and adoption of technology interventions in agricultural production.

1. **The Horticulture Mission for North East and Himalayan States (HMNEH)** was launched in 2001–2002. The scheme aimed to improve the production and productivity of horticulture crops in the North Eastern and Himalayan states of India with high-value, low-volume and low-perishability horticulture crops. It also supports the women farmers by providing employment opportunities in horticulture farming.

2. **Agricultural Technology Management Agency (ATMA)** came into existence in 2005–06 with the objective of promoting and managing the agricultural technology transfer by performing organisational arrangements and supporting innovative technologies.

3. With its introduction in 2016, the objective of **National e-Governance Plan in Agriculture (NeGP-A)** was to ensure increase farmers' access to agriculture-related information with the use of information and communication technologies (ICT) in agriculture.

4. **The National Food Security Mission** was launched in the year 2007 during the eleventh Five Year plan. With an outlay of USD1.2 billion, the NFSM aimed to increase the production of rice, wheat and pulses in the country by ten million, eight million and two million tonnes respectively by 2012. The NFSM was continued after the twelfth Five Year plan with the objectives of increased targets of production of foodgrains, supporting the value addition after crop harvest and ensuring better farm gate remuneration for farmers.

5. The year 2007 saw the launch of **RKVY.** The scheme was launched to encourage growth opportunities **in the** agriculture and allied sector by incentivising the states for increasing the outlays for the sector. The scheme was revamped later and came to known as **Rashtriya Krishi Vikas Yojana – Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (RKVY-RAFTAAR)**. It was implemented from 2017–18 to 2019–20 and the key focus areas were enhancement the pre and postharvest infrastructure, promotion of agri entrepreneurship, value addition and innovation in the agriculture sector.

6. **National Crop Insurance Programme (NCIP)** came into effect in the year 2013–14. The objective of this modified national insurance scheme is to ensure food security and crop diversification for sustained growth of the sector. Introduction of weather-based crop insurance and Coconut Palm Insurance Scheme helped to minimise the risks faced by the farmers as well as provide a means of finance during the tough times of crop failure and/or destruction due to several natural disasters and incidences.

7. Launched in the year 2015 with an outlay of USD 830 million, **PMKSY** aimed to boost the development of micro irrigation and watershed in the country, support the storage of water at micro level and engage in water conservation practices/water management. Since the inception of the scheme, states have received a central assistance of INR 13,332.23 crore for implementation of the 'Per Drop More Crop' component of PMKSY till December 2020.[38]

8. The organic farming sector received a boost from the GoI with the launch of the **Paramparagat Krishi Vikas Yojana (PKVY)** in 2015. This scheme encouraged the adoption of organic farming and development of sustainable organic farming models to increase soil fertility, resource conservation and climate change adaptation and risk mitigation. The Department of Agriculture, Cooperation and Farmers Welfare also implemented an organic farming certification system called the Participatory Guarantee System – India (PGS India). The portal has registered 46,189 local farmers groups and 1,279,930 approved farmers with 1,295,739.41 ha of area under organic farming.[39]

9. Foreign direct investment (FDI) was allowed under the automatic route for up to 100% in storage and warehousing.

2016–present

Since the year 2016, the agricultural sector saw unprecedented rate of transformation policies and reforms being introduced in India, focusing on various stage from production till marketing.

1. **PMFBY of 2016** replaced the National Agricultural Insurance Scheme (NAIS) and the Modified National Agricultural Insurance Scheme (MNAIS). This crop insurance policy aimed to provide financial support to farmers in covering their crop losses.

2. **eNAM – National Agriculture Market (eNAM)** came into existence as a pan-India electronic trading portal network connecting the existing APMC mandis. The objective was to create a unified national market for agricultural commodities and promote uniformity in agriculture marketing through integration of markets, remove market information asymmetry as well as promote real-time price discovery.

3. In order to protect the farmer's interest, **Contract Farming Law** came into existence in 2017. The draft model act places contract farming beyond the ambit of state APMCs. This means that buyers need not to pay market fee and commission of the APMCs for undertaking contract farming with farmers. Also, it promulgated establishment of an independent regulatory authority which shall mange and take over contract farming stakeholders from the existing APMCs.

4. Tax incentives and other sops were also announced for various subsectors within the domain of agriculture. Import duty was scrapped off on capital goods and raw materials for 100% export-oriented units, 100% excise duty exemption for goods used in the installation of cold storage facilities, service tax exemption for services like pre-conditioning, ripening, waxing, retail packing, precooling, labelling of fruits and vegetables were the key highlights of such incentives.

5. With Government's vision of doubling farmers' income by 2022**,** an **Agriculture Export Policy** was framed in 2022. The policy's key focus areas were agriculture export oriented production, export promotion, better farmer income realisation, synchronisation within policies, schemes and programmes, and removal of all restrictions on organic and processed food.

6. **Pradhan Mantri Annadata Aay SanraksHan Abhiyan (PM-AASHA)** was also announced in 2018. With an outlay of INR 15,053 crore, this procurement policy aimed to ensure fair remunerative prices for farmers in the country. Price Support Scheme (PSS), Price Deficiency Payment Scheme (PDPS) and the pilot Private Procurement and Stockist Scheme (PPSS) fall under this umbrella programme.

[38] https://agricoop.nic.in/sites/default/files/Web%20copy_eng.pdf
[39] pgsindia-ncof.gov.in

7. **National Mission on Food Processing (NMFP)** was launched by the Ministry of Food Processing Industries to promote setting up of food processing industries in the country. It aims to increase the capacity of food processing in the country through adoption of new technologies, improving the food products' quality as per the national/international standards, reduce wastage of agricultural produce, introduce new technologies and upgrade human resource capacities for overall development of the food processing sector.

8. **Pradhan Mantri Kisan Samman Nidhi Yojana (PM Kisan)** aims to provide a supporting income of INR 6,000 per year to small and marginal farmer families. The support is provided to farmers having a combined landholding/ ownership of up to two hectares in three equal instalments.

9. **Pradhan Mantri Kisan Urja Suraksha evam Utthan Mahabhiyan (PM KUSUM)** was launched with the aim of installing solar-powered pumps for farmers and grid-connected solar and other renewable power plants in the country.

The year **2020** saw many policy reforms in the agricultural sector and Government investments to financially boost the sector, with the prime objective of reducing the adversity caused by the COVID-19 pandemic.

1. **Amendments to the Essential Commodities Act (ECA) and Agricultural Produce Market Committee Act** were made in 2020 for farmers to get better prices for their agricultural output by providing more control over where and whom to sell. The amendment allowed farmers to sell their agricultural produce outside the APMC mandis to any buyer.

2. The e-NAM app – an e-commerce platform – was expanded to include about 415 more 'mandis' to the e-NAM platforms. Thus, the total number of electronically connected wholesale markets/mandis currently stands at to 1,000. The trade on the digital portal has already exceeded INR 91,000 crore. As per the current status, 1,000 APMC markets present in 18 states and three union territories (UTs) are integrated into the e-NAM digital platform. There are more than 1.73 crore farmers, 2,140 FPOs, 1.03 lakh commission agents and 2.23 lakh traders registered in the e-NAM portal.[40]

3. The Prime Minister of India announced an INR 20 lakh crore economic package to negate the impact of the COVID-19 pandemic out of which INR 1 lakh crore was allocated to the agriculture and allied sector. The main objective of the fund was to boost the creation of agricultural infrastructure like cold storage chains, post-harvest management, and warehouses.

[40] https://enam.gov.in

2. Overview of the Indian agrochemicals sector and its role in Indian agriculture

Overview of the Indian agrochemicals sector and its role in Indian agriculture

2.1. Overview of the Indian agrochemicals industry

The Indian agrochemicals industry is the fourth largest in the world (after the USA, Japan and China)[41]. The industry supports Indian agriculture by providing products which reduce yield loss due to pests and diseases and improve yield gain through plant and soil health products. The Indian agrochemicals industry was estimated to be worth around INR 50,000[42] crore in 2021–22, of which agrochemicals exports were valued at around INR 25,045 crore.[43] The industry is fairly fragmented with around 6,200+ agrochemical companies registered by the Central Insecticide Bureau and Registration Committee (CIB&RC), while the top 20–25 players enjoy a share of around 80% of the domestic and export markets.

The agrochemicals industry is responsible for carrying out consistent R&D and new product development to create new molecules that are able to counter ever-increasing pest attacks and resistance towards pesticides, while also ensuring sustainability, environment, human health and affordability by farmers. The agrochemicals industry in India is fairly dependent on the consumption of generic molecules while also launching and promoting new products every year. Since R&D of a new molecule is a long process that takes around five–seven years with investments as high as INR 2,000–3,000 crore, it is only viable for global giants in the industry to undertake the same. A majority of the players usually rely on strategic tie-ups, in-licensing and co-branding approaches for launching new products in the market. Also, manufacturing of agrochemicals is broadly a two-step process involving (i) synthesis of active ingredients from raw materials and (ii) mixing of inert material with the active ingredient for making different formulations. The Indian agrochemicals industry is largely dependent upon imports of raw materials as well as technical-grade pesticides to create formulations. Smaller players also buy technical-grade pesticides from larger domestic companies or rely on contract manufacturing for meeting their needs.

The industry is largely dependent upon sale of formulated pesticides through traditional distributor and retailer channels, which carry out a majority of the sales of agri inputs (seeds, fertilisers, agrochemicals, specialty nutrients, etc.) across the country. Major agrochemical companies deploy staff on the ground to promote new products among farmers and advise them through demonstrations and private extension activities such as farmer meetings.

41 https://news.agropages.com/News/NewsDetail---41622.htm
42 PwC research and analysis
43 Tradestat, Department of Commerce, Ministry of Commerce and Industry

2.2. Role of agrochemicals in Indian agriculture and the Indian economy

The agrochemicals sector contributes towards the growth of the agricultural sector and Indian economy in the following ways:

1. **Improving agricultural output:** Arable land in India is limited and is witnessing a decreasing trend over the years. Thus, in order to improve agricultural output, improving agricultural productivity in terms of production per ha is the only option. Agri inputs such as short-duration and high-yielding seed varieties, fertilisers and irrigation help in improving the productivity and cropping intensity. Agrochemicals play a major role by reducing damages from pests and improving overall yield. Studies indicate that agrochemicals can improve the yields or prevent yield loss by 37.2% in rice, 25–30% in wheat, around 30% in maize and pulses respectively,[44] and fungicides can prevent yield loss of 50–90% in fruits and vegetables.[45]

2. **Increasing agricultural exports:** India's exports of agricultural and allied goods were valued at around INR 1.53 lakh crore in 2021–22. Rice (basmati and non-basmati), fresh fruits, seafood and meat were among the most exported food items. Agrochemicals play an important role in not only improving the yields thereby creating surplus for exports but also improving the quality of produce, if used properly.

3. **Increasing agrochemicals exports:** India exported around INR 24,045 crore[46] worth of agrochemicals during FY22 while the total worth of Indian exports stood at INR 52.34 lakh crore in the same year. Although the contribution is small, the Indian agrochemicals industry can account for more if policy and private sector support enable India to become a global agrochemicals manufacturing hub.

2.3. Key challenges faced by the Indian agrochemicals industry

Large-scale commercialisation of agriculture, increasing cultivation of horticultural and high-value crops and improving cropping intensity are an outcome of the application of improved agri inputs, mechanisation and technology. Inputs such as high-yielding-varieties (HYV) of seeds and chemical fertilisers led to the success of the Green Revolution. Similarly, agrochemicals have been contributing towards pest and disease management, and yield improvement. Although all agri inputs with their optimised use can help unlock production potential, there are several challenges that the agri input sector, including the agrochemicals industry, face. Some of these key challenges are listed below.

- **Lack of awareness and non-scientific usage:** Decisions to purchase seeds, fertilisers and agrochemicals are quite influenced by fellow farmers and agri input retailers. This can often lead to non-scientific usage, resulting in underuse, overuse or untimely and improper application. This leads to lower performance of agri input products and suboptimal yields.

- **High reliance on generic molecules:** Generic molecules, some of which were introduced decades ago, still dominate agrochemical consumption. Agrochemicals companies are introducing new and better molecules but their adoption is slow and require significant investments in marketing and promotion. Also, the high R&D cost for agrochemicals coupled with a complex registration procedure has slowed down the introduction of new molecules in the market by companies.

- **Low usage of agrochemicals:** In terms of per ha usage of agrochemicals, India consumes only 0.31 kg/ha while nations such as Brazil, China and the US have 10–20 times higher usage compared to India. This can be attributed to non-scientific application, lower usage in less commercialised and subsistence crops, and lack of funds to invest in agrochemicals.

- **Current regulatory framework:** The Indian agrochemicals industry is regulated by the Directorate of Plant Protection, Quarantine and Storage which consists of bodies like the Central Insecticides Board and Registration Committee (CIB&RC) and central, regional and state pesticide testing laboratories. The Insecticides Act, 1968, and the Insecticide Rules, 1971, are the two major acts that regulate the industry. The current regulatory framework makes it difficult and slow to register new products, and manufacturing and marketing of agrochemicals is strictly regulated for quality and regulatory compliances. While it is necessary to ensure the safety of consumers, human health and the environment, significant steps are being taken towards improving the ease of doing business and investment promotion for the agrochemicals industry.

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44 https://www.ag.ndsu.edu/potatoextension/CAST_IP55_Contributions_of_Pesticid_4992B5674417F.pdf
45 http://croplifefoundation.files.wordpress.com/2012/07/completed-fungicide-report.pdf
46 http://croplifefoundation.files.wordpress.com/2012/07/completed-fungicide-report.pdf

3. Policy and regulatory landscape of agrochemicals in India

Policy and regulatory landscape of agrochemicals in India

3.1. Overview of the policy landscape for the agrochemicals sector

There is correlation between usage of pesticides and yield gains across crops. Therefore, usage of agrochemicals up to recommended levels is directly related with economic gains. Excess, irresponsible or ill-informed usage of pesticides may not only result in diminishing returns, but also serious impact on the environment, health and safety. Pesticides are synthetic chemicals, with different hazard ratings and can lead to human health and pollution-related problems if not used correctly. Therefore, the regulatory framework needs to take into account factors such as efficacy and impact on the environment and human health before registering and approving usage of any pesticides. Also, safeguarding farmers from low-quality, counterfeit or unsafe pesticides is important. The policy landscape in India covers these areas with specific sections within the legislations pertaining to areas such as registration of new molecules, licensing for manufacturing, sale and storage of pesticides, and quality testing.

The Indian agrochemicals sector has seen the introduction of policy and regulations aimed at benefiting the associated stakeholders. Some of the major regulatory bodies, policies, acts, bills and guidelines pertaining to the agrochemicals ecosystem in India are summarised below:

1. **Insecticides Act, 1968:** This law was enacted to regulate the import, manufacture, sale, transport, distribution and use of insecticides. The key aim was to prevent any risk which may arise to human beings or animals, and other areas of concern from the use of insecticides on crops. The CIB is responsible for the administration of this act and to advise Central and state governments on concerned technical matters. The Registration Committee (RC) was also formed for registration of insecticides and verification of claims made with respect to efficacy and safety for human beings and animals. All pesticides registered in India are enumerated in the schedule of the act. The RC also mandates that a label be placed on the packaging to indicate the nature of the product (household or agricultural) along with composition, active ingredients, target pests, recommended dosage, caution signs and safety precautions. The act also pertains to import and registration of pesticides and covers the registration process and timelines.

2. **Insecticides Rules, 1971:** The principal rules have been amended 27 times since their introduction and pertain to many important areas related to pesticides. The different chapters under the rules pertain to the following areas:

    1. Preliminary definitions: This chapter defines the terms used in the rules.

    2. Functions of the Board, RC and laboratory: This chapter provides details on the functions of the CIB, RC and laboratory.

    3. Registrations of insecticides: This chapter pertains to the manner of registration, issue of duplicate certificate of registration or alteration to the registration certificate, appealing against decisions of the RC and manner of refusal, and cancellation of certificate of registration.

    4. Grant of licences: This chapter covers in detail the rules and procedures related to grant and validity of licences for both manufacturing and sale of insecticides, segregation and disposal of expired pesticides, special provisions related to sulphur, and prohibition against storage or sale of insecticides in certain places.

    5. Packing and labelling: This chapter provides details on packaging of insecticides, leaflets with necessary information to be contained in packages, manner of labelling and prohibitions against altering any inscriptions on labels, containers or wrappers of insecticides.

    6. Insecticide analysis and insecticide inspectors: The rules describe the qualifications, duties and powers of an insecticide analyst. This chapter also covers rules pertaining to pesticide sampling and analysis and prohibition of sale or disposal of stock.

7. Transportation and storage of insecticides by rail, road or water: The rules describe the manner of packaging and storage while in transit by rail and specify the conditions to be maintained when storing insecticides on premises.

8. Import of pesticides: This chapter details the rules pertaining to place of import of pesticides and allowances for members of the board.

3. **Pesticide Management Bill (PMB), 2020:**[47] This bill first came into existence in 2008. After multiple revisions based on inputs from Government stakeholders, the private sector and research organisations, PMB, 2020, was introduced. It has been referred to the Standing Committee on Agriculture for examination and, when passed, it will replace the Insecticide Act, 1968. The bill aims to regulate the industry, monitor pesticide poisoning and compensate victims. The salient features of the bill are as follows:

    1. **Definitions** of pests and pesticides

    2. **Formation of a Central Pesticide Board (CPB)** which will advise the Central and state governments on technical matters pertaining to PMB. The CPB will advise the Central Government on formulating standards and best practices for (i) pesticide manufacturing, testing, usage, (ii) working conditions and training of workers, and (iii) recall and disposal of pesticides.

    3. **Registration of pesticides and registration criteria:** A certificate of registration issued by the registration criteria (RC) will be required by the persons/organisations who wish to import or manufacture a pesticide for industrial, domestic, industrial or other applications. The committee will be constituted by the Central Government and will:

        - specify the conditions for granting a certificate and issue certificates
        - periodically review the safety and efficacy of registered pesticides, basis which it may amend or cancel their certificates
        - notify substances with similar chemical or biological action as a pesticide.

        The RC will evaluate the information submitted in the application about the pesticide on factors such as safety, efficacy, necessity, end use, risks and availability of safer alternatives. The committee may not register pesticides if:

        - the information submitted is misleading
        - maximum residue limits (MRL) of pesticide on crops/commodities are not specified under the Food Safety and Standards Act, 2006
        - there is any scientific uncertainty regarding the risks, benefits and threats of irreversible damage to human health, other organisms and the environment.

    4. **Licences:** A licensing officer appointed by the state government will issue a licence to any person or organisation seeking to manufacture, distribute, exhibit for sale, sell, or stock pesticides, or undertake pest control operations.

    5. **Prices:** The Central Government may regulate prices of pesticides if deemed necessary to secure the distribution and availability of pesticides at fair prices.

    6. **Prohibition on certain pesticides:** The Central and state governments may, by notification, prohibit the distribution, sale, or use of a pesticide or a specified batch in an area, up to a period of one year. This may happen in case of any risks to human health, the environment and other organisms, or if there is any barrier to international trade of agriculture commodities.

[47] https://prsindia.org/billtrack/the-pesticide-management-bill-2020

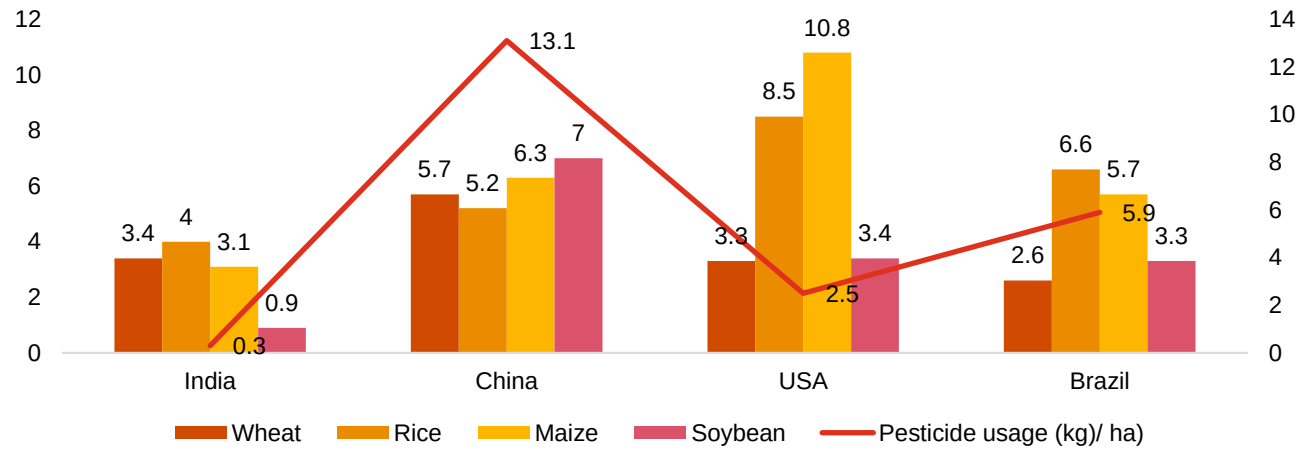
7. **Pesticide inspector:** For certain areas, the Central and state governments may appoint pesticide inspectors. The major duties of an inspector involve searching premises or a vehicle for compliance, documents or stock related to pesticides, sending samples of pesticides for test and analysis, and prohibiting the sale, distribution and usage of pesticides under certain conditions.

8. **Offences:** Manufacturing, importing, distributing, selling, exhibiting for sale, transporting, storing or undertaking pest control operations without a licence or certificate is punishable with imprisonment of up to three years, or a fine of up to INR 40 lakh, or both.

3.2. Policy recommendations to address the existing gaps in the agrochemicals sector

India lags behind countries like China, the US, Japan and Brazil in terms of the number of active ingredients registered and per ha usage of pesticides. Also, a correlation can be seen between these two parameters and the yield of major crops in these countries. Although it is understood that yield may not necessarily be due to these two parameters, it has been also established in previous sections that agrochemicals play a significant role in improving crop yields. The figure below illustrates the correlation between pesticide usage and crop yields in India, the US, China and Brazil.

Productivity of major food crops (MT/ha) and pesticide usage (kg/ha) in India, China, the US and Brazil



Source: Food and Agriculture Organization Corporate Statistical Database (FAOSTAT)

Also, while only 306[48] active ingredients are registered in India, China has over 700,[49] Japan has around 527[50] and the European Union (EU) has around 480[51] active ingredients registered, for both usage and exports. Thus, not only do these countries have access to many more products but they are also using them in sufficient quantities to achieve higher yields.

It is also understood that the current policy landscape governing the Indian agrochemicals industry is mainly focused on the registration process, licensing for manufacturing, storage and sale of pesticides, and protecting the farmers from any illicit practices. It should also be understood that these laws were created and legislated 50–60 years ago and pertain to the needs of those times, with amendments made as and when required.

The important role that the agrochemicals industry plays in Indian agriculture and the overall economy has been discussed in the previous sections. The growth and performance of the domestic agrochemicals industry is interlinked with the output of the agriculture sector, since farmers may only be able to invest in agrochemicals if the returns are good. Also, export of agrochemicals plays an important role in improving India's economic performance and shaping its position as an agrochemical and agricultural global powerhouse. Thus, it is of immense importance to transition towards domestically manufactured agrochemicals in order to reduce dependence on imports and vulnerability to disruptions in global supply chains. Achieving these goals can complement the Government's aim in the areas of Make in India and Aatmanirbhar Bharat.

[48] http://ppqs.gov.in/statistical-database
[49] https://news.agropages.com/News/NewsDetail---33834.htm
[50] www.famic.go.jp/english/
[51] https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=homepage&language=EN

To achieve the above objectives, the policy landscape must be conducive to the agrochemicals industry and the larger agriculture sector, enabling them to grow and flourish. Specifically, policy interventions are needed in four major areas: (i) improvement of farming extension services and promoting usage of scientifically recommended yield improvement practices, (ii) changes in the current regulatory and policy landscape of the agrochemicals sector, (iii) promotion of technology and mechanisation in agriculture, and (iv) improving the agricultural marketing ecosystem to improve the farming income of farmers.

Easing the registration process for new molecules, promoting domestic manufacturing, promoting exports, promoting technology and mechanisation, and improving the performance of public agricultural extension are some measures that will help. Sustainability also needs to be given high priority, as lack of responsible agrochemical manufacturing and usage practices by the industry and farmers can have serious negative impacts on the environment, health and safety.

The following are the key recommendations in the four thematic areas for policy interventions, especially in the context of improving the output of the agricultural sector, improving the income of farmers and boosting the growth of the Indian agrochemicals industry:

1. Improvement of the farming extension system

1. A Centre-designed and state-led strategic roadmap is needed for revamping the extension system in India. This should include a need-gap analysis, identification of areas of opportunity and improvement, and designing of interventions that can address these gaps. The challenges of the current extension system were highlighted as early as the Union Budget speech of 2007–08 by P. Chidambaram, the then Union Minister of Finance.[52] It was also stated that the Ministry of Agriculture, in consultation with state governments, will work towards replicating the training and visit (T&V) programme which played a key role during the Green Revolution in the 1960s .

2. Collaboration with private and development sector players (agri-input companies, AgriTech players, NGOs, etc.) is required to carry out specific metric-bound tasks such as promoting new methods and practices in farming (direct seeded rice, mulching/composting stubble, etc.), imparting training on yield improvement methods (integrated pest management [IPM], integrated nutrient management [INM], recommended package of practices) and promoting sustainability and equity (responsible farming practices, empowering women farmers, etc.).

3. Currently, the extension system relies on the Krishi Vigyan Kendra (KVK) network across the country to conduct extension activities through Agricultural Extension Officers. In order to improve the reach of extension services, a train-the-trainer approach may also be adopted wherein progressive farmers may be extensively trained with scientific methods of farming on their farms. This will not only create a pool of trained farmers but also help in demonstrating the techniques, methods and products being promoted on the field.

2. Changes in the current regulatory framework

1. In order to improve the options available to farmers and bring in the newest and most effective products into India, the registration procedure needs to be evaluated from the point of view of speed while ensuring sustainability and safety. Currently, the average time for pre-application processes (obtaining permission to import, obtaining data on shelf life and bio-efficacy) can take around three–four years. Also, even though the Insecticide Act, 1968, mentions that the registration process after submission of an application should take a maximum of 18 months (section 9, clause 3), the usual time period taken, as reported by the industry, can range from anywhere between three–five years. Even after this process, an application may get rejected. It is suggested that in case of delays of more than two years, the RC provide a provisional registration to a new product, subject to renewal every year until the application is either rejected or approved. This, however, should take into account factors such as safety ratings, studies and data on bio-efficacy and shelf life, and impact on target pests in countries like the US, China and Brazil., The entire process starting from data generation for new molecules, application and registration can cost around INR 30–40 crore over a period of five–ten years. Even after registration, companies need to invest a significant amount to promote the product to farmers through advertisements, demonstrations and on-farm meetings. This can effectively rule out smaller players in the industry from introducing new products.

[52] https://www.indiabudget.gov.in/budget_archive/ub2007-08/bs/speecha.htm

2. The Government may consider reviewing the quality control and sampling process of agrochemicals in order to enable ease of doing business for genuine players in the industry. While sampling and quality testing are important, the results of sample analysis done by private labs should also be considered, in order to encourage results from multiple sources. It is well known that similar to the pharmaceutical industry, counterfeit and low-quality pesticides are a major problem faced by the industry. Not only does this lead to revenue loss for reliable companies, but it also poses a risk to farmers and the environment since low-quality or illegal products can be channelised in this manner. Similar to the fertilisers industry, the Government can introduce mechanisms to track and monitor the movement and sale of agrochemicals through different media (e.g. QR codes, point-of-sale systems and mobile applications).

3. In order to boost local manufacturing, subsidies and production-linked incentives (PLI) based methods may be used, especially to promote manufacturing of technical-grade pesticides and export-oriented pesticides. Also, the Government may issue licences to interested players to manufacture export-oriented products, regardless of the status of registration of such molecules in India. A study may be conducted to identify the most imported pesticides that may garner immediate interest from importing countries This may help make India a global agrochemical manufacturing hub while improving the competitiveness and self-sufficiency of the domestic market.

4. The proposed PMB, 2020, is an extension of the existing regulations, in that it also focuses on the regulation of registration, manufacturing, sale and quality of pesticides while protecting farmers from harm caused by illicit practices. While this is important, there are also high penalties and legal consequences for those breaking the law. Therefore, multiple safeguards such as using digital technology to ensure traceability, introducing transparency in the quality testing process, involving private laboratories and introducing anonymity in sample testing may be implemented to prevent the motivation of the private sector to innovate and invest from being impacted. Also, while penalisation is important to curb illicit practices, it may discourage genuine industry players from entering into or expanding in the Indian market. While strict penalties may be made applicable for offenders selling banned or unregistered products, policymakers may also consider penalising in a slab-based manner based on the result of quality testing. For example, lower penalties may be considered for samples that are found containing 95–99% of the minimum content of the active ingredient.

5. PMB, 2020, is also silent on areas such as improvement of the R&D ecosystem, including infrastructure, funding and motivation for investment in R&D for agrochemicals. The Government may encourage public-private partnership (PPP) based R&D initiatives in which private sector players, research organisations and agricultural institutions may participate to jointly work towards developing better products. The development of new products can cost up to INR 2,000 crore over a period of 10–12 years. The recent consolidations in the global agrochemicals industry would have created synergies in the area of R&D for global players. Also, Europe, Japan and the US currently lead in R&D in agrochemicals. Thus, there is a need for the Indian agrochemicals industry and the Government to take up further research and new product development in order to be more competent on the global level.

3. Technology and mechanisation

1. Agrochemical application across India is largely non-mechanised, with a majority of pesticide application being done through knapsack, battery-operated or power sprayers, requiring a large amount of agricultural labour. This not only makes the process costly and slow, but also results in application becoming non-uniform and largely inefficient, where a significant volume of the agrochemicals solution sprayed is lost as runoff to the soil, wind or water bodies.[53] Use of machinery such as tractor-mounted or self-propelled boom sprayers and drones can result in much higher application efficiency in less time, making the process relatively cost-effective and sustainable.

2. Digital technology aided precision farming methods along with mechanised application can further enhance cost-effectiveness and efficiency through targeted application only at the areas needing it. Digital technology is already gaining adoption in the areas of pest/disease identification and alerts, product recommendation, e-commerce, and weather and market-related advisory, and can be furthered through extension and promotional campaigns.

[53] https://www.sciencedaily.com/releases/2018/08/180828114737.htm

3. With the release of the standard operating procedure (SOP) for drone-based spraying of agrochemicals and plant nutrients, there is a vast opportunity for AgriTech and agrochemical organisations to explore this service. Although drone-based spraying may not be suited for all crops and geographies in terms of cost vs. returns, it can have specialised applications in case of high-value crops, orchards, crops planted on undulating or hilly terrain, etc. Drones also provide an opportunity for imaging of crops to identify areas of high pest/disease infestation and carry out targeted application of agrochemicals. The Government and the private sector can work toward identifying, training and grooming social entrepreneurs in this space in order to promote this technology.

4. Improving the agricultural marketing ecosystem

1. The Government has been taking steps to improve the agricultural marketing ecosystem in order to improve the performance of agricultural value chains and farmer income. Initiatives such as National Agriculture Market (e-NAM) and the recent hikes in the minimum support price (MSP) of multiple crops safeguard farmers from market risks to some extent.

2. Investments and initiatives in the areas of FPO/FPC promotion and One District One Product (ODOP) can provide farmers with economies of scale to operate and improve their bargaining power while purchasing inputs and selling farm output. The Government may invite private sector players and NGOs to take stewardship of these activities at state/regional levels in order to ensure speedy progress and create the desired value.

3. Investment by the Government towards export-oriented agriculture can provide the benefit of export revenues to exporters and higher incomes to participating farmers. Initiatives aimed at limiting pesticide residues, promoting organic farming and ensuring traceability can help provide transparency and assurance to exporters and importers.

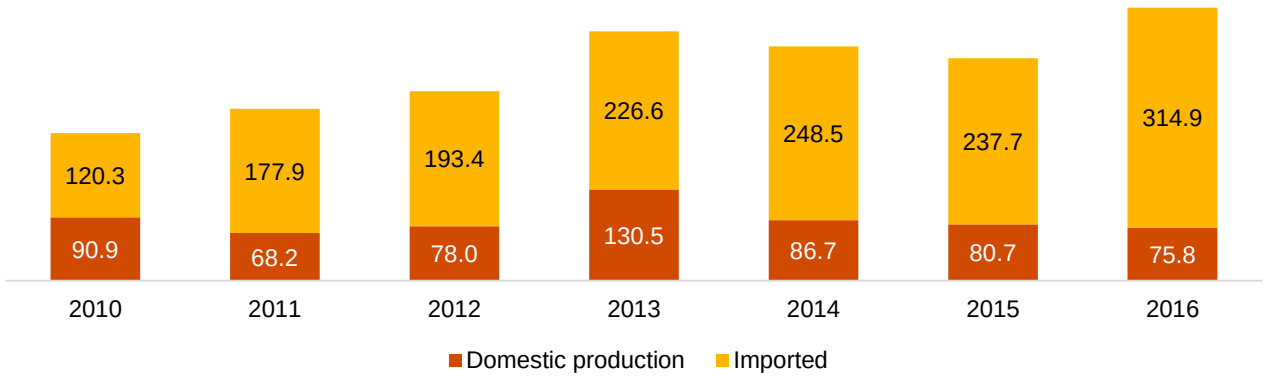
4. Indian agriculture faces high levels of wastage, especially in the case of horticultural crops. Improvements in the areas of storage, warehousing, cold chains, terminal markets and food processing facilities can help in tackling this issue while increasing the contribution of the agricultural and food processing sectors to the GVA.

4. Case study: Policy-led growth of Brazil's agrochemicals sector

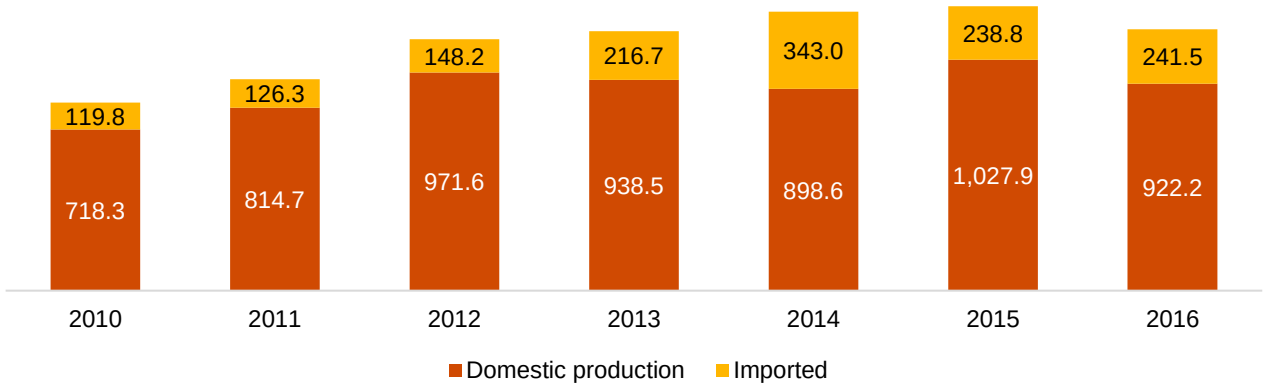
Case study: Policy-led growth of Brazil's agrochemicals sector

The agriculture sector in Brazil relies heavily on chemical inputs such as fertilisers, agrochemicals and pesticides for crop production. Brazil imports more than 80%[54] of its pesticide requirements (technical grade for manufacturing formulations) and the rate of pesticide application in Brazil is higher[55] than that of the US. Brazil emerged as the largest pesticide consumer in the world in the year 2008.

Technical material: Production and imports (in thousand tonnes)



Formulation: Production and imports (in thousand tonnes)



Source: Report on the coordinated audit on the preparedness of the Federal Government's Implementation of Sustainable Development Goals - National Phase, 2017

[54] Report on the coordinated audit on the preparedness of the Federal Government's Implementation of Sustainable Development Goals - National Phase, 2017

[55] https://www.worldometers.info/food-agriculture/pesticides-by-country/

Brazil's agrochemicals sector is valued at around USD 10 billion.[56] A majority of the inputs used for pesticide preparation in Brazil are imported. The share of imported technical material increased from 57% to around 80% in the period between 2010 and 2016. This clearly indicates Brazil's heavy dependence on foreign manufacturers of technical materials. In fact, Brazil is the world's largest importer of agrochemicals, with imports worth USD 3.73 billion in 2020.[57] Pesticides were the third most imported product in the country in that year. Brazil also has a developing domestic pesticide manufacturing industry which is comparatively small compared to its import market at present. The country exported pesticides worth USD 335 million in 2020 and was the twenty-third largest exporter of pesticides in the world. The increased usage of pesticides in Brazil is often linked with the production and export of agriculture commodities, mainly crops such as soybean and maize. Between 2000 to 2016, the value of foodgrain production in Brazil increased from USD 6.5 billion to USD 54.8 billion. Soybean and corn together accounted for produce worth USD 4.6 billion and USD 44.9 billion in the year 2000 and 2016 respectively. This period also saw a steep rise in the consumption of pesticides in the country as the sale of active ingredients increased from 162,461 tonnes in 2000 to 541,860 tonnes in 2016.[58]

The increase in pesticide consumption in Brazil coincided with the modernisation of agriculture in the country in the 1950s–70s. This was followed by the Green Revolution, which drove the use of chemical pesticides, fertilisers, biological inputs and machinery. Backed by direct financial support, tax exemptions and new rural credit facilities, there was a steep rise in pesticide consumption. In 1989, Brazil enacted Law 7802 (Pesticide Law) which laid out the principles for pesticide evaluation and registration standards. Law 7802/1989 has now been in force for over 30 years, focusing on solving issues related to the intensive use of agricultural inputs to boost production and addressing concerns around human health and environmental impact. The Brazilian Institute for the Environment and Natural Resources (IBAMA), which is part of the Ministry of Environment (MMA), is one of the key government agencies regulating activities that affect the environment and approval of agricultural chemicals (pesticides and herbicides). The authority shares this function with the Ministry of Health, which studies the toxicology aspects of agricultural chemicals and pesticides, and the Ministry of Agriculture, Livestock and Food Supply, which acts as the registration authority for pesticides.

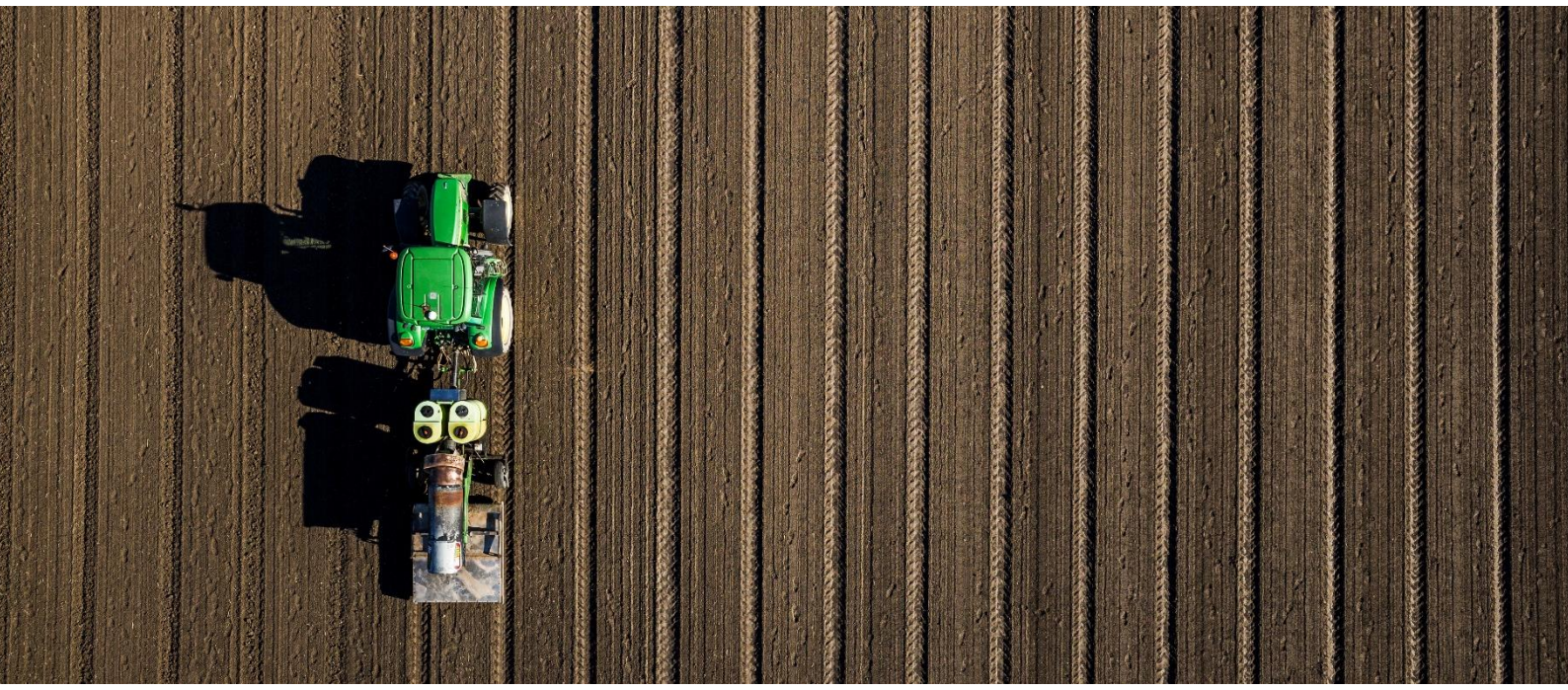
The pesticide industry is flourishing in Brazil due to favourable economic conditions and regulations such as large government subsidies offered on pesticides, low taxation on pesticide manufacturing companies and low costs for national registration of active chemical ingredients. Brazil is also streamlining the assessment process for agrochemicals by reducing bureaucracy, and offering implicit subsidies for pesticides and fertilisers, exemption from some federal and state taxes and subsidised loans. These initiatives have provided a significant boost to the country's agrochemical sector.

The table below summarises the key government grants and tax reliefs for the importation, production and sale of pesticides:[59]

Tax	Measures	Key highlights
Tax on Importation (II)	Relief or reduction of importation taxes and other provisions	The Brazilian importation tax rate is zero for several technical-grade pesticides.
	Regulation and management of customs activities and the supervision, control and taxation of foreign trade operations	

[56] Report on the coordinated audit on the preparedness of the Federal Government's Implementation of Sustainable Development Goals - National Phase, 2017
[57] https://oec.world/en/profile/bilateral-product/pesticides/reporter/bra
[58] Brazilian Institute of the Environment and Renewable Natural Resources
[59] Report on the coordinated audit on the preparedness of the Federal Government's Implementation of Sustainable Development Goals - National Phase, 2017

Tax	Measures	Key highlights
	Responsible for changes to the MERCOSUR Common Nomenclature (MCN). It also establishes the importation tax rates for the Common External Tariff (TEC) and prepares the list of Exceptions to the TEC.	
Tax on Industrialised Products (TIPI)	Relief or reduction of importation taxes and other provisions	For a majority of pesticides, the IPI rate is 0%.
	Approval of the Incidence Table for the TIPI.	
Tax relief for Contribution for Social Security Financing (COFINS) and the Program of Social Integration and Civil Servant Fund (PIS/PASEP)	Reduction to zero of the rates of contribution to PIS/PASEP and COFINS on the importation and sale of composts, fertilisers, agricultural products and other products in the domestic market	The rates for COFINS and contribution to PIS/PASEP applied for importation, the domestic fertiliser market and agricultural defence products is 0%.
	Reduction of the rates of PIS/PASEP and COFINS on the importation and commercialisation of the domestic market of fertilisers and agricultural defence products and other measures	
State Value Added Tax (ICMS)	Reduction to 60% of the ICMS tax base on inter-state sales of pesticides	



Conclusion

Agriculture continues to play a significant role in the Indian economy, both in terms of its contribution as well as being the largest source of livelihood for the country's population. The sector thrives due to large participation, rich natural resources and diversity of agroclimatic zones and soils, and vast arable land under cultivation. The Government has also played a very critical role in improving the sector's performance by prioritising it for policy initiatives and investments. Although the sector is growing consistently, it has not achieved its full potential, especially in terms of productivity per ha. The productivity data from leading producers like China, the US and Brazil reveal that there is a vast scope of improvement in agricultural productivity and overall production.

The agri input industry plays an important role in improving the productivity of crops. The role of agrochemicals in the industry's growth is well appreciated by farmers as well as the Government. However, the Indian agrochemicals industry can achieve many milestones in terms of growth and global leadership.

Major issues directly related to the agrochemicals industry need to be addressed, especially in the areas of simplifying registration, improving production and encouraging exports. Improvement in indirect areas such as farming extension services, technology and mechanisation in agriculture, and agricultural marketing ecosystem will lead to the rapid growth of farmer income and agricultural output, both of which will indirectly complement the growth of the agrochemicals industry. With the required prioritisation, policy and investment support, we can pave the way towards developing a flourishing agrochemicals industry in India.

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Notes

We hope to see you again

at the 12th edition of the Agrochemicals Conference on

18 July 2023

at the Hotel Taj Palace, New Delhi.

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