

# Independent Market Report For Indian Agriculture Value Chain

**Final Report: November 2024**

Frost & Sullivan Report

---

## Contents

1. Global & India Macro-Economic Outlook .....	6
1.1. Real GDP Growth and Forecasts: Global and Key Regions .....	6
2. Overview of the Agricultural Sector in India .....	9
2.1. Review of Indian Agri and Global Benchmarking.....	9
2.2.1 Historic review of land area under cultivation in India .....	11
2.2.2 Historic growth in land area for food grain crops in India.....	11
2.2.3. Historic review of crop production in India .....	13
2.3 Review of Crop Yields in India .....	16
2.4 Qualitative Overview of the Agriculture value chain in India .....	19
2.5 Challenges in the Agriculture Value Chain In India .....	24
2.6 Expanding key pain points undergoing positive transformation.....	24
2.7 Key Government Initiatives and Subsidies favoring sectorial growth .....	25
3. Agricultural Warehousing Market in India – An Overview.....	29
3.1.1 Capacity Distribution among Market Entities .....	31
3.1.2 Agricultural Warehousing Market in India: Structure: Organized vs Unorganized .....	31
3.1.3 Private Sector: Organized vs Unorganized .....	33
3.2 Agricultural Warehousing Market in India – Current and Future Opportunities.....	34
3.2.1 Agricultural Warehousing Market – India Market Size .....	34
3.3 Entities involved in warehousing and interlinkages between them .....	35
3.3.1 Farmers .....	35
3.3.2 Traders and Procurement Agents.....	36
3.3.3 Warehouse Owner and Operator.....	36
3.3.4 Agricultural Commodity Custodians (Collateral Management) Agencies .....	36
3.3.5 Ancillary Service Agencies.....	37
3.4 Agriculture Warehouse Market in India: Demand -Supply Landscape .....	38
3.5 Storage by Dry Commodity .....	40
3.6 Cold Storage Infrastructure in India .....	43
4. Agriculture Financing in agriculture commodities and collateral management in India .....	46
4.1 Overview of financing to the agriculture sector (pre-harvest to post-harvest).....	46
4.2 Overview of RBI’s role in financing the agriculture sector.....	49
4.2.1 Overview of Priority Sector Lending (PSL) guidelines .....	51
4.2.2 What Happens When PSL Targets Are Not Met? .....	53

4.2.3 Merits and De-merits of the role of the current PSL mechanism .....	54
4.3.4 Qualitative overview of the role of players other than banks .....	54
4.3 Overview and Typical high-level Process flow and technology interventions for Agricultural Commodity Custody based financing (Collateral Management) .....	55
4.4 Overview of the different types of stakeholders/players currently involved in the value chain .....	57
5 Review and Outlook of the Indian Tech Enabled Integrated Agricultural Services market in India.....	60
5.1 Market Overview and Structure.....	60
5.2 Current Tech Enabled Integrated Agricultural Services Business Models.....	61
5.2.1 Enhanced Warehousing Solutions.....	61
5.2.2 Integrated Financial Services .....	61
5.2.3 Standardization and Quality Assurance .....	62
5.2.4 Reducing wastage through Supply Chain Innovations: .....	62
5.2.5 Expanding Market Linkage with digital integrations: .....	62
5.3 Future Outlook of Tech Enabled Integrated Agricultural Services In India .....	73
5.4 Why the Time for AgriTech is Now .....	74
6. Competitive Benchmarking.....	87
Operational Benchmarking .....	87
Revenue of Major Competitors, ₹ Million.....	92
PAT/Net Income, ₹ Million .....	93
EBITDA, ₹ Million.....	94
EBITDA Margin, % .....	95
Total Equity, ₹ Million.....	96
Equity Ratio .....	97
Total Debt, ₹ Million.....	98
Debt Ratio .....	99
Debt Equity Ratio .....	100

## Disclaimer

The market research process for this study has been undertaken through secondary / desktop research as well as primary research, which involves discussing the status of the market with leading participants and experts. The research methodology used is the Expert Opinion Methodology. Quantitative market information was sourced from interviews by way of primary research as well as from trusted portals, and therefore, the information is subject to fluctuations due to possible changes in the business and market climate. Frost & Sullivan's estimates and assumptions are based on varying levels of quantitative and qualitative analyses, including industry journals, company reports and information in the public domain.

Forecasts, estimates, predictions, and other forward-looking statements contained in this report are inherently uncertain because of changes in the factors underlying their assumptions, or events or combinations of events that cannot be reasonably foreseen. Actual results and future events could differ materially from such forecasts, estimates, predictions, or such statements.

This study has been prepared for inclusion in the draft red herring prospectus, red herring prospectus, and the prospectus of “**Independent Market Report for Indian Agri Value Chain**” in relation to an initial public offering in connection with its listing on the Indian stock exchange.

This report and extracts thereof are for use in the draft red herring prospectus, red herring prospectus, and the prospectus issued by the company and all the presentation materials (including press releases) prepared by or on behalf of the company (and reviewed by Frost & Sullivan) in relation to the listing exercise. The company is permitted to use the same for internal and external communications as needed in the context of the Listing exercise. However, no part of the report may be distributed for any other commercial gain to parties not connected with the said Listing exercise.

This report has been exclusively prepared for the consumption of “**Independent Market Report for Indian Agri Value Chain**”, and any unauthorized access to or usage of this material by other is forbidden and illegal.

Frost & Sullivan has prepared this study in an independent and objective manner, and it has taken adequate care to ensure its accuracy and completeness. We believe that this study presents a true and fair view of the Indian Agriculture Commodity Warehousing, Collateral management & Other Allied Services, Agri based NBFCs, Agtech industry and Agri Input-Output marketplace within the limitations of, among other, secondary statistics and primary research, and it does not purport to be exhaustive. Our research has been conducted with an "overall industry" perspective, and it will not necessarily reflect the performance of individual companies in the industry. Frost & Sullivan shall not be liable for any loss suffered because of reliance on the information contained in this study. This study should also not be considered as a recommendation to buy or not to buy the shares of any company or companies as mentioned in it or otherwise.”

## **Abbreviations**

CWC- Central Warehousing Corporation

FCI – Food Corporation of India

SWC – State Warehousing Corporation

MT- Metric Ton

MMT- Million Metric Ton – Million Tons

ICAR- Indian Council of Agricultural Research

SBI- State Bank of India

FY- Financial Year

CY- Calendar Year

WDRA- Warehousing Development and Regulatory Authority

MoAFW- Ministry of Agriculture and Farmers Welfare

NABARD – National Bank for Agriculture and Rural Development

NWR- Negotiable Warehouse Receipt

E-NWR – Electronic Negotiable Warehouse Receipt

PSL – Priority Sector Lending

PMKSY - Pradhan Mantri Krishi Sinchayee Yojana

PMFBY - Pradhan Mantri Fasal Bima Yojana

E-NAM – Electronic National Agriculture Market

CM – Collateral Management

CMA – Collateral Management Agencies

FPO- Farmer Producer Organization

ARDC - Agricultural Refinance and Development Corporation

RBI – Reserve Bank of India

NBFC - Non-Banking Financial Company

RRB – Regional Rural Bank

StCB – State Co-Operative Bank

IoT- Internet of Things

KCC- Kisan Credit Card

# 1. Global & India Macro-Economic Outlook

## 1.1. Real GDP Growth and Forecasts: Global and Key Regions

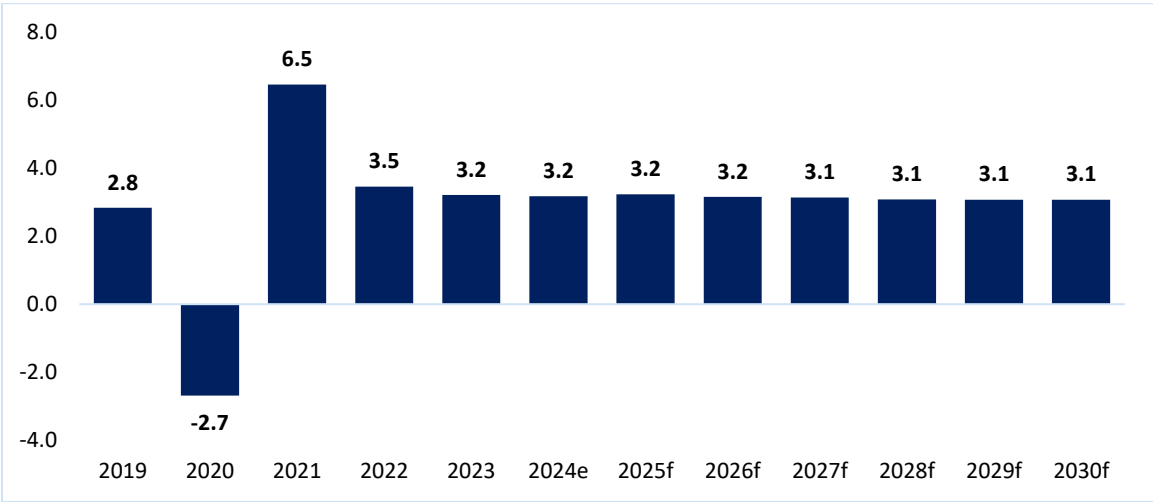
The global economy recorded a sharp deceleration to 3.5% in 2022 following a robust 6.5% post-COVID-19 pandemic growth rebound in 2021, as the Russo-Ukrainian war and the resultant supply disruptions led to a cost-of-living crisis across the world. However, H2 2023 saw an uptick on the back of global central banks' easy monetary policy stance as inflation rates gradually converged with targets.

In 2024, the global economy has demonstrated resilience, managing a stable yet moderate growth rate of 3.2%, reflecting both strengths and vulnerabilities across different regions. Advanced economies like the U.S. have shown some slowdown, offset by recovery trends in the Eurozone and buoyant growth in emerging markets driven by technological investments, notably in Asia. Despite ongoing challenges such as services inflation and geopolitical tensions, there's a cautious optimism due to easing inflation and shifts towards looser monetary policies. However, vulnerabilities such as high public debt, persistent geo-political volatility, trade fragmentation and rising fiscal challenges continue to weigh on outlook and remain concerns that could influence economic stability moving forward.

The global economy is expected to grow at an average of 3.1% over 2025-2030 (Exhibit 1), with momentum tilted towards emerging and developing economies. Tailwinds such as robust consumer demand, the presence of manufacturing economies-of-scale, competitive labor costs, and monetary policy prudence will benefit emerging markets over the medium to long-term. On the other hand, advanced economies will record a modest acceleration in economic growth over the forecast period. Downside risks such as a rapidly aging population, high debt levels, and continued weakness in property markets will weigh.

Further, extreme climate events and environmental challenges will have a significant impact on long-term global economic growth.

Exhibit 1: Real GDP Growth (%), Global, 2019-2030f



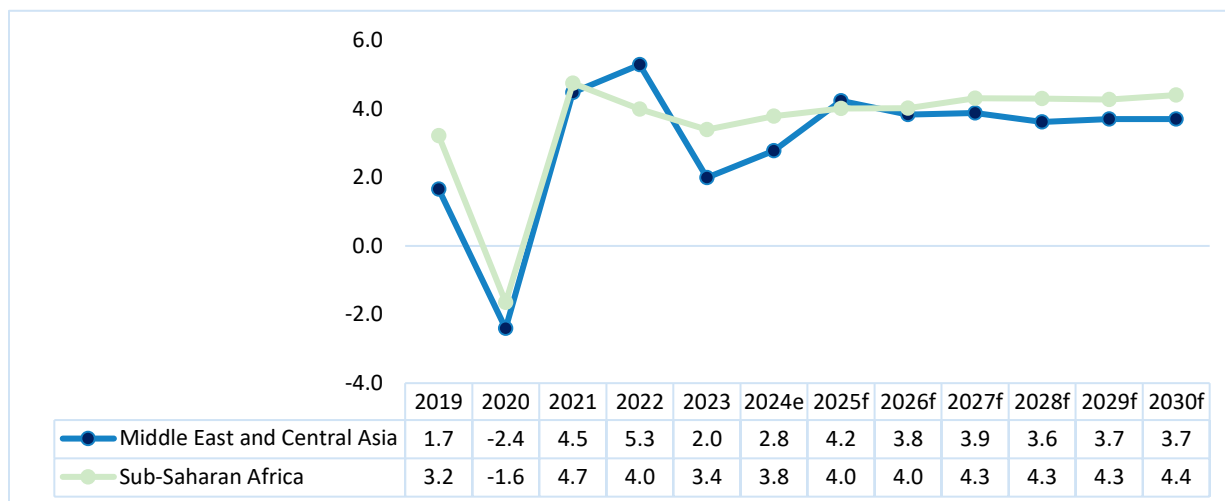
Note: e: estimate, f: forecast;

Source: International Monetary Fund: World Economic Outlook, April 2024, Frost & Sullivan

Following 5.3% economic growth in 2022, the Middle East and Central Asia economy recorded a steep drop to 2.0% in 2023 (Exhibit 2). Momentum was curtailed by upheavals due to the Israel-Hamas war and a slowdown in the regional oil sector (with the OPEC+ extending a cut of 1.65 million barrels per day, announced in April 2023, until the end of 2025). While growth will pick up slight pace in 2024, concerns of a regional spillover of the conflict, trade disruptions, and reduced oil production will impact near-term prospects. The Middle East and Central Asia economy will grow by ~3.8% between 2025-2030. Growing emphasis on economic diversification and strengthening the region’s non-oil economy will underpin economic activity.

On the other hand, the Sub-Saharan Africa region is expected to grow by 3.8% in 2024 and 4.0% in 2025 (Exhibit 2), as stabilizing public-debt ratios, falling inflation, and improving fiscal deficits will contribute towards positive macro-economic performance. Over the long-term, presence of a huge demographic dividend and abundant natural resources will support growth. However, challenges such as rising geopolitical tensions, high vulnerability to climate shocks, and political instability will limit economic development. Through 2030, the Sub-Saharan African economy is expected to grow by 4.4%.

**Exhibit 2: Real GDP Growth (%), Middle East and Central Asia<sup>1</sup> & Sub-Saharan Africa<sup>2</sup>, 2019-2030f**



*Note: e: estimate, f: forecast; Source: International Monetary Fund: World Economic Outlook, April 2024, Frost & Sullivan*

Following a 7.83% real GDP growth in Financial (FY)2022-23 (Exhibit 3), India has emerged as a global economic bright spot. With India’s strong economic growth outlook until FY 2029-30 (average of ~6.5%), the country is poised to overtake Germany and Japan to become the 3rd largest economy by FY 2029-30 in terms of nominal GDP. Nominal GDP will surpass \$7 trillion by the end of the decade. A huge consumer market, growing middle class, competitive labor costs, and the government’s massive capital expenditure push are some of the key long-term growth drivers.

<sup>1</sup> Middle East and Central Asia consists of Algeria, Afghanistan, Azerbaijan, Bahrain, Iran, Iraq, Kazakhstan, Kuwait, Libya, Mauritania, Oman, Qatar, Saudi Arabia, Somalia, Sudan, Tajikistan, Turkmenistan, United Arab Emirates, and Yemen

<sup>2</sup> Sub-Saharan Africa consists of Angola, Benin, Botswana, Burkina Faso, Burundi, Chad, Central African Republic, Democratic Republic of the Congo, Equatorial Guinea, Eritrea, Ghana, Gabon, Guinea, Guinea-Bissau, Liberia, Malawi, Mali, Nigeria, Republic of Congo, Sierra Leone, South Africa, South Sudan, Zambia, Zimbabwe

**Exhibit 3: Real GDP Growth (%), India, FY19-FY30f**



*Note: e: estimate, f: forecast, India's GDP is represented in fiscal year. For e.g. FY19 is the 12-month period between 1 April 2018 and 31 March 2019;*

*Source: Ministry of Statistics and Programme Implementation (MOSPI) – India, Frost & Sullivan*

Agriculture's contribution to India's Gross Value Added (GVA) reflects the sector's foundational importance yet reveals challenges in growth and modernization. Although the sector supports a substantial workforce of around 50-55% of the economic livelihood and 40-43% of the population as of FY 24, its growth lags behind that of faster-moving sectors such as services and manufacturing. This disparity highlights a need for structural transformation to achieve productivity gains and reduce the economic dependency of a vast population on low-income agricultural activities.

Future aspirations are centred on achieving sustainable growth through modernization, digital integration, and infrastructure investment. Enhanced efficiency in resource use, climate resilience through sustainable practices, and diversification into high-value agriculture (e.g., horticulture, fisheries, and organic farming) are critical. Moreover, policy reforms—such as those focused on market access, income support, and minimum support pricing—are essential to attract investment and foster a stable, remunerative agricultural economy. Going forward, the integration of technology, policy support, and public-private collaboration could drive growth, increase resilience, and align the sector with India's broader economic goals of inclusivity and sustainability.



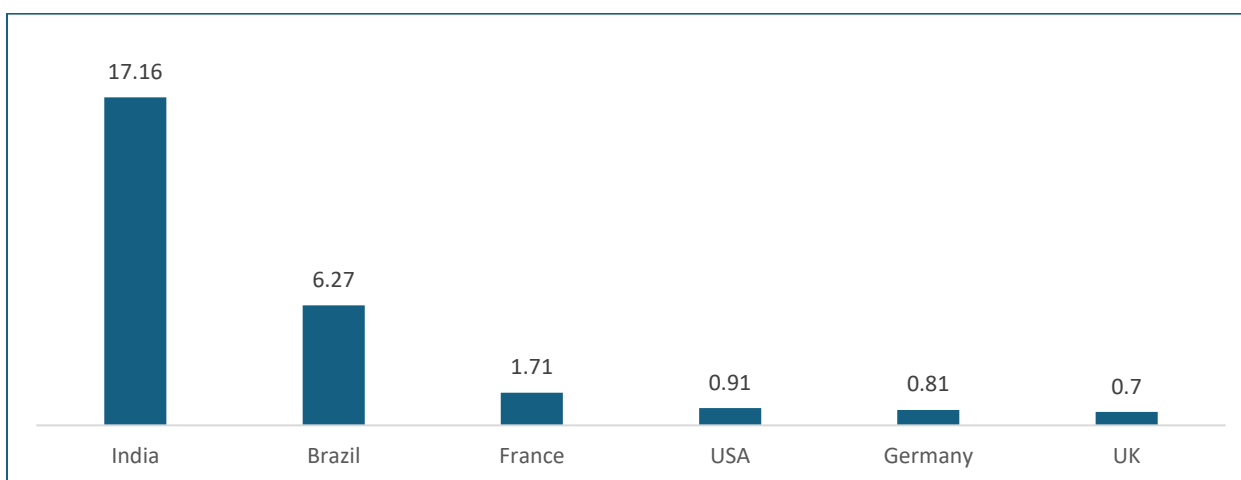
## 2. Overview of the Agricultural Sector in India

India's agricultural sector continues to evolve with significant strides in production and acreage, driven by a combination of technological advancements, government support, and strategic shifts in crop management. The FY 2023-24 marks a period of notable developments, with key crops showcasing resilience and growth despite global challenges. India's agricultural and allied sector has embarked on an impressive expansion journey, exhibiting an encouraging average annual growth rate of 4.18% from FY 2018-19 till FY 2023-24, reaching a size of ₹47,252.23 billion in FY 2023-24. The sector indicates a robust expected CAGR of nearly 6.92% between FY 2023-24 and FY 2028-29, poised to propel the market to an estimated size of ₹66,020.52 billion.

### 2.1. Review of Indian Agri and Global Benchmarking

Agriculture has historically been a cornerstone of economic activity worldwide, particularly in developing nations, where it serves as a primary source of income to 50-55% of the population, employment to 40-43% population, and food security for the nation. However, with increasing industrialization and the diversification of economies, the share of agriculture in GDP has steadily declined globally. This shift is most pronounced in developed nations, where mechanized and highly efficient agricultural systems have reduced the sector's relative contribution. In contrast, developing countries like India still rely heavily on agriculture, underscoring its socio-economic importance.

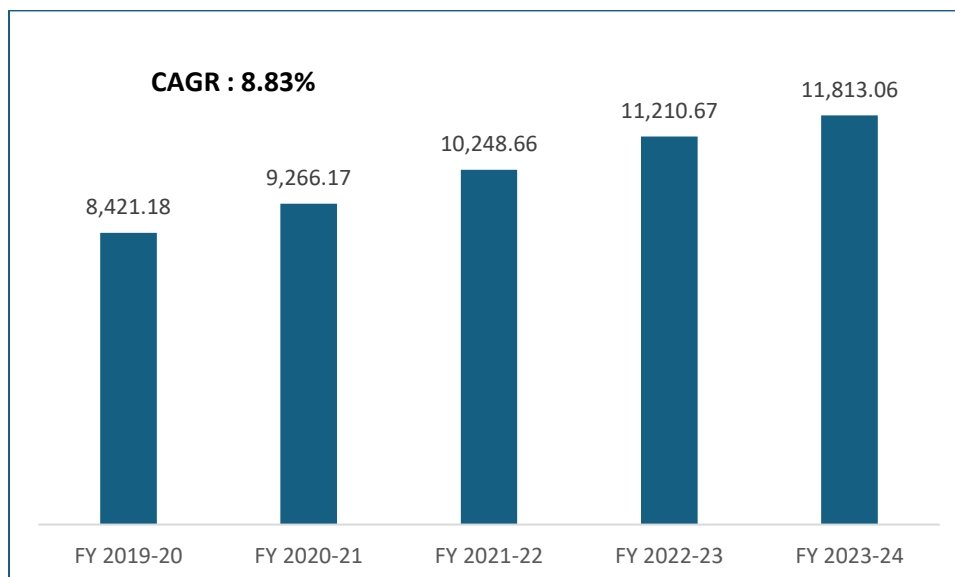
**Exhibit 4: Share of Agriculture, Forestry & Fishing in GDP (CY 2019 to 2023 aggregate) in %**



Source: FAOSTAT

India stands out globally with agriculture contributing an aggregated 17.16% to its GDP (average from CY 2019 till CY 2023), 18% in FY 2023-24, significantly higher than developed economies such as the USA (0.91%), Germany (0.81%), and the UK (0.7%). This disparity reflects India's heavy reliance on agriculture for employment and livelihoods. Despite contributing less to developed economies, their agriculture sectors are characterized by higher efficiency and advanced technologies. In contrast, India's agricultural productivity is constrained by fragmented landholdings, low mechanization, and limited infrastructure. These challenges highlight the need for structural reforms and modernization to improve productivity while reducing dependency on agriculture for economic stability.

**Exhibit 5: India's Agriculture and allied sector GVA at Current Prices, (₹ In Bn)**

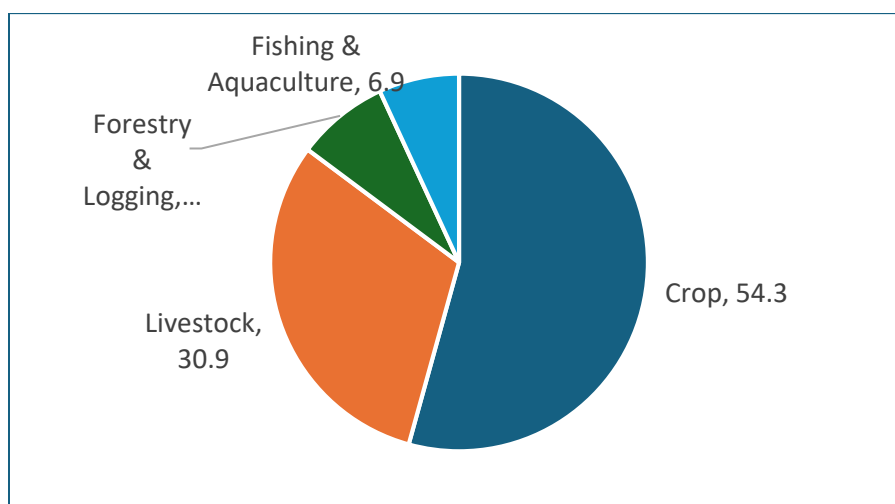


Source: Economic Survey 2023-24, MOSPI

The agriculture sector today confronts unprecedented challenges in the form of climate change, resource limitations, and escalating demands of a rapidly expanding population. This disparity highlights a need for structural transformation to achieve productivity gains and reduce the economic dependency of a vast population on low-income agricultural activities.

India's agriculture sector has demonstrated steady growth, as evidenced by the rise in Gross Value Added (GVA) from ₹8,421.18 billion in FY 2019-20 to ₹11,813.06 billion in FY 2023-24, reflecting a Compound Annual Growth Rate (CAGR) of 8.83%. This growth has been driven by favorable policy interventions, increased adoption of technology, and improved access to credit. However, the growth trajectory underscores the potential for further enhancements in productivity and sustainability, especially given India's significant reliance on rainfall and the impacts of climate change.

**Exhibit 6: India's Gross Value Output from Agriculture and Allied Sector- FY 2022-23 (in %)**



Source: Ministry of Agriculture and Animal Welfare 2023-24 Annual Report, PIB, \* FY 2023-24 was not released during the time of the research

The breakdown of agriculture's Gross Value Output from FY 2022-23\* reveals that crop production dominates the sector, accounting for 54.3% of total output. Livestock follows at 30.9%, while forestry and logging (7.9%) and fishing and aquaculture (6.9%) contribute smaller shares. This composition highlights the predominance of traditional cropping systems in India's agricultural economy. Expanding allied activities such as livestock, aquaculture, and forestry presents an opportunity for diversification, income stability, and resource optimization, particularly in rural areas. The balanced growth of all segments, supported by agritech interventions and value-chain integrations, is essential for achieving long-term sustainability and economic resilience.

To realize a robust agricultural sector, the inclusion of integrated agricultural services, government initiatives, and improved market linkages is vital. The AgriStack scheme, a digital backbone being developed by the government, aims to consolidate farmer data and provide services such as credit access, insurance, and precise input recommendations, thereby increasing productivity and income predictability. Agritech innovations—such as AI-driven crop management, drone-based crop monitoring, and precision farming tools—are expected to enhance yield efficiency and resource use, particularly in small and marginal farms.

Additionally, expanding warehousing capacity remains critical to minimizing post-harvest losses and stabilizing prices. Modernizing storage facilities and promoting public-private partnerships in warehousing can extend the shelf-life of produce and facilitate bulk handling for better market timing. Input and output market linkages are equally essential; strong upstream linkages ensure quality seeds, fertilizer, and other inputs reach farmers, while well-structured downstream linkages connect farmers directly to markets, reducing intermediaries and ensuring fair pricing. By aligning agritech, digital infrastructure, and effective market linkages, India can position agriculture as a more resilient, modernized sector capable of sustaining long-term growth and contributing more meaningfully to GVA.

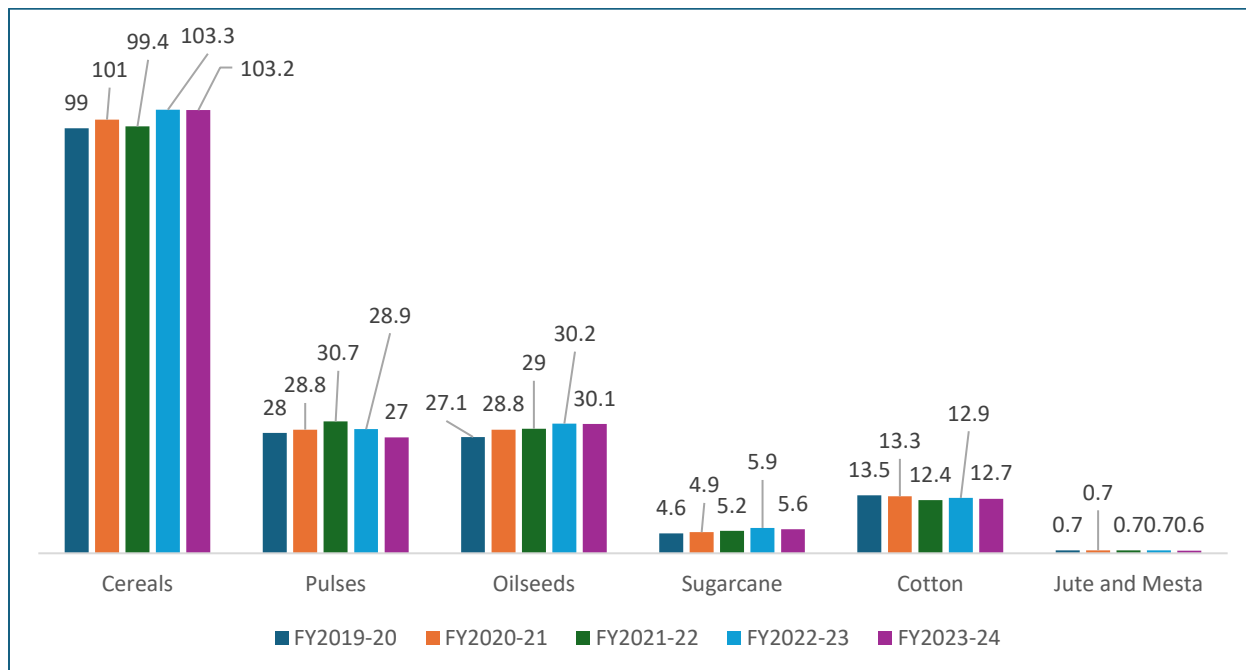
### **2.2.1 Historic review of land area under cultivation in India**

India's agricultural sector is witnessing a steady transformation driven by policies and innovations aimed at enhancing production, efficiency, and sustainability. Over the past decade, there has been significant growth in both food and non-food production, supported by a series of government schemes that target productivity and infrastructure improvements. The country's shift towards modern agricultural practices, alongside sustained policy support, ensures the sector's resilience amid challenges such as climate change and fluctuating market demands.

### **2.2.2 Historic growth in land area for food grain crops in India**

In FY 2023-24, the estimated area for production for major cereal foodgrains is 179.2 million hectares, with growth in land area dedicated to food grain crops in India highlighting the impact of targeted policy interventions, economic factors, and environmental challenges. Further, there has been consistent growth in agricultural production which has led to food security and has significantly reduced hunger and malnutrition.

**Exhibit 7: Historic Growth in Acreages for major crops (Million Hectares) (FY 2019-20 to FY 2023-24)**



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

### Cereals

Cereal acreages has consistently dominated India’s agricultural acreage, rising from 99 million hectares in FY 2019-20 to 103.2 million hectares in FY 2023-24, reflecting its critical role in ensuring food security. This growth is attributed to favorable monsoon conditions, increased irrigation coverage, and the adoption of high-yield varieties such as DRR Dhan 42 for rice and HD 3226 for wheat. Despite this steady growth, challenges such as water scarcity and soil degradation in high-production states like Punjab and Haryana emphasize the need for sustainable farming practices.

### Pulses

The acreages of pulses has demonstrated modest fluctuations, beginning at 28 million hectares in FY 2019-20 and declining slightly to 27 million hectares in FY 2023-24. This variability is largely due to erratic rainfall and lower acreage in key states such as Madhya Pradesh and Maharashtra during certain years. However, initiatives like the National Food Security Mission (NFSM) and the adoption of disease-resistant seed varieties have played a significant role in maintaining production levels. Pulses remain crucial for ensuring dietary protein security and reducing import dependency.

### Oilseeds

Oilseed acreages has shown remarkable growth, increasing from 27.1 million hectares in FY 2019-20 to 30.1 million hectares in FY 2023-24. This upward trend reflects the success of programs such as the National Mission on Edible Oils (NMEO), which has promoted high-yielding varieties and improved farming techniques. Groundnut and mustard cultivation have particularly benefited from better price incentives and market linkages, addressing India’s heavy reliance on edible oil imports.

## Sugarcane

Sugarcane acreages experienced a steady increase from 4.6 million hectares in FY 2019-20 to 5.6 million hectares in FY 2023-24, supported by irrigation development and crop diversification in states like Uttar Pradesh and Maharashtra. The growing demand for ethanol as part of the government's biofuel policy has also contributed to increased production. However, water-intensive sugarcane cultivation raises sustainability concerns, particularly in drought-prone regions.

## Cotton

Cotton acreages has remained relatively stable, starting at 13.5 million hectares in FY 2019-20 and reaching 12.7 million hectares in FY 2023-24. While advancements in genetically modified (Bt) cotton and pest-resistant strains have helped maintain productivity, climate volatility and pest outbreaks have posed challenges in major cotton-growing regions such as Gujarat and Telangana.

## Jute and Mesta

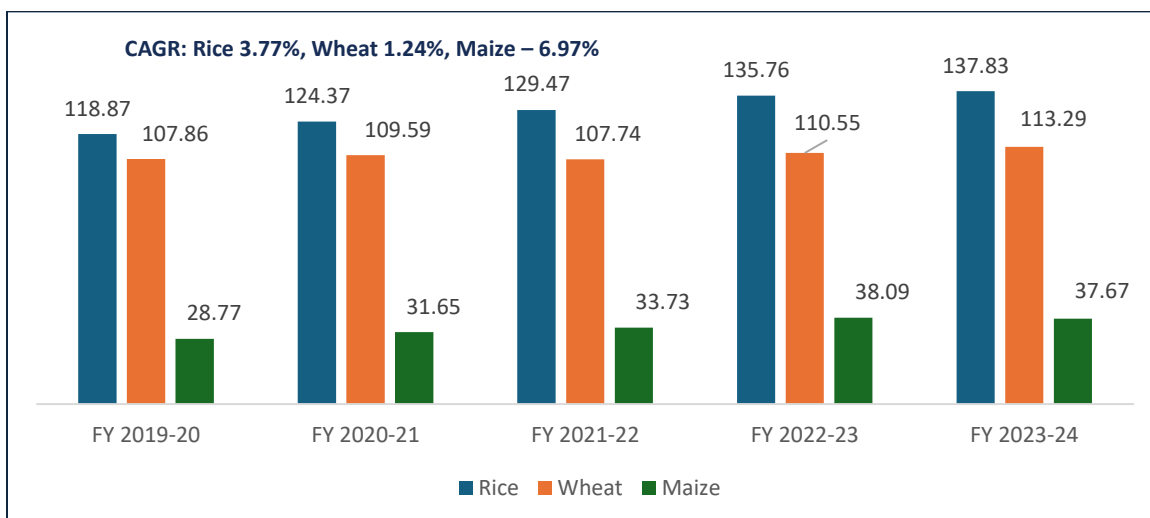
Jute and Mesta acreages have seen a slight decline, moving from 0.7 million hectares in FY 2019-20 to 0.6 million hectares in FY 2023-24. This reduction reflects declining global demand and competition from synthetic alternatives. Nonetheless, the government's promotion of eco-friendly products and initiatives to modernize jute processing could revive production in the future.

The consistent growth of cereals and oilseeds acreages reflects their critical importance to the economy, while the stability of pulses, sugarcane, and cotton production acreages demonstrates the impact of government interventions. Looking forward, sustainable practices, technological integration, and better market linkages and access to finance will be key to enhancing productivity and securing food and income stability for millions of farmers.

### **2.2.3. Historic review of crop production in India**

The growth of agricultural production has been closely tied to the development of agri-infrastructure and financing mechanisms. The Agriculture Infrastructure Fund (AIF), with a budget of ₹ 1,000 billion, has been pivotal in improving post-harvest management, particularly through the expansion of warehousing and cold storage facilities. This has reduced post-harvest losses and allowed farmers to store perishable goods for extended periods, thereby enhancing marketability and income. Furthermore, the introduction of Kisan Rail has improved the logistics of transporting perishable agricultural commodities across the country, ensuring timely delivery and minimizing spoilage.

**Exhibit 8: Historic Growth of Production of Rice, Wheat and Maize (Million tons) (FY 2019-20 to FY 2023-24)**



Source: Department of Agriculture and Farmers Welfare, Final Estimate

#### Rice:

Rice production in India has consistently remained robust, the fiscal year FY 2023- 24 according to Final Estimates by the Ministry of Agriculture and Farmer Welfare is 137.83 million tons. This represents a slight increase from the previous year’s production of 135.76 million tons, supported by favorable monsoon rains and the implementation of advanced irrigation techniques under the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY).

The government’s focus on improving rice productivity has led to significant investments in research and development. The introduction of climate-resilient rice varieties, such as IR-64 and Swarna Sub1, has resulted in yield improvements of 8-10% per hectare, particularly in flood-prone areas. These varieties have been specifically bred to withstand extreme weather conditions, ensuring stable yields even in adverse climates.

#### Wheat:

Wheat, a cornerstone of India’s agricultural economy, has shown remarkable growth production. For FY 2023-24, wheat production was 113.29 million tons and increase of 2.5% from previous year. This increase is driven by several factors, including favorable weather conditions during the Rabi season, widespread adoption of precision farming techniques, and the introduction of high-yield, climate-resilient wheat varieties.

Key wheat-producing states like Punjab, Haryana, and Uttar Pradesh have seen a 3-5% increase in acreage, supported by government policies that encourage efficient water use and soil health management. The introduction of precision farming techniques, such as laser land levelling and direct seeding, has further enhanced yield efficiency, with average yields improving by 2-5% per hectare.

The adoption of advanced seed varieties, such as HD-3226 and DBW-187, has played a crucial role in boosting wheat yields. These varieties are known for their high yield potential and resistance to common wheat diseases such as rust.

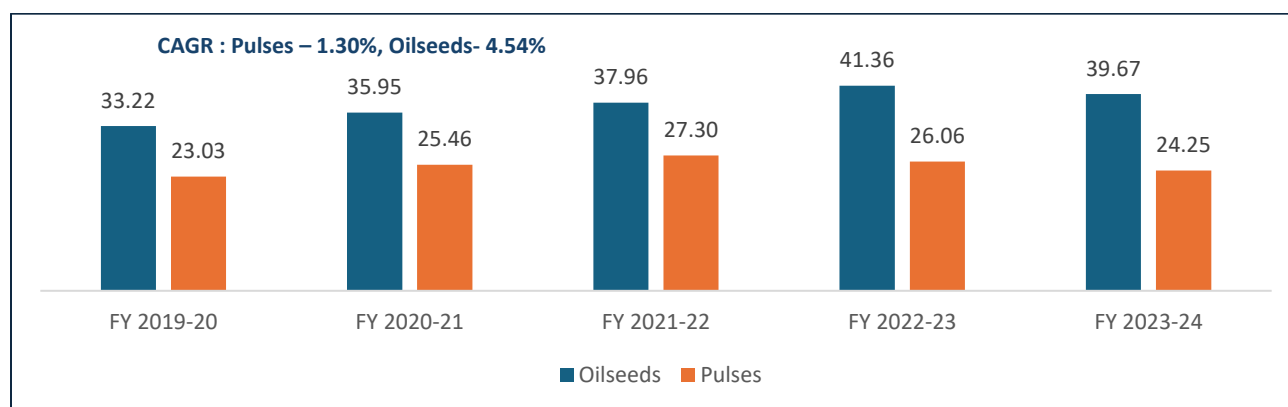
### Maize:

Maize production in India for FY 2023-24 is estimated at 37.67 million tons, marking a significant increase from 28.77 million tons in FY 2019-20. This remarkable surge is largely driven by the rising demand for maize in the animal feed and biofuel industries, both of which have seen exponential growth in recent year.

### Pulses & Oilseeds:

Pulses, essential for ensuring protein security in India, have witnessed substantial growth in both production and yield, supported by a strong emphasis on self-sufficiency and improved farming practices. The total production of pulses in FY 2023-24 was according to the final estimates 24.25 million tons, a decrease from 26.06 million tons in FY 2022-23. The decrease can be attributed to drought like situation in states such as Maharashtra and Rajasthan.

**Exhibit 9: Historic Trend of Production of Pulses & Oilseeds, Million Tons (FY 2019-20 to 2023-24)**



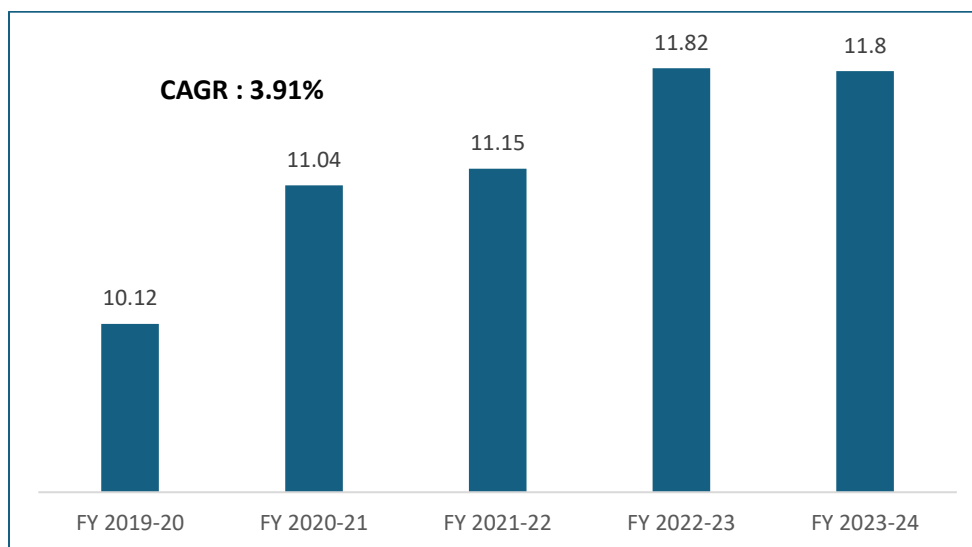
Source: Department of Agriculture and Farmers Welfare, Final Estimate

The introduction of high-yielding and disease-resistant seed varieties has been a game-changer for pulses production. Varieties such as Pusa Arhar-16, which is a hybrid pigeon pea, and IPFD 10-12, a high-yielding variety of green gram, have shown yield improvements of up to 15%. These varieties are not only more productive but also more resilient to common pests and diseases, reducing the need for chemical.

### Spices:

India continues to dominate the global spice market, with production in FY 2023-24 projected at 11.8 million tons growing at a CAGR of 3.91% from FY 2019-20. States like Kerala, Andhra Pradesh, and Gujarat have reported significant growth in spice cultivation, driven by both domestic and international demand.

**Exhibit 10: Historic Growth of Spice in India (Million Tons) (FY 2019-20 to-2023-24)**



*Source: Spice Board of India \* 2023-24 Final numbers not released during the time of the research- subject to revision*

The Spices Board of India, under the Ministry of Commerce, has implemented several initiatives to enhance spice production and quality. For instance, the National Mission on Edible Oils and Oil Palm (NMEO-OP) has been extended to cover spice cultivation, providing financial assistance for the adoption of high-yielding varieties and modern cultivation practices. Additionally, the Integrated Development of Horticulture (MIDH) program offers subsidies for the construction of spice processing units, which has significantly improved the post-harvest value chain.

Kerala, known for its black pepper and cardamom, has particularly benefited from the e-Spice Bazaar initiative, which provides real-time market information and facilitates direct farmer-to-buyer transactions. This has not only increased farmer's income but also ensured better price realization for their produce. Similarly, Andhra Pradesh has seen a rise in turmeric production, supported by government grants for organic farming practices that enhance the spice's export quality.

### **2.3 Review of Crop Yields in India**

India's average crop yields are far below global standards. For instance, the average yield for cereals in India is around 3.6 tons per hectare, compared to over 7 tons per hectare in countries like UK, 8 tons per hectare in USA and below the Asia average of 4.4 tons per hectare. Similarly, water use efficiency is low, with agriculture accounting for nearly 80% of total water usage, but much of it is wasted due to inefficient irrigation practices. This inefficiency in resource use is becoming increasingly untenable in the face of climate change, which is expected to exacerbate water scarcity and make weather patterns more unpredictable.



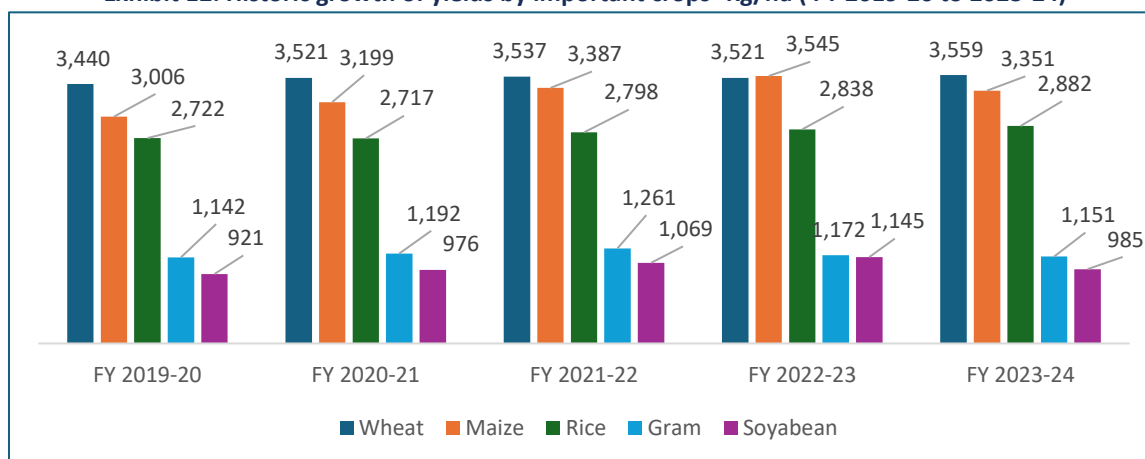
**Exhibit 11: Aggregated Crop yield comparison by countries ( tons/hectare)**

CROP TYPE	INDIA	BRAZIL	CHINA	UK	USA	ASIA	WORLD	POTENTIAL IN INDIA
Cereals	3.6	4.9	6.4	7.7	8.1	4.4	4.2	
Fibre crops	0.5	1.4	2.1	1.5	1	0.9	0.9	
Fruit	14.9	18	16.6	27.5	20.4	15.3	13.8	27
Oilseeds	0.3	0.5	0.7	1.4	0.6	1.1	0.7	2.5
Pulses	0.8	1.1	1.8	3	1.9	0.9	1	1.6
Sugar crops	84.9	73.4	76.3	65.9	73	73.9	71.6	
Vegetables	15.6	25.2	26.3	20.5	34.5	22.2	20.1	36
Rice	4.2	6.6	7.1		8.3	4.9	4.7	5
Wheat	3.5	3.3	5.9	8.6	3.1	3.5	3.7	4.5

Source: FAOSTAT, ICAR

India’s agricultural yields have experienced significant growth across key crops, with increases ranging from 2% to 10% between FY 2019-20 and FY 2023-24. This upward trajectory reflects a combination of technological innovations, targeted agricultural interventions, and region-specific practices aimed at maximizing productivity while addressing environmental challenges. For example, wheat yields have surged by an impressive 11% in between FY 2019-20 to FY 2023-24 in some regions in comparison to the national average growth of 3%, driven by the adoption of advanced farming techniques, while rice yields have grown significantly by around 6%. These gains demonstrate how the agricultural sector has evolved through a blend of qualitative improvements—such as sustainable practices and high-quality inputs—and quantitative advancements in crop genetics and precision farming. There remains several opportunities in increasing the yields of fruits, oilseeds, pulses, vegetables, rice and wheat driven through commercialized, organized efficiency as agri-technology in modern age with the aid of precision farming, auxiliary equipment along with micro-policies targeted for each potential crop.

**Exhibit 12: Historic growth of yields by important crops- Kg/ha ( FY 2019-20 to 2023-24)**



Source: Ministry of Agriculture and Farmer’s Welfare

Wheat yields jumped significantly from 3,440kg/ha in FY 2019-20 to 3,559 kg/ha in FY 2023-24. This increase is largely due to the incorporation of precision agriculture tools like IoT-enabled soil sensors, which optimize nutrient application and irrigation. Additionally, wheat breeding programs utilizing Marker-Assisted Selection (MAS) have produced varieties with enhanced resistance to rust and heat stress, particularly benefiting farmers in Punjab and Uttar Pradesh. The adoption of conservation agriculture techniques, such as residue retention, has improved soil health and reduced input costs, directly boosting productivity.

Rice yields improved steadily from 2,722 kg/ha in FY 2019-20 to 2,882 kg/ha in FY 2023-24, driven by the spread of Direct Seeded Rice (DSR) methods, which reduce water usage and labor dependence. The introduction of climate-resilient rice varieties like DRR Dhan 42 has helped farmers in eastern states combat droughts and salinity. Complementing this is the Bharat Nirman irrigation initiative, which provided irrigation infrastructure in water-deficient regions, contributing to stable yields across varying climatic conditions.

Gram in pulses yields rose from 1,142 kg/ha in FY 2019-20 to 1,151 kg/ha in FY 2023-24, aided by innovations in crop management such as Zero Budget Natural Farming (ZBNF), which has improved soil health and moisture retention. The development of early-maturing varieties has minimized exposure to erratic monsoons, especially in Madhya Pradesh and Maharashtra, helping farmers secure consistent yields under changing climatic conditions.

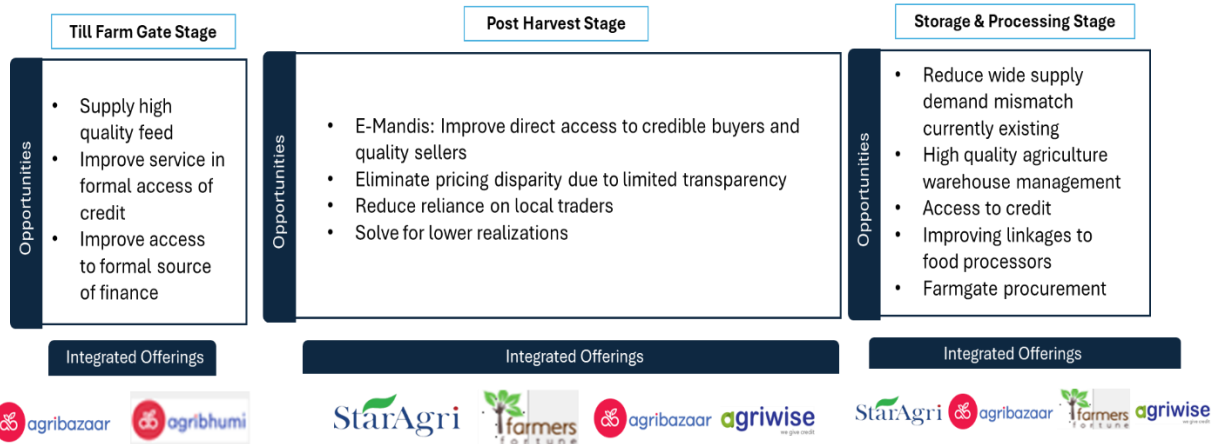
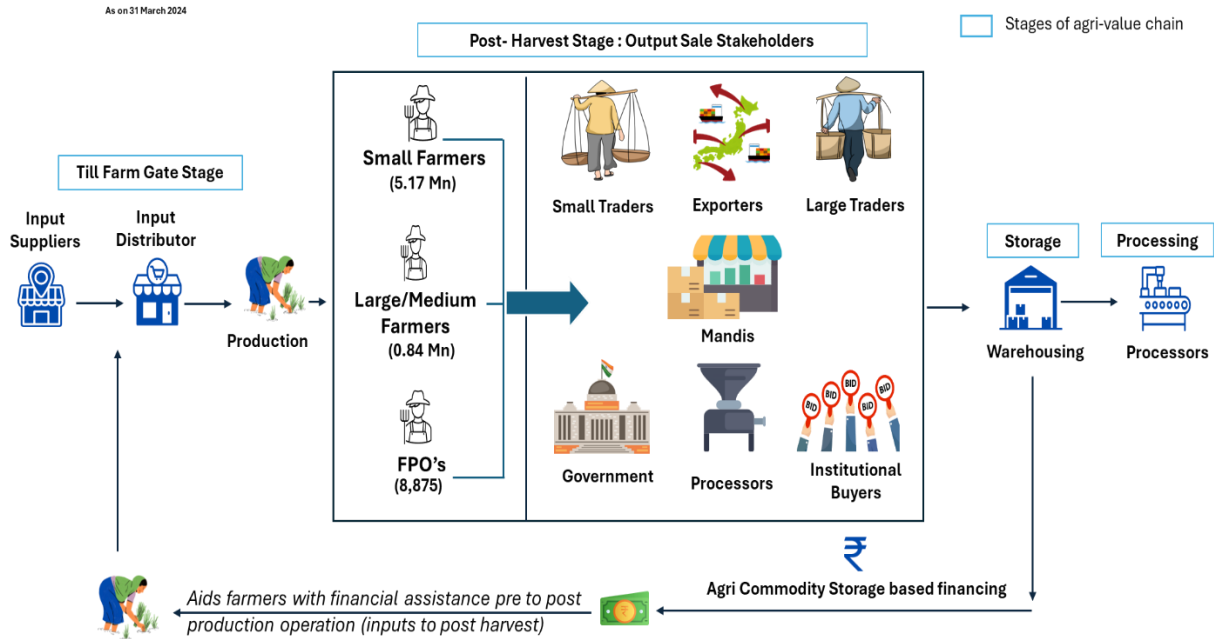
Soybean yields experienced significant fluctuations, rising from 921 kg/ha in FY 2019-20 to a peak of 1,145 kg/ha in FY 2022-23 before dropping to 985 kg/ha in FY 2023-24. This variability is attributed to changes in rainfall patterns, as soybeans are predominantly rainfed in India. However, government initiatives like the National Food Security Mission (Oilseeds and Oil Palm) have supported soybean farmers by promoting high-yielding, drought-resistant varieties such as MACS 1407 and JS 20-34.

Additionally, efforts like the Atmanirbhar Bharat Abhiyan have incentivized oilseed production through financial subsidies and cluster-based farming approaches, improving access to quality seeds and technical know-how. Programs emphasizing better soil management practices, such as the distribution of bio-fertilizers and integrated pest management, have further contributed to yield enhancements. These measures aim to stabilize production, even in regions prone to climatic uncertainties like Madhya Pradesh and Maharashtra, which are key soybean-growing states.

## 2.4 Qualitative Overview of the Agriculture value chain in India

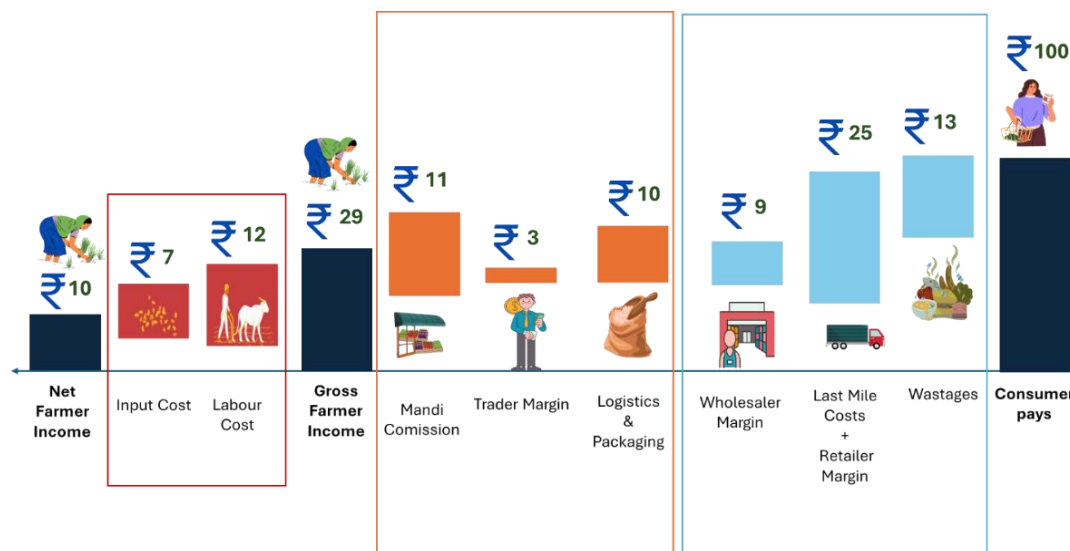
The agricultural value chain in India is complex and multi-layered, with several intermediaries involved from the farm to the final consumer. Each intermediary adds a layer of cost while taking a significant margin, often resulting in the farmer receiving a fraction of the final retail price.

**Exhibit 13: Agriculture Value chain in India & Supporting Services**



Source: Frost & Sullivan

Exhibit 14: Illustrative Margins from Farmer to Consumers











Source: Frost & Sullivan analysis, costs have been modelled on ₹/kg for commodities such as wheat, rice, potato, onion

India's agricultural sector, while being one of the largest in the world, is riddled with inefficiencies and challenges across the value chain, primarily due to its fragmented structure. This smallholder dominance not only limits economies of scale but also significantly impacts access to markets, adoption of modern technologies, and overall productivity. One of the most critical areas where these challenges manifest is in the value chain, where the margins at each stage are disproportionately distributed, often to the detriment of the farmers.

#### 2.4.1 Pre-Harvest Operations: Stakeholders

##### Input Suppliers- Seeds – Fertilizers

Input suppliers play a pivotal role by providing essential resources such as seeds, fertilizers, credit and advisory services. The value chain starts with companies that develop high-yield, climate-resilient seed varieties and extends to financial institutions that enable farmers to purchase these inputs.

	Seeds	Fertilizers	Agrochemicals
<b>Cost</b>	2-6% of crop cost	10-15% of crop cost	6-10% of crop cost
<b>Major components</b>	<ul style="list-style-type: none"> <li>GMO</li> <li>Organic/Non-GMO</li> </ul>	<ul style="list-style-type: none"> <li>Urea (high subsidy)</li> <li>NPK</li> <li>DAP</li> <li>SSP, MOP</li> </ul>	<ul style="list-style-type: none"> <li>Pesticides</li> <li>Fungicides</li> <li>Herbicides</li> </ul>
<b>Key players</b>	 	  	  

Smallholder farmers often pay higher prices for these inputs due to lack of bargaining power and limited access to bulk purchasing options. Moreover, the fragmented nature of input supply chains means that the quality of inputs is inconsistent, leading to lower yields and higher production costs. For instance, input costs can account for 20-25% of the total production costs, with margins for input supplier ranging from 10-15%.

Once inputs are procured, the next stage involves the actual cultivation of crops. Here, the primary costs include labor, irrigation, and maintenance of crops. Due to the small size of landholdings, farmers cannot achieve economies of scale, leading to higher per-unit production cost. Additionally, the reliance on traditional farming practices means that labor costs remain high, with little to no mechanization to improve efficiency. Labor and other direct cultivation costs typically account for another 30-35% of the total production cost, with farmers shouldering a bulk of these expenses.

#### 2.4.2. Production Operations: Stakeholders

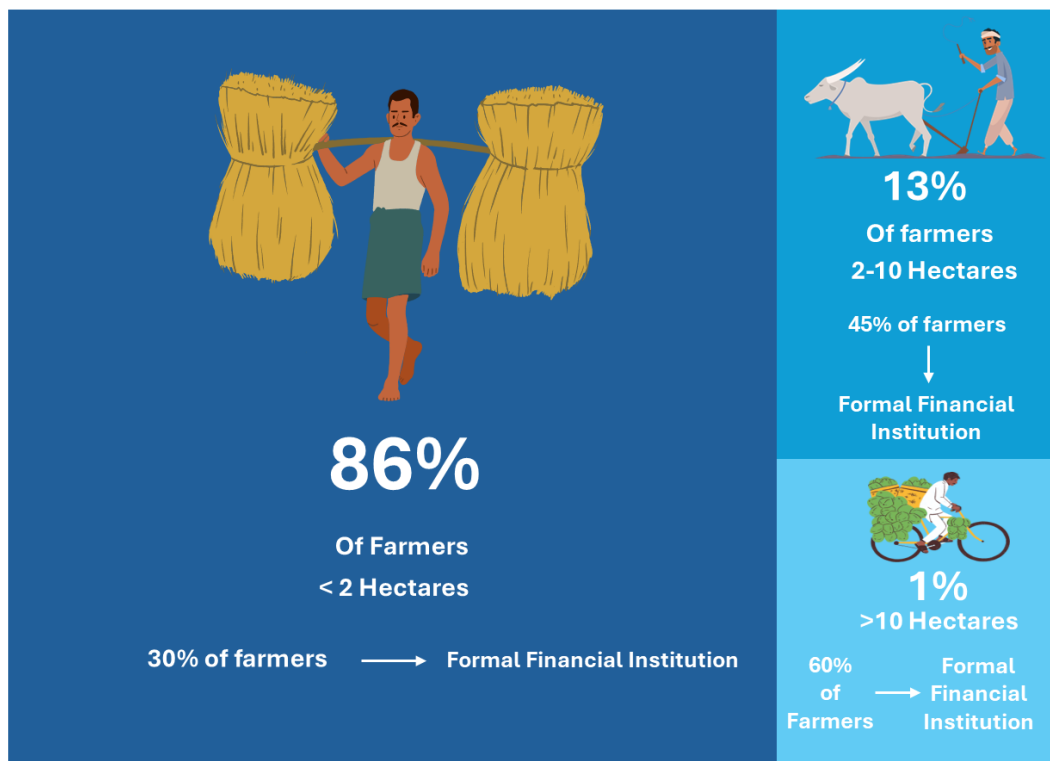
##### Farmers and Landowners

Farmers are the cornerstone of the agricultural value chain. In emerging markets, smallholder farmers constitute most of the agricultural workforce. These farmers often face challenges such as limited access to modern farming techniques and financial resources. However, large-scale farmers in more developed markets typically have better access to technology, inputs, and direct market linkages, allowing them to bypass intermediaries and sell directly to processors or retailers.

Farmers can be broadly categorized into organic and conventional producers. Organic farming, driven by consumer demand for healthier and environmentally sustainable products, is gaining traction globally, especially in markets such as the EU and North America. Conversely, conventional farming remains dominant in many emerging markets due to its lower input costs and higher yields, albeit with environmental trade-offs.

Primary producers in India, mostly small and marginal farmers, make up over 86% of India’s agricultural landscape. These farmers rely on external inputs such as seeds, fertilizers, and finance to cultivate their crops.

**Exhibit 15: Farm Holding Structure in India**

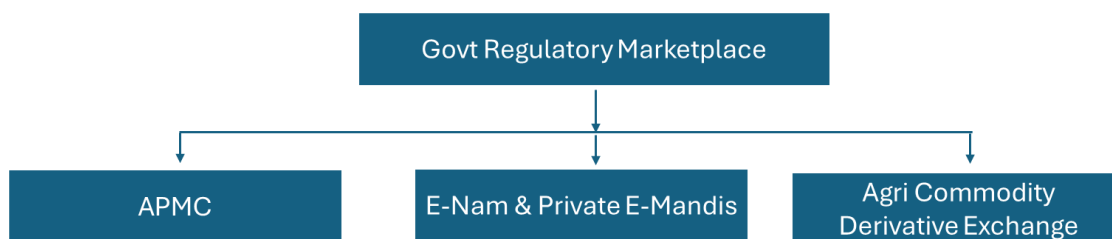


Source: Secondary sources & Frost & Sullivan Analysis

The Farmer Producer Organizations (FPOs) initiative aims to address this issue by pooling resources from small farmers to enhance bargaining power and facilitate access to advanced technologies. FPOs benefit from equity grants and credit guarantees. In FY 2019-20, the government launched a scheme to form and promote 10,000 FPO's by 2024 with an allocation of ₹ 68.65 billion, ₹ 44.95 billion from FY 2019-20 to 2023-24 and ₹ 23.69 billion from FY 2023-24 to 2027-28. For 2024-25, ₹ 5.81 billion has been allocated, an increase from ₹ 5 billion from FY 2023-24.

### 2.4.3 Post Harvest Operations: Stakeholders

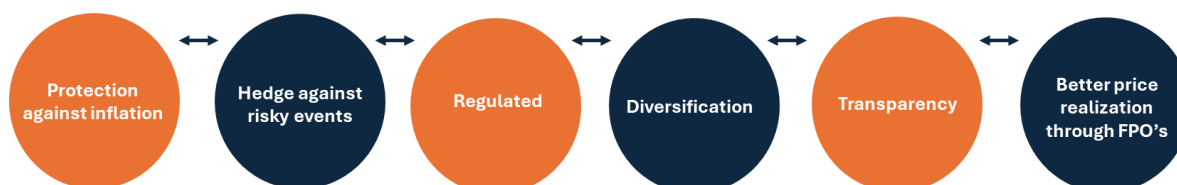
#### 2.4.3.1 APMC and Interstate Mandis



**APMC** – The marketing boards were set up by state governments in India to protect farmers from the exploitative practices of large retailers and to keep the farm-to-retail pricing spread from reaching unfairly high levels. States have enacted the Agriculture Produce Marketing Regulation (APMR) Act to govern APMCs.

**e-NAM and Private E-Mandis** – It is an online marketplace for trading agricultural products operated by the Indian government and private e-mandis by private players. Through e-NAM, farmers, traders, and consumers can trade in agricultural commodities online. Better price discovery and more effective agricultural products marketing are made possible by this market. To Promote efficiency in agriculture marketing, and improve price discovery, the government implemented the e-NAM Scheme. Under the e-NAM Scheme, the Government provides free software and assistance of ₹7.5 million per APMC mandi for related hardware, including quality assaying equipment and the creation of infrastructure for cleaning, grading, sorting, packaging, etc. As of 14th March 2024, more than 17.7 million farmers and 25.6 million traders have been registered on the e-NAM portal. A very few private players have also established private e-Mandis to facilitates online trade between farmers & buyers. JV between the State Government and NCDEX e-Market Limited have digitalized all APMCs of the Karnataka States. Star Agribazaar Technology Private Limited also operates private eMandi in the states of Rajasthan & Madhya Pradesh.

**Agricultural Commodity Derivative Exchange**- Trades in standardized derivatives (futures and options) of agricultural and non-agricultural commodities are conducted on the electronic trading platforms of accredited stock exchanges. This type of trading is based upon approval from the Securities and Exchange Board of India (SEBI) and compliance with current laws and regulations governing the commodity derivatives market, such as those governing the National Commodity & Derivatives Exchange (NCDEX) & Multi Commodity Exchange (MCX). Multi Commodity Exchange (MCX). Characteristics of these markets are: -



#### 2.4.3.2 Traders and Aggregators

Small-scale farmers in emerging markets often rely on local traders or aggregators to sell their produce. These traders operate within informal markets, purchasing commodities in bulk and selling them to larger traders or processors. This intermediary role is crucial in linking fragmented smallholder farmers to larger market players. However, the absence of formal contracts and price volatility in these markets often results in lower returns for farmers.

Digital platforms are increasingly transforming the traditional trader model, particularly in India. Platforms such as Agribazaar, DeHaat, Otipy, Ninjacart etc. in India enable farmers to connect directly with buyers, reducing reliance on intermediaries and enhancing price transparency. These platforms also provide additional services such as logistics, financing, and agricultural inputs, further integrating the value chain.

#### 2.4.3.3 Processors and Millers

Processing firms and millers play a vital role in converting raw agricultural commodities into consumable products. In emerging markets, these firms are adopting technologies such as mechanization and automation to improve efficiency and product quality. The shift towards value-added processing is driven by rising consumer demand for processed and ready-to-eat foods, especially in urban areas.

#### 2.4.3.4 Wholesale and Retail Distribution

The final stage in the procurement process involves wholesalers and retailers who distribute the finished products to consumers. In many emerging markets, this stage is characterized by a fragmented retail sector, comprising traditional markets, small shops, and an increasing number of modern retail chains. Wholesalers aggregate products from various processors and distribute them across these diverse retail channels.

The integration of supply chains through modern retail chains and e-commerce platforms is gaining momentum in emerging markets. For example, in India, e-commerce giants such as Amazon, Bigbasket, Swiggy, Blinkit and Flipkart are reshaping how agricultural products reach consumers, offering greater convenience and variety.

#### 2.4.3.5 Agricultural Value Chain Services

The agricultural services sector in India encompasses a wide range of activities, from input supply to post-harvest management, financing, and market linkages. Over the past decade, the demand for these services has grown significantly, driven by the rise in agricultural productivity and the introduction of technological advancements.

The financing aspect of the agriculture sector has also grown substantially, with companies such as Star Agri with their unique business model and full stack, end to end integrated agricultural services, enabling farmers to access critical inputs and mechanization tools. This growing demand for agricultural services, especially in warehousing, finance, and digital platforms, is supported by technological innovations such as precision farming and e-NAM, which are transforming traditional farming practices and creating new opportunities for both organized and unorganized players.

## 2.5 Challenges in the Agriculture Value Chain In India

Stage of Value Chain	Pain Point Areas	Challenges
Pre-Production	<ul style="list-style-type: none"> <li>• Harvest preparation</li> <li>• Input Supply</li> <li>• Nutrient Management</li> <li>• Access to Finance</li> </ul>	<ul style="list-style-type: none"> <li>• High Cost of inputs</li> <li>• Limited accessibility to quality inputs</li> <li>• Delayed supply of inputs</li> <li>• Adulteration</li> <li>• Export due to Fertilizer regulation in Western Countries</li> </ul>
Production	<ul style="list-style-type: none"> <li>• Irrigation and water management</li> <li>• Crop Management</li> <li>• Farm Mechanization</li> </ul>	<ul style="list-style-type: none"> <li>• Water Shortage</li> <li>• Low Yield</li> <li>• Pests</li> <li>• Labor shortage</li> <li>• Lack in mechanization</li> </ul>
Post- Production	<ul style="list-style-type: none"> <li>• Harvesting</li> <li>• Storage</li> <li>• Processing</li> <li>• Transportation &amp; Distribution</li> </ul>	<ul style="list-style-type: none"> <li>• Limited access to modern harvesting equipment</li> <li>• Lack of access to storage</li> <li>• Limited processing facilities</li> <li>• Delays in transport</li> <li>• Poor roads</li> <li>• Limited market access</li> </ul>

## 2.6 Expanding key pain points undergoing positive transformation

India faces multiple challenges ranging from insufficient pre-harvest due to low yield, inadequate post-harvest infrastructure, restricted access to markets, limited access to credit, to the struggle for remunerative incomes and the limitations of using obsolete global farming techniques.

### *Post-Harvest losses due to inadequate storage and infrastructure*

India suffers from significant post-harvest losses, particularly in dry commodities such as grains and pulses, amounting to approximately 4-10%, overall, with total post-harvest losses estimated at ₹ 1,530 Billion annually. The primary cause of these losses is the lack of adequate storage facilities which accounts for 35-40% share of the loss in the entire chain from harvesting till reaching processors. It is estimated that India has a total storage capacity of 215 million tons for dry commodities in FY 2023-24, but over 70% of this is outdated or lacks proper temperature and moisture control, leading to spoilage of dry commodities, particularly during the monsoon season.

### *Access to formal credit and collateral challenges*

A key issue in the agricultural value chain is the lack of access to affordable and timely credit for small and marginal farmers, particularly those cultivating dry commodities such as pulses and oilseeds. Only about 30% of these farmers have access to formal financial institutions, leading to over-reliance on informal credit channels with high interest rates.



### *Fragmented and Inefficient Market Linkages*

The market linkage for dry commodities remains highly fragmented, resulting in price inefficiencies and poor bargaining power for farmers. Despite policy efforts like the e-NAM (National Agriculture Market) platform, a significant portion of dry commodity farmers continue to sell through traditional mandis, where they face high transportation costs, delayed payments, and a lack of price transparency. Only around 42% of total agricultural produce, including dry commodities, is currently sold through regulated markets, while the rest is sold in informal settings where prices fluctuate unpredictably.

### *Logistics Bottlenecks and High Transport Costs*

Efficient movement of dry commodities from farm gates to market remains a critical challenge, particularly in landlocked states such as Madhya Pradesh, Bihar, and parts of Uttar Pradesh. Dry commodities such as wheat, maize, and pulses are often transported over long distances, with post-harvest handling losses occurring during transit, contributing to a 6-10% share on the overall losses. Inadequate rural road infrastructure and high fuel costs further compound this issue, limiting market access for many farmers. The average cost of transportation for grains can account for as much as 15-20% of the final price, reducing competitiveness in regional and national market.

## **2.7 Key Government Initiatives and Subsidies favoring sectorial growth**

The agricultural sector of India is driven by a series of specialized government initiatives and targeted subsidies. These programs, designed to address critical bottlenecks, provide precise financial support for key areas such as infrastructure development, mechanization, crop diversification, and climate resilience. From significant capital investments in marketing infrastructure to subsidies on precision irrigation and organic farming inputs, these initiatives are helping farmers adopt advanced techniques and reduce operational costs. The structured support for post-harvest management, along with risk-mitigation mechanisms like crop insurance and interest subvention, is enabling greater efficiency across the supply chain, enhancing both productivity and farmer incomes.

Some of the key initiatives are:

### **1. Agricultural Marketing Infrastructure (AMI) under Integrated Scheme for Agriculture Marketing:**

This scheme provides capital subsidies to develop storage and marketing infrastructure, crucial for reducing post-harvest losses. Farmers and FPOs can receive subsidies of 25% in plains and 33.33% in hilly areas. As of FY 2023-24, Over 48,357 projects have been sanctioned under this scheme, improving market access by enabling better storage, cold chain logistics, and direct market linkages for farmers.

### **2. National Mission on Oilseeds and Oil Palm (NMOOP):**

NMOOP offers a 50% subsidy on critical inputs, including high-quality seeds, fertilizers, and farm machinery to increase the cultivation of oilseeds such as groundnut and mustard. Under this scheme, an additional 6.5 lakh hectares of land will be brought under oil palm cultivation by FY 2025-26, with a focus on North-Eastern states.

### **3. Sub-Mission on Agricultural Mechanization (SMAM):**

To boost mechanization, the SMAM scheme provides a 40-50% subsidy on farm machinery for small and marginal farmers. This has resulted in the creation of over 25,527 Custom Hiring Centers (CHCs) as of FY 2022-23, where farmers can rent equipment such as tractor and harvesters at affordable rates. The scheme

aims to reduce labor costs, enhance productivity, and ensures that small farmers have access to modern technology.

#### **4. National Project on Organic Farming (NPOF):**

NPOF promotes organic farming through a 50% subsidy for inputs such as bio-fertilizer and compost. The scheme also supports certification processes, helping farmers gain access to premium organic markets. As part of this initiative, more than 380 organic farming cluster covering 8.41 lakh hectares have been formed, and over 6.23 lakh farmers are registered on the Jaivik Kheti portal.

#### **6. Soil Health Card Scheme:**

Since its launch in 2015, this scheme has issued over 220 million soil health cards to farmers by FY 2019-20, helping them optimize nutrient use based on soil conditions. The goal is to reduce the excessive use of fertilizers and enhance productivity. As a result, many farmers have reported a 10-25% reduction in fertilizer use, leading to healthier soil and improved crop yields.

#### **7. Modified Interest Subvention Scheme (MISS):**

This scheme provides interest subsidies for short-term crop loans taken through the Kisan Credit Card (KCC). Farmers receive loans at 7% interest, with an additional 3% incentive for timely repayment, reducing the effective interest rate to 4%. In FY 2023-24, more than ₹230 Billion has been allocated to agricultural loans under this initiative.

#### **8. Pradhan Mantri Fasal Bima Yojana (PMFBY):**

Launched in 2016, PMFBY offers crop insurance to farmers at a nominal premium. The farmers have received a claim of ₹ 1,500 Billion. Over the past 10 years, there has been a threefold increase in easy loans for farmers from banks. The scheme provides financial protection against crop losses due to unpredictable weather, pest attacks, and natural disasters. PMFBY is the largest crop insurance scheme in the world in terms of farmer enrolment and is the third largest scheme in terms of insurance premiums. The scheme provides a simple and affordable crop insurance product to ensure comprehensive risk cover for crops to farmers against all non-preventable natural risks from pre-sowing to post-harvest. The overall insured area is projected in 2023-24 to have reached reached 610 lakh ha . Recent Technology interventions in PMFBY includes National Crop Insurance Programme (NCIP- Digi-Claim-Payment Module), Yield Estimation Based on Technology (YES-Tech: introduced for gradual migration to Remote-Sensing based yield estimation to help assess yields as well as fair and accurate Crop Yield Estimation), Weather Information Network & Data System (WINDS) - initiative to set up a network of Automatic Weather Stations & Rain Gauges at Taluk/ Block and Gram Panchayat (GP) levels) and Collection of Real-time Observations and Photographs of Crops (CROPIC - an initiative that has been taken up to collect periodic photographs of crops to assess crop damage and act as an input for Technology-based yield estimation models.

#### **9. Minimum Support Price (MSP) and Price Support Scheme (PSP)**

Established since the Green Revolution, India's MSP program guarantees a fixed price for specific crops, encouraging agricultural productivity and ensuring food security. Recommended by the Commission of Agricultural Costs and Prices (CACP) before each harvest season, MSP aids farmers in achieving fair prices and stabilizing income. The Food Corporation of India (FCI) and state agencies procure wheat and paddy, while NAFED handles oilseeds, pulses, and cotton under the Price Support Scheme when prices fall below

MSP. These policies support farmers with stable income, encourage investment in modern technology, and ensure availability of essential grains at affordable prices for consumers.

Growth Drivers:

- 1) **Technological Advancements in Post-Harvest and Supply Chain Management:** Increasing adoption of post-harvest technologies is transforming Indian agriculture by reducing wastage and improving supply chain efficiency, especially for dry commodities such as grains and pulses. Post-harvest losses in cereals, such as wheat, can reach up to 6% due to outdated storage practices. Digital warehousing platforms integrated with e-NAM and private trading solutions such as Agribazaar are optimizing farm-to-market movement, enhancing price realization for farmers. Advanced storage technologies, including climate-controlled silos and smart inventory management, further minimize losses. Additionally, AgriStack's unified digital infrastructure is streamlining supply chains through real-time data on crop yields, prices, and storage needs, enabling integrated services from companies such as StarAgri and DeHaat.
- 2) **Growing Focus on Agri-Market Linkages and Digital Marketplaces:** The traditional disconnect between farmers and end-markets has historically limited the income potential for dry commodity producers, resulting in poor price discovery and market volatility. However, the growing focus on digital platforms and market linkages is transforming how agricultural products are traded. Platforms such as Agribazaar have enabled direct connections between farmers and buyers, reducing the dependence on intermediaries and ensuring better price transparency.
- 3) **Policy Support and Financial Inclusion Through Innovative Products:** Policy frameworks and government interventions continue to be strong growth drivers for the Indian agricultural sector. Programs such as the Pradhan Mantri Fasal Bima Yojana (PMFBY), Kisan Credit Card (KCC), Agriculture Infrastructure Fund (AIF), and Agricultural Marketing Infrastructure Scheme (AISM) are enhancing financial inclusion by offering crop insurance, credit access, access to quality storage and subsidies to farmers. Together, these initiatives form a cohesive strategy aimed at mitigating risks, enhancing storage capabilities, and driving financial inclusion. By providing farmers with comprehensive risk coverage, modern storage infrastructure, and accessible financing, these policies catalyze growth across the agricultural value chain.

#### **PMFBY : Driving Transformational Growth in the Indian Agriculture sector**

The Pradhan Mantri Fasal Bima Yojana (PMFBY) has become a vital enabler of financial security for India's farmers, addressing the risks associated with crop failure due to adverse weather, pests, and other unforeseen events

PMFBY has driven advancements in crop insurance through technology integration, including satellite-based yield estimation (YES-Tech), instant claim processing via Digi-Claim, and real-time monitoring through CROPIC. These tools have enhanced the efficiency and accuracy of the scheme. Farmer registrations under PMFBY have seen consistent year-on-year growth, with enrollments reaching to 40 million in FY 2023-24, marking a 27% rise compared to FY 2022-23. This upward trend highlights the scheme's growing relevance and accessibility for farmers across the country. Very few private agencies such as Agribazaar, AgroTech Risk, Niruthi, CropIn, WRMS,

AMNEX and RMSI have been selected as Tech implementation partner, to use tech for the purpose of yield estimation.

### **Strengthening Agricultural Infrastructure: AIF and AISM**

Complementing PMFBY, the Agriculture Infrastructure Fund (AIF) and Agricultural Marketing Infrastructure Scheme (AISM) are critical enablers for improving agricultural efficiency and sustainability. These schemes address bottlenecks in post-harvest management, storage, and marketing, laying the groundwork for enhanced productivity and profitability. Robust agricultural infrastructure is essential for minimizing post-harvest losses and ensuring efficient supply chain management. Recognizing this, the Indian government has implemented key initiatives to bolster warehousing and rural storage facilities.

The Agriculture Infrastructure Fund (AIF), launched in July 2020, aims to provide medium to long-term debt financing for investments in viable projects related to post-harvest management and community farming assets. As of July 18, 2024, the AIF has facilitated the establishment of 13,353 warehouses, with sanctioned loans amounting to ₹ 112.58 billion.

### 3. Agricultural Warehousing Market in India – An Overview

The agricultural warehousing market in India is at a transformational stage, where, fueled by bottom-up and top-down demand, the sector is seeing a positive drive of private participation both in terms of funds and operators in the space. This sector is also playing a pivotal role in building efficiencies for the output market which ensures consumers in the country have access to economical and high-quality products.

India's agricultural sector has embarked on an impressive expansion journey, exhibiting an encouraging average annual compounded growth rate of 4.18% from FY 2019-20 till FY 2023-24, and the agri-warehousing market in India has witnessed a growth of 14.36% during the period FY 2021-22 and FY 2023-24. The private organized sector accounted for 26-27 MMT during the period FY 2023-24.

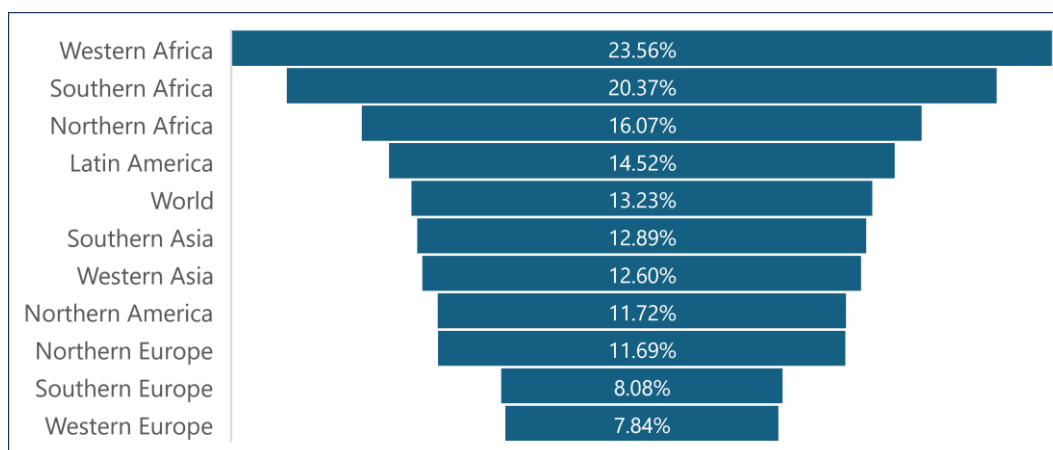
This sector is also witnessing substantial backward and forward integration in terms of tech aggregation as players in this space are expanding in pre-production and post-harvest stages. Players in this space are gradually operating as full-fledged, end-to-end integrated agri service operators. For example, players such as Star Agri who have traditionally operated as warehouse providers, owing to technology and traceability, are able to cater to farmers and end-consumers parallelly with high-quality services such as financial credit, agricultural advisory, direct linkage to marketplaces, as well as precision farming services.

Agriculture warehousing is, at the core of its service, trying to solve a critical challenge that plagues Indian agriculture's growth:

#### Post Harvest Losses

Based on NABARD reports, Post-harvest losses (PHL) in India for dry commodities like cereals, pulses, and oilseeds represent a critical challenge, with losses estimated at ₹ 1,530 billion annually, amounting to approximately 4-15% of volume of the total agricultural (perishables and non-perishables) output. In cereals, particularly wheat and rice, post-harvest losses are recorded between 4% and 6% post-production. Storage remains the largest leakage point accounting for 35-40% loss share, from production till processing.

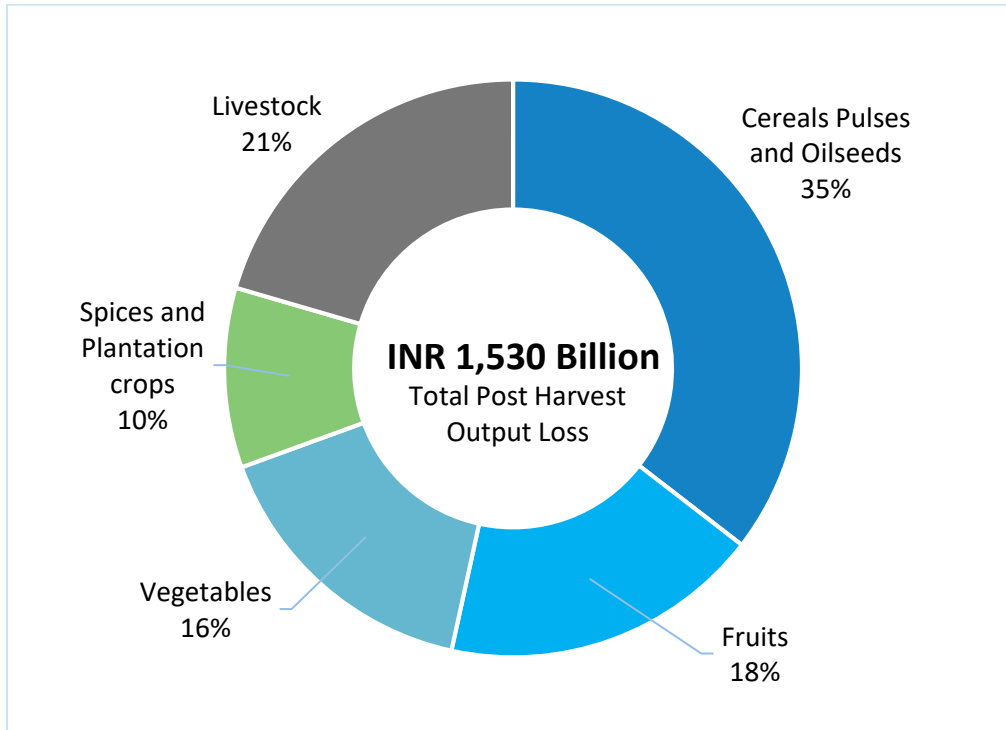
**Exhibit 16: Global Post Harvest Losses CY 2022**



Source: FAO, NABARD 2022 study, ICRIER

A major contributor to dry commodity losses in India is the limited storage infrastructure. India has a shortage of modern grain silos, forcing a significant portion of the harvest to be stored in open or semi-covered environments, making it vulnerable to moisture, pests, and spoilage

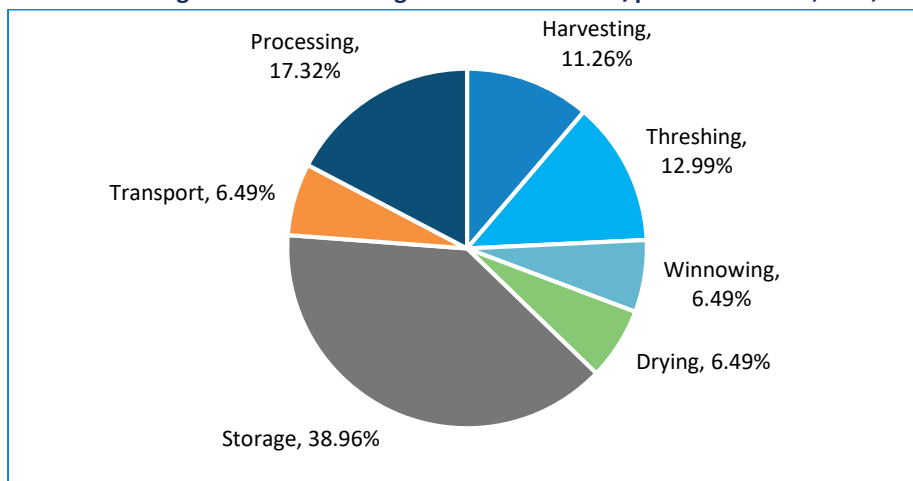
**Exhibit 17: India Post Harvest Losses by crop (CY 2023)**



Source: Ministry of Food Processing, PIB, Frost & Sullivan Analysis

India’s cereal sector, especially for crops like paddy and wheat, suffers notable post-harvest losses due to poor handling and inadequate storage infrastructure. For example, paddy losses are reported at 4.77%, while wheat experiences a slightly lower loss at 4.17%, primarily due to its higher resistance to moisture compared to other cereals. However, both crops are vulnerable during the storage phase. A specific study from NABARD research highlights that traditional storage methods—such as wooden or bamboo granaries used by small and marginal farmers—are unable to protect the produce from climatic changes. This leads to spoilage due to humidity and pest attacks. Paddy’s losses are more severe during the threshing stage, particularly among smaller farms that lack mechanized harvesting equipment. The lack of affordable combine harvesters increases the time paddy is left exposed to environmental factors, exacerbating losses.

**Exhibit 18: Wastage share at each stage of the value chain/process - Wheat, Rice, Pulses**



Source: Frost & Sullivan Analysis

Transportation-related inefficiencies contribute heavily to India's high post-harvest loss figures, particularly for oilseeds and pulses, which are often transported over long distances to reach processing centers or markets. For instance, in the case of oilseeds like soybean, a significant portion of the 7.51% loss occurs during transportation. India's road infrastructure, while expanding, still lacks adequate grain-handling facilities, leading to spillage and contamination. Moreover, many farmers still rely on traditional jute sacks, which are not moisture-proof and fail to protect oilseeds from spoilage during transit.

India's oilseeds sector also experiences substantial post-harvest losses due to the limited adoption of modern storage technologies. For example, mustard suffers losses of 4.46%, while groundnut faces losses as high as 5.73%. Pulses face similar challenges. For instance, black gram (urad) and green gram (moong) experience post-harvest losses of 5.83% and 6.19%, respectively, during the drying and threshing stages. Poor farm-level storage exacerbates the issue, with a 0.27% loss rate during the storage of black gram alone. This results from farmers storing pulses in traditional facilities such as jute bags or unlined bins, which provide little protection against environmental factors.

Due to the largely unregulated and informal players in the value chain, this results in inefficiencies such as poor-quality storage conditions, leading to pest infestations, moisture damage, and higher post-harvest losses.

### **3.1.1 Capacity Distribution among Market Entities**

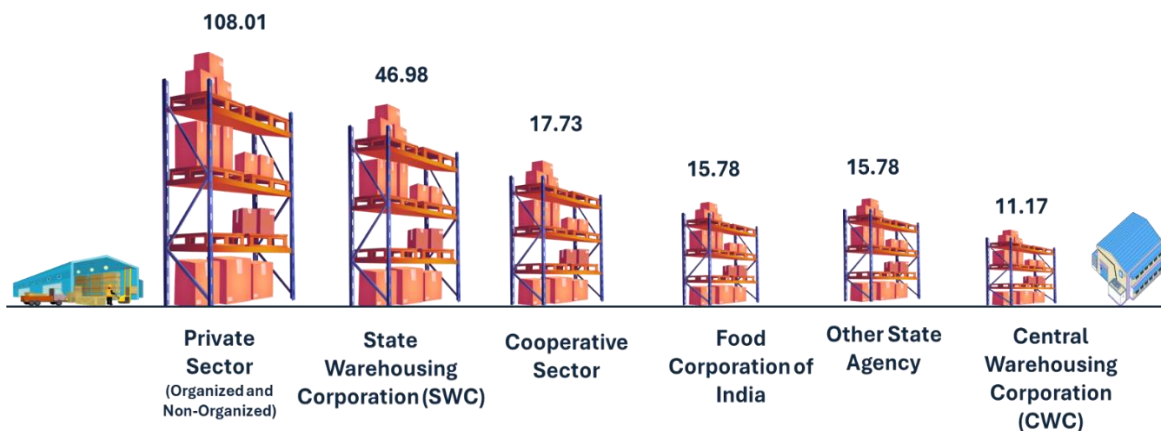
India's agricultural warehousing capacity is dominated by the private sector, which holds approximately 50.1% (including capacity leased by the government from private sectors) of the total warehousing space as of FY 2023-24. This dominance reflects the rise of private investments and the establishment of large-scale, technologically advanced storage facilities by organized players. Within the private sector, the capacity ownership is locally fragmented and unorganized. A large portion of private capacity has been developed to meet the capacity gap of FCI and other state agencies and leased out to such agencies. There are some large service providers like StarAgri who lease the warehouses from private owners and offer storage as a service to depositors.

### **3.1.2 Agricultural Warehousing Market in India: Structure: Organized vs Unorganized**

The agricultural warehousing sector in India is a complex and multi-layered ecosystem that includes both organized and unorganized players, each catering to distinct storage needs with varying degrees of efficiency and sophistication. The organized sector is expanding rapidly, driven by increasing demand for reliable, scalable, and compliant warehousing solutions in urban and semi-urban areas, where commercial agriculture and large-scale agribusinesses are prevalent. In contrast, the unorganized and locally fragmented sector remains dominant in rural regions, fulfilling local storage requirements through minimal infrastructure and often lacking the advanced capabilities of organized storage facilities.

### Exhibit 19: Total Storage Capacities in Public and Private Warehousing Entities- (In Million Tons)

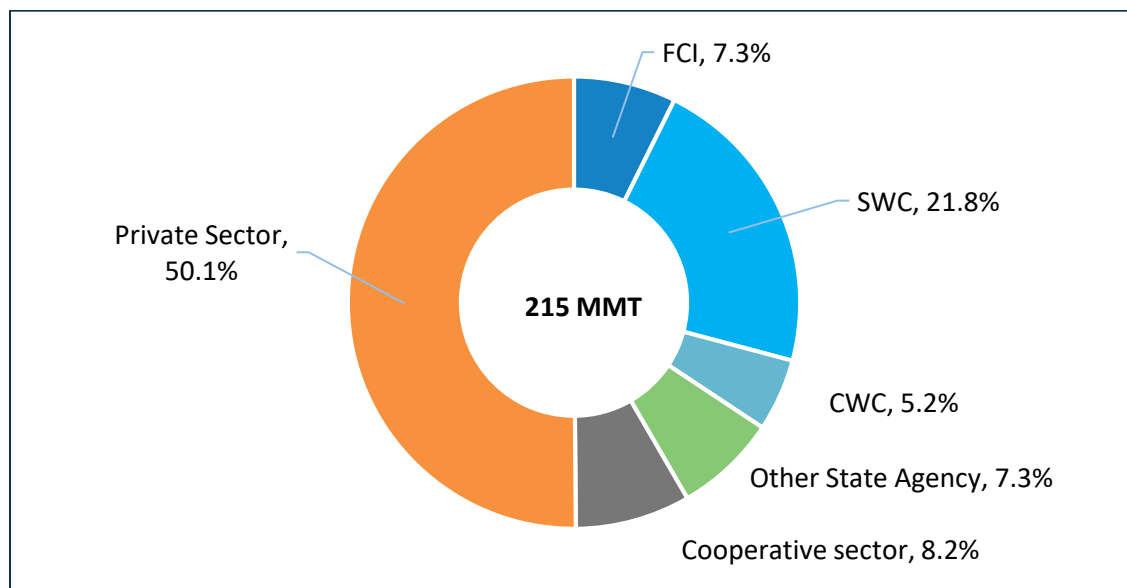
Estimated for FY 2023-24 : 215 Million Tons



Source: FCI August Report 2024, WDRA, FCI, CWC Annual Report, Lok Sabha Q&A Sessions, PIB, Frost & Sullivan Analysis

The warehousing market in India can be segmented by capacity distribution and market share across different entities. These include government entities such as the Food Corporation of India (FCI) and State Warehousing Corporations (SWCs), as well as cooperative bodies, other state agencies, and the private sector, which itself divides into organized and unorganized segments. This segmentation highlights a fragmented but evolving landscape in which each entity contributes to the overall warehousing capacity in India.

### Exhibit 20: Storage Capacity owned by entities: FY 2023-24\*



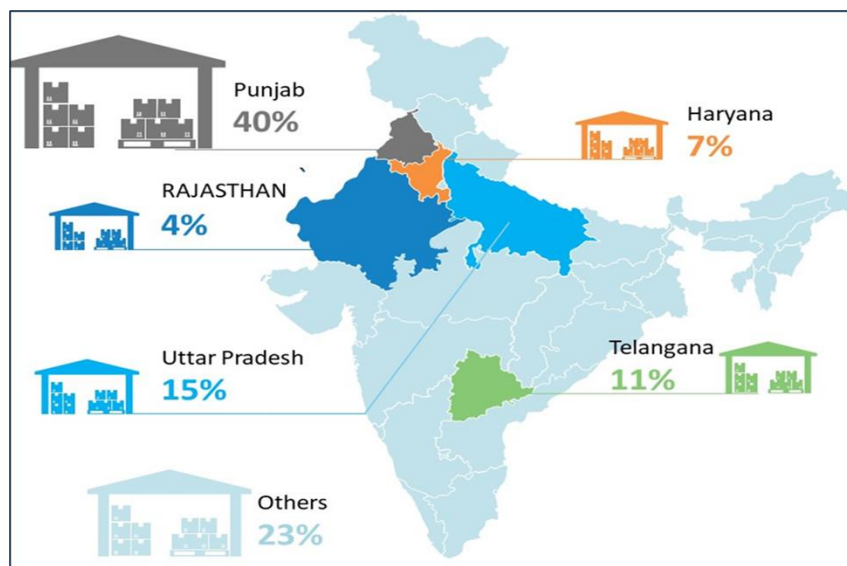
Source: WDRA Annual Report 2022-23, FCI, Dept Food and Public Distribution, Frost & Sullivan Analysis- \* Estimated for 2023-24

The State Warehousing Corporations (SWCs) account for around 21.8% of total storage capacity, with significant storage infrastructure spread across states with high agricultural output. Punjab, for instance, accounts for approximately 40% of SWC storage, followed by Uttar Pradesh with 15%, and Telangana with



11%. Despite this extensive network, SWCs also face challenges related to aging infrastructure and limited mechanization, everything which impacts their ability to store efficiently.

**Exhibit 21: State Warehousing Corporations (SWC) - State Wise Capacity Share- FY 2022-23**



Source: CWC Annual Report 2022-23

The Food Corporation of India (FCI) owns around 7.3% of the capacity, focusing on buffer stock management and food security, while cooperatives and other state agencies collectively contribute about 15.5%. Government and non-private sector entities are estimated to have procured dry agricultural commodities valued at approximately ₹3,000–5,000 billion for FY 2023-24 marketing season, representing a conservative baseline based on known MSP rates and procurement volumes. This procurement serves to ensure food security, supply fair price shops through the Public Distribution System, and maintain strategic buffer stocks for government programs and social welfare schemes. It is important to note that the actual value may exceed this range, as government agencies, through mechanisms such as the Food Corporation of India’s Open Market Sales Scheme (OMSS), occasionally release additional stock to private sector processors at predetermined prices to balance market dynamics.

### 3.1.3 Private Sector: Organized vs Unorganized

The private sector has emerged as a critical player in the agricultural warehousing space, largely due to its ability to innovate and scale up operations rapidly. Within the private sector, organized players such as Star Agri have significantly expanded their market presence by offering high-quality, technologically equipped storage facilities that comply with national standards.

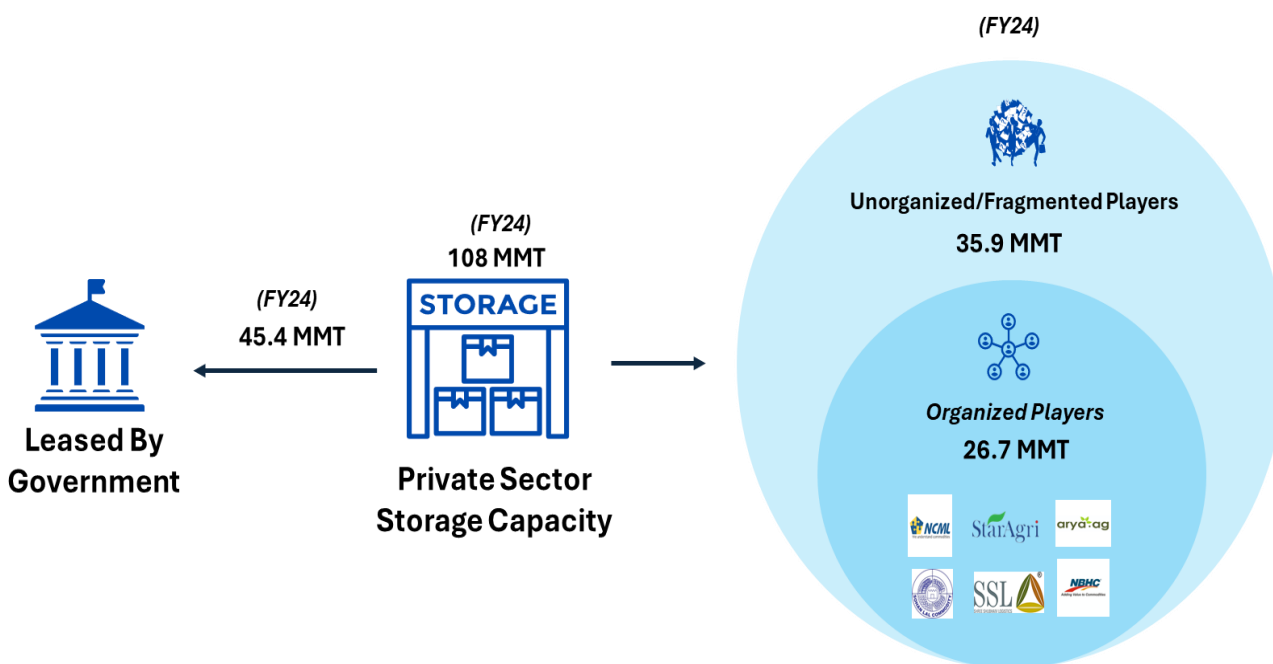
**Exhibit 22: Key players in the private agri-warehousing**



These organized private agri-warehouses support not only storage but also play a crucial role in financing agriculture through mechanisms such as Warehouse Receipt Financing (WRF). Organized private agri storage capacity in India is estimated at 26.7 MMT in FY 2023-24, indicating the substantial market share

held by entities such as Star Agri, which leads the way in integrating modern storage technology with value-added services such as quality assurance, logistics, and packaging.

**Exhibit 22: Storage Capacity by Organized vs Unorganized Private Sector**



Source: FCI August Report 2024, WDRA, FCI, CWC Annual Report, Lok Sabha Q&A Sessions, PIB, Frost & Sullivan Analysis

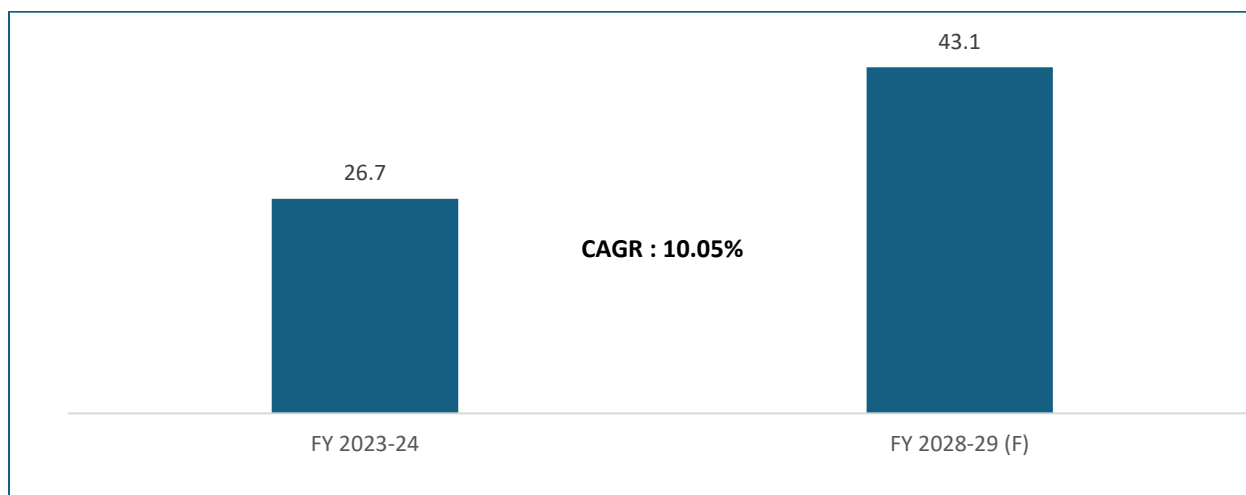
On the other hand, the unorganized and fragmented players sector, continues to serve an essential role, especially in rural regions or operate privately near the mandis. This segment consists primarily of local godowns and informal, on-farm storage facilities that provide nearby and affordable options for smallholder farmers and local traders. Typically, these facilities operate with basic infrastructure, lacking advanced climate control or pest management, which contributes to high post-harvest losses. In many cases, storage fees are charged on a per-bag basis, making this option viable for farmers who are unable to access formal storage solutions.

### 3.2 Agricultural Warehousing Market in India – Current and Future Opportunities

#### 3.2.1 Agricultural Warehousing Market – India Market Size

The organized private sector agri warehousing capacity has been estimated to be 26.7 million tons in FY 2023-24 and is expected to reach 43.1 million tons by FY 2028-29 (F). This growth is driven by government schemes such as PMFBY, AIF and AISM which have been put in place to boost capacity building coupled with increasing agricultural production, rising demand for organized storage solutions, streamlining better access to finance and growing private sector involvement. Key government initiatives like Atmanirbhar Bharat and Make in India are also promoting the development of world-class storage facilities to support India’s ambition of becoming a global manufacturing and export hub.

**Exhibit 23: Organized Private Sector Agri-Warehousing Capacity In India (MMT) – FY 2023-24 to FY 2028-29**



*Source: WDRA, Invest India, and Frost & Sullivan Analysis*

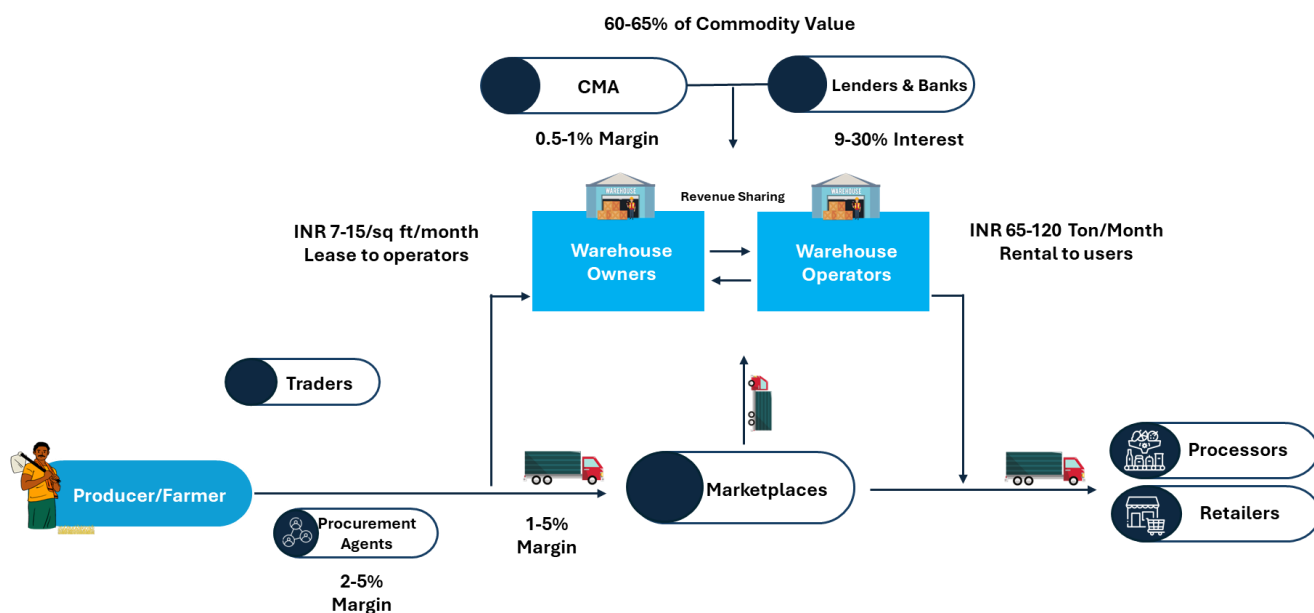
Agricultural warehousing plays a pivotal role in safeguarding the quality of agricultural produce in India, particularly for commodities like grains, oilseeds, and perishables. The sector ensures that farmers and other stakeholders across the supply chain can store produce safely, thereby minimizing post-harvest losses and optimizing distribution. Traditionally, this sector has been dominated by public sector entities such as the Food Corporation of India (FCI), State Warehousing Corporations (SWCs), and Central Warehousing Corporation (CWC). Together, these public players account for about 50% of India's storage capacity, which is estimated at 105-110 million tons out of the 215 million ton supply capacity, the rest is owned by private players (organized and unorganized/fragmented local players).

### **3.3 Entities involved in warehousing and interlinkages between them**

#### **3.3.1 Farmers**

Farmers are the primary producer of agricultural commodities and the foundational pillars of the agricultural value chain. Post harvesting their farm produce, farmers sell their crops either to local traders or agents. In certain cases, the farmers are directly contracted by multinationals to sell crops directly to them or as part of a Farmer Producer Organization (FPO). In the agriculture warehousing and finance ecosystem, direct farmers account for a minute share in services opted by a customer. It is estimated that as of FY 2023-24, direct farmers contribute not more than 5-7% of the organized agriculture warehousing and financing. Farmers at a local level store their produces at local godowns owned by unorganized players where the rental is on a per bag basis (₹ 5-10/bag). Majority of the financing which reaches the direct farmer is through traders or agents.

**Exhibit 24: Illustration of value chain linkage and dynamics**



Source: Frost & Sullivan Analysis

### 3.3.2 Traders and Procurement Agents

Procurement agents, who either work directly with ultimate buyers or independently, purchase commodities from farmers. Agents typically charge a service fee in the range of 2-5% (1-2% for facilitating the trade and the remaining 3% for expenses), depending on the commodity and procurement terms. These agents often utilize warehousing services, especially when purchasing large volumes of grains or pulses, and may also interact with collateral management agencies to finance such transactions.

### 3.3.3 Warehouse Owner and Operator

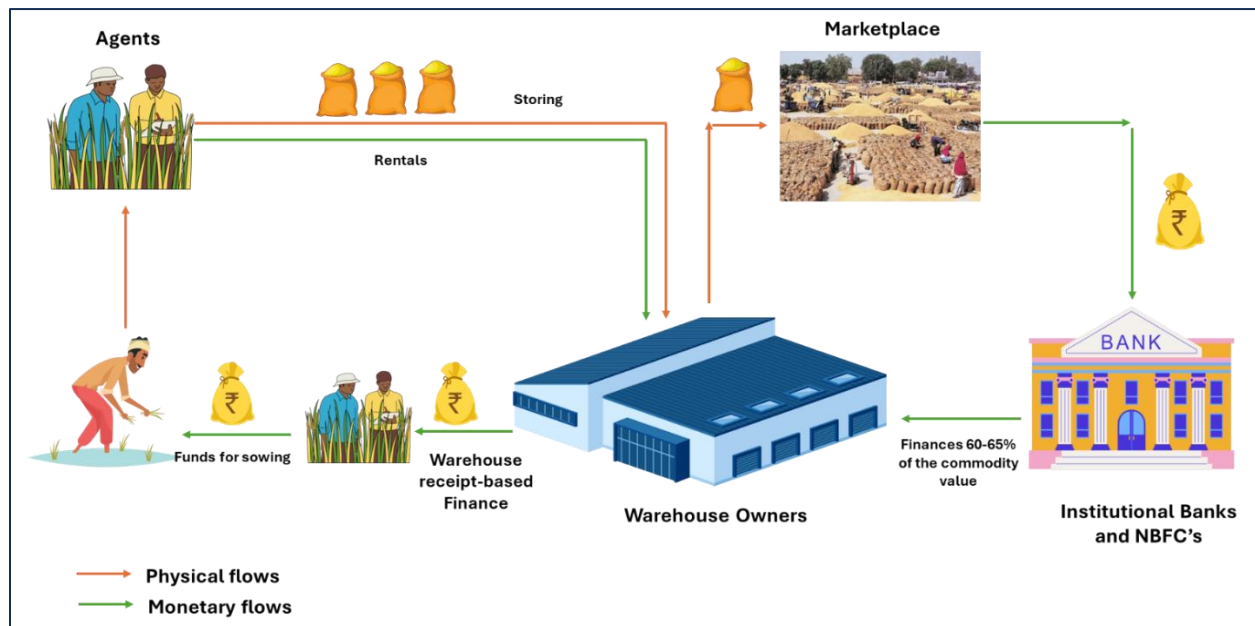
In the agri-warehousing space, warehouse owners play a vital role by leasing out storage space to operators, who manage day-to-day operations. Star Agri a key player here, leasing warehouses from owners and acting as an operator, providing high quality asset management services and acting as a custodian of the commodities stored in the agri warehouses. Warehouse owners generally earn revenue through leasing arrangements, charging operators a rental fee based on the type and volume of commodities stored. Warehouse owners usually lease out their warehouses and their services (WMS) to an operator at a rate around ₹ 12-15 sq ft/month in metro cities like Mumbai, in other places the blended rental rate is around ₹ 7-8 sq/ft/month. However, there is a new emerging trend in the business model - revenue sharing is on the rise where the owner and operator have a 60:40 arrangement of revenue achieved through the warehousing operations. This gives flexibility to the operator to not have a fixed rental particularly for months where net utilization is low. For the owner, this arrangement incentivizes them to maintain and upgrade the warehouse as the business grows.

### 3.3.4 Agricultural Commodity Custodians (Collateral Management) Agencies

Agricultural Commodity Custodians (Collateral Management Agencies) are one of the key stakeholders in the Agriculture Warehousing & Financing ecosystem. They manage commodities stored in warehouses, ensuring that the quality and quantity of goods meet lender requirements before issuing warehouse receipts. These receipts serve as collateral, which farmers and traders can use to obtain financing.

Agricultural Commodity Custodians or Collateral Management agencies typically charge 0.5-1% of the loan value annually for their services.

**Exhibit 25: Flowsheet for stages of Agri warehousing and finance**



Source: Frost & Sullivan Analysis

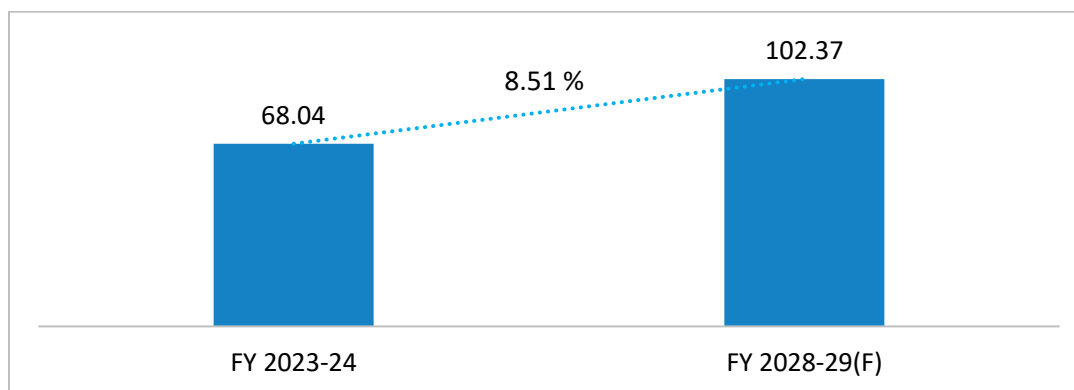
Financial lenders, including banks and non-banking financial companies (NBFCs), provide loans against warehouse receipts. The interest rates range from 9 to 25%, depending on the borrower's creditworthiness, loan tenure, and associated risks. These partnerships are critical, as the warehouse receipts enable banks to lend based on stored commodity values. This financing model benefits both the farmer and the buyer by offering liquidity when market conditions may not favor immediate sales.

### 3.3.5 Ancillary Service Agencies

Entities offering ancillary services such as pest control, logistics, and quality certification are indispensable to the agricultural warehousing ecosystem. Warehouse owners and operators, CMAA often collaborate with such service providers to offer end-to-end solutions for stored commodities, ensuring that products meet market standards and remain viable for both local and international markets. Warehouse operators and owners usually charge an additional 10-20% of the rental value to provide ancillary services which keep the goods in an anytime sellable state. 95% of the ancillary cost goes towards the cost of outsourced ancillary agencies for warehouse operators.

The market for value-added services in the collateral management industry, which includes testing, certification, quality assurance, and risk management, is experiencing steady growth. These services are estimated to grow as agri-warehousing demand increases, with projections indicating a compound annual growth rate (CAGR) of 8.51% from FY 2023-24 to FY 2028-29(F).

**Exhibit 26: Value Added Services in Agri Warehousing, (₹ Billion)**



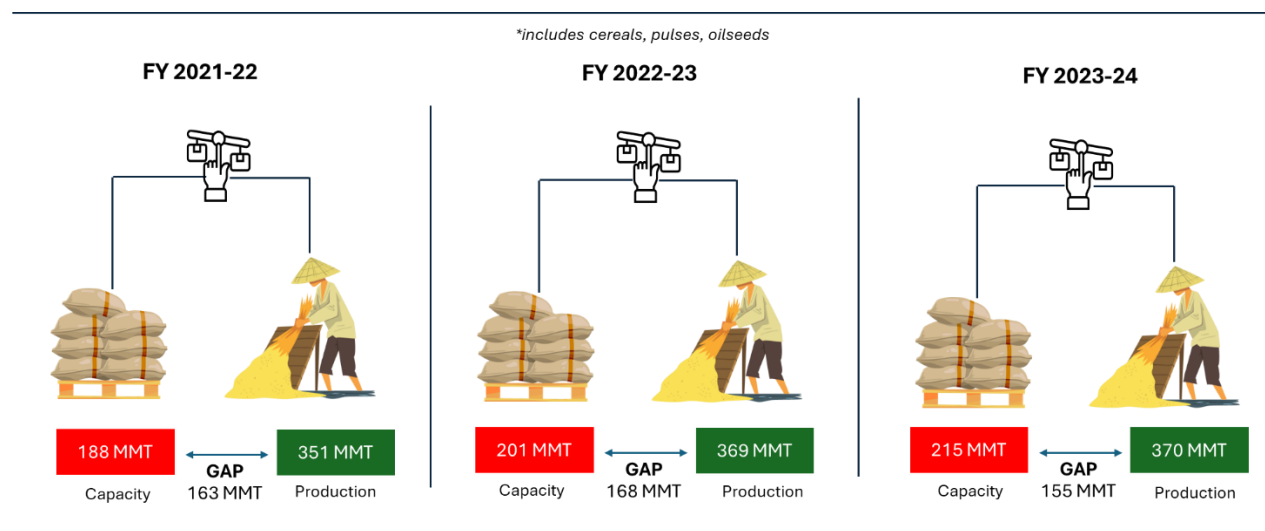
Source: Frost & Sullivan Analysis

The increasing demand for high-quality storage solutions and the growing complexity of agricultural supply chains are driving the expansion of the value-added services market. As more stakeholders recognize the importance of maintaining the quality and security of collateralized commodities, the adoption of these services is expected to rise, further boosting the market’s growth.

### 3.4 Agriculture Warehouse Market in India: Demand -Supply Landscape

India's agricultural production has experienced significant growth, with the production of dry commodities such as cereals, pulses, and oilseeds reaching 369.85 – 370 million tons in FY 2023-24. Production is further estimated to surge owing to factors such as rising disposable incomes, increased food & staples consumption owing to digital commerce, however, the country’s warehousing infrastructure has not kept pace with this production surge, resulting in substantial storage gaps. As of FY 2023-24, the total warehousing capacity for agricultural produce in India, including both government-managed and privately-owned facilities, stood at 215 Million Tons. This capacity meets only 50-60% of the total storage demand, leaving a deficit of nearly 155 Million Tons.

**Exhibit 27: Demand Supply Gap Analysis- Dry Commodity (FY 22 to FY 24), Million Tons (MMT)**

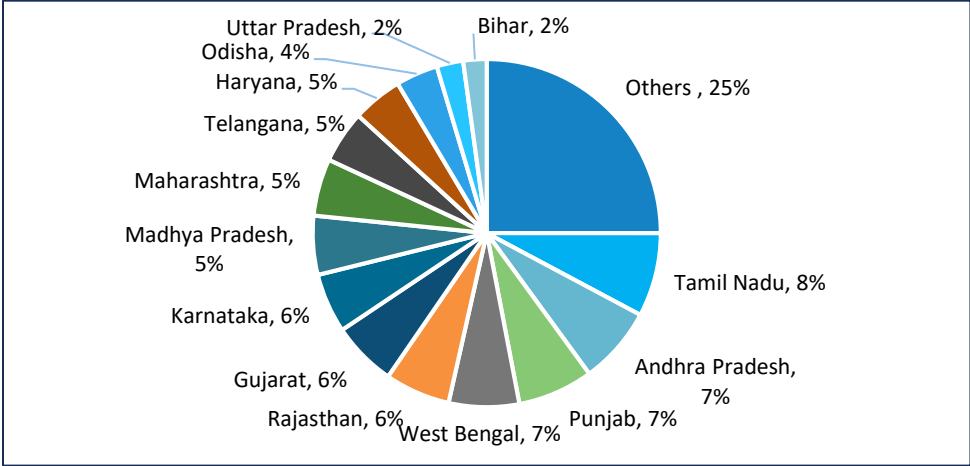


Source: FCI Annual Report, WRDA, MOAFW- Final Estimated 2023-24, Frost & Sullivan Analysis

The availability of warehousing infrastructure directly influences the consumption patterns of stored agricultural products. In regions with sufficient storage capacity, such as the North Zone, grains can be stored for longer periods, allowing for better management of supply throughout the year and minimizing the need for distress sales immediately after harvest. For example, in Punjab, where storage capacity meets 85-90% of the demand, grains are stored under more controlled conditions, reducing post-harvest losses and ensuring a more stable supply to both domestic and international markets.

The distribution of storage capacity across India is highly uneven, leading to significant regional disparities that exacerbate post-harvest losses and inefficiencies in the supply chain. Punjab and Haryana, the two leading producers of food grains, benefit from relatively well-developed storage infrastructure. Despite this extensive infrastructure, these states often face bottlenecks during peak procurement seasons due to the over-reliance on government facilities, leading to inefficiencies and delays in grain handling.

**Exhibit 28: Agriculture Warehouse registered by Region under CWC ( FY 2022-23)**



Source: CWC Annual Report on State Wise Capacity and Utilization, As on Sept 2023

In contrast, the West zone presents a higher total storage capacity benefiting from substantial contributions from both owned and hired facilities. This zone has demonstrated excellent efficiency in storage management, attributed to significant infrastructure investments like advanced warehousing and integration with state government capabilities. Notably, states like Madhya Pradesh and Maharashtra contribute heavily to this capacity, underscoring the strategic importance of this region in FCI’s national storage network.

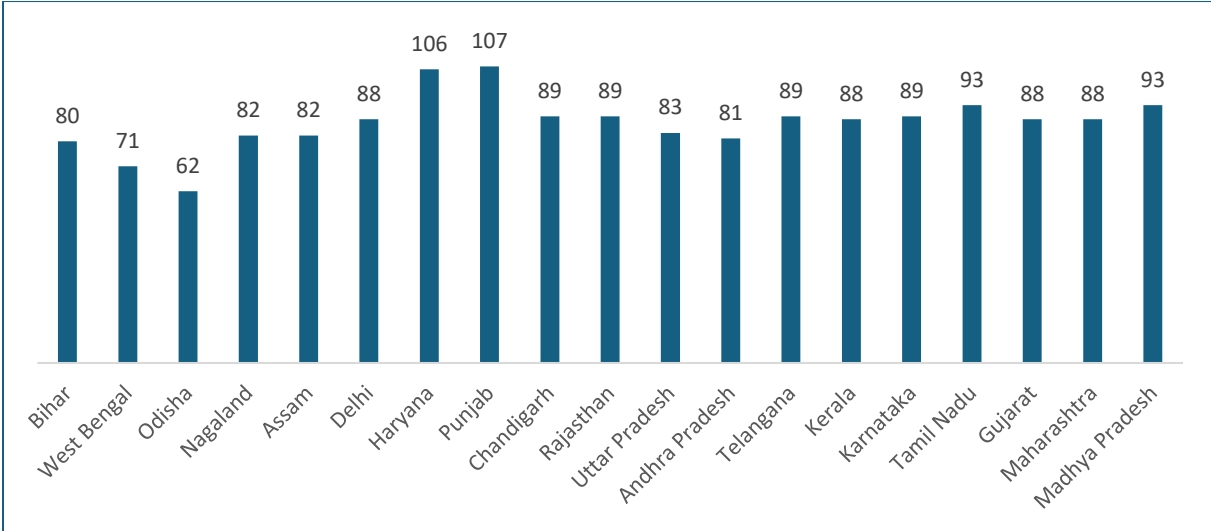
Eastern and North-Eastern regions of India continue to face severe storage shortages. In states like Bihar and Odisha, the available storage capacity can only accommodate 60-70% of the agricultural production. The shortfall in these regions not only affects the immediate storage needs but also impacts the broader agricultural supply chain, leading to increased spoilage and wastage.

**Utilization Rates**

The utilization rates of agricultural storage facilities in India reveal significant inefficiencies, particularly in regions with either overbuilt or severely lacking infrastructure. In well-developed regions like Punjab, Haryana, and Uttar Pradesh, the utilization rates of government-run facilities such as those owned by the public entities, frequently exceed 90-100% during peak procurement seasons. For instance, in Punjab, the government’s storage utilization rate reached 107% during the peak wheat procurement season in FY 2022-23, indicating overuse of temporary storage solutions such as Covered and Plinth (CAP) storage.

These high utilization rates, while indicative of robust procurement activities, also highlight the bottlenecks and logistical challenges that arise when existing infrastructure is stretched beyond its capacity.

**Exhibit 29: Utilization rate of CWC agri warehouses by different states (2023-24), %**



Source: Department of Food and Public Distribution (As on September 2023)

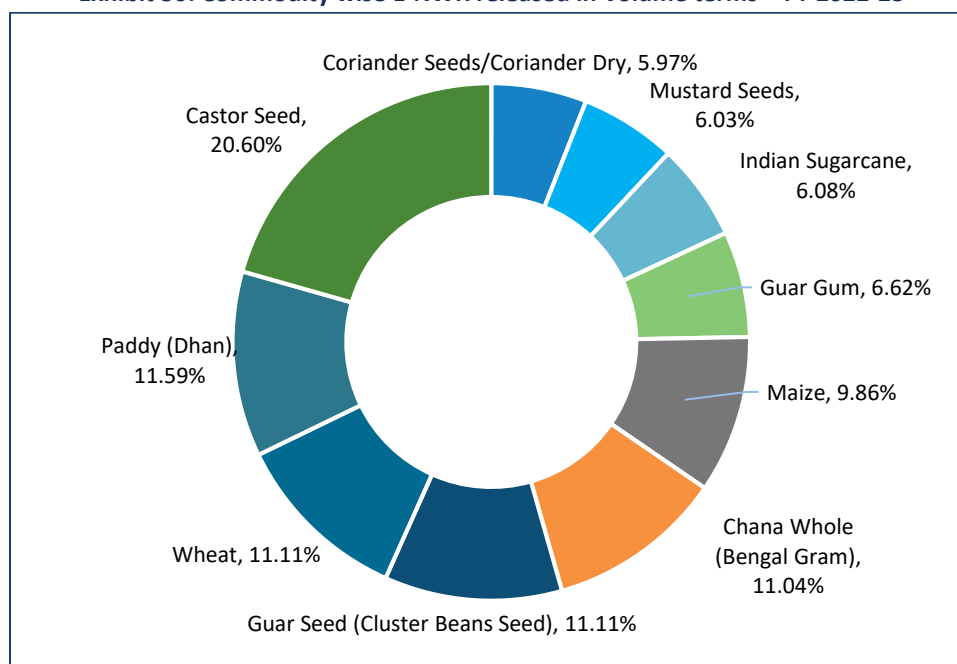
In contrast, the private sector, which manages approximately 50-55% (including capacity leased by the government) of the total storage capacity, typically operates with a lower utilization rate, averaging around 65-70% nationally. This lower utilization can be attributed to several factors, including regional imbalances in storage demand, the fragmented nature of private warehousing, and the strategic location of these facilities, which may not always align with the areas of highest production. However, in regions with well-developed agricultural supply chains, private warehouses have reported utilization rates as high as 85-90%, particularly for high-demand commodities such as pulses and oilseeds. The private sector’s flexibility in adjusting storage availability based on market demand allows it to maintain more efficient operations compared to some government-run facilities, which are often constrained by rigid procurement schedules and policy mandates.

**3.5 Storage by Dry Commodity**

India’s agricultural warehousing landscape reflects both the diversity of its agricultural production and the strategic efforts by the government and private sector to manage and optimize post-harvest storage. The issuance of electronic Negotiable Warehouse Receipts (e-NWR) offers a window into how various commodities are stored across the country, highlighting the critical role of warehousing in supporting the agricultural economy. As of FY 2022-23, the total quantity of commodities issued under e-NWR amounted to 5,06,137 Tons, distributed across a range of essential crops that underscore the varied nature of Indian agriculture.



**Exhibit 30: Commodity wise E-NWR released in Volume terms – FY 2022-23**



Source: WDRA annual report 2022-2023

Castor Seed leads the pack, representing 20.60% of the total storage under e-NWR in FY 23. This prominence is due to India's dominant position in the global castor oil market, where Gujarat plays a critical role. The state's focus on enhancing warehousing infrastructure for castor seeds has been supported by initiatives under the National Horticulture Mission (NHM), which has allocated funds specifically for the construction of dedicated storage facilities for high-value crops like castor. Furthermore, the Gujarat State Warehousing Corporation has invested heavily in expanding storage capacity, ensuring that the state remains a key player in the national and international castor markets.

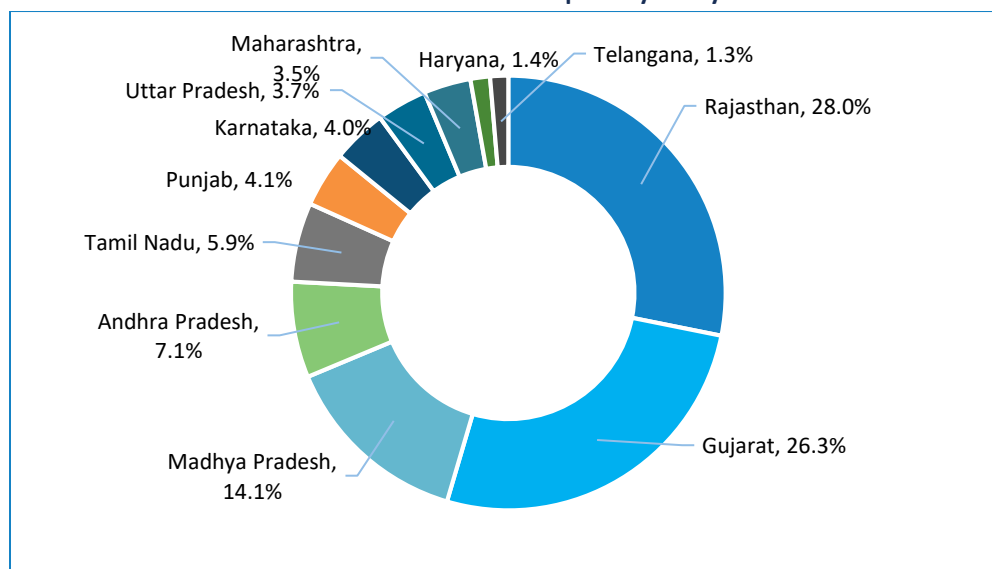
Paddy (Dhan), a staple food crop, accounts for 11.59% of the storage, stored under e-NWR. The extensive storage of paddy is essential not only for food security but also for maintaining stable market prices. Government schemes like the Pradhan Mantri Annadata Aay SanraksHan Abhiyan (PM-AASHA), which guarantees minimum support prices (MSP) for crops including paddy, have driven the need for secure storage to handle the vast procurement undertaken by agencies like the Food Corporation of India (FCI). The FCI itself has been a major beneficiary of the Private Entrepreneur Guarantee (PEG) Scheme, which has seen the construction of additional storage facilities specifically designed to handle large volumes of paddy, ensuring that procurement activities do not overwhelm existing infrastructure.

Wheat, another crucial staple, holds an 11.11% share of storage, stored under e-NWR. The extensive storage of wheat is a direct result of India's robust procurement system, supported by schemes like the Decentralized Procurement Scheme (DCP). Under this scheme, states are encouraged to procure, store, and distribute food grains, with a significant portion of the wheat being stored in both government and private warehouses.

Guar Seed (Cluster Beans Seed) and Chana Whole (Bengal Gram) each represent 11.11% and 11.04% of the total storage volume. The National Food Security Mission (NFSM) has been instrumental in promoting the production and storage of pulses through targeted financial incentives for warehouse construction. Additionally, the National Agricultural Cooperative Marketing Federation of India (NAFED) has been

actively involved in procuring and storing these commodities, supported by warehouse financing through the Warehouse Infrastructure Fund (WIF) managed by NABARD.

**Exhibit 31: State Wise E-NWR issued based on the quantity of dry commodities stored in MT**



Source: WRDA annual report 2022-23

The state-wise distribution of e-NWR provides a deeper understanding of how agricultural storage is utilized across India’s diverse regions. Gujarat and Rajasthan emerges as the leader in e-NWR issuance in FY 2022-23. This is a testament to the states’ advanced warehousing infrastructure, which has been bolstered by significant investments under the State Agricultural Marketing Board’s initiatives. Gujarat’s success is also linked to its strategic location and strong agricultural marketing networks, which facilitate efficient storage and movement of goods, particularly castor seed and wheat.

Rajasthan is , driven primarily by the storage of guar seed and other pulses. The state’s success in this area can be attributed to the targeted efforts under the Rajasthan Agri Export Policy, which encourages the establishment of modern warehouses to support the export-oriented agriculture sector. The state government, in collaboration with the Rajasthan State Warehousing Corporation (RWC), has invested in expanding warehousing infrastructure, focusing on creating hubs that can support the storage needs of high-value crops like guar seed, which is crucial for both domestic markets and exports.

In contrast, states like Bihar and Odisha face significant challenges in their warehousing infrastructure, reflected in their minimal issuance of e-NWR. The underutilization in these states highlights the infrastructural gaps that persist despite the broader national focus on agricultural warehousing. These gaps are exacerbated by limited access to financial resources and lower private sector involvement. However, recent government efforts under the Pradhan Mantri Kisan SAMPADA Yojana (PMKSY) and the Gramin Bhandaran Yojana aim to address these challenges by providing subsidies and low-interest loans for warehouse construction in these under-served regions. These programs are expected to gradually increase storage capacity and improve the overall utilization rates in these areas.

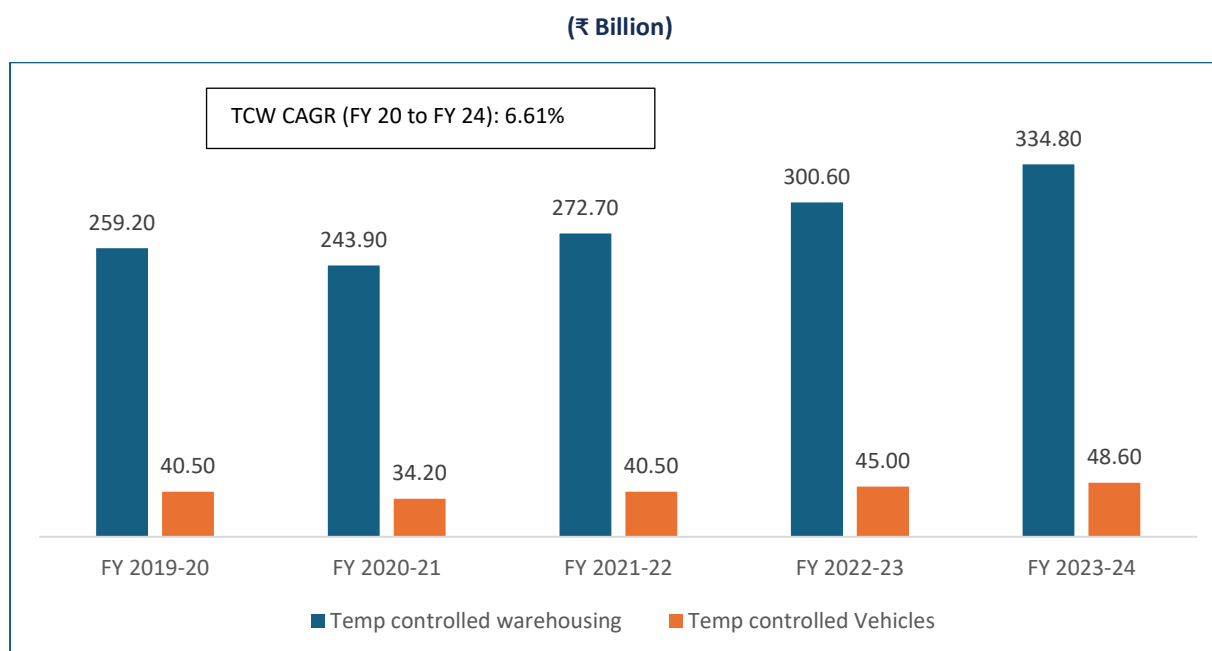
Madhya Pradesh and Uttar Pradesh also show significant activity in e-NWR issuance. These states benefit from a combination of strong agricultural production and proactive state-level policies that support the expansion of warehousing capacity. In Madhya Pradesh, for example, the Mukhyamantri Krishi Rin Yojana has provided critical financing for the development of warehousing facilities, particularly in rural areas

where storage capacity is often inadequate. Uttar Pradesh, under its State Warehousing Policy, has focused on improving the utilization of existing facilities and expanding capacity in key agricultural districts, supported by investments from both public and private sector.

### 3.6 Cold Storage Infrastructure in India

The cold storage infrastructure in India is an essential component of the agricultural supply chain, particularly for the preservation of perishable commodities such as fruits, vegetables, dairy, meat, and seafood. As of FY 2023-24, the market size of temperature-controlled warehousing (TCW) in India is estimated to be around ₹334.80 Billion, with temperature-controlled vehicles (TCV) contributing an additional ₹ 48.60 Billion. This brings the total market size of the cold storage and transportation sector to approximately ₹ 383.42 billion.

**Exhibit 32: Market size for temperature controlled warehousing and vehicles in India (FY 2019-20 to 2023-24)-**

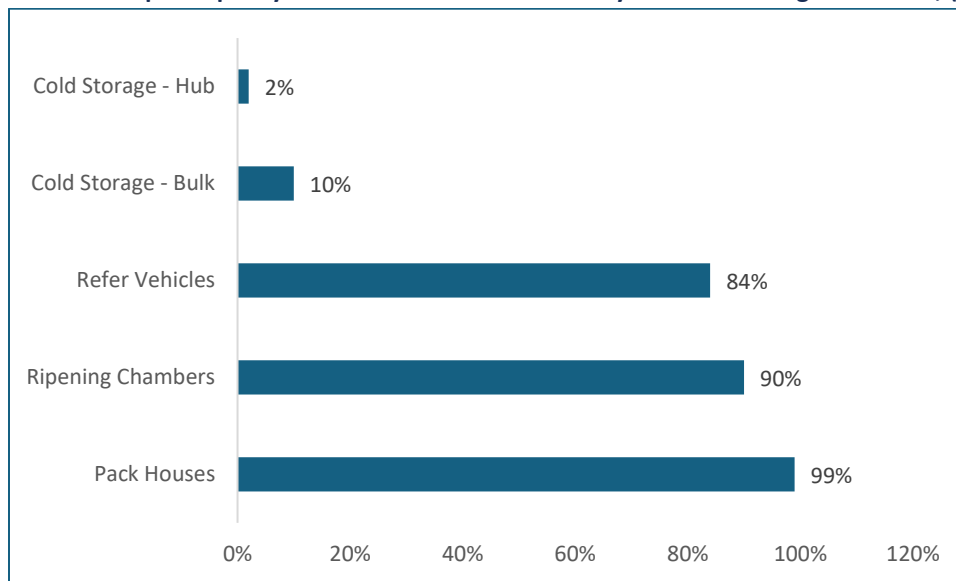


*Source: Frost & Sullivan analysis*

Despite this considerable market size, the cold storage infrastructure in India faces a significant demand-supply gap, particularly at the fruit and vegetable level. According to recent assessments, the gap in ripening chamber is as high as 90%, while the shortage of refrigerated vehicles stands at 84%. The situation is even more critical in the case of cold storage hubs, where only 2% of the required infrastructure is currently available. Bulk cold storage facilities also suffer from a 90% gap, and pack houses, crucial for pre-cooling and sorting produce before storage, face a staggering 99% shortfall.

This substantial gap in cold storage infrastructure has several implications. The lack of adequate cold storage leads to post-harvest losses, which are particularly acute in the fruits and vegetables segment, where losses can reach up to 10-15% due to the absence of proper storage facilities.

**Exhibit 33: Gap in capacity at Cold Chain Infrastructure by value chain stage – CY 2023, (%)**

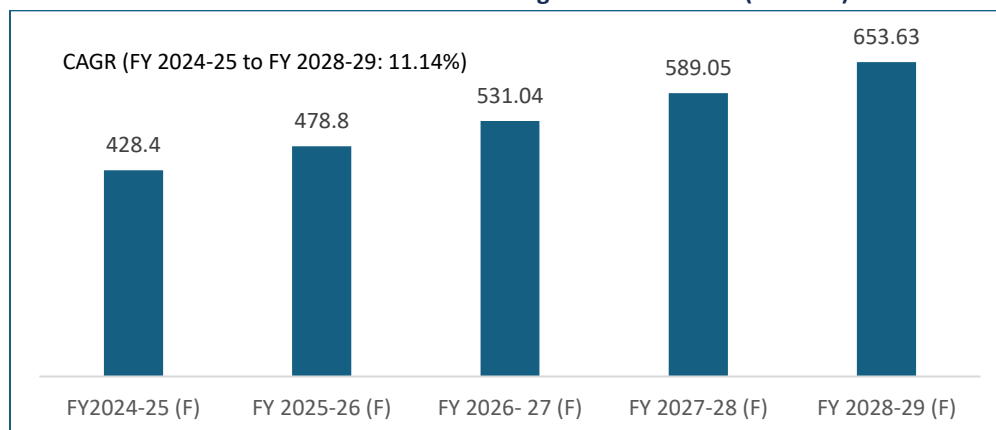


Source: Ikea Foundation research in collaboration with UK Aid- March 2023

To address these challenges, the Indian government has launched various initiatives aimed at bolstering cold storage capacity. These include the Mega Food Parks Scheme and the Cold Chain, Value Addition, and Preservation Infrastructure Scheme under the Ministry of Food Processing Industries (MoFPI), which provide financial assistance for the creation of integrated cold chain and preservation infrastructure. The government also offers fiscal incentives such as tax breaks under the Income Tax Act, concessional duties on imported refrigeration equipment, and eligibility for external commercial borrowings. Despite these efforts, more needs to be done to close the demand-supply gap, particularly in regions where infrastructure is severely lacking.

The cold storage sector in India is poised for rapid expansion, with the market expected to grow from ₹383.42 Billion in FY 2023-24 to ₹ 653.63 billion by FY 2028-29. This growth will be driven by increased demand across multiple sectors, including pharmaceuticals, organized retail, and food processing, as well as by rising exports of temperature-sensitive products. However, realizing this potential will require substantial investments in cold storage infrastructure, particularly in multi-purpose facilities that can cater to diverse commodities.

**Exhibit 34: Forecast Of Cold Storage Market In India (₹ Billion)**



Source: WDRA, Invest India, and Frost & Sullivan Analysis

Several flagship schemes are driving the expansion of cold storage infrastructure. The Pradhan Mantri Kisan SAMPADA Yojana (PMKSY), for instance, has been instrumental in financing cold storage projects. Under this scheme, the government offers subsidies of up to 50% for setting up integrated cold chain and value addition infrastructure, including pre-cooling facilities, refrigerated storage, and transportation.

Despite the overall growth, regional disparities in cold storage capacity remain a significant challenge. For instance, the North-Eastern region, which has a high production of horticultural products, faces a severe shortage of cold storage facilities. The North-East Region Cold Storage Infrastructure Development Program has been launched to address this gap, providing financial assistance and technical support to set up modern cold storage units in states like Assam, Manipur, and Meghalaya. Similarly in the south region, the Andhra Pradesh Horticultural Cold Chain Project is focused on enhancing cold storage facilities in the state, particularly for mangoes, which constitute a significant portion of the state's agricultural exports. The project aims to increase the state's cold storage capacity by 25% by 2025, ensuring that more of the mango harvest can be stored and exported without quality degradation.

## 4. Agriculture Financing in agriculture commodities and collateral management in India

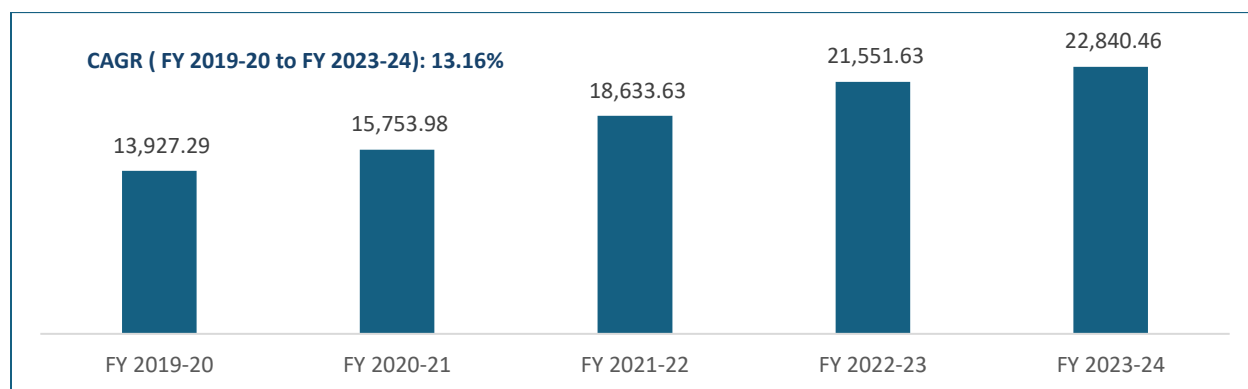
### 4.1 Overview of financing to the agriculture sector (pre-harvest to post-harvest)

The financing of the agriculture sector in India is multifaceted, spanning the entire agricultural lifecycle from pre-harvest to post-harvest activities. Given the crucial role that agriculture plays in India's economy, contributing around 18% to the GDP as of 31<sup>st</sup> May 2024 and employing more than 40-43% of the workforce, access to timely and affordable finance is a linchpin for enhancing productivity, reducing rural poverty, and ensuring food security. The financing needs in agriculture can be categorized into pre-harvest, harvest, and post-harvest stages, each having distinct requirements and challenges.

**Pre-Harvest Financing:** Pre-harvest financing is primarily aimed at facilitating the purchase of essential inputs like seeds, fertilizer, pesticides, and machinery. It is during this stage that farmers need access to timely, short-term loans to support the cultivation process. In India, a significant proportion of these loans are disbursed through institutional channels like public sector banks, cooperative societies, and microfinance institutions.

Of the Small and marginal farmers, who account for 86% of India's total landholdings, only 30% rely on formal credit for these pre-harvest inputs while the rest rely on informal financing source which often comes with brutal re-payment terms and high interest rates. The Kisan Credit Card (KCC) scheme has played a pivotal role in providing these farmers with access to short-term loans at concessional rates. The introduction of KCC in 1998 by the Government of India helped formalize agricultural credit and remove dependency on informal lending channels. As of 31<sup>st</sup> January 2024, banks issued 75 million KCC with a limit of ₹9,400 Billion.

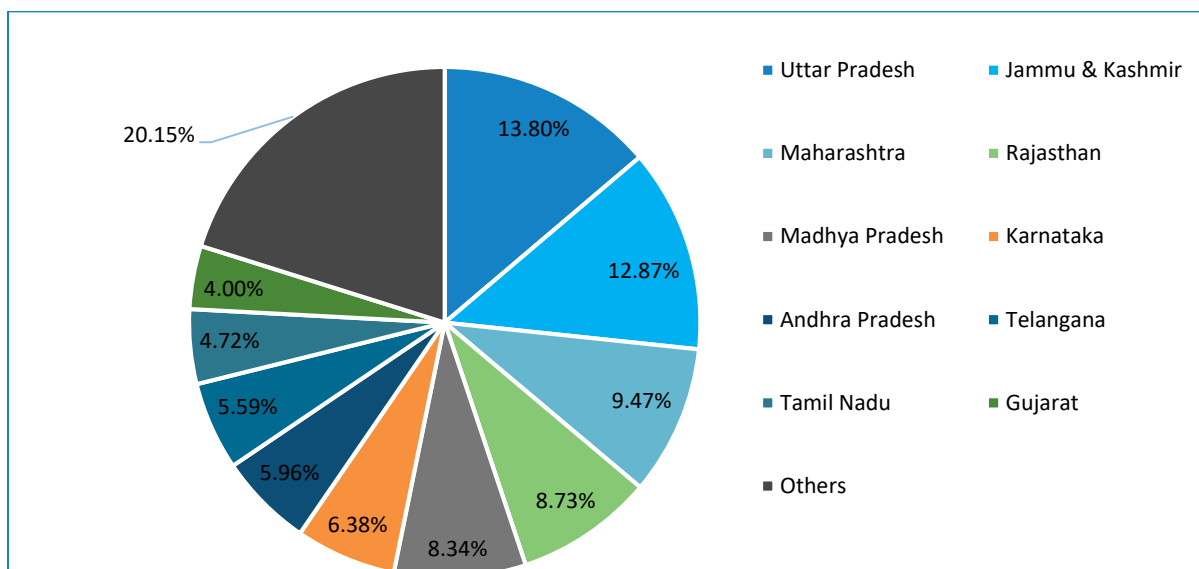
**Exhibit 35: Total Agricultural Credit Reported By RBI, (₹ billion)**



*Source: RBI, NABARD, WDRA, Frost and Sullivan Analysis*

The penetration of Kisan Credit Card (KCC) across India reflects significant regional disparities, driven by variations in agricultural infrastructure, farmer awareness, and access to institutional credit. As of September 2023, Uttar Pradesh leads with the highest share of KCC account holders at 20.15%, followed by Jammu & Kashmir at 13.80% and Maharashtra at 12.87%. These states exemplify the success of proactive government outreach and strong cooperative banking networks, which have ensured a high degree of formal credit penetration. Uttar Pradesh, in particular, has capitalized on its extensive rural banking infrastructure and widespread campaigns to promote KCC, making it a model for other regions.

**Exhibit 36: Share of Top 10 KCC account holders as by state as of September 2023**



Source: Frost & Sullivan analysis, Digital Sansad \* data as of September 2023

Jammu & Kashmir’s high penetration rate reflects the impact of targeted initiatives aimed at bringing marginalized farmers into the formal financial system. Despite the state’s challenging geography and smaller cultivable land sizes, strong cooperative banking networks have enabled small and marginal farmers to access credit through KCC. Maharashtra also performs well due to its well-developed cooperative credit ecosystem, which caters effectively to the needs of its diverse farming communities. However, drought-prone areas in Vidarbha and Marathwada continue to struggle with credit access, underscoring the persistent regional imbalances within the state.

Madhya Pradesh and Andhra Pradesh also show a moderate uptake of KCC, with shares of 8.34% and 5.96%, respectively. These states have made strides in expanding institutional credit to farmers, but land fragmentation and low financial literacy among smallholders have impeded further growth. Farmers in these regions often face challenges related to limited awareness of the KCC scheme’s benefits and the bureaucratic complexities of the application and renewal processes.

On the other hand, Tamil Nadu (4.72%) and Gujarat (4.00%) are among the states with the lowest shares of the top 10 KCC account holders, despite having relatively advanced agricultural sectors. In Tamil Nadu, the prevalence of tenant farming and the lack of formal tenancy documentation have left many farmers excluded from formal credit systems. Similarly, in Gujarat, the challenges of fragmented landholdings and the reliance on informal lending mechanisms have restricted KCC adoption. These states also suffer from insufficient awareness campaigns, limiting the reach of the scheme among small and marginal farmers who stand to benefit the most.

One of the key challenges across states with lower KCC penetration is the exclusion of tenant farmers from formal credit networks. These farmers, who often lack land ownership documents or tenancy agreements, are unable to meet the eligibility requirements for KCC loans. Consequently, they are forced to rely on informal moneylenders who charge exorbitant interest rates, perpetuating a cycle of debt and financial insecurity. This structural limitation is especially evident in Tamil Nadu and Gujarat, where tenant farmers

constitute a significant portion of the agricultural workforce but remain outside the ambit of institutional credit.

Addressing these disparities requires focused interventions to improve access to KCC benefits for marginalized farmers. Digitizing land records and formalizing tenancy agreements can enable tenant farmers to access institutional credit and reduce their reliance on informal lenders. Additionally, financial literacy campaigns tailored to the needs of smallholders can create greater awareness about the advantages of KCC and the process of applying for it. Streamlining the credit application and renewal processes can further remove barriers, especially in states with low penetration rates. By tackling these systemic issues, the KCC scheme can achieve broader and more equitable financial inclusion, driving sustainable growth in India's agricultural sector.

**Harvest Financing:** During the harvest phase, the need for financing shifts toward procuring equipment and labour to harvest crops efficiently and at the right time. The costs of labour, machinery (such as combine harvesters, threshers, and transport vehicles), and other logistical needs can be substantial, especially in labour-intensive states like Bihar and Uttar Pradesh, where mechanization is still underdeveloped.

Government-backed initiatives such as Custom Hiring Centres (CHCs) provide a crucial mechanism for farmers to rent expensive machinery at affordable rates, which helps mitigate the financial burden of purchasing such equipment. Financing for CHCs is typically available through the Sub-Mission on Agricultural Mechanization (SMAM), which offers up to 40% financial assistance for establishing these centres. This initiative allows even small and marginal farmers, who otherwise would not have the capital to invest in mechanized equipment, to access modern tools and improve harvesting efficiency.

Additionally, farmer producer organizations (FPOs) play a key role in aggregating smallholder demands for credit and machinery, enabling collective bargaining for better terms with banks and suppliers. With over 8,000 FPOs registered as of FY 2023-24 under various schemes, these organizations not only enhance credit access but also reduce post-harvest losses by coordinating logistics and storage.

**Post-Harvest Financing:** Post-harvest financing plays a pivotal role in managing storage, transportation, processing, and the eventual sale of produce. It provides working capital, stabilizes cash flows, and enables farmers and traders to cover operational expenses efficiently. This stage encompasses the financing of warehousing (both dry and cold storage), grading, sorting, packaging, and logistics. However, the agricultural sector in India faces significant challenges, particularly in rural areas, due to inadequate and outdated storage infrastructure, leading to considerable post-harvest losses.

Collateral Management Agencies (CMAs) such as Star Agri, have emerged as crucial enablers of credit flow in the agricultural value chain, bridging the gap between farmers and institutional lenders. These agencies manage the commodities stored in warehouses, ensuring that the quality and quantity of goods meet the requirements of financial institutions before issuing warehouse receipts. By acting as custodians of agricultural produce, CMAs provide the necessary assurance to lenders, facilitating the issuance of loans against stored commodities.



## **Role of CMAs in Enabling Credit Flow**

CMAs play a multifaceted role in the post-harvest financing ecosystem:

1. **Quality Assurance and Risk Mitigation:** CMAs conduct rigorous quality checks and ensure proper storage conditions to maintain the value of stored commodities. This reduces the risk for lenders and increases the credibility of the collateral.
2. **Warehouse Receipt Financing (WRF):** CMAs are instrumental in operationalizing Warehouse Receipt Financing by issuing receipts that serve as collateral for loans. Farmers and traders can access credit without having to sell their produce immediately, allowing them to avoid distress sales and capitalize on favourable market prices.
3. **Market Linkages and Transparency:** Many CMAs such as Star Agri through Agribazaar, have integrated technology to offer value-added services, such as price discovery tools, market analytics, and direct buyer linkages. These services enhance farmers' bargaining power and market access, making the credit system more effective and transparent.
4. **Scalability and Accessibility:** By partnering with warehouses in rural and semi-urban areas, CMAs expand the reach of post-harvest financing to small and marginal farmers, who traditionally struggle to access formal credit.

## **4.2 Overview of RBI's role in financing the agriculture sector**

The Reserve Bank of India (RBI) has historically been central to supporting agricultural finance through various policies and financial structures. Recognizing the sector's critical role in India's economy, the RBI has implemented several mechanisms to ensure a consistent flow of credit to agriculture, facilitating both short-term operational needs and long-term capital investments.

From its inception in 1935, the RBI has prioritized agricultural financing, establishing the Agricultural Credit Department (ACD) under Section 54 of the RBI Act to oversee rural credit. The ACD initially focused on policy guidance, research, and cooperation with state governments and cooperative institutions. However, with the evolution of agriculture, the RBI took a more direct approach by establishing the Agricultural Refinance Corporation (ARC) in 1963. The ARC provided medium- and long-term credit to banks and cooperatives, thus formalizing agricultural refinancing.

The ARC was later restructured into the Agricultural Refinance and Development Corporation (ARDC) in 1975, coinciding with the Green Revolution's focus on modernizing Indian agriculture through mechanization, irrigation, and better seeds. The ARDC played a pivotal role in supporting these capital-intensive investments.

### **Transition to NABARD**

In 1982, the establishment of the National Bank for Agriculture and Rural Development (NABARD) marked a significant shift. NABARD took over the responsibilities of the ACD, the ARDC, and the Rural Planning and Credit Cell (RPCC), becoming the primary agency for refinancing and overseeing rural credit institutions. This transition allowed the RBI to shift its focus to broader financial and regulatory oversight while continuing to influence agricultural finance through NABARD.

While the RBI delegated many of its direct functions to NABARD, it remains involved in shaping policy for agricultural finance and providing refinancing support through NABARD for cooperative banks and regional rural banks (RRBs).

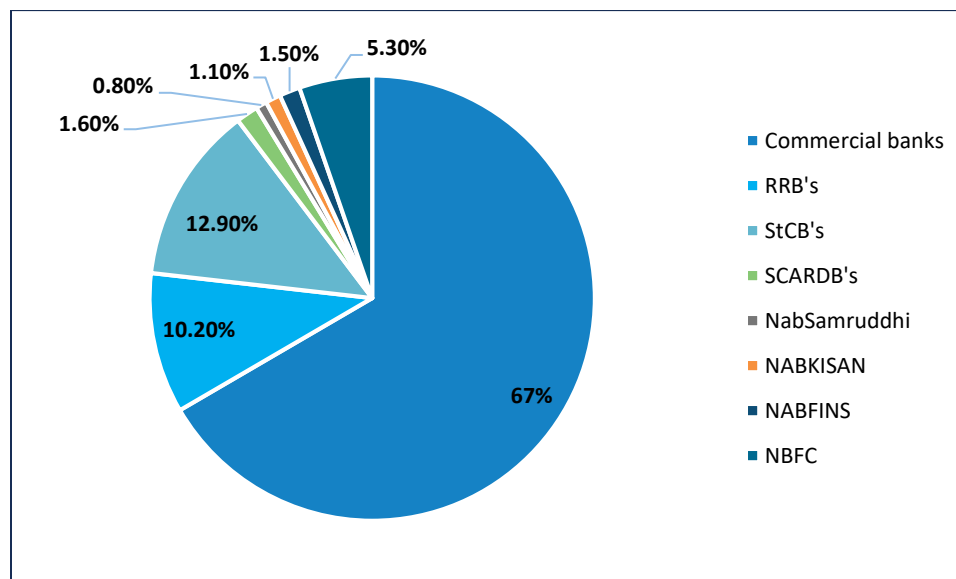
### Department of Refinance (DOR) and Credit Mechanisms

The Department of Refinance (DOR) within NABARD handles the majority of refinancing activities aimed at promoting liquidity and credit accessibility in agriculture. Through short-term and long-term refinance schemes, the DOR supports Seasonal Agricultural Operations (SAO) as well as long-term investments in agricultural infrastructure.

- Short-term refinance is primarily aimed at funding seasonal inputs such as seeds, fertilizer, and pesticides. This helps farmers manage immediate operational needs while stabilizing their cash flow. The Short Term Cooperative Rural Credit Fund (STCRCF) and Short Term Regional Rural Bank (STRRBF) Refinance Fund provide concessional refinancing options to State Cooperative Banks (StCBs) and Regional Rural Banks (RRBs).
- Long-term refinance focuses on supporting capital investments in agriculture, such as purchasing machinery, building storage facilities, and irrigation systems. In FY 24, approximately ₹1,324.86 billion was disbursed, with commercial banks accounting for more than 66% of long-term refinance(NABARD). The Long-Term Rural Credit Fund (LTRCF) helps ensure concessional lending for these investment activities.

In times of natural disaster or crop failures, the DOR also facilitates medium-term conversion loans, which convert short-term crop loans into medium-term loans, providing financial stability to affected farmers.

**Exhibit 37: Long Term Refinance Disbursement by Banking entities (FY 2023-24)**



Source: NABARD

## Cooperative and Rural Credit Structures

One of the RBI's significant contributions has been the development and oversight of the cooperative credit structure, which provides a major portion of rural credit, especially for small and marginal farmers. Initially, the RBI played a direct role in expanding the cooperative credit network, working closely with State Cooperative Banks (SCBs) and State Land Development Banks (SLDBs) to ensure both short-term and long-term credit flows to agriculture. This system has been integral in delivering credit to underserved regions where traditional commercial banking has been less effective.

The cooperative credit structure remains vital in the rural economy, and the RBI's role has shifted towards providing refinancing support and ensuring the system remains solvent and effective. The RBI's National Agricultural Credit Fund has been a critical source of long-term loans to state governments, helping to strengthen rural credit systems.

## Modernizing Agricultural Finance Through Technology

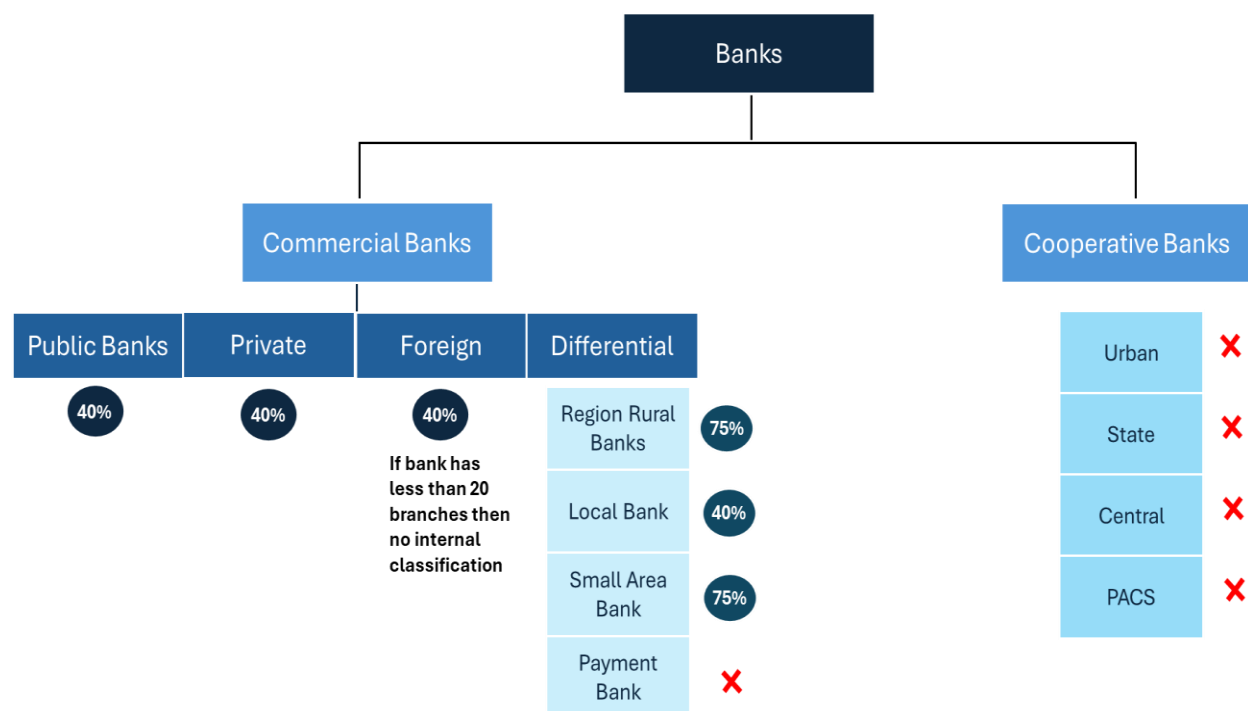
The RBI has actively supported the digital transformation of rural credit systems. By promoting digital banking initiatives like e-NAM (National Agriculture Market) and the digitization of land records, the RBI has contributed to improving transparency, efficiency, and credit delivery to farmers. These initiatives also align with the RBI's broader goal of financial inclusion, reducing the dependence on informal lending channels by enabling rural populations to access formal financial services digitally.

The RBI's focus on mobile banking, digital credit scoring, and other technological solutions ensures that even smallholder farmers can access credit facilities more conveniently. This is especially crucial as farmers become more integrated into market-oriented value chains.

### **4.2.1 Overview of Priority Sector Lending (PSL) guidelines**

As of 2024, the PSL target for the agriculture sector has been set for 18%. The Priority Sector Lending (PSL) guidelines issued by the Reserve Bank of India (RBI) ensure that specific sectors that are critical to economic and social development, including agriculture, receive targeted financial support from banks. The PSL framework mandates that all scheduled commercial banks (SCBs), small finance banks (SFBs), and regional rural banks (RRBs) allocate a percentage of their Adjusted Net Bank Credit (ANBC) to priority sector, with agriculture being one of the key focus areas. This requirement is aimed at promoting financial inclusion, encouraging investment in underserved regions, and supporting critical rural infrastructure.

## Allocation Requirement:



Source: RBI

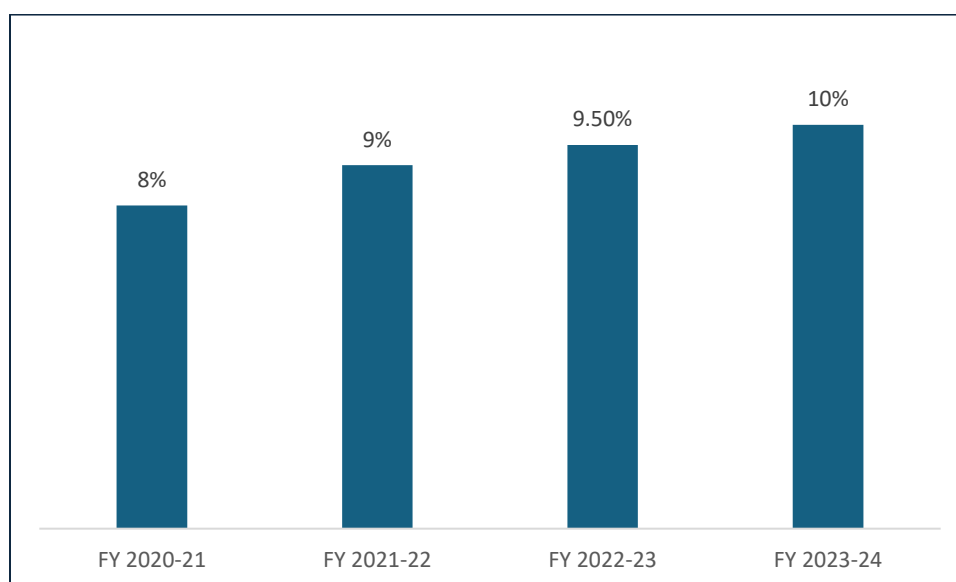
- Domestic SCBs and RRBs must allocate 40% of their ANBC to priority sector, of which 18% must be directed to the agricultural sector.
- A sub-target of 10% is set specifically for Small and Marginal Farmers (SMFs), ensuring that smaller landholder who often face credit exclusion are given access to formal financial services. Small farmers are defined as those with landholdings of less than 2 hectares

## Comprehensive Coverage:

Category	Details
<b>Crop production loans</b>	Short-term loans to finance inputs like seeds, fertilizer, and pesticides.
<b>Self-Help Groups (SHGs)</b>	Credit for group farming activities.
<b>Farmer Producer Organizations (FPOs)</b>	Loans to FPOs for collective farming and allied activities.
<b>Tenant Farmers &amp; Sharecropper</b>	Credit to farmers without land titles, provided through SHGs and Joint Liability Groups (JLGs).
<b>Agri-Infrastructure</b>	Loans for infrastructure such as cold storage, irrigation systems, and warehousing facilities.
<b>Renewable Energy for Agriculture</b>	Loans for renewable energy systems used in agriculture, such as solar pumps.

## Target Beneficiaries

Exhibit 38: PSL - Small and Marginal Farmers loan target in PSL Target beneficiaries



Source- RBI, Frost & Sullivan Analysis

The PSL guidelines prioritize small and marginal farmers, tenant farmers, and sharecropper, who often face difficulty in accessing credit due to a lack of formal land titles or collateral. By setting sub-targets for these groups, the RBI ensures that banks must actively engage in lending to the most vulnerable segments of the agricultural sector.

### 4.2.2 What Happens When PSL Targets Are Not Met?

Banks that fail to meet their PSL targets face financial and operational consequences designed to encourage compliance. The most common mechanism is mandatory contributions to development funds like the Rural Infrastructure Development Fund (RIDF), managed by NABARD. RIDF was established in 1995 to support infrastructure projects in rural and agricultural sector, especially in regions where banks fall short of their direct lending targets.

While RIDF contributions help develop essential rural infrastructure—such as irrigation systems, rural roads, and warehouses—they do not directly increase access to credit for farmers. Banks that contribute to the RIDF may still struggle to meet their direct lending targets, thus limiting their direct impact on financial inclusion in rural areas.

Another method of compliance is through the purchase of Priority Sector Lending Certificates (PSLCs). PSLCs allow banks that exceed their PSL targets to sell the excess credit to banks that fall short. While PSLCs provide flexibility to banks, they do not solve the underlying issue of insufficient direct lending to the agricultural sector in underserved regions. Banks that rely heavily on PSLCs are, in effect, bypassing the need to engage with rural borrower directly, which can limit the intended impact of the PSL framework.

Banks that consistently fail to meet their PSL targets face restrictions on other areas of operation, such as delays in receiving regulatory approvals for new branches or changes in business strategy. These restrictions are designed to ensure that banks take their PSL obligations seriously and engage more actively in priority sector.

#### 4.2.3 Merits and De-merits of the role of the current PSL mechanism

Merits	De-Merits
<p><b>Financial Inclusion:</b> By mandating that banks allocate a significant portion of their credit to small and marginal farmers. PSL ensures that the most underserved communities are included in the formal financial system</p>	<p><b>Quality of Lending:</b> While the PSL mechanism ensures that banks meet numerical lending targets, there is often a focus on quantity over quality. Some banks may provide credit without adequate risk assessment, leading to high levels of non-performing assets within the priority sector</p>
<p><b>Risk Mitigation for farmers:</b> PSL credit facilitates timely access to funds for crop production and allied activities, reducing the dependency on informal credit sources, which often charge exorbitant interest rates</p>	<p><b>Regional Disparities:</b> Despite the universal application of PSL, certain regions, particularly North-East India and hilly states, remain underserved due to weaker banking infrastructure and high credit risk. Banks in these regions often choose to contribute to RIDF or purchase PSLC's rather than increase direct lending</p>
<p><b>Comprehensive Sectoral Coverage:</b> PSL guidelines go beyond crop production to cover infrastructure and renewable energy fostering modernization in agriculture and promoting sustainability</p>	<p><b>Over-Reliance on PSL's:</b> The growing use of PSLC's has led to concerns that banks are using this mechanism as a shortcut to meet their PSL target without directly engaging with the agricultural sector. This limits long term impact of PSL on financial inclusion and rural development</p>

#### 4.3.4 Qualitative overview of the role of players other than banks

Non-Banking Financial Companies (NBFCs) and NBFC-MFIs (Microfinance Institutions) play a pivotal role in reaching underserved areas of the agricultural sector. By partnering with Scheduled Commercial Banks (SCBs) and Small Finance Banks (SFBs), NBFCs extend their reach to remote rural markets, providing credit to small and marginal farmers.

##### Co-Lending and On-Lending Limits

As per the PSL guidelines:

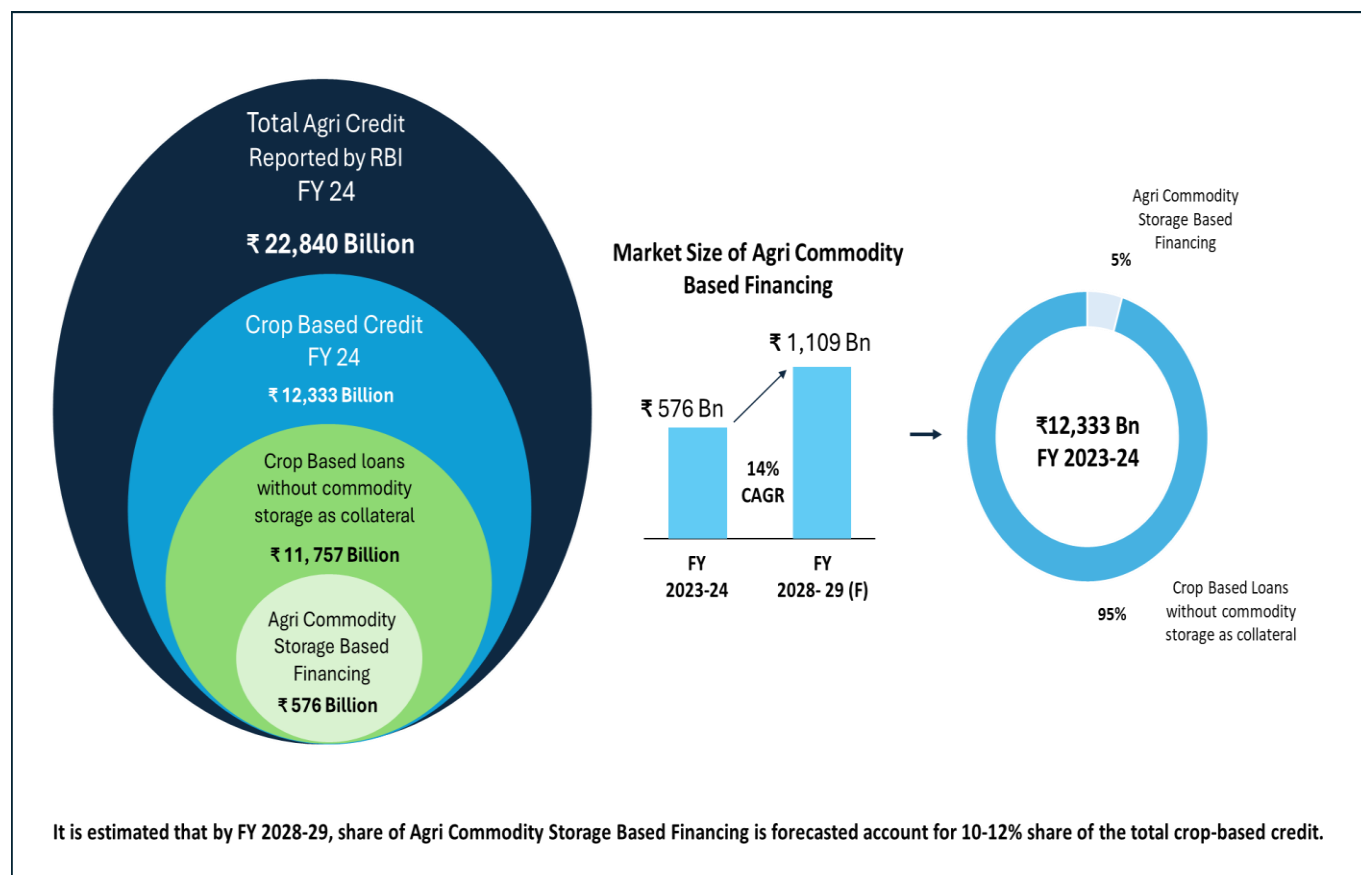
- SCBs can lend up to 5% of their total PSL portfolio to NBFCs (including Housing Finance Companies - HFCs) for on-lending.
- SFBs can lend up to 10% of their total PSL portfolio to NBFC-MFIs and other MFIs (Societies, Trusts, etc.), ensuring that smaller microfinance institutions gain access to bank funds.

These limits provide flexibility while ensuring that the majority of direct credit is provided through traditional banking channels.

### 4.3 Overview and Typical high-level Process flow and technology interventions for Agricultural Commodity Custody based financing (Collateral Management)

The agriculture commodity storage/custody-based financing (collateral management) segment within India's agricultural finance market has shown steady growth, driven by the increased demand for structured financing solutions that enable farmers and agribusinesses to leverage stored produce as collateral. In FY 2023-24, the collateral management (agri-commodity storage-based financing) market size was valued at approximately ₹576 Billion, projected to grow at a compound annual growth rate (CAGR) of around 14%, reaching over ₹ 1,109 Billion by FY 2028-29. This growth trajectory reflects the sector's critical role in providing liquidity, especially to small and medium-sized agricultural enterprises that often struggle to access traditional bank credit.

**Exhibit 39: Market landscape for Agricultural Commodity Storage Based Financing in India (FY 24 to FY 29)**



Source- RBI, WDRA, NABARD, Economic Survey 2023-24, Frost & Sullivan Analysis; Note: Informal Agriculture Finance lending indicates Agri Based Financing without agri commodity as collateral management

As of June 2024, Star Agri is estimated to be the largest player within the Agri Commodity Based Financing (Collateral Management) in India with an AUM in between ₹ 130-165 Billion in India, serviced by the largest agricultural warehousing capacity of 4.5-5.2 MMT.

The process ensures that commodities pledged as collateral are securely stored, monitored, and valued accurately, facilitating financial transactions and ensuring risk management across the supply chain.

**Exhibit 40: Process flow for collateral management**



**1. Commodity Assessment and Valuation:**

- The process begins with the accurate assessment and valuation of agricultural commodities. This involves not only determining the quantity and quality but also ensuring that the commodities meet the necessary standards for storage and financing.

**2. Storage in Secured Warehouses:**

- Following the valuation, the commodities are stored in warehouses. These facilities are usually equipped with sensors that monitor environmental conditions such as temperature, humidity, and pest control measures in real time. This technology ensures that the quality of the stored commodities is maintained throughout the storage period, reducing the risk of spoilage and ensuring that the collateral retains its value.

**3. Issuance of Warehouse Receipts**

- Upon the storage of commodities, Collateral Management Agencies issues Warehousing Receipts (WR). These digital receipts are a pivotal innovation in the collateral management process, enabling seamless, transparent, and secure transactions between stakeholders. The WR's are stored on a blockchain-enabled platform, ensuring that each transaction is recorded immutably, enhancing the security and trust in the collateral management system. The physical receipts are handed over to the tenant who's commodity is warehoused, which is leveraged to securing loan from banking establishments
- The NWR not only serve as proof of ownership but also facilitate quick and easy access to credit from financial institutions, as these receipts can be digitally transferred and used as collateral for loans. This system significantly reduces the turnaround time for obtaining finance, making it easier for farmers and trader to secure working capital.

**4. Continuous Monitoring and Risk Management:**

- CMA's along with Warehouse Operators are continuously monitoring the quality, quantity and market price of the commodity.

**5. Disposition and Liquidation:**

- In the event of a loan default, the stored commodities can be liquidated to recover the outstanding amount. Warehouse owner/operators such as Star Agri facilitates this process through its digital platforms, such as Agribazaar, which connects sellers directly with



buyer. This online marketplace ensures that the liquidation process is quick and that the commodities are sold at the best possible market prices, maximizing recovery for the financial institutions.

## 6. Technology Interventions

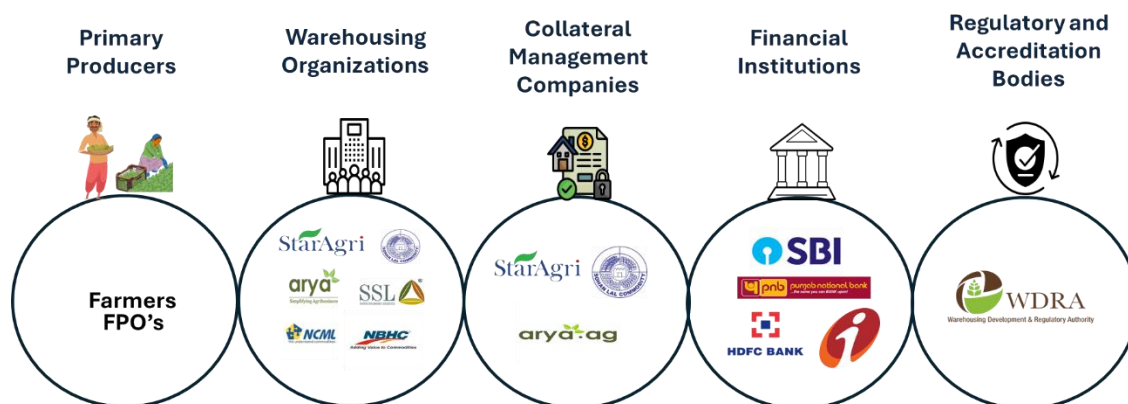
Players in this category are integrating technology into the collateral management process, ensuring efficiency, transparency, and security at every step. Key technological interventions include:

- **Artificial Intelligence (AI) and Machine Learning (ML):** These technologies are utilized for the accurate grading and quality assessment of commodities. AI and ML algorithms analyze data collected by sensor to predict potential issues and suggest preventive measures, ensuring the quality of the collateral is maintained.
- **Digital Platforms:** Digital platforms, such as Agribazaar, streamline the process of selling and liquidating collateral. These platforms connect farmers, traders, and buyer directly, reducing the need for intermediaries and ensuring that the commodities are sold quickly and at fair market prices.

## 4.4 Overview of the different types of stakeholders/players currently involved in the value chain

In the Indian agricultural collateral management ecosystem, a diverse set of stakeholders work together to ensure that agricultural commodities, when pledged as collateral, are managed effectively and securely. This ecosystem includes a wide range of players, from producer to financial institutions, all of whom contribute to the efficiency and stability of the value chain. Below is an overview of these stakeholders.

**Exhibit 41: Key Stakeholders in the Collateral Management Value Chain**



### Farmers and Farmer Producer Organizations (FPOs)

- **Primary Producer:** The backbone of the value chain, farmers across India, particularly small and marginal ones, rely on collateral management services to secure better financing and market access for their produce. Organizations like the Small Farmers Agribusiness Consortium (SFAC) play a critical role in promoting FPOs, which help small farmers collectively bargain for better prices and access credit more easily.
- **Farmer Producer Organizations (FPOs):** These collectives are instrumental in aggregating produce, thus enhancing the bargaining power of small farmers. Notable FPOs that

collaborate with collateral management firms include Sahyadri Farms, Green Earth Producer, and several others supported by NABARD and SFAC.

### **Warehousing Companies**

- **Private Warehousing Companies:** Companies such as Star Agri, National Bulk Handling Corporation (NBHC), and Sohan Lal Commodity Management (SLCM), are major players in this sector. They provide storage solutions that ensure the quality and safety of agricultural commodities, which are crucial for securing loans.
- **Public Warehousing Entities:** The Central Warehousing Corporation (CWC) and State Warehousing Corporations (SWCs) are key public sector players providing storage facilities across the country. These entities often collaborate with private players to manage the vast storage needs of India's agricultural sector.

### **Agriculture Commodity Custodians (Collateral Management) Companies**

- **Specialized Firms:** Companies like Star Agri, NBHC, and Arya Collateral Management play a central role in managing the collateral by ensuring the commodities are correctly valued, stored, and maintained. These companies also offer additional services such as quality testing, certification, and risk management.

### **Financial Institutions**

- **Public Sector Banks:** Institutions such as State Bank of India (SBI), Punjab National Bank (PNB), and Bank of Baroda are among the largest lenders to the agricultural sector, providing loans against warehoused commodities. These banks heavily rely on collateral management firms for risk assessment and valuation.
- **Private Sector Banks and NBFCs:** HDFC Bank, ICICI Bank, and Kotak Mahindra Bank, along with Non-Banking Financial Companies (NBFCs) like Mahindra Finance and Muthoot Finance, are increasingly active in this space, offering tailored financing solutions to farmers and traders. The use of e-NWR has significantly eased the process of securing loans, making these institutions key players in the value chain.

### **Regulatory and Accreditation Bodies**

- **Warehousing Development and Regulatory Authority (WDRA):** WDRA is the key regulatory body overseeing the warehousing sector in India. It accredits warehouses, ensuring they meet stringent standards for storing agricultural commodities, which in turn safeguards the interests of financial institutions and farmers.
- **FSSAI and APEDA:** The Food Safety and Standards Authority of India (FSSAI) and the Agricultural and Processed Food Products Export Development Authority (APEDA) provide necessary certifications related to food safety and export quality, ensuring that agricultural commodities meet national and international standards.

### **Securities Custodians**

- **Depositories and Custodians:** National Securities Depository Limited (NSDL) and Central Depository Services Limited (CDSL) are key players in managing electronic records of financial

securities. Their role in securely managing these records is critical as more transactions move to digital platforms.

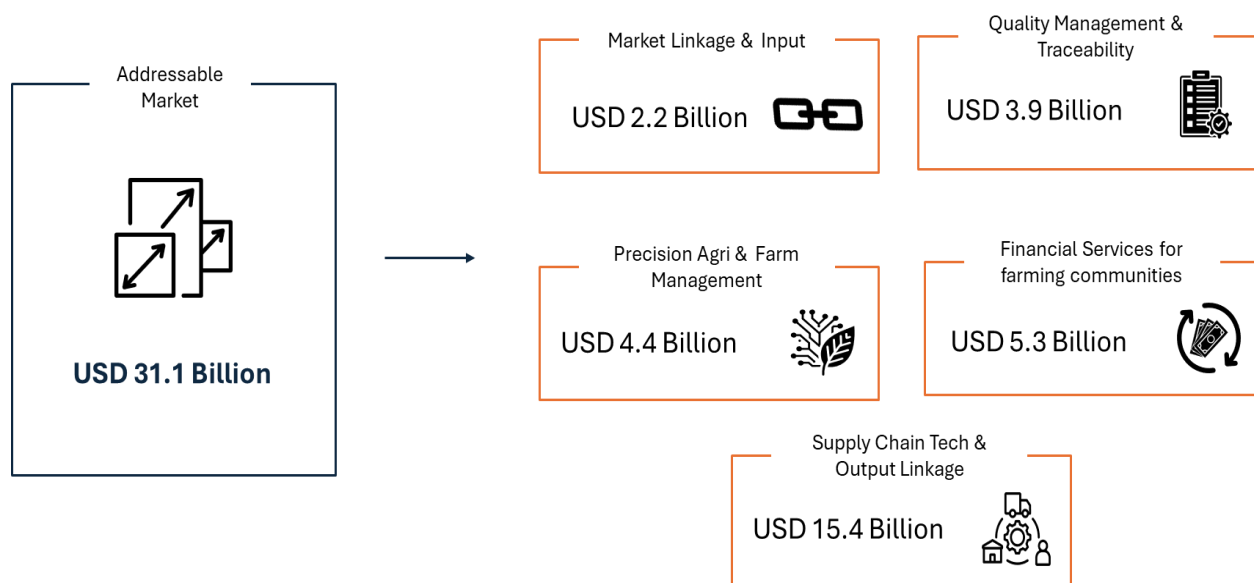
- **Custodian Banks:** Banks like HDFC Bank, ICICI Bank, and Axis Bank offer custodial services for WR's and other securities, providing an additional layer of security and trust in the financial transactions involving agricultural commodities.

## 5 Review and Outlook of the Indian Tech Enabled Integrated Agricultural Services market in India

### 5.1 Market Overview and Structure

As one of the largest employers in the country, agriculture plays a critical role in India's economy, contributing about 18 % as of 31<sup>st</sup> May 2024, to the national GDP. However, this contribution is disproportionately low compared to the sector's potential, largely due to inefficiencies in the value chain, fragmented landholdings, and a lack of access to modern technology.

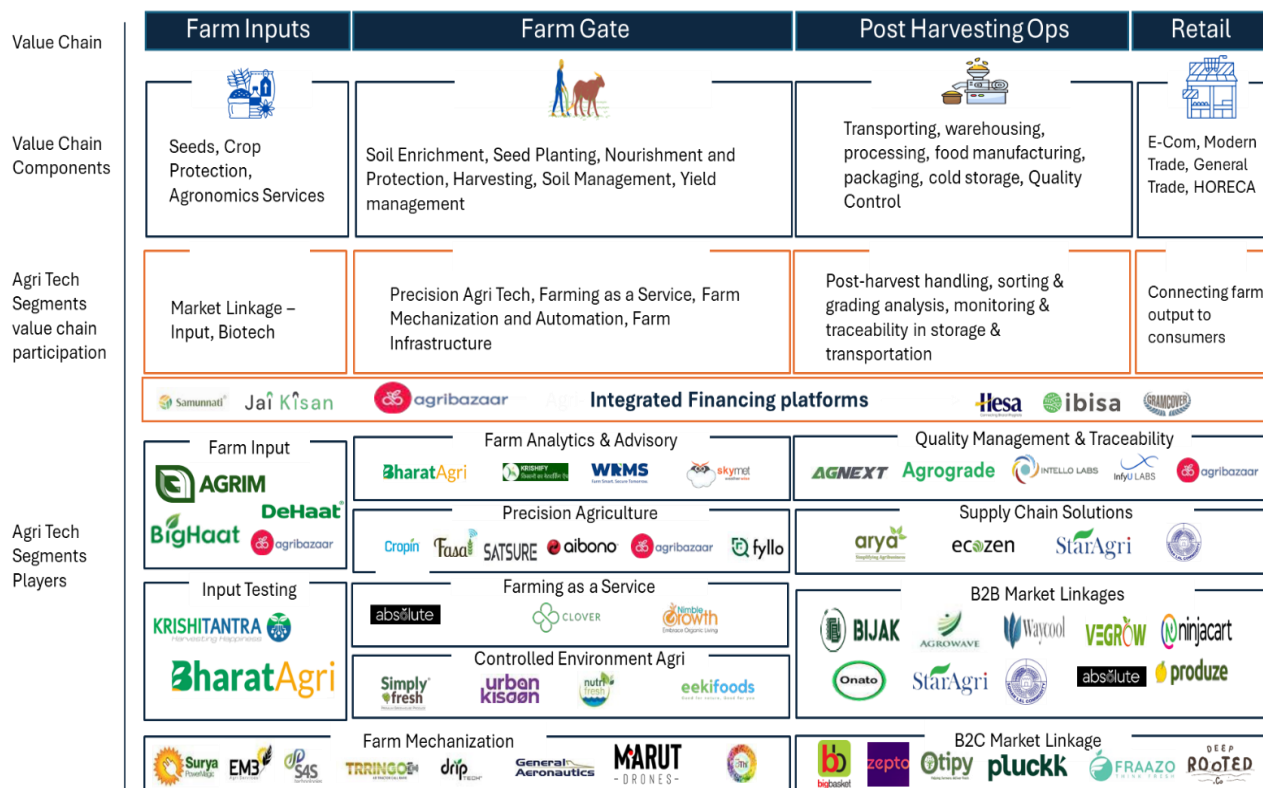
**Exhibit 42: Integrated Tech Enabled Agricultural Services Addressable Market Size (CY 2023)**



Source: Frost & Sullivan Analysis

The Indian integrated agricultural services landscape continues to evolve and integrated service providers are emerging as a dominant force, poised to reshape the agricultural value chain from end to end. Agritech companies offer a suite of services encompassing everything from input procurement and farm advisory to post-harvest management and market linkages. These platforms seek to address the systemic inefficiencies of Indian agriculture by integrating multiple services into a seamless ecosystem, ensuring that farmers have access to the tools and resources they need at every stage of the agricultural process. The addressable size of the integrated agricultural services industry is expected to scale from an estimated \$31.1 billion in CY 2023 to an astounding \$75 billion by CY 2030 (F). This represents a compound annual growth rate (CAGR) of 13.45%, driven by the convergence of digital innovation, regulatory support, and evolving market dynamics.

**Exhibit 43: Tech Enabled Integrated Agricultural Services Ecosystem in India and Emerging players**



Source: Frost & Sullivan Analysis

The sub-segments include precision agriculture, digital marketplaces, farm management software, supply chain solutions, and financial services tailored for the agricultural sector. Each of these areas has seen varying levels of adoption and success, depending on factors such as regional differences, crop types, and the technological literacy of the farming community.

## 5.2 Current Tech Enabled Integrated Agricultural Services Business Models

Various agritech companies and startups are pioneering innovative solutions designed to overhaul the output linkage system and create more value for all stakeholder involved.

### 5.2.1 Enhanced Warehousing Solutions

Efficient warehousing is critical to addressing many of the challenges in output linkage, particularly those related to price volatility and post-harvest losses. Companies like Star Agri are leading the charge by providing decentralized warehousing solutions that are accessible even to small and marginal farmers. These facilities allow farmers, aggregators and traders to store their produce during periods of low prices, thereby reducing the pressure to sell immediately after harvest. By leveraging data and IoT, these companies are also able to offer real-time monitoring of stored goods, ensuring optimal conditions and minimizing losses.

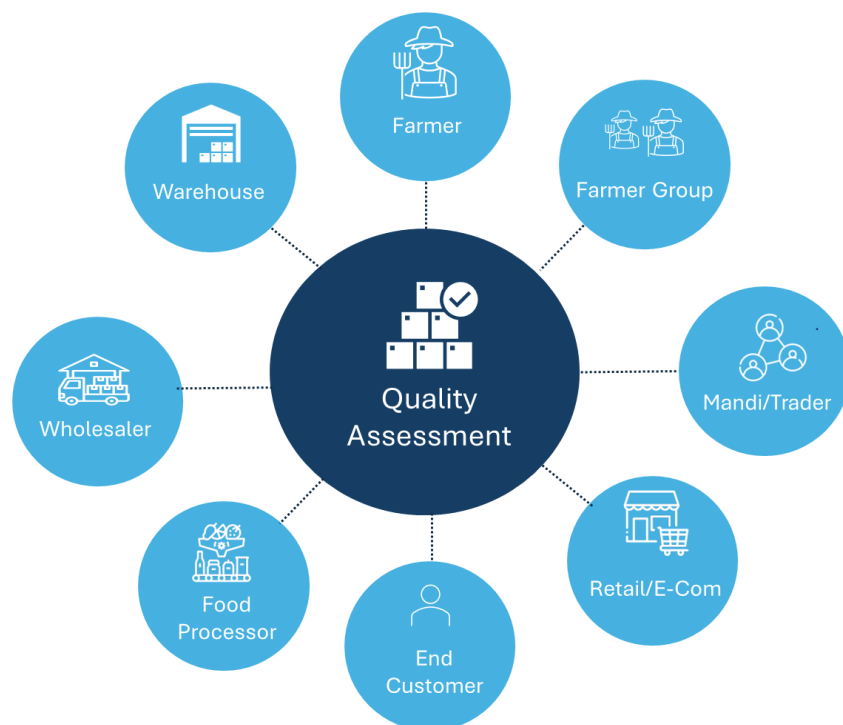
### 5.2.2 Integrated Financial Services

To tackle the issue of limited access to finance, integrated agricultural services firms are integrating financial services with their warehousing and market linkage platforms. For example, Star Agri offers collateral-backed loans that provide farmers, aggregators, traders and processors with the liquidity they

need without having to sell their produce at unfavourable times. This integration of finance with storage and distribution services helps farmers manage cash flow more effectively and reduces their dependence on predatory informal lender.

### 5.2.3 Standardization and Quality Assurance

Improving the consistency of quality standards across the value chain is essential for enhancing the competitiveness of Indian agriculture. Platforms like Bijak and AgriBazaar (owned by StarAgri) are implementing trust layer that include rating and accountability systems for participants. These systems help reduce counterparty risk and ensure that all transactions meet predefined quality standards. By standardizing quality assessments, these platforms enable better price realization for farmers and build trust with buyers, which is crucial for expanding market access, particularly in export markets.



### 5.2.4 Reducing wastage through Supply Chain Innovations:

Startups like WayCool and Ecozen are focusing on supply chain innovations that minimize wastage and improve the efficiency of produce movement. WayCool employs data analytics to optimize logistics, reducing the time and cost associated with transporting produce from farm to market. Ecozen, with its solar-powered cold storage units, is addressing the need for reliable and sustainable storage solutions in remote areas. These innovations are particularly important for reducing the 10-15% wastage typically seen in perishable commodities, thereby increasing the overall efficiency of the output linkage system.

### 5.2.5 Expanding Market Linkage with digital integrations:

Digital marketplaces are playing a pivotal role in transforming the output linkage system by directly connecting farmers with institutional buyers, retailers, and even end consumers. Companies like AgriBazaar, DeHaat and Ninjacart are examples of platforms that aggregate demand and supply at scale, reducing the need for intermediaries and ensuring better prices for farmers. These platforms also enable more efficient matching of supply with demand, which helps stabilize prices and reduce volatility. By offering value-added services such as digital payments, logistics support, and quality assessments, these

platforms are making it easier for farmers to access broader markets and achieve better financial outcomes.

The focus on export-oriented models is also growing, particularly for high-value produce that meets international standards. Companies like Absolute are leveraging precision farming techniques to produce higher-quality goods that can be sold in developed markets at premium prices. These export-oriented models not only provide farmers with higher margins but also help them diversify their income streams, making them less vulnerable to domestic market fluctuations.

*Farm Inputs*

India's agricultural sector has long been plagued by inefficiencies in the distribution of farm inputs such as seeds, fertilizer, and pesticides. The problem is compounded by the highly fragmented nature of the supply chain, which results in high costs, inconsistent quality, and limited access to necessary resources, particularly for smallholder farmers.

The addressable market for farm inputs is estimated to be worth \$ 2.2 billion as of CY 2023, representing around 7.07% of the total Agritech market. The inefficiencies in this segment have historically led to significant yield gaps, where Indian farmers achieve lower productivity levels compared to their global counterparts due to poor input quality and suboptimal application methods. The impact is evident in the nation's agricultural output, which despite being substantial, lags in per-hectare yields when compared to countries like China or the United States.

To address these issues, Agritech startups such as StarAgri, DeHaat and BigHaat have developed platforms that directly connect farmers with input supplier, effectively cutting out the middlemen and reducing costs.

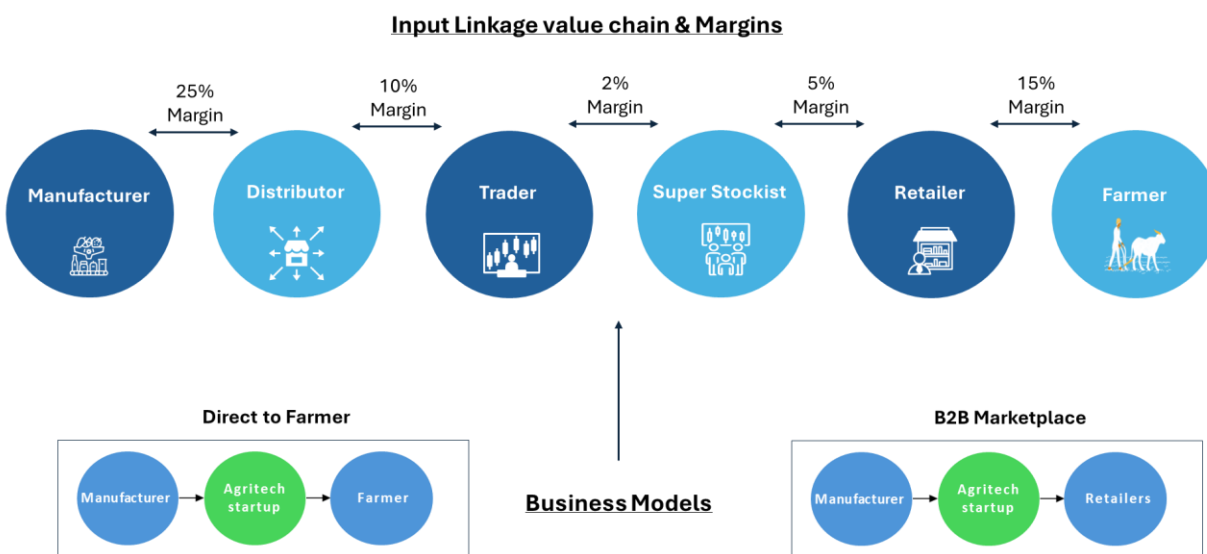
**Pre-Production Pain Points**

 <p>Non-uniformity of input prices across locations</p>	Direct partnership with leading as well as SME manufacturers providing improved access to right inputs to farmers/retailers
 <p>Lack of adequate farmer knowledge and incentive to retailers leading to inefficient input usage</p>	Quality assurance on inputs and input advisory to assist farmers with right inputs for their crops
 <p>Lower mechanization with limited access to resources</p>	Access to equipment and tech to lower cultivation cost

The growth of these platforms underscores the significant opportunity in this space. The Farm Inputs market has seen increased investor interest due to its scalable nature and the clear impact it has on improving agricultural productivity. These startups have not only attracted funding but also built robust distribution networks, enabling them to scale rapidly and reach a broad base of farmers, thereby addressing one of the most critical bottlenecks in Indian agriculture.

The input linkage in Indian agriculture is the foundational stage of the agricultural value chain, encompassing the supply and distribution of critical agricultural inputs such as seeds, fertilizer, agrochemicals, and machinery. This segment is crucial as it directly impacts crop productivity, quality, and overall agricultural efficiency. However, the current state of input linkage in India is fraught with challenges, from fragmented supply chains to suboptimal input utilization, creating significant inefficiencies.

**Exhibit 44: Input Linkage value chain, margins and business model**



Source: Frost & Sullivan analysis

### *Precision Agriculture and Farm management*

As of CY 2023, the addressable Precision Agriculture and Farm Management segment was valued at \$ 4.4 billion, making up 14.15% of the total Agritech market. This sub-segment is growing rapidly as more farmers recognize the benefits of adopting technology to manage their farms more efficiently. Precision agriculture involves the use of IoT devices, drones, satellite imagery, and data analytics to monitor crop health, optimize irrigation, and manage pests. The potential impact is enormous, as these technologies can increase yields by up to 30%, reduce water usage by 20-40%, and lower input costs significantly.

The adoption of precision agriculture in India is still in its early stages, but the impact has been significant in regions where it has been implemented. For example, in Maharashtra, a state frequently affected by drought, the use of IoT-based precision irrigation systems has helped farmers reduce water usage by up to 40%, while simultaneously increasing crop yields.

Components of Precision Farming are:

**Digital Solution & Precision AgriTech:** Firms in this sector deploy satellite imagery, drone technology, and sensors to collect data, which is then processed using artificial intelligence and machine learning to guide precision farming practices. These practices include variable rate technology (VRT) for optimal resource application, and real-time crop and soil monitoring to tailor agricultural practices to specific conditions.

**Farming as a Service (FaaS):** This model utilizes cloud computing and IoT platforms to offer integrated farming services, including remote crop monitoring, automated irrigation, and precision fertilization, on a Subscription basis. The service aims to provide scalable and accessible agricultural solutions to improve yield and reduce labor through comprehensive data analysis and machine-assisted operations.

**Temperature Controlled Environmental Agriculture:** Companies operating in this area specialize in indoor farming techniques that control environmental variables such as light, humidity, temperature, and CO2 levels. Utilizing advanced hydroponics and vertical farming technologies, these firms achieve optimal plant growth conditions, resulting in increased productivity and sustainability by significantly reducing water usage and eliminating pesticide dependency.



Smart Farm Machine: Enterprises in this category are focused on developing autonomous tractors, drones, and robotic systems that utilize GPS mapping, computer vision, and predictive analytics to perform complex agricultural tasks. These machines enhance precision in planting, weeding, and harvesting, thereby increasing efficiency, reducing waste, and minimizing the environmental footprint of farming operations.

**Satellites and weather imagery**

Detailed advisory from pre-sowing to harvesting using weather and satellite imagery

- Provides advisory on a subscription basis or freemium basis (monetizing through other services)
- Low/Zero subscription charges leading to higher penetration

Players

**Sensors & IT**

Crop level personalized intelligence using IoT, sensors, and AI

- Engaging with enterprises on contractual basis or with farmers on subscription basis
- Upfront cost of hardware and monthly charges impacting adoption

Players

**Temperature Controlled Environment Agriculture**

Farm-to-fork manufacturers who grow products scientifically aiming for efficiency, less wastage, free form positioning products therefore selling high quality products at an ambitious economical rate

Players

**Drones and Smart farm machines**

Startups in this space build smart machines that enable farm mechanisation, automation and surveillance. They also offer, offer farm automation, surveillance and mapping services utilising drones

Players

Private players such as Agribazaar plays a pivotal role in implementing YES TECH by enhancing data collection, analysis, and yield estimation processes. By integrating satellite imagery, IoT sensors, and AI-based analytics, private companies can provide advanced tools for real-time monitoring of crop health, soil conditions, and weather patterns.

**Potential Benefit of IoT**

<b>25-40%</b> Superior Yields	<b>15-20%</b> Lower Input Cost
<b>30-50%</b> Lower Water Usage	<b>30-40%</b> Lower Pesticide Use

This technology-driven collaboration can help reduce the dependency on traditional crop-cutting experiments by offering precise digital yield assessments, which streamline insurance claim settlements under the Pradhan Mantri Fasal Bima Yojana (PMFBY). Private sector innovation in remote sensing and digital mapping supports timely decision-making, empowering farmers with actionable insights for sustainable crop management and risk mitigation.





### Quality Management and Traceability







One of the major challenges in Indian agriculture is the lack of standardized quality and traceability systems, which often leads to inefficiencies, food safety concerns, and low-price realization for farmers. This problem is particularly acute in the context of exports, where Indian produce often fails to meet international quality standards, resulting in significant losses. The issue of traceability is also critical in the domestic market, where consumers are increasingly demanding information about the origin and quality of their food.

**Traceability & Testing**

Startups in this space offer detailed quality assessment solutions across the value chain monitoring and testing services including physical and chemical tests

- Proprietary AI tech enables testing within 30 seconds
- Subscription based model make testing more affordable
- Portable and accurate technology
- Enables 40% reduction in rejections and 30% reductions in food loss

**Players**

**Investors**

The addressable Quality Management & Traceability segment, valued at \$ 3.9 billion in CY 2023, addresses these challenges by providing solutions that ensure the quality of agricultural produce from farm to fork. This segment represents 12.54% of the total Agritech market and is becoming increasingly important as the demand for transparency in the food supply chain grows.

Companies like Star Agri (Agribazaar), AgNext and Intello Labs are leading the charge in this space. AgNext uses AI and IoT to provide real-time quality assessments of agricultural produce. The platform offers solutions for various commodities, including tea, spices, and grains, ensuring that they meet the required quality standards.

### Supply Chain Technology & Output Market Linkage

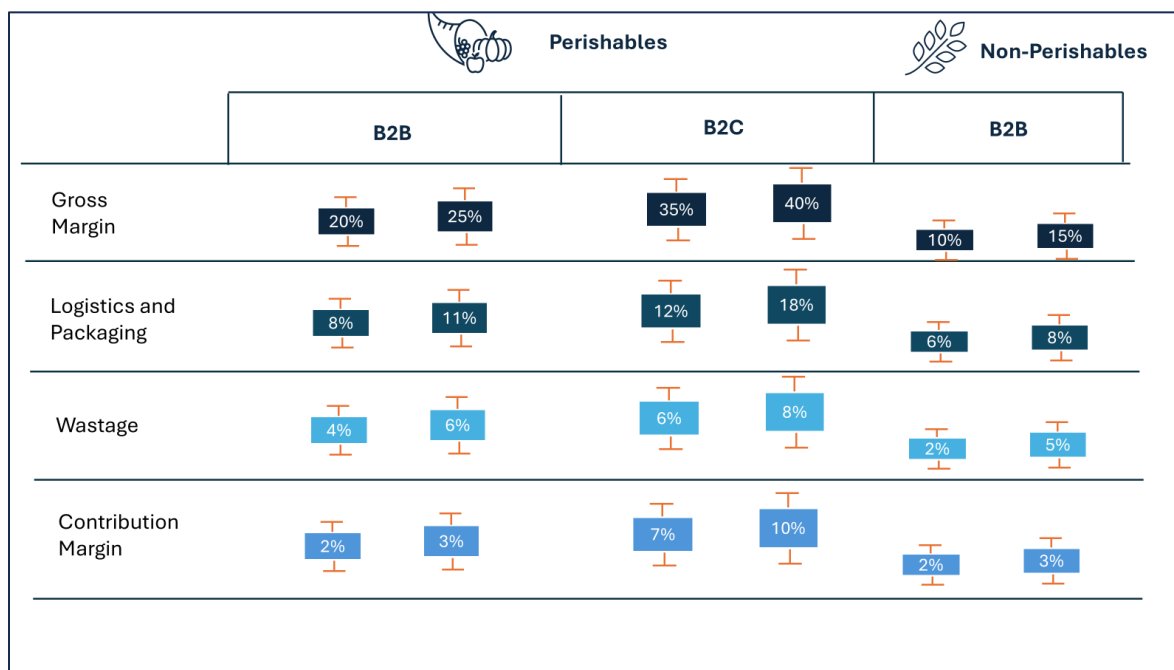
The Indian agricultural supply chain is notoriously inefficient, characterized by a lack of infrastructure, multiple intermediaries, and significant post-harvest losses. This inefficiency not only reduces the income of farmers but also contributes to higher prices and lower quality for consumers. Moreover, the presence of multiple intermediaries means that farmers often receive less than 25% of the final retail price of their produce.

#### Current Output Linkage Challenges

**Output Price Volatility:** One of the most significant challenges in output linkage is price volatility. Agricultural markets in India are highly susceptible to fluctuations due to factors such as speculative trading, government interventions, and inconsistent supply. These fluctuations create uncertainty for farmers, who often find themselves forced to sell their produce at lower prices during periods of surplus. The lack of a robust mechanism to stabilize prices means that farmers are frequently unable to realize the full value of their produce, leading to reduced income and financial instability.

66

**Exhibit 45: Margin Structure for Agri Products at each stage of the value chain**



**Inadequate Storage Facilities:** The lack of adequate storage infrastructure, particularly for perishables, is another major bottleneck in the output linkage system. This situation is especially acute for small and marginal farmers who do not have the resources to invest in private storage solutions. Without proper storage, farmers are compelled to sell their produce immediately after harvest, often at lower prices, which leads to significant post-harvest losses and reduced income.

**Limited Access to Finance:** Financial inclusion remains a challenge for many farmers, particularly when it comes to accessing credit against their produce. The traditional banking system's reluctance to extend credit to smallholders without collateral means that many farmers are unable to secure the necessary funds to store their produce and wait for better market conditions. This lack of access to formal credit forces farmers to rely on informal lender who charge exorbitant interest rates, further exacerbating their financial woes.

**Inconsistent Quality Standards:** The absence of standardized quality checks across the agricultural value chain results in inconsistent product quality, which is a significant deterrent for institutional buyer and consumers alike. Without consistent quality standards, it becomes difficult to ensure that produce meets market requirements, leading to lower prices and reduced competitiveness in both domestic and international markets. This inconsistency also increases the reliance on intermediaries who often manipulate quality assessments to their advantage, further eroding farmer incomes.

**Post-Harvest Losses:** Post-harvest losses, particularly for perishable commodities, are a persistent issue. Factors such as untimely harvesting, adverse weather conditions, and the absence of cold chain logistics contribute to these losses, which can account for up to 15% of total produce in some cases. In dry commodities these losses account for 4-10% with storage holding the largest share of loss from farm-gate to processor. These losses not only represent a direct economic hit to farmers but also exacerbate food security issues in a country where millions still face hunger and malnutrition.

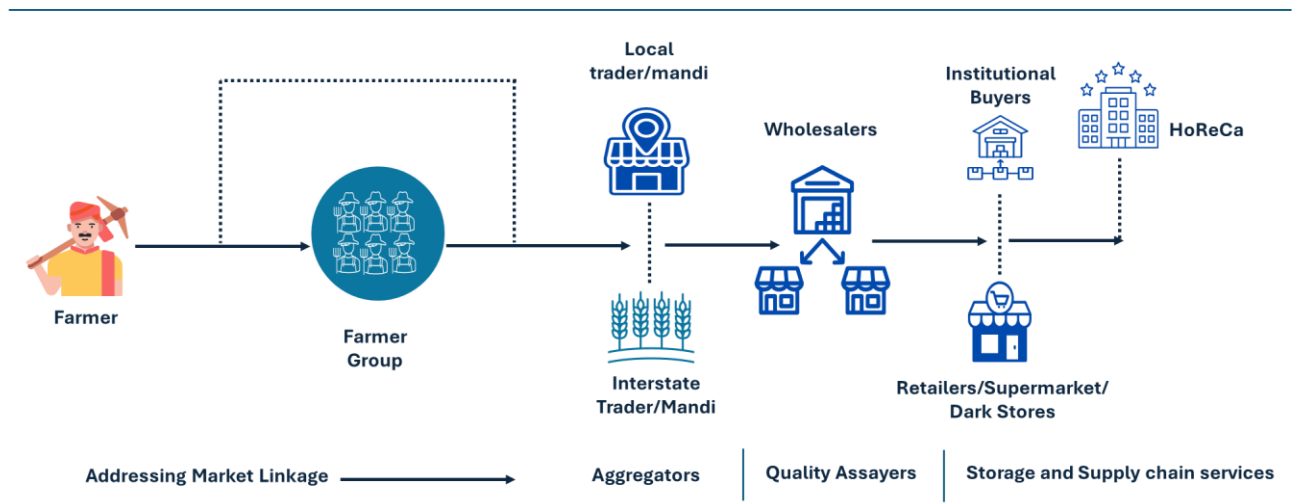
## Post-Production Pain Points

## Agritech Solution

Lower realizations to farmers because of wastages and multiple value chain participant leakages	Provision of cheaper and innovative financing products for farmers and other ecosystem players
Sub-optimal demand supply match on account of fragmented producer and consumer base	Building in transparency and trust-based platforms for supply demand matching
Limited resources and infrastructure in supply chain leading to losses, lack of transparency and price uncertainty	Solutions focused on providing easy access to supply chain resources for all stakeholders in the form of quality assaying and storage

Output linkage in Indian agriculture is a critical segment of the agricultural value chain that encompasses the processes of aggregation, processing, storage, transportation, and distribution of farm produce. This stage plays a pivotal role in determining the economic outcomes for farmers and the availability of quality produce for consumer. However, the traditional output linkage system in India is fraught with inefficiencies, high levels of wastage, and a reliance on intermediaries, which collectively diminish the profitability for farmers and inflate costs for consumers. Recent year have seen significant innovations, and the emergence of new business models aimed at addressing these challenges and optimizing the output linkage system.

**Exhibit 46: Output Linkage value chain in India**



## Stages of Output Linkage

### Aggregation and Collection: Modernizing Traditional Systems

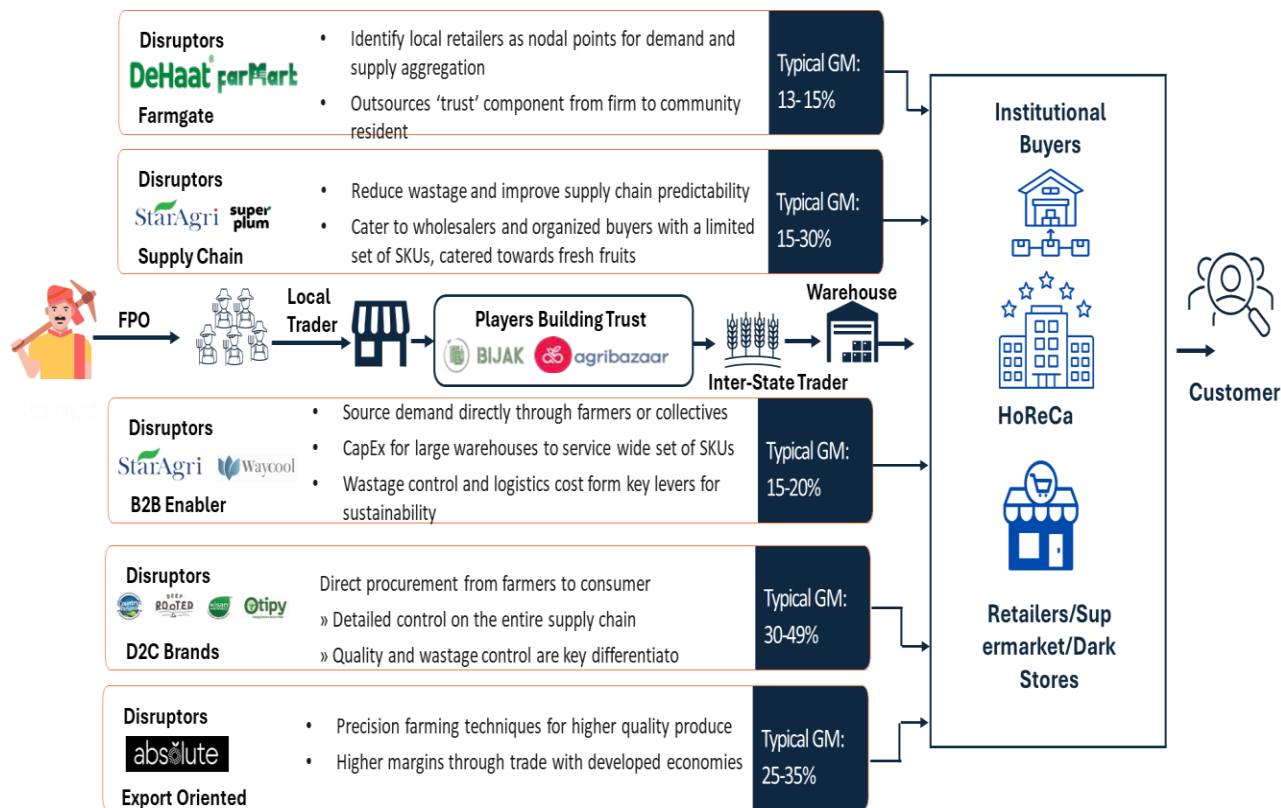
In the traditional output linkage system, aggregation and collection typically occur at the local trader or mandi level, where farmers bring their produce for sale. This stage is highly fragmented, with multiple intermediaries involved, leading to inefficiencies and a lack of price transparency. Farmers often receive lower prices due to the bargaining power of intermediaries, who take significant margins at each stage.

However, modern interventions are beginning to disrupt this status quo. Agritech companies such as StarAgri, NinjaCart and DeHaat have introduced platforms that connect farmers directly with institutional buyers, effectively cutting out the middlemen. These platforms leverage technology to facilitate the aggregation of produce directly from farms, ensuring that the quality is maintained, and wastage is minimized. By streamlining this process, these startups not only enhance price realization for farmers but also provide fresher and more affordable produce to consumer.

### Post-Harvest Processing and Storage: Reducing Wastage, Enhancing Value

The lack of adequate post-harvest processing and storage infrastructure has long been a bottleneck in the Indian agricultural sector, leading to significant post-harvest losses. Innovative solutions from companies like Star Agri, Arya Collateral and Ecozen are making strides in addressing these challenges. Star Agri offers a comprehensive suite of services including warehousing, collateral management, and financing, allowing farmers to store their produce safely and access credit against it. This enables farmers to sell their produce when market conditions are more favourable, thereby maximizing their income. Ecozen, on the other hand, focuses on decentralized cold storage solutions powered by solar energy, which are particularly valuable in rural areas with unreliable electricity supply. These innovations not only reduce wastage but also enhance the quality and marketability of agricultural produce.

**Exhibit 47: Disruptors in the Output Linkage Ecosystem**



## Distribution and Logistics

The distribution and logistics stage is where the produce is transported from storage facilities to the market. In the traditional system, this process is often inefficient, with poor infrastructure and fragmented supply chains leading to delays, increased costs, and product spoilage. These inefficiencies are particularly detrimental for perishable goods, which require timely delivery to maintain freshness and quality.

To address these issues, companies like Star Agri, WayCool and Stellapps are implementing technology-driven logistics solutions. WayCool provides integrated supply chain services that optimize every aspect of the logistics process, from procurement to last-mile delivery.

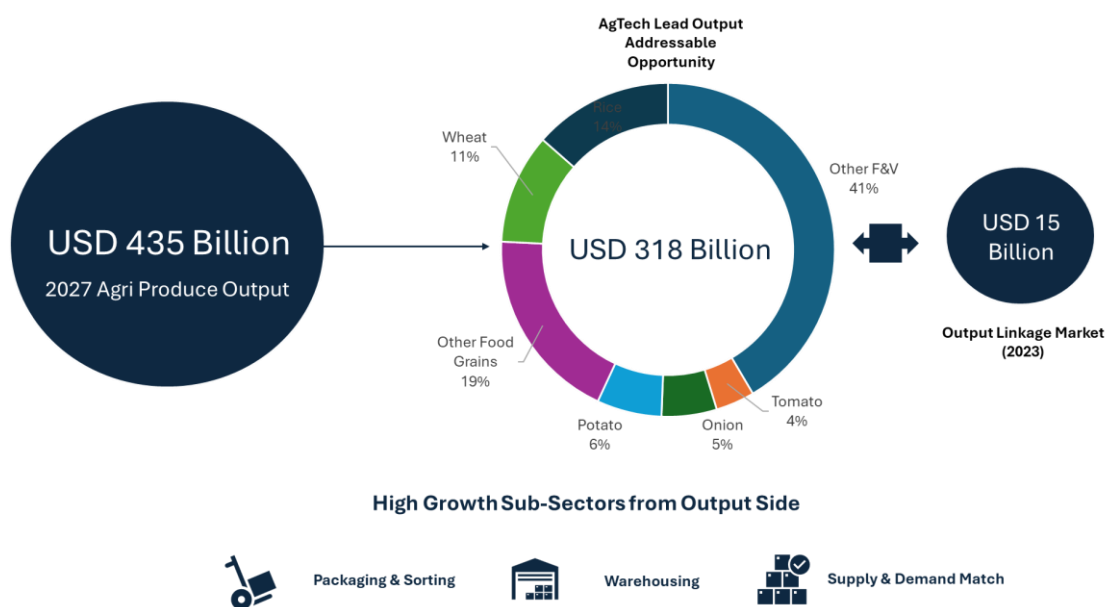
## Market Linkage and Sales

The final stage of output linkage involves connecting the produce with buyers, whether they are institutional clients, retailers, or direct consumers. Traditionally, this connection has been facilitated through APMC mandis, where produce is auctioned to the highest bidder. However, this system is often inefficient, with limited price transparency and high transaction costs due to the involvement of multiple intermediaries.

Digital marketplaces are transforming this stage by providing platforms where farmers can directly connect with buyers. Companies like AgriBazaar (by StarAgri) and Bijak are at the forefront of this transformation. These platforms offer transparency, reduce the need for intermediaries, and provide additional services such as quality assessments, digital payments, and logistics support. By integrating these services, digital marketplaces help improve price realization for farmers while offering buyers access to a broader and more diverse range of produce.

The addressable Supply Chain Technology & Output Market Linkage segment is the largest in the Agritech industry, valued at \$ 15.4 billion in CY 2023, or 49.52% of the total market. This segment includes solutions that streamline the supply chain, reduce post-harvest losses, and connect farmers directly with buyers, thereby increasing their income and improving the quality of agricultural produce.

**Exhibit 48: Addressable Market Opportunity for AgTech Lead Output**



Source: Frost & Sullivan analysis

The growth of the supply chain segment within agritech underscores the critical need for innovation in the agricultural supply chain. As these companies continue to scale, they are not only improving the efficiency of the supply chain but also empowering farmers to capture more value from their produce. The supply chain segment is expected to continue growing, driven by the increasing demand for fresh, high-quality produce and the need to reduce post-harvest losses.

### Financial Services

Access to finance is one of the most significant challenges faced by Indian farmers, particularly smallholders who often lack collateral and a formal credit history. This lack of access to affordable credit limits their ability to invest in quality inputs, adopt modern technologies, and manage risks such as crop failure due to weather events. The problem is exacerbated by the high cost of credit from informal sources, which can trap farmers in a cycle of debt.

**Agri FinTech- Credit & Insurance**

- Players usually offer multiple types of financing including financing for inputs, equipment financing, working capital financing, warehouse financing and invoice financing
- Offer technology platforms for insurance across the agricultural value chain like crop, motor, livestock, etc
- B2B2C approach driven by technology, partnering with businesses that sell or procure enables cheap financing
- Nurtures farmer collectives as an asset class and enables access to mainstream financial market for small farmers

**Players**



**Investors**



2023 Revenue: 30 Crore – 200 Crore; Funding – USD 9 – 112 Million

The addressable Financial Services for Farming Communities market, valued at \$ 5.3-7 billion in CY 2023, represents 17% -21.86% of the total Agritech market. This segment includes a range of services, from digital lending platforms to insurance products, designed to improve financial inclusion for farmers.

The growth of financial services in the Agritech sector is crucial for improving the livelihoods of millions of smallholder farmers. By providing them with access to affordable credit and insurance, these platforms are enabling farmers to invest in their farms, adopt new technologies, and manage risks more effectively. As financial inclusion continues to improve, this segment is expected to grow significantly, driven by the increasing adoption of digital financial services in rural areas.

### Integrated Agri Services

As the Indian Agritech landscape continues to evolve, full-stack solutions are emerging as a dominant force, poised to reshape the agricultural value chain from end to end. Integrated Agri Services refers to players offering a comprehensive suite of technology-driven solutions designed to support the entire agricultural value chain. This includes, but is not limited to, digital marketplaces for agricultural inputs and outputs, crop advisory through advanced analytics, IoT-enabled soil and weather management, innovative warehousing solutions, and collateral-based financing options. An integrated service provider not only facilitates the buying and selling of agricultural products but also provides crucial support services such as



secure storage and value-adding financial services, thereby enhancing the efficiency, profitability, and sustainability of agricultural practices. Such a platform seamlessly connects various stages of the agricultural process—from pre-sowing to post-harvest—leveraging technology to optimize production, improve market access, and increase farmer income. Among the players in the Integrated Agri Services Star Agri remains the largest by revenue and the most profitable technology led integrated value chain services platform during the period FY 22 till FY 24.

**Exhibit 49: Emerging players in the integrated agri services**

### Integrated Agricultural Services

- End to end commercial play drives stickiness
- Focusing on both software and hardware offerings
- Partnership with corporate players to enable market linkages
- Proprietary agronomy engine that manages the entire farming lifecycle
- Provides omnichannel experience to farmers



The rise of full-stack integrated agricultural services solutions is driven by a clear demand for simplicity and integration in a sector that has traditionally been fragmented and siloed. Farmers, particularly smallholder, face a myriad of challenges—ranging from access to quality inputs and credit to the complexities of market access. Full-stack platforms like Agribazaar (Star Agri), DeHaat and Ninjacart are stepping in to fill these gaps, providing a one-stop solution that not only enhances productivity but also improves profitability by reducing dependency on intermediaries and optimizing the use of resources.

Data underscores the growth trajectory of these integrated agri services. DeHaat, for instance, has expanded its services to over 1.8 million farmers, facilitated by a robust funding pipeline that includes over \$ 222 million raised by 2024. The platform’s end-to-end service model has enabled it to scale rapidly, addressing critical pain points across the agricultural value chain. Similarly, Ninjacart’s tech-driven supply chain platform connects farmers directly with retailers, reducing wastage and ensuring that farmers receive better prices. The company has attracted substantial investments, including a \$ 150 million injection from prominent investors, reflecting the strong market validation of its model.

Looking forward, the integrated agri services is likely to become the standard in Agritech, driven by the increasing need for integrated solutions that can scale. As these platforms continue to mature, we can expect them to expand their offerings to include advanced financial services, precision farming tools, and blockchain-based traceability, further enhancing their value proposition. Moreover, the ongoing digital transformation in rural India, supported by government initiatives like the Digital India program, will

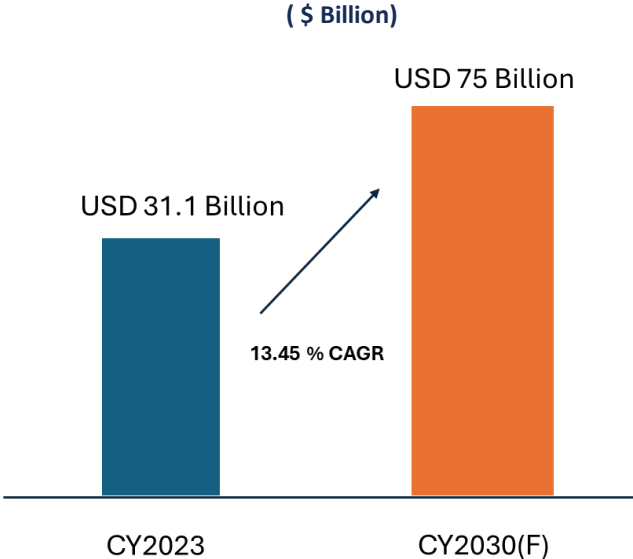


accelerate the adoption of full-stack solutions, enabling them to reach deeper into the heart of Indian agriculture.

### 5.3 Future Outlook of Tech Enabled Integrated Agricultural Services In India

As per the projected data, the addressable size of the industry is expected to scale from an estimated \$31.1 billion in CY 2023 to an astounding \$ 75 billion by CY 2030 (F). This represents a compound annual growth rate (CAGR) of 13.45%, driven by the convergence of digital innovation, regulatory support, and evolving market dynamics. The journey ahead for Integrated agricultural services in India is not just about growth in numbers but signifies a strategic realignment of how agriculture is practiced, perceived, and sustained in the country.

**Exhibit 50: Forecasted addressable market size of Tech Enabled Integrated Agricultural Services in India**



*Source: Frost & Sullivan analysis*

The COVID-19 pandemic served as a catalyst for change, disrupting traditional supply chains and accelerating the adoption of digital platforms for trading, financing, and farm management. This shift has not only increased the efficiency of agricultural operations but also exposed structural weaknesses in traditional systems, creating a fertile ground for integrated agriculture service solutions to take root. The pandemic highlighted the importance of resilience in agricultural supply chains, and digital technologies have emerged as the most effective tool to build that resilience

The Indian integrated agriculture services industry is entering a period of strategic importance, where the interplay of digital technology, capital investment, and regulatory support will redefine the agricultural economy. In addition, the mobile and internet revolution has placed personalized technology in the hands of the farmer even in remote areas across the country. Investors are recognizing the unique opportunity presented by Agritech to not only generate financial returns but also contribute to socio-economic development on a national scale.

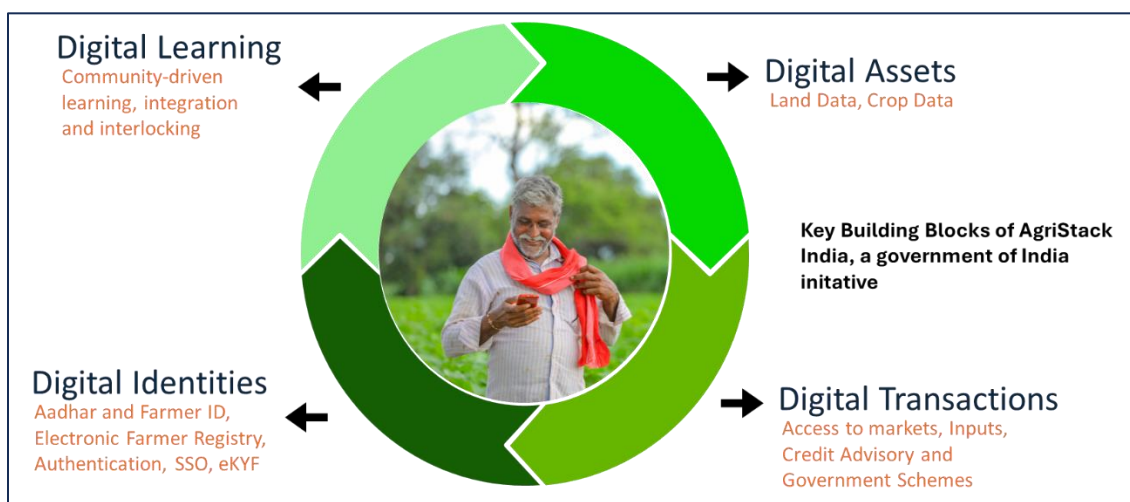
## 5.4 Why the Time for AgriTech is Now

### 1) India's Digital Agriculture Mission

The Digital Agriculture Mission is a transformative initiative by the Indian government aimed at modernizing agriculture through advanced technology and digital integration. Launched with a budget of ₹28.2 Billion, the mission supports various digital initiatives designed to improve productivity, sustainability, and farmer services. This mission operates through key pillars that address the needs of farmers, government agencies, and the agricultural ecosystem at large, emphasizing data-driven decision-making and resource optimization.

#### Agri-Stack

AgriStack is an ambitious initiative by the Indian government to revolutionize the agricultural sector through comprehensive digital integration. By establishing a robust digital public infrastructure (DPI), AgriStack aims to provide farmers with unique digital identities, streamline access to essential services, and enhance overall agricultural productivity. This initiative is part of India's broader digital transformation strategy, and it seeks to modernize agriculture by integrating cutting-edge technologies to solve long-standing challenges in the sector.



#### **Objectives of AgriStack:**

**Farmer-Centric Services:** AgriStack's central objective is to assign a unique digital ID to each farmer, consolidating key information such as land holdings, crop details, and insurance history. This centralized data approach simplifies farmers' access to a wide range of services, including formal credit, insurance schemes, government subsidies, and minimum support prices (MSP) programs. By reducing the reliance on physical documentation and cumbersome processes, AgriStack aims to make agricultural services more accessible, especially for smallholder and marginalized farmers.

**Data-Driven Decision Support:** By leveraging advanced technologies like artificial intelligence (AI) and remote sensing, AgriStack offers real-time data on critical factors such as crop health, soil conditions, and weather patterns. These insights empower farmers to make informed decisions, optimize their input usage, and mitigate risks like pest outbreaks or adverse weather conditions. For instance, AI-based tools can help farmers identify the best time for sowing and harvesting crops, while remote sensing can provide early warnings about potential issues such as water stress or pest infestations.

**Enhanced Agricultural Planning:** The use of geo-referenced village maps and crop-sown registries within AgriStack is pivotal in improving agricultural resource management. These tools provide detailed, real-time data on land usage, enabling better crop diversification, yield estimation, and resource allocation. The availability of such precise data also helps policymakers develop more effective agricultural programs and interventions, ensuring that resources such as fertilizer and water are optimally distributed.

#### **Current AgriStack Status as of 2024:**

**Pilot Implementations:** AgriStack's rollout has seen pilot projects successfully launched in six key states: Uttar Pradesh, Gujarat, Maharashtra, Haryana, Punjab, and Tamil Nadu. These pilots have focused on testing critical components of the initiative, such as the creation of unique Farmer IDs and the execution of digital crop surveys. The outcomes of these pilots have provided valuable insights into scaling the platform nationwide.

**Progress in Digital Identities:** A major goal of AgriStack is the creation of digital identities for 110 million farmers over a three-year period. The plan is to cover 60 million farmers in FY 2024-25, followed by an additional 30 million in FY 2025-26, and the remaining 20 million in FY 2026-27. These digital identities will be instrumental in making farmers eligible for various government schemes and services, enhancing their access to formal financial systems.

**Georeferencing and Digital Crop Surveys:** AgriStack has made significant progress in mapping and georeferencing India's farmlands. As of FY 2023-24, approximately 0.36 million, accounting for 56% of India's villages, have been georeferenced, marking a critical milestone in land mapping and agricultural planning. Moreover, the Digital Crop Survey (DCS) has been piloted in 12 states and is set to expand to 19 states, covering over 80% of the nation's farmland by Kharif 2024. This process involves capturing geotagged photos and data to improve crop monitoring and production estimates, which will help refine agricultural policies and interventions.

**Budgetary Allocations:** In the Union Budget 2024-25, the Indian government reaffirmed its commitment to AgriStack, allocating significant resources for its implementation over the next three years. The budget prioritizes the digital transformation of the agriculture sector, aiming to bring over 60 million farmers under the formal land registry system. This investment undercores the government's vision to digitize and modernize Indian agriculture by integrating advanced technologies into the sector.

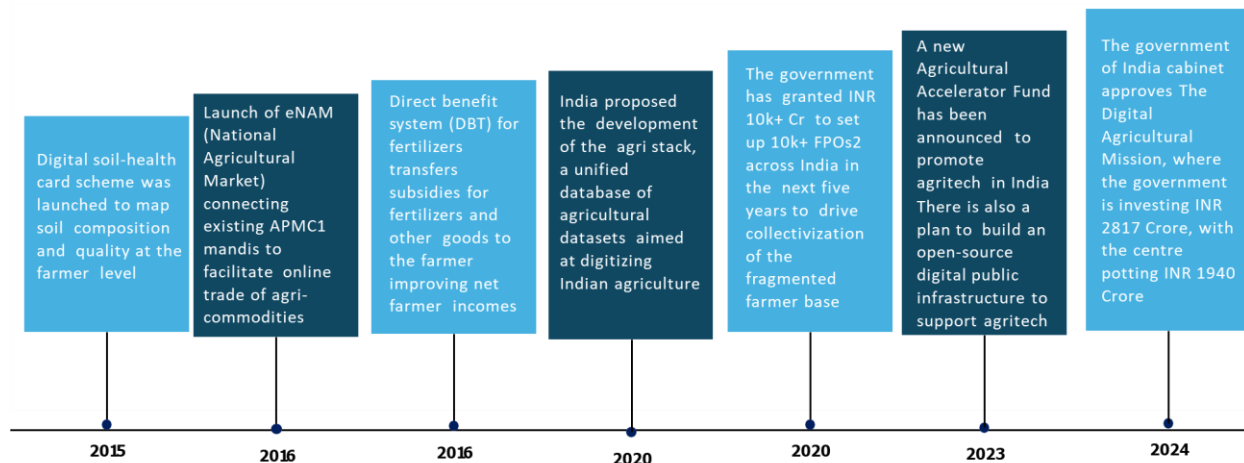
## **2) Soil Profile Mapping**

This pillar focuses on detailed soil mapping at a scale of 1:10,000 across 142 million hectares. With 29 million hectares as of August 2024, already mapped, the initiative offers critical information on soil health, aiding farmers in precise nutrient application, which improves yields and sustains soil quality over time.

### **Digital General Crop Estimation Survey (DGCES)**

The Digital General Crop Estimation Survey provides accurate crop yield estimates through enhanced crop-cutting experiments. This supports more reliable data for policy planning, insurance, and disaster response, facilitating government schemes and financial products aligned with actual crop conditions.

### 3) Favourable Government policies coupled with digital India vision:



India's journey toward integrating digital technologies in agriculture began in the early 2000s, marked by the implementation of the National e-Governance Plan (NeGP) in 2006. While not directly aimed at agriculture, the NeGP laid the foundation for digital infrastructure and connectivity in rural areas, which would later become crucial for the digital transformation of the agricultural sector. The introduction of basic IT infrastructure and the push towards internet connectivity set the stage for more focused agricultural digital initiatives in the following decades.

#### The 2010s: A Decade of Focused Digital Initiatives

The 2010s witnessed a significant shift with the launch of several key initiatives tailored to enhance the agricultural sector. Among the most impactful was the National Agricultural Market (e-NAM) in 2015. This pan-India electronic trading platform was designed to bridge the gap between farmers and markets, improve price discovery, and increase transparency in the sale of agricultural commodities. By enabling farmers to directly access a wider market, e-NAM began reducing the traditional dependencies on middlemen, leading to better pricing for agricultural products.

The Digital India Mission, also launched in 2015, was another transformative initiative. This mission aimed to transform India into a digitally empowered society and knowledge economy. Crucially, it focused on improving internet connectivity in rural areas, an essential prerequisite for the adoption of digital agriculture technologies. The improved connectivity facilitated the deployment of digital tools and platforms in farming, ranging from market access to weather forecasting and precision farming technologies.

In 2019, the Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) scheme was introduced. While its primary objective was to provide income support to small and marginal farmers, it indirectly contributed to the digital agriculture ecosystem by enhancing farmers' financial literacy and their openness to adopting new technologies. This scheme also demonstrated the potential of direct benefit transfers (DBT) in simplifying subsidy distribution and ensuring that benefits reach the intended recipients efficiently, a model that can be further leveraged in digital agriculture.

## The 2020s: Accelerating Digital Transformation

The 2020s have been characterized by an accelerated push towards digital agriculture. The expansion of the National Agriculture Market (e-NAM) to cover more markets across the country has been a significant development, extending the benefits of digital trading platforms to a larger number of farmers. This period also saw the introduction of the Digital Agriculture Mission in 2020, which has been pivotal in promoting the use of digital technologies across various aspects of farming, including precision agriculture, farm mechanization, and e-commerce.

A noteworthy advancement during this decade has been the launch of e-NAM 2.0 in 2023, which aims to further modernize the platform by integrating it with other government schemes and making it more accessible and efficient. This integration is crucial for creating a seamless digital ecosystem where various facets of agriculture—from procurement to distribution—are interconnected, enabling better resource management and decision-making.

The government has also been proactive in addressing the challenges that come with digitization, such as data privacy and security. Ongoing efforts to develop regulations that protect farmers' data while ensuring the efficient functioning of digital platforms are vital for maintaining trust and encouraging broader adoption of digital tools in agriculture.

### PMFBY and YES-Tech

In the 2020s, India's agricultural sector has experienced a significant digital transformation, driven by initiatives like the Pradhan Mantri Fasal Bima Yojana (PMFBY) and the Yield Estimation System based on Technology (YES-Tech). Launched in 2016, PMFBY is a government-sponsored crop insurance scheme that integrates multiple stakeholders on a single platform, providing farmers with financial support in the event of crop loss due to natural calamities, pests, or diseases.

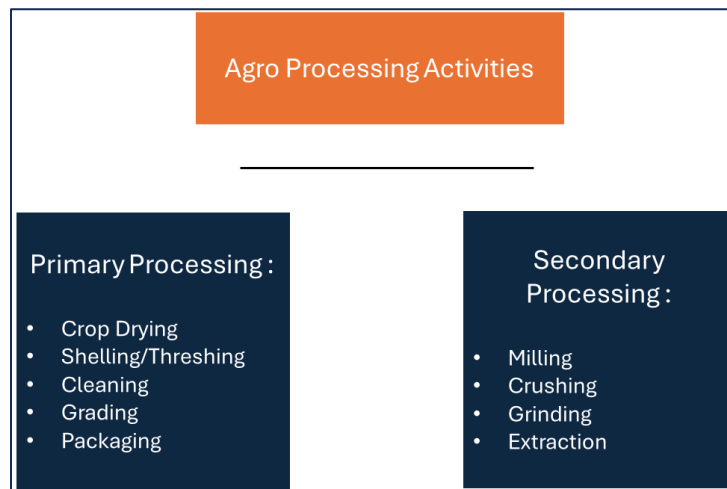
To enhance the efficiency and accuracy of crop yield assessments under PMFBY, the Ministry of Agriculture and Farmers Welfare introduced YES-Tech in 2023. This technology-driven yield estimation system leverages advanced methodologies and best practices to provide accurate yield assessments at the Gram Panchayat level. The YES-Tech Manual, developed after extensive testing and piloting in 100 districts across India, offers comprehensive guidelines for implementing this system.

The integration of YES-Tech into PMFBY represents a significant advancement in India's digital agriculture landscape. By utilizing technology for precise yield estimation, the government aims to streamline crop insurance processes, reduce discrepancies in yield data, and ensure timely compensation for farmers. This initiative aligns with the broader Digital India vision, emphasizing the use of technology to empower farmers and enhance the resilience of the agricultural sector.

## **4 ) Growth in Food Processing Industry, EXIM and Consumer Demand**

### **Boosting Primary Processing Industry with Infra and Policy support**

Primary processing is essential in transforming India's agricultural output, serving as a critical step between the farm and the market. It significantly enhances the quality, shelf-life, and value of agricultural produce, thereby strengthening the entire agricultural value chain. The Indian government, recognizing the pivotal role of primary processing, has invested heavily in infrastructure, technology, and farmer support initiatives to bolster post-harvest management and value addition.



### Reduction of Post-Harvest Losses Through Infrastructure Development

A key benefit of primary processing is the reduction of post-harvest losses, which have historically plagued Indian agriculture. Post-harvest losses in India account for up to 4-15% of the total production of various crops (perishable and non-perishable). These losses, resulting from inadequate handling, storage, and processing, amount to a significant economic burden on farmers and the overall agricultural economy.

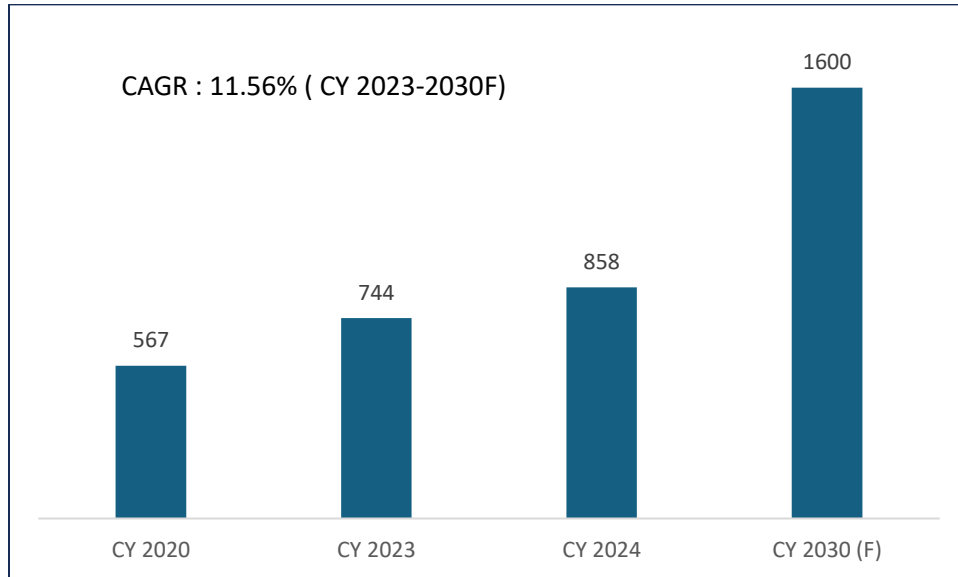
The Agriculture Infrastructure Fund (AIF), launched in 2020 with an outlay of ₹1,000 Billion, is designed to address this issue by financing the creation of modern agricultural infrastructure such as processing units, cold storages, and warehouses.

Under the AIF scheme, a processing center for pulses was established in the state of Madhya Pradesh, the largest pulse-producing region in India. The facility offers sorting, grading, and milling services, allowing farmers to reduce post-harvest losses by over 30% and increase their income by selling processed, higher-value products rather than raw pulses. This also improved access to export markets, particularly in South Asia and Africa.

### Value Addition Through Modern Processing Technologies

Primary processing activities, such as drying, cleaning, sorting, and grading, enhance the intrinsic qualities of raw agricultural commodities, allowing them to fetch higher prices in the market. For instance, processed commodities like milled pulses, graded oilseeds, and polished rice command significantly higher market value than their unprocessed equivalents. In the case of rice, the processes of dehusking, parboiling, and polishing add substantial value, making the product suitable for both domestic consumption and international export markets.

**Exhibit 51: India Food & Grocery Market size- CY 2020-30 (\$ Billion)**



*Source: Frost & Sullivan analysis- Includes dairy, staples, fresh produce, snacks, cooking ingredients, confectionery*

As India's food and grocery market grows from \$744 billion in CY 2023 to \$1,600 by CY 2030, there is a corresponding rise in demand for processed foods, particularly in urban centres. Changing consumer preferences, driven by the desire for convenience, ready-to-cook, and ready-to-eat products, is driving businesses to invest in primary processing infrastructure to meet this demand.

Grains, fruits, and vegetables are at the forefront of this shift, with processed foods expected to account for a growing share of consumer spending. The increased demand for packaged rice, frozen vegetables, and pre-cut fruits is an indicator of the opportunities available for businesses that invest in primary processing. By utilizing cold storage and packaging technologies, businesses can meet the rising demand for convenience foods while maintaining the quality and safety of their products.

The increasing presence of e-commerce platforms and the growth of organized retail in Tier 1 and Tier 2 cities is also contributing to the rising demand for processed and packaged foods. Businesses that can offer well-packaged, high-quality processed grains, fruits, and vegetables are better positioned to take advantage of these growing distribution channels.

The government's Mega Food Parks Scheme (MFPS), aimed at creating state-of-the-art processing facilities, has played a crucial role in developing high-tech processing zones that facilitate value addition. Each Mega Food Park is designed to include modern primary processing infrastructure such as grain storage silos, rice milling units, oilseed processing plants, and pulse milling facilities

## Overview of key government policies relating to primary processing

Scheme Name	Description	Outlay/Impact
Pradhan Mantri Kisan Sampada Yojana (PMKSY)	Focuses on agro-produce handling, leveraging significant investments and benefiting millions of farmers.	₹314 billion expected to leverage; impacts 2 million farmers
Mega Food Parks	Develops modern infrastructure facilities for food processing along the value chain from farm to market.	As of March 31, 2024, 41 Mega Food Park projects have been approved under India's Mega Food Park Scheme. These projects span across several states with a total estimated project cost of ₹46.36 Billion, of which ₹19.71 billion in grants has been approved, and ₹1.48 Billion has been disbursed. Several projects are operational, while others are under implementation in states like Andhra Pradesh, Gujarat, and Haryana
Operation Green	Operation Greens was launched in 2018 to stabilize the supply chain and reduce post-harvest losses of Tomato, Onion, and Potato (TOP) crops. It aims to enhance value realization for farmers and ensure price stability.	As of 2024, ₹6.34 Billion has been approved in grants for 53 projects.
Creation/Expansion of Food Processing/Preservation Capacities (Unit)	Aims to augment individual processing and preservation capacities.	As of April 2024, the Creation/Expansion of Food Processing & Preservation Capacities (CEFPPC) scheme under Pradhan Mantri Kisan Sampada Yojana (PMKSY) has approved several projects related to fruits, vegetables, and dry agri products. These projects include F&V (fruits & vegetables) processing, grain milling, and consumer products. States like Andhra Pradesh, Assam, and Maharashtra have seen significant approvals, with

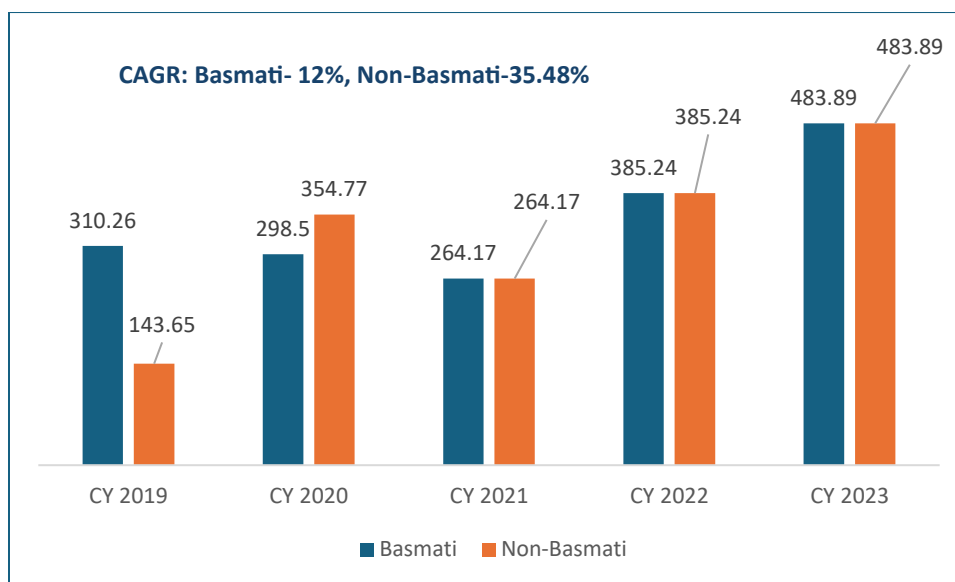


Scheme Name	Description	Outlay/Impact
		Maharashtra leading with 89 approved units.
Infrastructure for Agro-processing Cluster	Establishes efficient agro-processing cluster close to production areas.	As of 2024, 76 projects have been approved under the scheme, with a total grant allocation exceeding ₹7.5 Billion, fostering agro-industrial growth nationwide
Food Safety and Quality Assurance Infrastructure	Enhances the quality assurance infrastructure for food products.	Significant projects in Tamil Nadu and Uttar Pradesh are completed, improving regional food safety. In Maharashtra, ongoing labs like Aura Analytical Services further enhance food quality testing capabilities, addressing local needs
Creation of Backward and Forward Linkages	Develops robust supply chain mechanisms for connecting processors and producer .	In Maharashtra, projects like Mahindra Agri Solutions in Nashik and Malganga Milk in Ahmednagar have greatly improved milk and horticulture supply chains, benefiting over 75,000 farmers. In Gujarat, initiatives like Shakti Cashew in Rajkot have enhanced horticulture processing, boosting both employment and farmer income. Projects in Himachal Pradesh and Jammu & Kashmir are still under implementation, focusing on horticulture and milk processing
Production Linked Incentive Scheme for Food Processing Industry (PLISFPI)	Encourages the creation of global food manufacturing champions and promotes Indian brands of food products.	Budget allocated of ₹ 109 Billion from FY 22 to FY27

## EXIM

India's agricultural exports and imports have undergone significant transformations between CY 2019 and CY 2024, particularly in key commodities like rice, wheat, maize, pulses, and oilseeds. This period has been characterized by a blend of rapid export growth, domestic supply challenges, and evolving government policies aimed at balancing food security with external trade opportunities. While India has cemented its position as a global leader in certain exports like rice, its reliance on imports, especially for pulses and oilseeds, highlights structural inefficiencies in domestic production and processing. African countries like Tanzania, Uganda, Nigeria and Zambia are strategically critical in offering a consistent supply of pulses and oilseeds to India, and also play a crucial role in the spices and grain trade with India

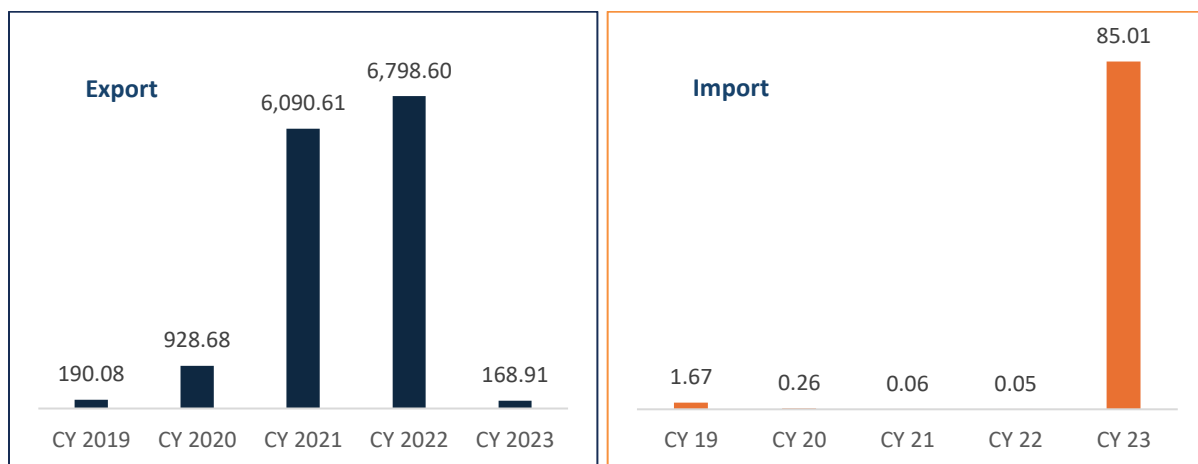
**Exhibit 52: Export of Rice from India, ₹ Billion, 2019-2023**



Source: Agricultural and Processed Food Products Export Development Authority; Frost & Sullivan

India's strategic position as the world's largest rice exporter has been further solidified despite domestic regulatory interventions. The 20% export tariff imposed on non-Basmati white rice in September 2022, followed by the July 2023 export ban, was aimed at stabilizing domestic prices amid rising inflation. Despite these restrictions, the global demand for Indian rice, particularly from regions affected by geopolitical disruptions, remains robust. Indian rice prices are expected to remain at elevated levels through 2024 due to constrained global supply.

**Exhibit 53: Wheat Export (L), Import (R) CY 2019-2023 (Kilo Tons)**

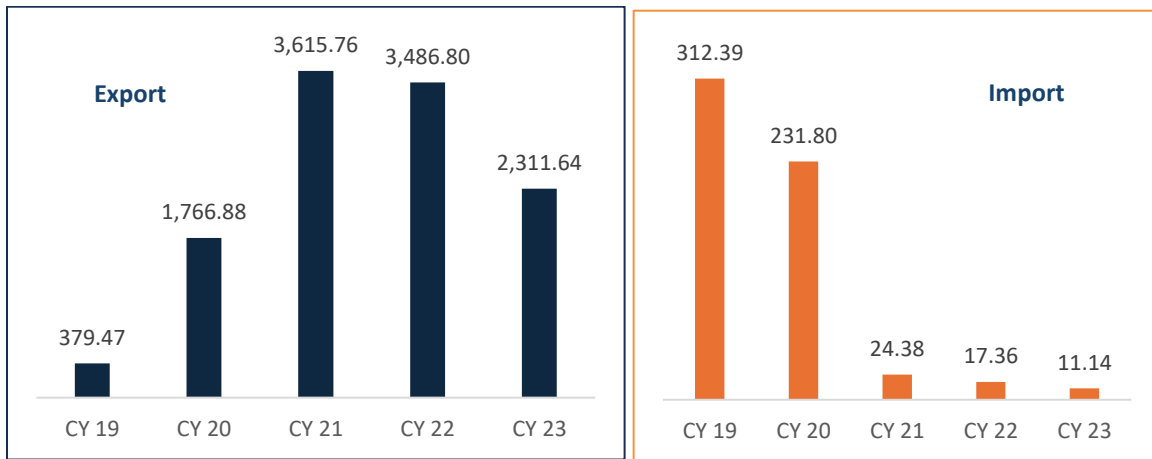


Source- Trademap, DataGov.in Frost & Sullivan Analysis

India's wheat trade from CY 2019 to CY 2023 is a study in contrasts, marked by rapid export growth followed by an abrupt policy shift towards export restrictions. In the first half of this period, India's wheat exports surged due to both favourable domestic production and unprecedented global demand. Exports rose from a modest 190 KT in CY 2019 to a staggering 6,798 KT in CY 2022, driven by the global supply crisis precipitated by the Russia-Ukraine war. This period also saw India capitalize on global price spikes, as wheat became a highly sought-after commodity due to supply chain disruptions and food security concerns in import-dependent countries. However, the dramatic rise in exports coincided with adverse domestic climatic conditions. The 2022 heatwave, one of the most severe in recent decades, severely impacted India's wheat crop, reducing yields significantly and triggering inflationary pressures in the domestic market.

In response, the Indian government imposed a wheat export ban in May 2022, a move aimed at controlling food inflation and maintaining adequate public stock levels for distribution through the Public Distribution System (PDS). By CY 2023, wheat exports had plummeted to just 168.91 KT, while wheat imports surged to 85.01 KT as domestic stocks hit a 7-year low.

**Exhibit 54: Maize Export (L), Import (R) CY 2019-2023 (Kilo Tons)**



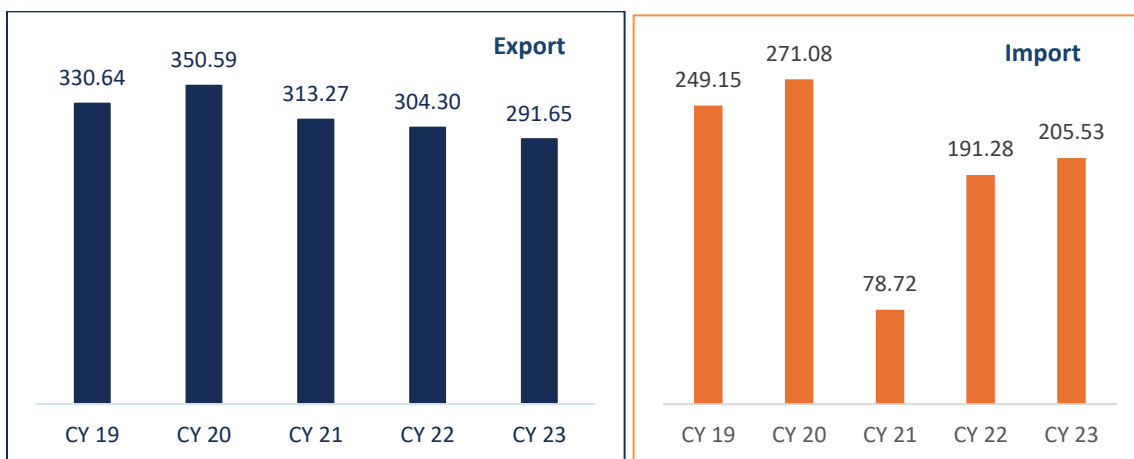
Source- Trademap, Frost & Sullivan Analysis

India's maize trade has evolved significantly over the past five year, with maize becoming a vital commodity in both export and domestic markets. Maize exports grew from 379.47 KT in CY 2019 to a peak of 3,615.76 KT in CY 2021, driven by rising global demand for animal feed and food processing ingredients. Southeast Asian nations, particularly Vietnam and Bangladesh, turned to Indian maize to meet their feed requirements for poultry and livestock, as their domestic production lagged behind demand.

India's competitive pricing, favourable weather conditions, and surplus production during this period allowed it to expand its export footprint. However, the country's export performance began to slow down by CY 2023, with maize exports falling to 2,311.64 KT. This reduction in exports was primarily due to growing domestic consumption of maize for industrial uses, particularly the ethanol blending program initiated by the Indian government.

The government's push towards increasing the ethanol content in petrol to reduce fossil fuel dependence has significantly boosted domestic demand for maize as a feedstock for ethanol production. Consequently, maize, which was once predominantly exported, is increasingly being absorbed by the domestic market for both biofuel production and food processing. The National Biofuel Policy, combined with the rising use of maize in the starch and food industries, has restricted the volumes available for export, reflecting India's shifting priorities in maize utilization.

**Exhibit 55: Oilseeds Export (L), Import (R) CY 2019-2023 (Kilo Tons)**



Source- Trademap, Frost & Sullivan Analysis

India's oilseeds sector, despite being a major global producer, is heavily dependent on imports of edible oils. Oilseed exports have remained limited, largely due to the low domestic crushing capacity and the growing internal demand for edible oils such as palm oil, soybean oil, and sunflower oil. By CY 2023, India was importing 15-16 million tons of edible oils annually, making it one of the largest importers of edible oils globally

Efforts to increase domestic oilseed production, such as the National Mission on Edible Oils-Oil Palm (NMEO-OP), aim to reduce India's reliance on imports. However, the current infrastructure for oilseed processing and low oil extraction yields continue to drive high levels of edible oil imports. India's edible oil imports are expected to remain elevated in the coming years, despite government initiatives aimed at enhancing domestic production.

### **Building Infrastructure to Boost EXIM Trade - Enhancing Export Competitiveness and Global Market Access**

India's vast agricultural landscape and its strategic position as one of the leading producer of agricultural commodities demand a robust and efficient export-import (EXIM) infrastructure. Ports play a pivotal role in this process, handling approximately 90% of the country's external trade by volume. In recent year, the Indian government has prioritized the development and modernization of port infrastructure to enhance the EXIM trade of agricultural commodities, particularly through initiatives such as the Sagarmala Programme and other targeted investments. This section explores the key developments in port infrastructure, how they are transforming the agricultural trade landscape, and the overall impact on the sector.

#### **Sagarmala Programme: Enhancing Port Connectivity and Efficiency**

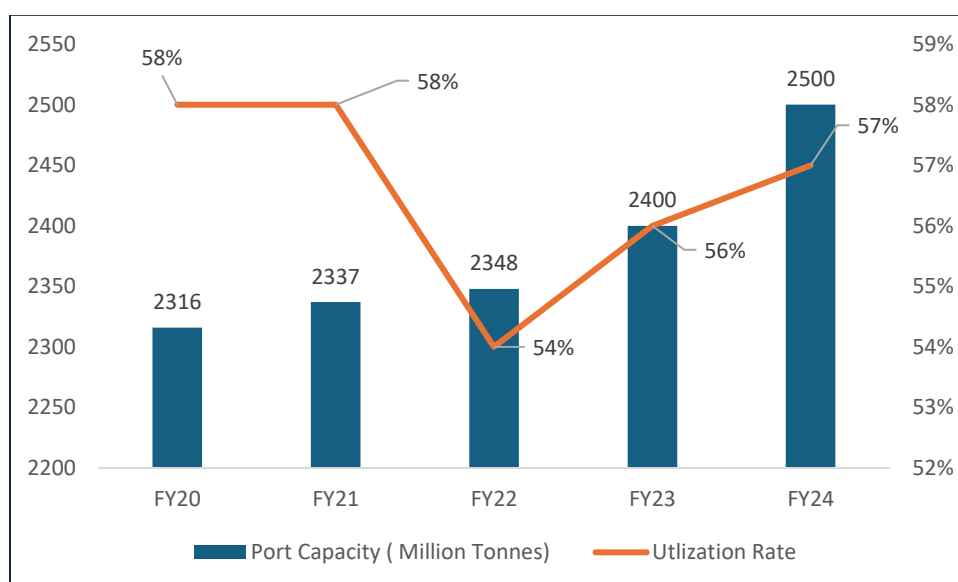
Launched in 2015, the Sagarmala Programme is a flagship initiative of the Government of India aimed at transforming the port and maritime sector by addressing challenges related to port infrastructure and improving logistics efficiency. By focusing on port-led development, the program aims to reduce logistical costs and turnaround times, thereby improving India's global competitiveness in agricultural exports. The Sagarmala initiative are set to increase their capacity to over 3,300 million tons per annum (MTPA) by 2025, with a significant portion dedicated to non-major ports that handle substantial agricultural

commodities like pulses, oilseeds, rice, and maize. These capacity expansions are crucial as agri-commodity volumes have steadily increased, requiring more efficient infrastructure for handling, storage, and transportation.

India operates 12 major ports and 217 non-major ports, and both segments are integral to the agricultural export economy. The Major Port Authorities Act 2021 further decentralized the governance of these ports, granting greater operational autonomy to port authorities. This autonomy has led to increased efficiency, allowing ports to upgrade infrastructure based on market demands.

One of the key enhancements has been the modernization of cargo-handling facilities. For example, JNPT (Jawaharlal Nehru Port Trust) and Mundra Port have invested in specialized grain silos, which enable efficient handling and storage of bulk agricultural commodities like wheat and maize. Additionally, these ports have developed advanced containerization facilities, which are critical for the safe transportation of processed agricultural products such as oilseeds and pulses.

**Exhibit 56: Capacity and Utilization rate for Indian Ports**



Source- Indian Port Association

In addition to port modernization, the government has prioritized the development of coastal shipping and inland waterways to reduce logistical costs and offer an eco-friendly alternative to road and rail transport. The use of coastal shipping for bulk agricultural commodities such as wheat, maize, and rice has been a cost-effective option, particularly for moving goods between production hubs and export gateways.

As part of the Sagarmala initiative, India has expanded its inland waterway networks, with investments in the National Waterway 1 (NW-1) on the Ganges River and National Waterway 2 (NW-2) on the Brahmaputra River. These waterways provide a direct route for agricultural commodities from inland states like Uttar Pradesh and Bihar to export hubs such as Haldia and Kolkata. By reducing dependence on road and rail transport, inland waterways help cut down transportation costs for bulk agri-products by 60-70%, a significant benefit for exporters.

## 6. Competitive Benchmarking

### Operational Benchmarking

Company Name	Description	Business Model	Funding as of 2023 (In Million)	Key Investors
Green Agrevolution Private Limited (DeHaat)	Integrated agritech platform offering end-to-end services from seed to market, including AI-driven advisory, market linkage, and supply chain solutions.	Direct-to-farmer and farmer-to-market services	\$ 230 Mn	Sofina, Omnivore, Temasek
Farmart Services Pvt limited	Agri-commerce platform facilitating on-demand agricultural services and products, including farm equipment rental and crop management support.	Direct-to-farmer services platform	\$ 45 Mn	ResponsiAbility Investments, General Catalyst, Omidyar Network, Avaana Capital Advisor
WayCool	Operates a tech-driven supply chain model that manages the flow of agricultural goods from farms to businesses, optimizing efficiency and reducing waste.	B2B supply chain solutions for agribusinesses	\$ 342 Mn	Stride Ventures, Lightrock, Stride Ventures, Trifecta Capital
Star Agriwarehousing and Collateral Management Ltd (SACML)	Operates an asset light warehouse solution along with deep penetration into integrated agriculture services	B2B & B2G for procurement, warehousing and logistics solution  Own Agribazaar – an integrated agriculture service application	\$32 Mn	Temasek
Arya Collateral Warehousing Services Pvt Ltd	Comprehensive agri-platform offering solutions across the agricultural cycle including warehousing, financing, and market linkage.	B2B services for grain grower and bulk buyer	\$ 112 Mn	Omnivore, Lightorck, Quona capital, Blue Earth Capital

Company Name	Description	Business Model	Funding as of 2023 (In Million)	Key Investors
National Bulk Holding Corporation	Specializes in commodity and collateral management services with an extensive network for warehousing and quality control to secure agri-financing.	B2B services for commodity management and collateral financing	India Value Fund Advisors purchased National Bulk Handling Corporation for \$ 49.17 Mn in the 2013-14	India Value Fund Advisors  True North
NCML	Manages integrated post-harvest logistics and supply chain services, specializing in handling and storage solutions to stabilize market prices.	B2B supply chain management for post-harvest commodities	\$ 119 Mn acquisition by Fairfax India, in the year of 2015 buying 74% stake	Fairfax India
Shri Shubham Logistics	Provides customized logistics and warehousing solutions focused on the agricultural sector	Logistics and warehousing solutions tailored for agribusinesses	Tano capital invested \$ 13.64 Mn in the year 2013	Tano Capital

Source: Tracxn, Pitchbook, Company Website, News Reporting



Company Name	Operational Focus	Value Chain Strength	Digital Integration	Services Offered	Warehousing Capacity/Utilization Rate/AUM/GMV
Green Agrevolution Private Limited (DeHaat)	Full Stack, Input to Output Linkage	<ul style="list-style-type: none"> <li>• Diverse input provision</li> <li>• Extensive market linkage</li> </ul>	DeHaat App, AI-based crop advisories	<ul style="list-style-type: none"> <li>• Agricultural inputs distribution</li> <li>• Crop-specific advisory through AI</li> <li>• Market linkage for selling produce</li> </ul>	Warehouse capacity- 9-15KT
Samunnati Financial Intermediation and Services Pvt Ltd	Financial Services	<ul style="list-style-type: none"> <li>• Innovative financial products</li> <li>• Risk management</li> </ul>	Mobile platform for loan management	<ul style="list-style-type: none"> <li>• Tailored financial solutions for agribusinesses</li> <li>• Loans, insurance products, and market linkages</li> </ul>	AUM - ₹ 11.28 Billion
Farmart Services Pvt limited	Farm Management	<ul style="list-style-type: none"> <li>• Comprehensive farm management</li> <li>• Advisory services</li> </ul>	ERP system for farm management	<ul style="list-style-type: none"> <li>• On-demand farm machinery rental</li> <li>• Agronomy services</li> <li>• Market access solutions</li> </ul>	GMV - ₹ 3-6 Billion
WayCool	Output Market Linkage, Farm to Fork	<ul style="list-style-type: none"> <li>• Optimized supply chain</li> <li>• Direct farm to fork efficiency</li> </ul>	Waycool's proprietary supply chain software	<ul style="list-style-type: none"> <li>• Farm-to-retail supply chain management</li> <li>• Food processing</li> <li>• Distribution of fresh produce</li> </ul>	
Star Agriwarehousing and Collateral Management Ltd (SACML)	Full stack, end to end value chain integrated agricultural services	<ul style="list-style-type: none"> <li>• Extensive reach with network of 2000 warehouses across 300 locations, digital platform for input linkages, market linkages and advisory services.</li> </ul>	Agrigate, tradefloor, marketplace, agribhumi	<ul style="list-style-type: none"> <li>• Procurement services, storage, WHR based financing, supply chain financing, input market linkage, output market linkage, farm management and advisory</li> </ul>	Warehouse Capacity- 4.5-5.2 MMT AUM- ₹ 130-165 Billion

Company Name	Operational Focus	Value Chain Strength	Digital Integration	Services Offered	Warehousing Capacity/Utilization Rate/AUM/GMV
Arya Collateral Warehousing Services Pvt Ltd	Output Market Linkage, Collateral Financing	<ul style="list-style-type: none"> <li>• Supply chain financing</li> <li>• Secure storage solutions</li> </ul>	Arya.ag trading and finance platform	<ul style="list-style-type: none"> <li>• Post-harvest services including commodity storage</li> <li>• Financing against stored commodities</li> <li>• Integrated market linkages</li> </ul>	Warehouse capacity – 3-3.5 MMT Warehouse AUM- ₹ 70-90 Billion
National Bulk Holding Corporation	Post-Harvest Management, Collateral Management	<ul style="list-style-type: none"> <li>• Effective risk management</li> <li>• Secure storage facilities</li> </ul>	NBHC digital asset management platform	<ul style="list-style-type: none"> <li>• Commodity management</li> <li>• Collateral management</li> <li>• Quality testing and certification</li> </ul>	Warehouse Capacity - 1.10 MMT
NCML	Supply Chain	<ul style="list-style-type: none"> <li>• Efficient storage and logistics</li> <li>• Market access</li> </ul>	NCMS logistics software	<ul style="list-style-type: none"> <li>• Integrated supply chain management services</li> <li>• Commodity finance</li> <li>• Agri-infrastructure projects</li> </ul>	Warehouse capacity- 1.5 MMT AUM - ₹ 1.31 Billion as of 2023

Company Name	Operational Focus	Value Chain Strength	Digital Integration	Services Offered	Warehousing Capacity/Utilization Rate/AUM/GMV
Shri Shubham Logistics	Supply Chain, Logistics	<ul style="list-style-type: none"> <li>Efficient warehousing and transportation solutions</li> </ul>	Logistics management platform	<ul style="list-style-type: none"> <li>Customized warehousing solutions</li> <li>Agricultural logistics and allied services</li> </ul>	Warehouse capacity- 1.8 MMT AUM- ₹ 30-50 Billion

Source: Company Website, News Reporting, Frost & Sullivan analysis

## Revenue of Major Competitors, ₹ Million

Company name	FY 2021-22	FY 2022-23	FY 2023-24 <sup>#</sup>
Star Agriwarehousing and Collateral Management Ltd (SACML)	3,794.25	6,975.57	9,892.52
Arya Collateral Warehousing Services Pvt Ltd	1,935.51	2,882.49	3,397.04
National Commodities Management Ltd (NCML)	2,943.90	2,571.00	NA
National Bulk Handling Corporation Private Limited	2,111.58	2,392.84	NA
Shri Shubham Logistics	1,221.23	1,086.89	1,075.06
Green Agrevolution Private Limited (DeHaat)	12,743.17	19,649.86	NA
Farmart Service Private Limited*	2,081.81	10,237.12	NA
Waycool	7,723.80	12,514.41	NA

**Note :** Revenue considered here does not include other income.

\*Financial information for Farmart Service Private Limited is based on standalone data, whereas for rest of the companies consolidated data is mapped.

<sup>#</sup>NA refers to financial data not available for the financial year

Source: Company's Financial Statements

**PAT/Net Income, ₹ Million**

Company name	FY 2021-22	FY 2022-23	FY 2023-24 <sup>#</sup>
Star Agriwarehousing and Collateral Management Ltd (SACML)	121.41	287.54	465.99
Arya Collateral Warehousing Services Pvt Ltd	6.65	75.85	190.66
National Commodities Management Ltd (NCML)	-643.80	-1,855.10	NA
National Bulk Handling Corporation Private Limited	90.25	92.25	NA
Shri Shubham Logistics	-369.18	-293.50	-175.17
Green Agrevolution Private Limited (DeHaat)	-15,641.00	-10,943.74	NA
Farmart Service Private Limited*	-174.94	-463.40	NA
Waycool	-11,909.37	-25,916.52	NA

**Note :** \*Financial information for Farmart Service Private Limited is based on standalone data, whereas for rest of the companies consolidated data is mapped.

<sup>#</sup>NA refers to financial data not available for the financial year

Source: Company's Financial Statements

## EBITDA, ₹ Million

Company name	FY 2021-22	FY 2022-23	FY 2023-24 <sup>#</sup>
Star Agriwarehousing and Collateral Management Ltd (SACML)	543.18	707.36	863.90
Arya Collateral Warehousing Services Pvt Ltd	135.72	490.62	765.57
National Commodities Management Ltd (NCML)	-125.10	26.10	NA
National Bulk Handling Corporation Private Limited	190.68	208.80	NA
Shri Shubham Logistics	203.88	224.62	189.16
Green Agrevolution Private Limited (DeHaat)	-15,565.81	-10,851.62	NA
Farmart Service Private Limited*	-153.29	-437.68	NA
Waycool	-11,671.60	-25,296.21	NA

**Note :** \*Financial information for Farmart Service Private Limited is based on standalone data, whereas for rest of the companies consolidated data is mapped.

<sup>#</sup>NA refers to financial data not available for the financial year

Source: Company's Financial Statements

## EBITDA Margin, %

Company name	FY 2021-22	FY 2022-23	FY 2023-24 <sup>#</sup>
Star Agriwarehousing and Collateral Management Ltd (SACML)	14.32%	10.14%	8.73%
Arya Collateral Warehousing Services Pvt Ltd	7.01%	17.02%	22.54%
National Commodities Management Ltd (NCML)	-4.25%	1.02%	NA
National Bulk Handling Corporation Private Limited	9.03%	8.73%	NA
Shri Shubham Logistics	16.69%	20.67%	17.60%
Green Agrevolution Private Limited (DeHaat)	-122.15%	-55.22%	NA
Farmart Service Private Limited*	-7.09%	-3.16%	NA
Waycool	-151.11%	-202.14%	NA

**Note :** \*Financial information for Farmart Service Private Limited is based on standalone data, whereas for rest of the companies consolidated data is mapped.

<sup>#</sup>NA refers to financial data not available for the financial year

Source: Company's Financial Statements

## Total Equity, ₹ Million

Company name	FY 2021-22	FY 2022-23	FY 2023-24 <sup>#</sup>
Star Agriwarehousing and Collateral Management Ltd (SACML)	3,734.67	4,025.16	4,596.18
Arya Collateral Warehousing Services Pvt Ltd	4,503.69	4,616.08	4,853.23
National Commodities Management Ltd (NCML)	5,926.90	4,612.20	NA
National Bulk Handling Corporation Private Limited	2,378.71	1,734.02	NA
Shri Shubham Logistics	1,297.62	1,003.61	825.40
Green Agrevolution Private Limited (DeHaat)	-20,137.34	-30,659.66	NA
Farmart Service Private Limited*	568.58	2,564.74	NA
Waycool	-18,398.02	-43,869.96	NA

**Note :** \*Financial information for Farmart Service Private Limited is based on standalone data, whereas for rest of the companies consolidated data is mapped.

<sup>#</sup>NA refers to financial data not available for the financial year

Source: Company's Financial Statements



## Equity Ratio

Company name	FY 2021-22	FY 2022-23	FY 2023-24 <sup>#</sup>
Star Agriwarehousing and Collateral Management Ltd (SACML)	0.52	0.57	0.58
Arya Collateral Warehousing Services Pvt Ltd	0.75	0.52	0.41
National Commodities Management Ltd (NCML)	0.40	0.35	NA
National Bulk Handling Corporation Private Limited	0.45	0.43	NA
Shri Shubham Logistics	0.26	0.22	0.19
Green Agrevolution Private Limited (DeHaat)	-2.19	-2.56	NA
Farmart Service Private Limited*	0.53	0.62	NA
Waycool	-2.31	-6.14	NA

**Note :** \*Financial information for Farmart Service Private Limited is based on standalone data, whereas for rest of the companies consolidated data is mapped.

<sup>#</sup>NA refers to financial data not available for the financial year

Source: Company's Financial Statements

## Total Debt, ₹ Million

Company name	FY 2021-22	FY 2022-23	FY 2023-24 <sup>#</sup>
Star Agriwarehousing and Collateral Management Ltd (SACML)	2,119.99	1,425.27	1,486.41
Arya Collateral Warehousing Services Pvt Ltd	1,063.41	3,577.74	6,338.00
National Commodities Management Ltd (NCML)	7,216.00	7,120.40	NA
National Bulk Handling Corporation Private Limited	1,400.48	1,090.52	NA
Shri Shubham Logistics	3,288.10	3,259.57	3,078.06
Green Agrevolution Private Limited (DeHaat)	28,503.12	41,085.35	NA
Farmart Service Private Limited*	457.83	1,431.22	NA
Waycool	23,700.20	47,076.10	NA

**Note :** \*Financial information for Farmart Service Private Limited is based on standalone data, whereas for rest of the companies consolidated data is mapped.

<sup>#</sup>NA refers to financial data not available for the financial year

Source: Company's Financial Statements

## Debt Ratio

Company name	FY 2021-22	FY 2022-23	FY 2023-24 <sup>#</sup>
Star Agriwarehousing and Collateral Management Ltd (SACML)	0.30	0.20	0.19
Arya Collateral Warehousing Services Pvt Ltd	0.18	0.41	0.53
National Commodities Management Ltd (NCML)	0.49	0.53	NA
National Bulk Handling Corporation Private Limited	0.27	0.27	NA
Shri Shubham Logistics	0.67	0.70	0.70
Green Agrevolution Private Limited (DeHaat)	3.10	3.43	NA
Farmart Service Private Limited*	0.44	0.35	NA
Waycool	2.98	6.59	NA

**Note :** \*Financial information for Farmart Service Private Limited is based on standalone data, whereas for rest of the companies consolidated data is mapped.

<sup>#</sup>NA refers to financial data not available for the financial year

Source: Company's Financial Statements

## Debt Equity Ratio

Company name	FY 2021-22	FY 2022-23	FY 2023-24 <sup>#</sup>
Star Agriwarehousing and Collateral Management Ltd (SACML)	0.57	0.35	0.32
Arya Collateral Warehousing Services Pvt Ltd	0.24	0.78	1.31
National Commodities Management Ltd (NCML)	1.22	1.54	NA
National Bulk Handling Corporation Private Limited	0.59	0.63	NA
Shri Shubham Logistics	2.53	3.25	3.73
Green Agrevolution Private Limited (DeHaat)	-1.42	-1.34	NA
Farmart Service Private Limited*	0.83	0.57	NA
Waycool	-1.29	-1.07	NA

**Note :** \*Financial information for Farmart Service Private Limited is based on standalone data, whereas for rest of the companies consolidated data is mapped.

<sup>#</sup>NA refers to financial data not available for the financial year

Source: Company's Financial Statements