

Farm mechanisation: A catalyst for sustainable agricultural growth

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FICCI

Foreword



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As the Chairman of the FICCI National Agricultural Committee, it is with great pleasure that I introduce this insightful report on mechanisation in agriculture, which plays a pivotal role in transforming the agricultural landscape, particularly in the context of India.

Agriculture, undeniably, stands at the cornerstone of economies worldwide, serving as the primary source of livelihood for millions. In India, where nearly half of the workforce is engaged in agriculture, its significance cannot be overstated. However, amidst evolving global dynamics, the sector faces multifaceted challenges, ranging from dwindling land availability to the imperative of feeding a burgeoning global population expected to reach 10 billion by 2050.[1]

In this scenario, the modernisation of agriculture emerges as a crucial imperative. Mechanisation, with its potential to enhance productivity, alleviate drudgery, reduce costs and mitigate climate risks, emerges as a promising solution. This report meticulously examines the landscape of farm mechanisation, delving into its global outlook and contextualising its relevance within the Indian agricultural framework.

Moreover, the report aptly underscores the emergence of transformative trends such as precision agriculture, drone technology and AI-driven robotics, heralding a new era of efficiency and sustainability. Embracing these innovations is important in order to unlock the full potential of mechanisation and steer Indian agriculture towards resilience and prosperity.

The report also highlights the emerging trends in farm mechanisation and suggests strategic approaches and interventions required for renewing Indian agriculture through mechanisation. I hope that the findings will inform policy discourse and inspire concerted actions towards realising the vision of a modern, sustainable and inclusive agricultural sector in India.

1 Food and Agriculture Organization, 2022, The future of food and agriculture; https://www.fao.org/documents/card/en/c/cc0959en

Message from PwC



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The importance of agriculture in India's economic landscape can be gauged from the fact that it provides employment to around 46%[2] of the country's workforce even today. However, this workforce is steadily moving out of the sector towards manufacturing and services sectors. There is an urgent need to increase per unit productivity for ensuring sustainable food security and making agriculture remunerative. Moreover, it's important to respond to impending challenges of climate change that have a profound impact on crop yields.

Out of the multiple strategic interventions required to spur sustainable agricultural growth and achieve the vision of Viksit Bharat, improving the level of farm mechanisation seems to hold tremendous potential. The overall farm mechanisation level in India stands at 47%,[3] which is still below the level of developing countries like Brazil and China where it is around 70%.[4] Farm mechanisation is even more important in India where 82%[5] farmers belong to the small and marginal categories and half of the arable land is under the rainfed category. In these conditions, it becomes imperative for farmers to ensure the completion of activities in timely manner.

Multiple evidence suggests that the average yield in agriculture has direct correlation with farm mechanisation. For example, states with higher level farm mechanisation like Punjab and Haryana have high grain yield as compared to other states. Therefore, farm mechanisation is vital for making agriculture more remunerative for small and marginal farmers.

The agricultural sector has made enormous progress in the last few years. Multiple stakeholders like industry, Government, farmers, research and academia need to collaborate in order to overcome the various challenges in the farm mechanisation sector. Focused R&D on the development of suitable implements for small and marginal farms is imperative. Along with conventional farm implements, new and advanced technologies like usage of drone, precision agriculture, AI and robotics are also emerging in the global agricultural ecosystem. Multiple focused interventions are required to ensure small and marginal farmers' access to emerging technologies so that technological advancements can be leveraged for improving the economic situation of farmers.

In a nutshell, embracing technological innovation in farm machinery plays a crucial role in achieving three predominant facets of sustainability towards people, planet and profitability. In line with this, we've proposed a few strategic interventions in this report, which would be useful in simulating the discussions and ideas towards development of farm mechanisation in the country.

2 Indian economic survey, 2022; https://www.indiabudget.gov.in/economicsurvey/

3 https://prsindia.org/policy/report-summaries/farm-mechanisation-for-small-and-marginal-farmers#:~:text=Status%20of%20farm%20mechanisation%3A%20As,86%25%20of%20total%20operational%20holdings.

4 ibid

5 https://www.fao.org/india/fao-in-india/india-at-a-glance/en/





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Executive summary

Despite its falling share in global gross domestic product (GDP), the agricultural sector remains the backbone of the rural economy in the developing world by providing employment to a majority of the population. In India, the sector employs around 46%[6] of the total workforce. Therefore, modernisation of agriculture is of utmost importance in order to ensure the enhancement of livelihoods. Other than employment, the sector also plays a pivotal role in ensuring food security for an increasing global population. It has been estimated that the world population will reach 10 billion by 2050[7] from the present count of around 8 billion. Ensuring food security for such a huge population can be challenging, considering that the area under cultivation is significantly decreasing across the globe due to various factors like climate change. Therefore, the modernisation and development of agriculture requires a multi-pronged approach in order to combat the array of challenges faced by the sector.

This modernisation can be brought about by increasing the level of farm mechanisation which can greatly help the overall agricultural ecosystem by ensuring timely completion of farming activities, drudgery reduction, cost reduction and climate change risk mitigation. Moreover, it can help in making agriculture more sustainable and lucrative. Farm mechanisation involves the use of various machinery to ease farming processes like land preparation, sowing, transplantation, monitoring and harvesting.

Globally, the Asia-Pacific region holds the highest share (43%) in the global farm machinery market.[8] Among different kinds of farm machinery, tractors are used the most, having a share of almost 55%.[9] In India, of all farming equipment used by farmers, tractors make up 80% of the total share. Due to the inclination towards increased tractor use in the country, the Indian agricultural sector is said to be 'tractorised'. At present, the farm power availability in India is at 2.49 kW/ha.[10] The Government of India has thus set an ambitious target of raising the farm power availability in the country to 4.0 kW/ha by 2030.[11] The overall level of farm mechanisation in India is towards the lower end, at about 47%, as compared to other developing nations like Brazil and China where it is around 70%.[12]

6. Indian economic survey,2022; https://www.indiabudget.gov.in/economicsurvey/
7. Food and Agriculture Organization, 2022, The future of food and agriculture; https://www.fao.org/documents/card/en/c/cc0959en
8. https://www.prnewswire.com/news-releases/by-2032--the-value-of-agricultural-equipment-market-is-expected-to-reach-us-108-86-bn--future-market-insights-inc-301629480.html
9. FICCI, 2017, Mechanization: Key to higher productivity to double farmers' income
10. Ministry of Agriculture & Farmers Welfare, 2018, Report on monitoring, Evaluation and Impact Assessment of SMAM; https://farmech.dac.gov.in/SMAM/Evaluation%20Report%20SMAM/Final%20Report%20M&E%20SMAM%20.pdf
11. Standing committee on agricultural, animal husbandry, and food processing, 2022-23, Research and development in farm mechanization for small and marginal farmers in the country; https://sansad.in/getFile/lsscommittee/Agriculture,%20Animal%20Husbandry%20and%20Food%20Processing/17_Agriculture_Animal_Husbandry_and_Food_Processing_58.pdf?source=loksabhadocs
12. https://www.india-briefing.com/news/india-farm-mechanization-sector-opportunities-challenges



In India itself, the average farm power availability varies greatly across different states – i.e. 5–6 kW/ha in Punjab and Haryana 0.2 kW/ha in the north-eastern regions.[13] This discrepancy is one of the major reasons for the uneven development of agriculture in India. It is also important to note that the farm mechanisation level varies according to the types of crops as well – cereal crops like wheat and rice stand at about 50–60% mechanisation, whereas horticulture crops have a much lower level of mechanisation.[14] However, at the same time, farm power availability has increased tremendously in India during the recent decades, helping India to become one of the major net exporter of tractors in the world.

Along with the traditional farm machinery, new trends are emerging in the field of farm mechanisation which leverage the power of emerging technologies like AI. Such changes have enabled precision agriculture and use of robotics, drone technology etc. These technological advancements have the potential of bringing a new revolution in agriculture by greatly increasing efficiency and reducing human intervention.

Although the sector has seen considerable progress in recent times, there are some pressing challenges like fragmented landholdings, unavailability of matching equipment, lack of sufficient capital and lack of required skills which hinder the growth of mechanisation in India. Therefore, a multi-pronged approach encompassing interventions related to field operations, institutions, training and capacity building, awareness generation, research and development is essential.

13. Ministry of Agriculture & Farmers Welfare, 2018 Report on monitoring, Evaluation and Impact Assessment of SMAM; https://farmech.dac.gov.in/SMAM/Evaluation%20Report%20SMAM/Final%20Report%20M&E%20SMAM%20.pdf

14. Standing committee on agricultural, animal husbandry, and food processing, 2022-23, Research and development in farm mechanization for small and marginal farmers in the country; https://sansad.in/getFile/lsscommittee/Agriculture,%20Animal%20Husbandry%20and%20Food%20Processing/17_Agriculture_Animal_Husbandry_and_Food_Processing_58.pdf?source=loksabhadocs

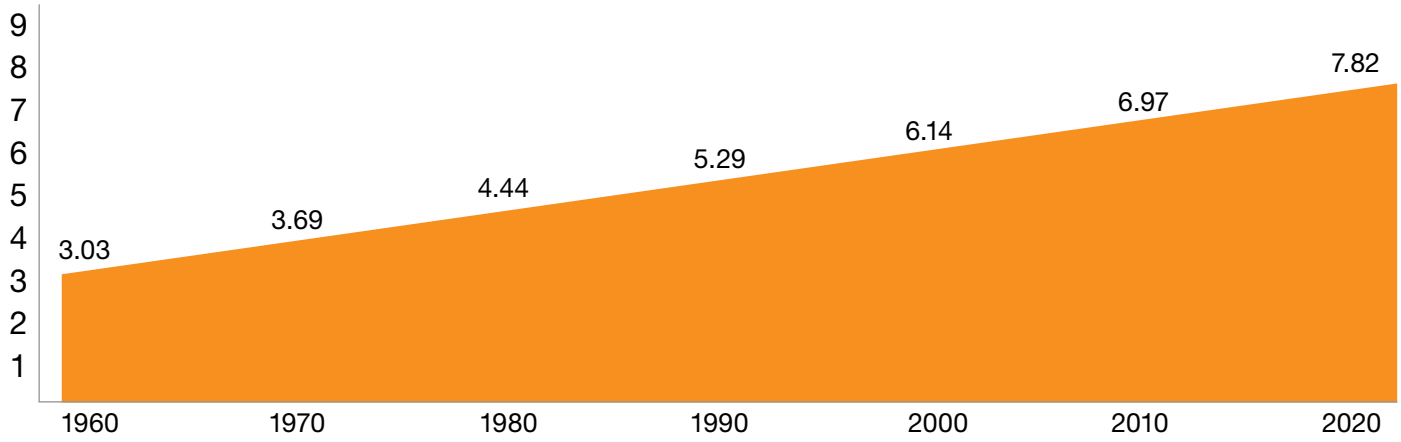


1.

Mechanisation: Driver for agricultural transformation

The world population has seen significant growth during the last 60 years, from 3 billion in 1960 to 8 billion in 2020.[15] This unprecedented growth has brought about a multitude of challenges with it, one of which is ensuring food security across the world. Increasing agricultural productivity in regions like Africa and Asia will contribute towards the same.

Figure 1: World population growth (in billion)



Source: https://data.worldbank.org/indicator/SP.POP.TOTL

Increasing the agricultural productivity will also prove instrumental in improving the livelihoods of about 26.6% of the global workforce employed in agriculture.[16] Underdeveloped and poor countries have the highest share of workforce employed in agriculture. Multiple interventions are being explored for increasing the agricultural productivity, one of which includes increasing farm mechanisation levels.

Types of farm machinery

Generally, the terms 'farm mechanisation' or 'agricultural mechanisation' are used in a broad sense to denote any type of mechanical power associated with agriculture. However, on a deeper level, there are subtle differences between these terms.

Agriculture mechanisation: It is a broad term generally used for all types of agriculture-related machines, tools and equipment.

Farm mechanisation: Although used interchangeably with agricultural mechanisation, it actually refers to machinery used inside the boundaries of a farm unit or plot.

Tractorisation: Tractorisation refers to the utilisation of various sizes of tractors to carry out various farm activities. Indian agricultural machinery is usually dominated by tractors, as they are easily available.

Agriculture equipment: This term describes mechanical machinery used in agriculture which is stationary in nature – e.g. irrigation pump set.

15 The World Bank, 2020, population databank; https://data.worldbank.org/indicator/SP.POP.TOTL

16 FAO, FAOSTAT 2022, Employment indicators: Agriculture; https://www.fao.org/faostat/en/#home



Agriculture machinery can be classified on the basis of usage in agricultural activities. Farming activities like sowing, weeding and threshing require different types of machinery each. Figure 2 shows the classification of agricultural machinery on the basis of various operations.

Figure 2: Classification of agricultural machinery on the basis of various operations

Preparation of land	Sowing and transplantation	Irrigation	Weeding	Crop protection	Harvesting and threshing
• Tractors • Power tiller • Cultivator • Ridger • Harrow • Rotavator • Zero till multi crop • Laser land leveler • Roto seed drill • Super seeder • Hand ridger	• Multi-crop planter • Rice transplanter • Drum seeder • Seed drill • Drum seeder • Super seeder • Roto seed drill • Rotary dibbler	• Tube well • Diesel engine • Drip • Sprinkler • Rain gun	• Cono weeder • Power weeder • Hand cultivator • Roller weeder • Gruber weeder • Brush cutter • Twin wheel hoe • Sickle	• Power sprayer • Aero blast sprayer • Fertiliser broadcaster • Herbicide applicator	• Combine harvester • Thresher • Reaper cum binder • Brush cutter • Multi-crop thresher • Paddy thresher • Sugarcane cutter • Balers • Power reaper

Source: PwC analysis

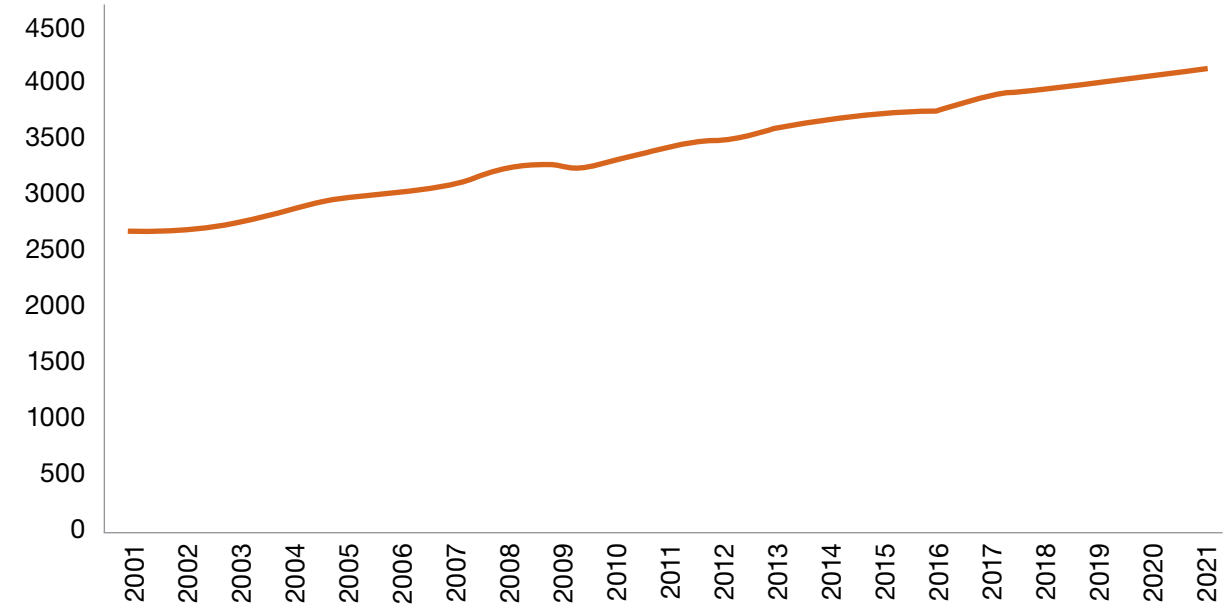
Tractors are abundantly used for various agricultural activities in India as well as across the globe. In recent times, usage of bigger machinery like combine harvesters is seeing an increasing trend. However, smaller machinery like sprinklers and reaper cum binder are yet to gain traction as most farmers rely on manual means to carry out the related tasks.



1.1. Agriculture and mechanisation: Global outlook

Although the share of agriculture in global GDP has decreased to around 4%,[17] the sector still employs the majority of the workforce in underdeveloped regions of the world – e.g. about 48.8% of the population in Africa, which can be classified as one the most underdeveloped and poorest regions in the world, works in agriculture.[18]

Figure 3: Total value of agriculture production across (in USD billion)

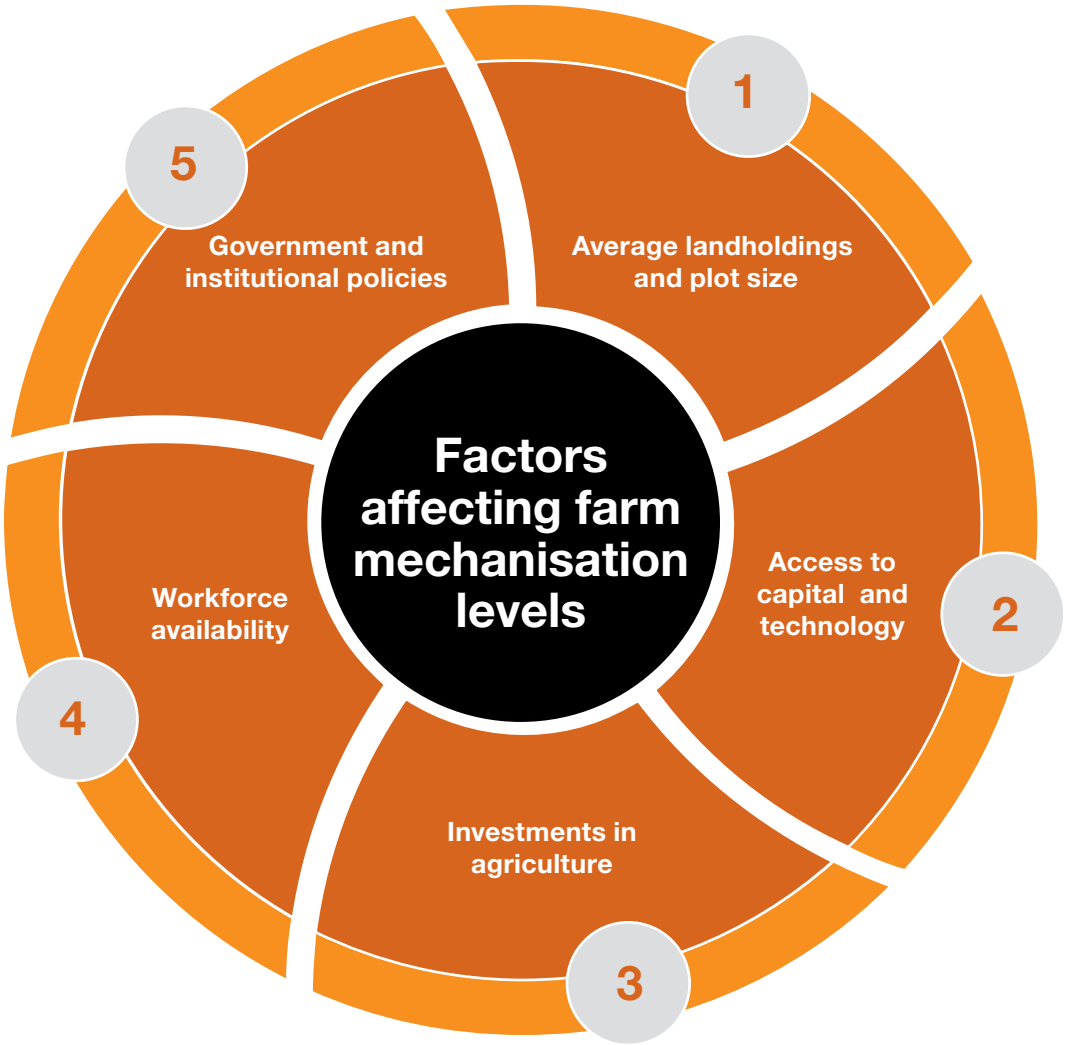


Source: https://www.fao.org/faostat/en/#home

The value of agricultural production has seen an increasing trend in recent times and has gone up from USD 2,680.8 billion in 2001 to USD 4,143.4 billion in 2021, registering an increase of 55% in 20 years.[19]

17 The World Bank, Agriculture and Food Topic; https://www.worldbank.org/en/topic/agriculture
18 FAO, FAOSTAT 2022, Employment indicators: Agriculture; https://www.fao.org/faostat/en/#home
19 IBID

Figure 4: Factors affecting farm mechanisation level



Source: PwC analysis

It is estimated that the global food production may need to increase by around 60% by 2050 in order to feed the increasing global population.[20] However, it is pertinent to note here that the agricultural production in developed regions has already plateaued out. Therefore, going forward, developing or least-developed regions hold the maximum potential for meeting the increasing global food demand.

Farm power availability and agricultural productivity are closely linked to each other. However, farm mechanisation is one of the most neglected aspects in underdeveloped regions, with a majority of farming operations being done manually. The level of farm mechanisation in agriculture varies highly across the globe depending upon various factors, as highlighted in Figure 4. Lack of farm mechanisation results in subsistence agriculture in most of the underdeveloped regions of the world. Therefore, it is vital to increase the level of farm mechanisation which will act as a catalyst for agricultural development across the globe.

20 https://www.downtoearth.org.in/news/agriculture/food-production-will-need-165-600-million-hectares-more-land-to-meet-demand-by-2050-85271



1.2. Agriculture in India

The Indian economy has come a long way and become one of the largest economies in the world. This rapid progress enabled the creation of diverse employment opportunities for millions of people. Even today, the agricultural sector remains an integral part of the rural economy, employing 46%[21] of India's total workforce. Of these, almost 82% farmers belong to the small and marginal categories. India is one of the largest agricultural economies globally, being the largest producer of milk and pulses. It is also the second-largest producer of cereals like wheat and rice as well as fruits and vegetables.[22]

Figure 5: Major highlights of Indian agriculture

- Employing around 46% of the total workforce in the country
- 82% farmers belonging to small and marginal categories
- Uneven regional growth
- Largest producer of milk and pulses
- Second-largest producer of wheat, rice, fruits and vegetables

Source: PwC analysis

Figure 6: Challenges in farm mechanisation

- Small plot size
- Low holding capacity
- Lack of market access
- Low bargaining power in the market
- No access to timely credit
- Limited access to mechanisation

Source: PwC analysis

Despite employing the majority of the workforce, the contribution of agriculture towards India's GDP is currently declining and stands at 18.3% as of 2022-23.[23] The sector is plagued by numerous challenges which contribute to the falling farm incomes for the workforce. Lack of access to farm mechanisation is one major challenge impeding the growth of Indian agriculture. Therefore, efforts are underway to overcome these challenges and make agriculture more viable for small and marginal farmers.

21 Indian economic survey, 2022; https://www.indiabudget.gov.in/economicsurvey/

22 FAO: India at a glance; https://www.fao.org/india/fao-in-india/india-at-a-glance/en/

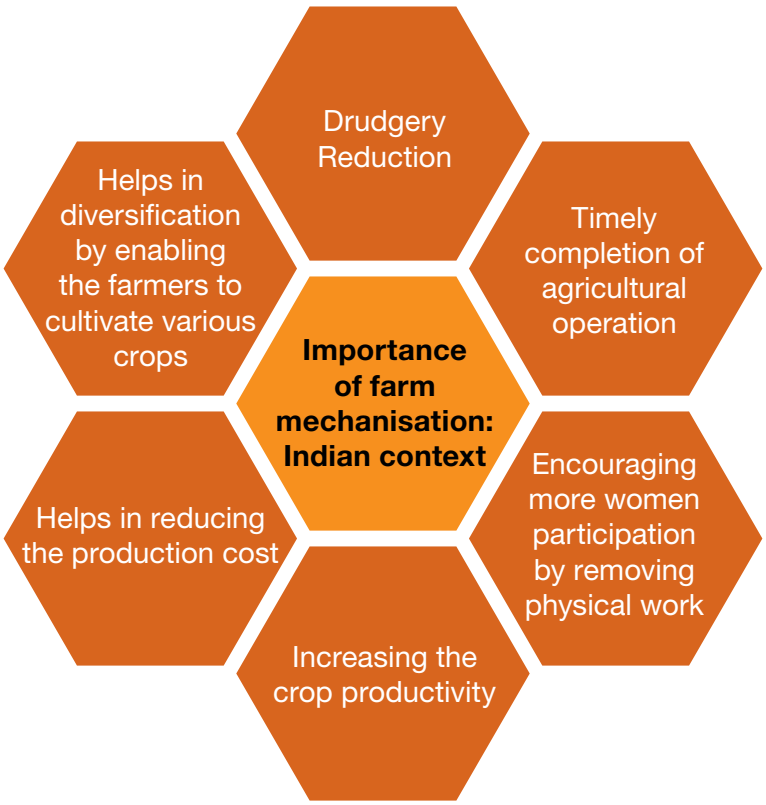
23 Ministry of Statistics & Programme Implementation (MoSPI), 2022-23, Second Advance Estimates of National Income; https://mospi.gov.in/sites/default/files/press_release/PressNoteNAD_28feb23final.pdf

1.3. Role of farm mechanisation in Indian agriculture

Farm mechanisation can help in dealing with some of the persistent challenges involved in agricultural operations. In the Indian context, this becomes even more important as the majority of the working population is engaged in the sector or dependent on it for its livelihood. Farm mechanisation can play a pivotal role in making agriculture a remunerative activity by contributing to productivity enhancement and overall cost reduction.

Mechanisation can help in reducing the drudgery involved in various agricultural activities like ploughing. It has been estimated that a farmer needs to walk around 66 km to plough 1 ha of land using bullocks.[24] The mechanisation of such activities can also help in increasing the participation of women in agricultural activities by removing the barrier of physically demanding tasks.

Figure 7: Importance of farm mechanisation



Source: PwC analysis

One important factor to consider here is Indian agriculture's high dependence on rain. Coverage in India is very low as only 53% of the total arable land has some kind of irrigation source which leaves remaining 43% land dependent on rain for water.[25] Timely completion of various agricultural activities like ploughing or sowing is very crucial in the case of rainfed agriculture in order to properly utilise the moisture provided by the rain, especially in regions with water scarcity.

24 Indian council of agricultural research; http://ecoursesonline.iasri.res.in/mod/page/view.php?id=473

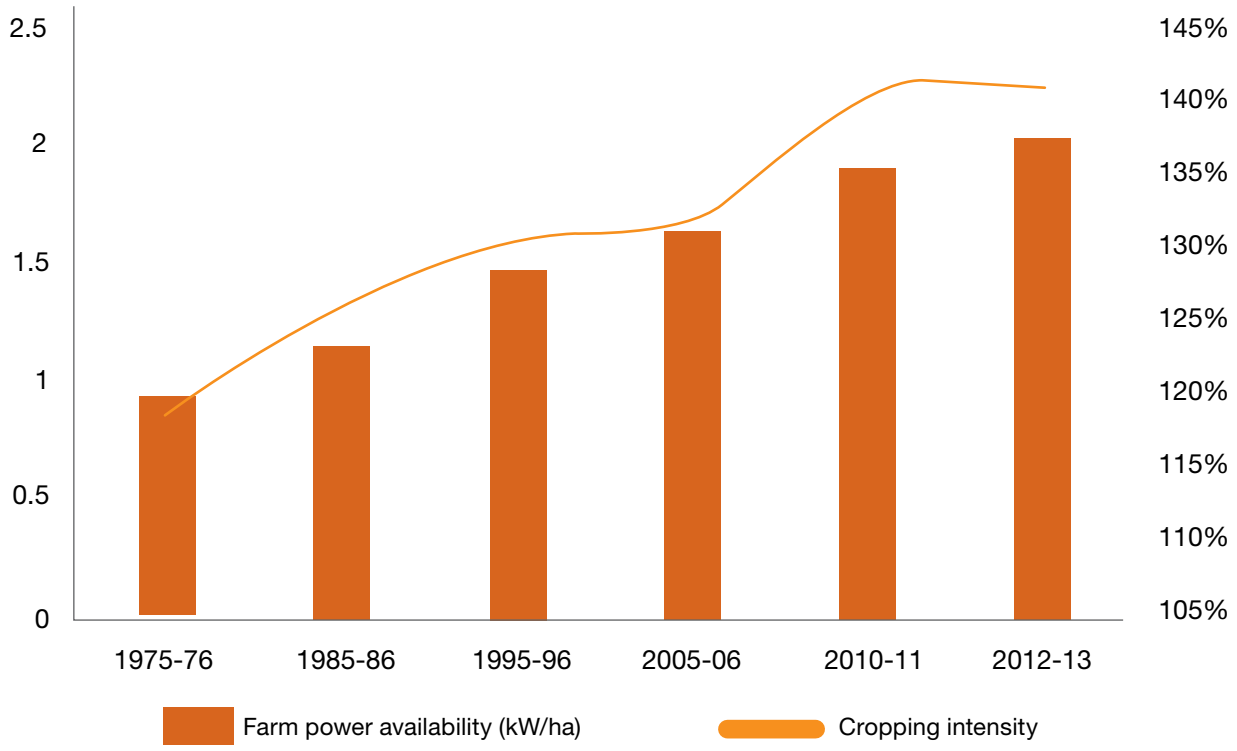
25 Agricultural statistics at a glance, Department of agriculture and farmers welfare, 2022; https://agriwelfare.gov.in/en/Agricultural_Statistics_at_a_Glance

The overall farm power availability in India has increased from 0.36 kW/ha in 1975–76 to 2.48 kW/ha in 2016–17.[26] This shows an increase of around 600%, which is significant considering the high proportion of small and marginal farmers in India.

This increase farm power availability has played a key role in increasing the overall efficiency of Indian agriculture. For example, cropping intensity has increased from 120% to 142% during the same period, indicating the overall increase in arable land utilisation.[27]

As mentioned earlier, there is a direct relationship between farm power availability and crop intensity, which leads to higher productivity and land utilisation. The following graph shows the relationship between farm power availability and cropping intensity.[28]

Figure 8: Farm power availability and crop intensity



Source: Central Institute of Agricultural Engineering, Bhopal, 2014, Status, challenges and strategies for farm mechanization in India, https://krishi.icar.gov.in/jspui/handle

Share of farm power for agriculture through animal and human sources have decreased significantly from 83% in 1960 to about 12% in 2013–14. At the same time, the share of power through tractor and tiller has increased from 2.54% in 1960-61 to 49.29% in 2013-14.[29] This significant increase acted as catalyst for improving the viability of Indian agriculture.

26 Standing committee on agricultural, animal husbandry, and food processing, 2022-23, Research and development in farm mechanization for small and marginal farmers in the country; https://sansad.in/getFile/lsscommittee/Agriculture

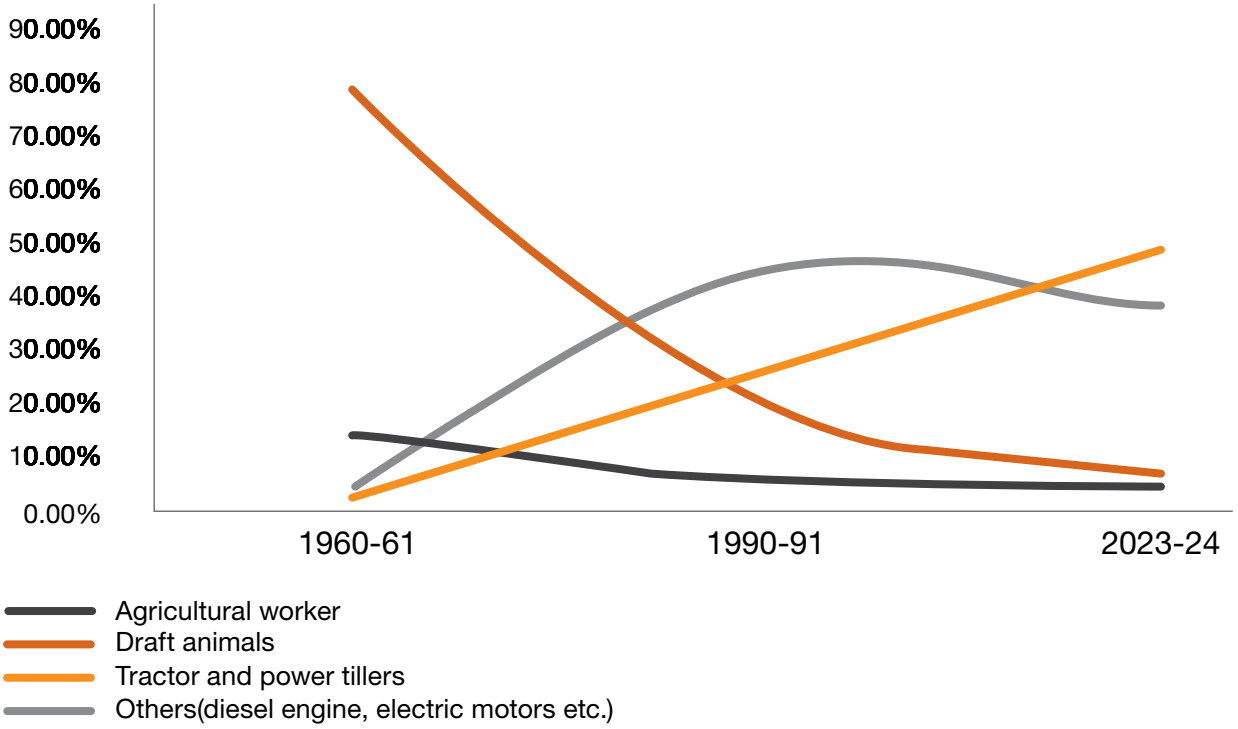
27 Ibid.

28 Central Institute of Agricultural Engineering, Bhopal, 2014, Status, challenges and strategies for farm mechanization in India; https://krishi.icar.gov.in/jspui/handle/123456789/47892

29 Ministry of Agriculture & Farmers Welfare, 2018, Report on monitoring, Evaluation and Impact Assessment of SMAM; https://farmech.dac.gov.in/SMAM/Evaluation%20Report%20SMAM/Final%20Report%20M&E%20SMAM%20.pdf



Figure 9: Power source in agriculture



Source: Ministry of Agriculture & Farmers Welfare, 2018, Report on monitoring, Evaluation and Impact Assessment of SMAM; https://farmech.dac.gov.in/SMAM/Evaluation%20Report%20SMAM/Final%20Report%20M&E%20SMAM%20.pdf

Despite this significant increase, the overall level of farm mechanisation in India is still very much lower (47%) than that of developed nations (>90%). However, challenges like lack of access to credit prevent small and marginal farmers from purchasing farm machinery and thus impede the transformation of the Indian agricultural sector.

A study on evaluation of the Sub Mission on Agriculture Mechanization (SMAM) scheme showed that only 5% of the farmers availed bank loans for the purchase of farm machinery.[30] Additionally, the level of farm mechanisation varies across the country as well. While states like Punjab and Haryana see wider adoption of such technologies, Jharkhand and other north-eastern states continue to lag behind. Various Government and institutional efforts are underway to overcome these challenges and ensure the holistic development of the sector.

30 Ministry of Agriculture & Farmers Welfare, 2018, Report on monitoring, Evaluation and Impact Assessment of SMAM; https://farmech.dac.gov.in/SMAM/Evaluation%20Report%20SMAM/Final%20Report%20M&E%20SMAM%20.pdf

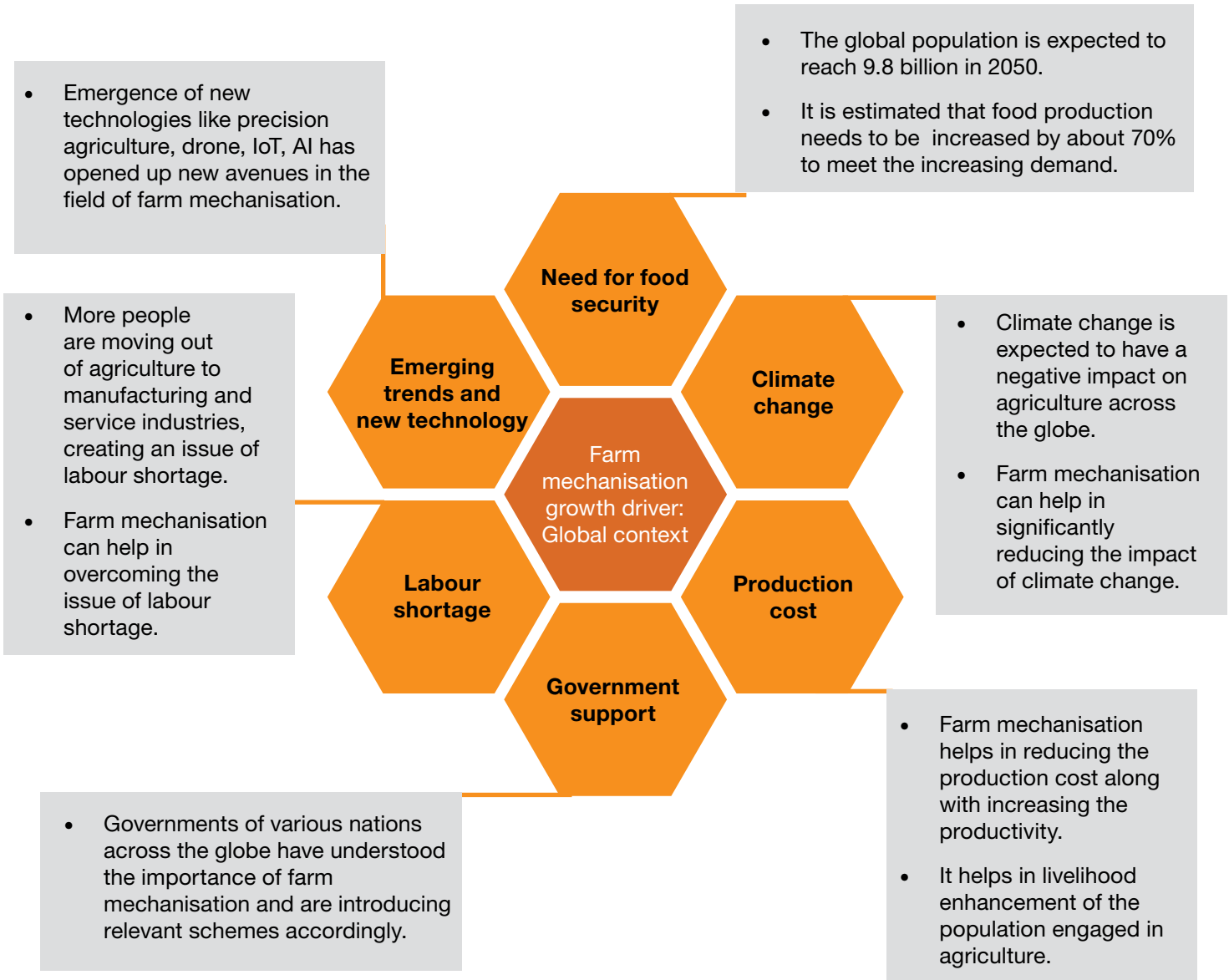
1.4. Growth catalysts for farm mechanisation

Policymakers across the globe are recognising the fact that increasing the level of farm power availability and mechanisation is key to achieving better agricultural productivity and food security. Developed nations (North America and Europe) were able to achieve high mechanisation by 1960s.

1.4.1. Global context

Farm mechanisation in Asia, South America and some nations of North Africa picked up the pace only after the 1960s. Green revolution in agriculture played an important part in expediting the growth of farm mechanisation. Unfortunately, even today, sub-Saharan Africa has not been able to achieve the required level of growth in farm mechanisation.[31] We've analysed the various drivers behind the growth of farm mechanisation across the globe in Figure 10.

Figure 10: Farm mechanisation growth driver: Global context



Source: World Bank and FAO data

31 FAO, 2022, The state of food and agriculture; https://www.fao.org/publications/home/fao-flagship-publications/the-state-of-food-and-agriculture

1.4.2. Indian context

Farm mechanisation is a necessary technological intervention to increase agricultural productivity.

Table 1: Growth drivers for farm mechanisation in India

A. Societal	
Higher involvement of women	• Migration of men from eastern states like Bihar and Jharkhand to other states for employment opportunities is a well-known trend.[32] • In the absence of men, women take up the responsibility of looking after their farming lands, which necessitates the mechanisation of activities that require high physical labour.
Reducing drudgery	• Agricultural activities like rice transplantation and harvesting involves high amounts of drudgery. • Mechanisation will enable the timely completion of such activities.
Increasing labour shortage in rural areas	• Migration has created a labour shortage in rural areas as people are migrating to urban areas for employment in other industries. Schemes like Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) have also provided other avenues for earning livelihoods. • Farm mechanisation will help in overcoming the challenge of labour shortage.
B. Cultivation	
Taking more crops from one field	• Farm mechanisation can help in taking more crops from one field by reducing the time span between various agricultural activities like sowing, harvesting etc. Higher cropping intensity will help in increasing incomes for farmers.
Productivity enhancement	• Higher level of farm mechanisation leads to higher crop productivity.
Mitigating climate change risks	• Indian agriculture is more prone to climate change risks as 60% of the net cultivated area is rainfed in the country.[33] • Adoption of farm mechanisation can help in mitigating these risks by ensuring the timely completion of farming activities.
C. Economic	
Shifting of the workforce from agriculture to manufacturing and service sectors	• As the economy develops, the contribution of manufacturing and services sectors increases in the total GDP. Consequently, the workforce from agriculture also shifts to these sectors, thus necessitating faster adoption of farm mechanisation.
Access to finance	• Institutional credit to the agriculture sector in India has experienced tremendous boost in recent times. It increased from INR 4.3 thousand crores in 1982–83 to INR 18.63 lakh crore in 2021–22.[34] • This increased flow of credit is enabling the farmers to purchase various kinds of farm machinery to drive mechanisation growth.

Source: PwC analysis

32 International Institute of Population Science, Cause and consequence of out migration from Ganga plain; https://iipsindia.ac.in/sites/default/files/other_files/FactSheet_MGP_0.pdf

33 Department of Science and Technology, Climate change and agriculture in India; https://dst.gov.in/sites/default/files/Report_DST_CC_Agriculture.pdf

34 NABARD, Regional disparity in institutional credit to agriculture sector in India: trends and performance; https://www.nabard.org/auth/writereaddata



2

Farm mechanisation market

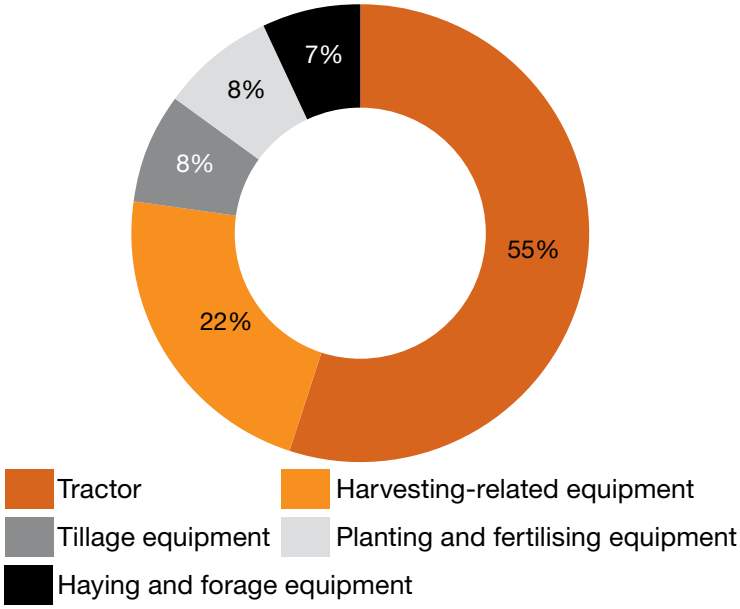
In this section, we look at the overall farm mechanisation market including region- and crop-wise information. We also highlight some of the major players operating in the Indian farm mechanisation market.

2.1. Global market: An overview

The global agricultural machinery market has seen significant growth in recent years and is estimated to be valued at USD 169 billion in 2022.[35] This growth is expected to continue in the future, estimated to reach USD 297.86 billion by 2032 at a compound annual growth rate (CAGR) of 5.1% during this period. Region wise, Asia is expected to be the main driver of this growth. In Asia, India and China are expected to be the contributors for the same.

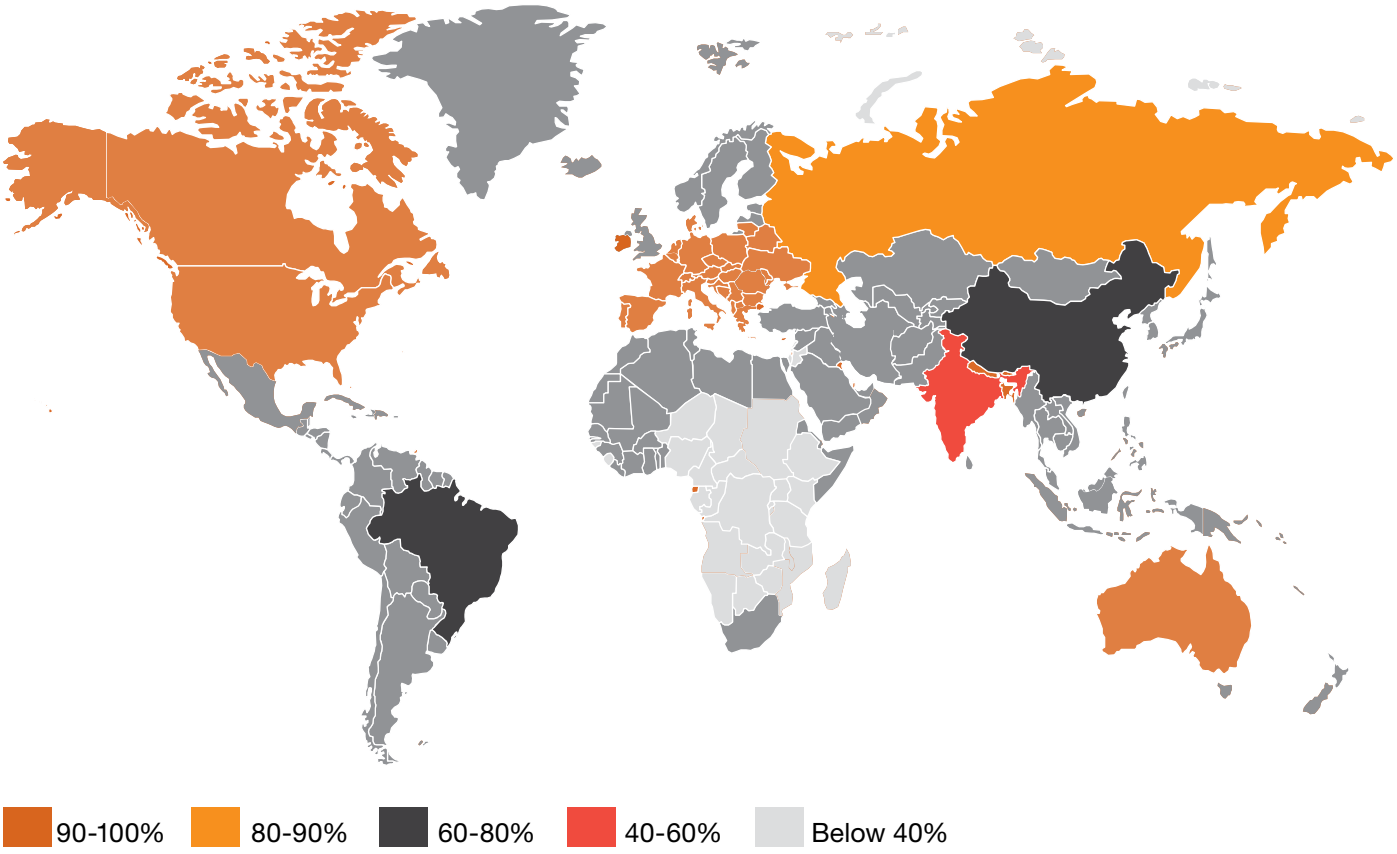
Talking about the percentage share of different agricultural machinery in the global market, 55% of the market share is occupied by tractors, followed by harvesting-related machinery at 22%. Tillage, planting and foraging-related equipment contributes to around 8%, 8% and 7%, respectively.[36] As for the level of farm mechanisation, it ranges from around 95% in North America and Europe to approximately 20% in sub-Saharan Africa.[37]

Figure 11: Share of different agricultural machinery in global market



Source: FICCI, 2017, Mechanization: Key to higher productivity to double farmers' income

Figure 12: Level of farm mechanisation across the globe



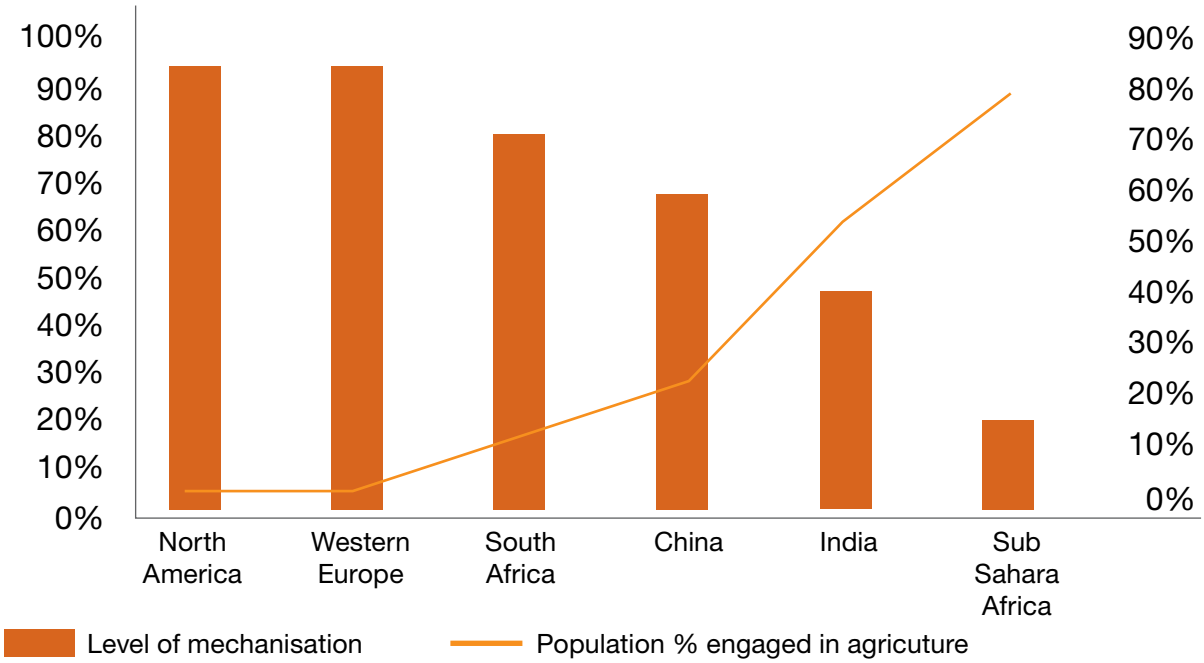
Source: https://www.fao.org/3/cb9479en/online/sofa-2022/trends-drivers-motorized-mechanization and PwC analysis

35 https://www.fortunebusinessinsights.com/agriculture-equipment-market-102665
36 FICCI, 2017, Mechanization: Key to higher productivity to double farmers' income
37 https://www.fao.org/3/cb9479en/online/sofa-2022/trends-drivers-motorized-mechanization.html



One more important takeaway here is the total population engaged in agriculture with respect to the level of farm mechanisation. The proportion of population engaged in agriculture is inversely proportional to the level of mechanisation in a particular region. For example, only about 2–5% population is engaged in agriculture in North America and western Europe, whereas more than 50% of the population is engaged in agriculture in Africa and India.[38] One inference from this data can be that mechanisation leads to higher productivity per worker.

Figure 13: Level of mechanisation vs population engaged in agriculture across the globe



Source: FAO, FAOSTAT 2022, Employment indicators: Agriculture; https://www.fao.org/faostat/en/#home

38 FAO, FAOSTAT 2022, Employment indicators: Agriculture; https://www.fao.org/faostat/en/#home

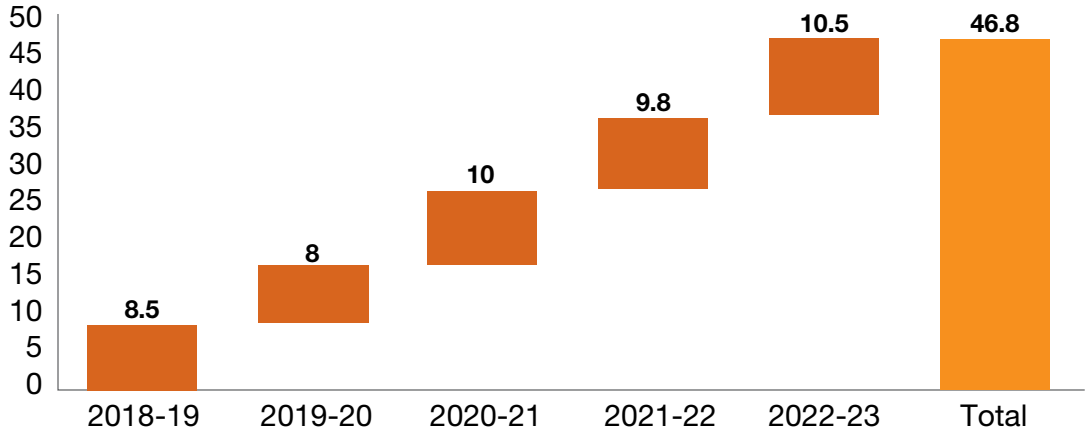


2.2. India market

The Indian farm machinery market is estimated to be valued at around USD 16.73 billion in 2023.[39] The growth potential for this market is huge and it is expected that by 2028, the market value will go up to USD 22.15 billion.[40]

India's share in the global farm equipment market is 7%.[41] As the Indian farm machinery market is highly dominated by tractors, farm mechanisation in the country is often referred to as 'tractorisation' instead. Tractors contribute around 80% of the total machinery in India, with the rest comprising harvesting- and threshing-related machinery. The Indian tractor market alone was around USD 7.54 billion in 2020, and it is expected to touch USD 12.7 billion by 2030.[42]

Figure 14: Tractor production in India during last five years (in lakhs)



Source: NCAER, Making India a global powerhouse, 2023;
https://www.ncaer.org/publication/making-india-a-global-power-house-in-the-farm-machinery-industry

39, 40 https://www.india-briefing.com/news/india-farm-mechanization-sector-opportunities-challenges-31243.html/

41 NCAER, Making India a global powerhouse, 2023; https://www.ncaer.org/publication/making-india-a-global-power-house-in-the-farm-machinery-industry

42 https://www.financialexpress.com/business/express-mobility-indias-pre-owned-tractor-market-a-10-bn-opportunity-2758103/



At present, India is the largest manufacturer of tractors in the world. The tremendous increase in tractor production experienced by India during the last few years has turned the country into a net exporter of tractors. Highly fragmented landholdings is one of the biggest challenges in achieving the desired level of farm mechanisation. Followed by the tractor, the next important equipment in terms of number of units sold is the thresher, due to its high utility in harvesting. Moreover, use of rotavator is picking up due to better efficiency and quality in land preparation.

Figure 15: Features of Indian farm mechanisation



80%
of farm machinery comprises tractors

44%
Lack of small and suitable equipment for small and marginal farmers. Large farms are more mechanised, but only around 44% of small and marginal farmers use farm machinery

Source: NCAER, Making India a global powerhouse, 2023; https://www.ncaer.org/publication/making-india-a-global-power-house-in-the-farm-machinery-industry



2.2.1. Region-wise overview

Level of farm mechanisation is highly uneven across the region as farm power availability ranges from 6 kW/ha in Punjab to 0.5 kW/ha in the north-eastern states. This uneven distribution is a major reason for the inconsistent agricultural production across the nation. Majority of the farmers (63.5%) rely on rental farm machinery and only 4.4% of households own their own tractors with the largest concentrations being in Punjab and Haryana.[43] Table 2 shows the state-wise farm power availability[44] across the nation.

Table 2: State-wise farm power availability

High		Medium		Low	
Punjab	6.01	Andhra Pradesh	2.48	Jammu & Kashmir	1.33
Haryana	5.49	Karnataka	2.43	Jharkhand	1.33
Bihar	3.49	West Bengal	2.12	Himachal Pradesh	1.32
Uttar Pradesh	3.48	Madhya Pradesh	2.00	Kerala	1.24
Tamil Nadu	3.46	Orissa	1.97	Assam	1.2
Telangana	3.40	Rajasthan	1.81	Mizoram	0.69
Uttarakhand	3.05	Chhattisgarh	1.45	Sikkim	0.69
Gujarat	3.00	Maharashtra	1.44	Manipur	0.64
				Nagaland	0.61
				Arunachal Pradesh	0.57
				Meghalaya	0.37

Source: Standing committee on agricultural, animal husbandry, and food processing, 2022-23, Research and development in farm mechanization for small and marginal farmers in the country; https://sansad.in/getFile/lsscommittee/Agriculture

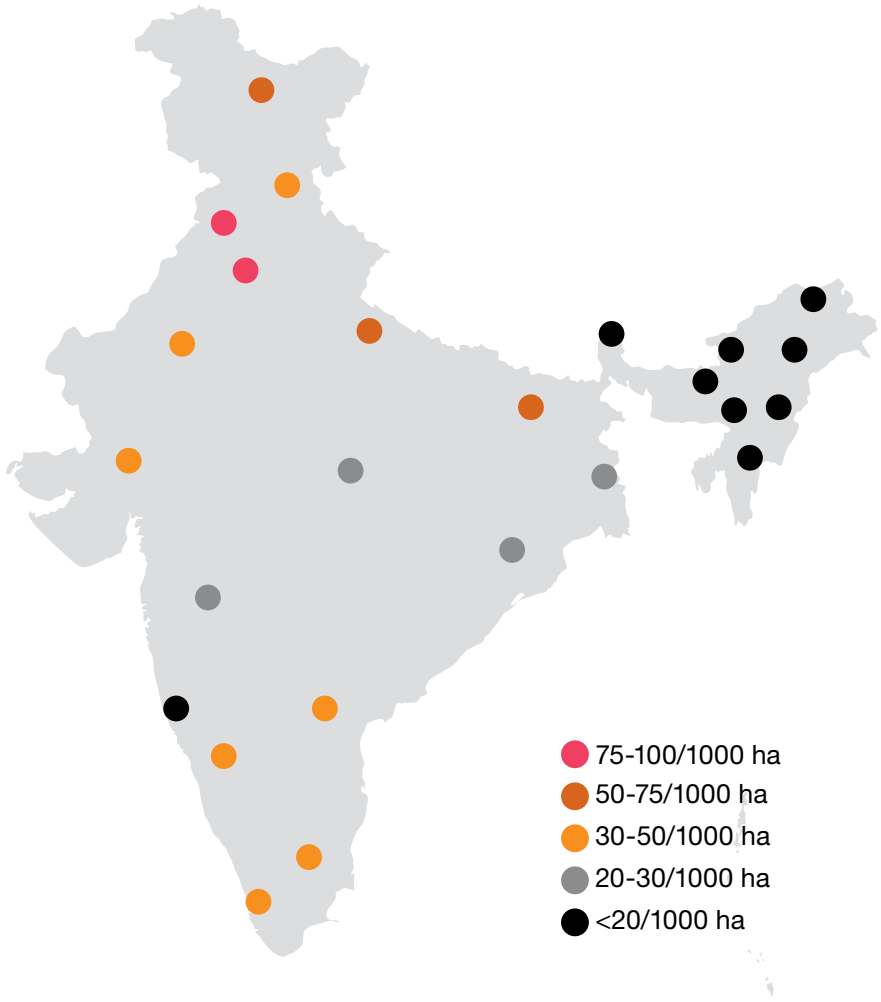
As evident from the table, north-eastern states have the lowest availability of farm power in the nation. One more important observation here is that the farm power availability in the rainfed area is very low (0.3–0.5 kW/ha). Therefore, there is an urgent need to increase the farm power availability in these areas.

43 NCAER policy brief, Making India a global powerhouse, 2023; https://www.ncaer.org/publication/making-india-a-global-power-house-in-the-farm-machinery-industry

44 Standing committee on agricultural, animal husbandry, and food processing, 2022-23, Research and development in farm mechanization for small and marginal farmers in the country; https://sansad.in/getFile/lsscommittee/Agriculture,%20Animal%20Husbandry%20and%20Food%20Processing/17_Agriculture_Animal_Husbandry_and_Food_Processing_58.pdf?source=loksabhadocs

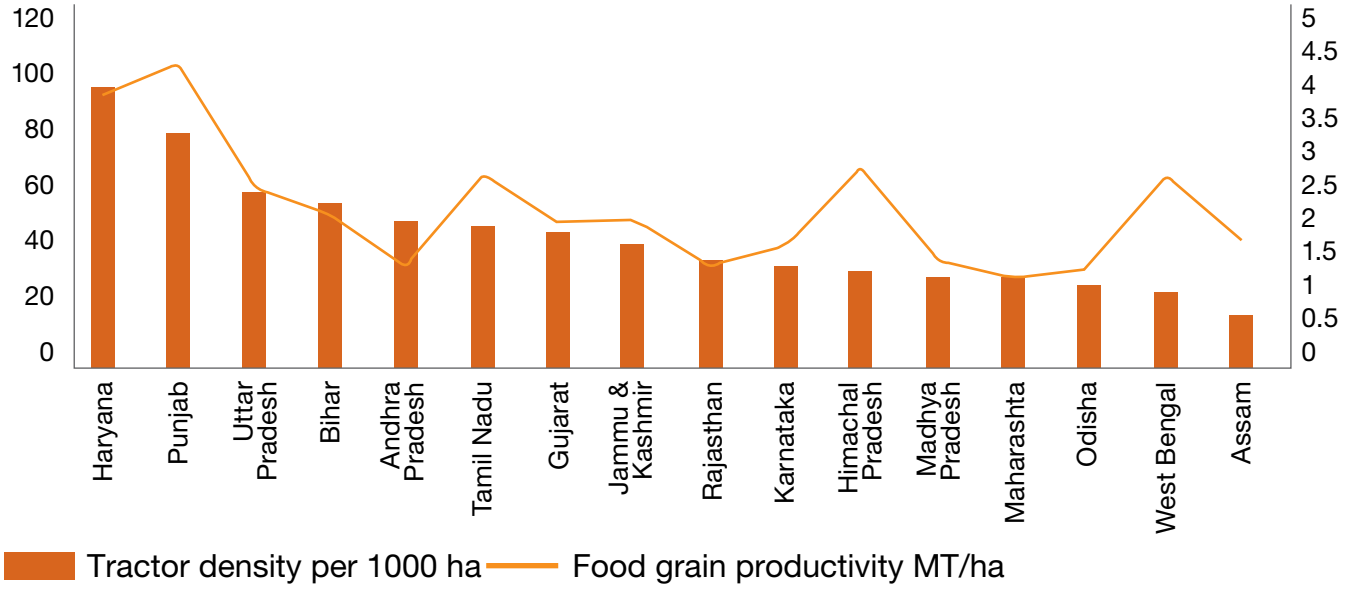
Same is the case with tractor density, which is not uniform across the states. Haryana has the highest tractor density in the country at 96 tractors per 1,000 Ha. This is followed by Punjab, which has 79 tractors per 1,000 Ha.[45] Talking about the category of tractors across various states, Punjab, Haryana, Maharashtra, Tamil Nadu and Andhra Pradesh have a higher share of 41–50 HP tractors, while Odisha, Bihar and Rajasthan have 31–40 HP tractors.[46] In terms of the impact of tractor density on grain productivity, a strong correlation has been observed – i.e. food grain yields tend to be higher wherever tractor densities are high.

Figure 16: Tractor density across various states in India



Source: Central Institute of Agricultural Engineering Bhopal, 2017; Trends of tractorisation in India

Figure 17: Tractor density vs grain productivity across states



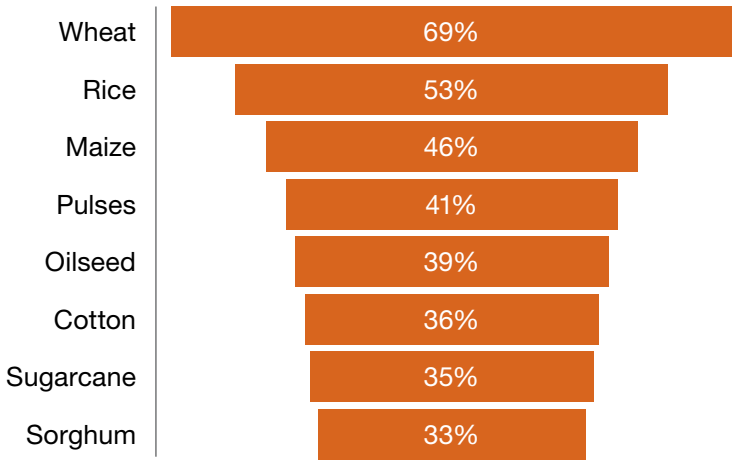
Source: Central Institute of Agricultural Engineering Bhopal, 2017, Trends of tractorisation in India; https://krishi.icar.gov.in/jspui/bit-stream/123456789/47889/1/R-17.pdf

45 Central Institute of Agricultural Engineering Bhopal, 2017, Trends of Tractorisation in India; https://krishi.icar.gov.in/jspui/bit-stream/123456789/47889/1/R-17.pdf

46 Need for farm mechanization; https://farmech.gov.in/06035-02-15052006.pdf

2.2.2. Crop-wise overview

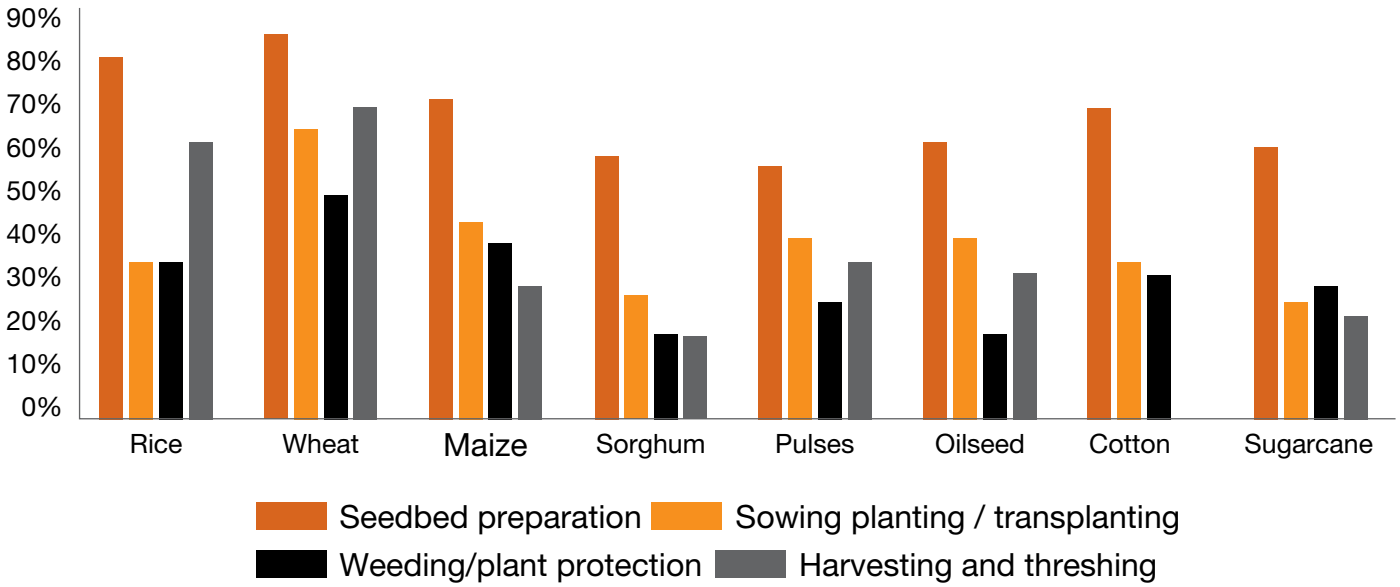
Figure 18: Crop-wise level of farm mechanisation



Source: Standing committee on agricultural, animal husbandry, and food processing, 2022-23, Research and development in farm mechanization for small and marginal farmers in the country; https://sansad.in/getFile/lsscommittee/Agriculture,%20Animal%20Husbandry%20and%20Food%20Processing/17_Agriculture_Animal_Husbandry_and_Food_Processing_58.pdf?source=loksabhadocs

Farm mechanisation level also varies highly in terms of crops and various agricultural activities. Cereal crops like rice, wheat and maize are comparatively more mechanised as compared to other crops like cotton, oilseed and sugarcane.[47] Furthermore, agricultural activities which are more labour-intensive like land preparation and threshing get preference for mechanisation due to high labour costs involved. Apart from this, mechanisation also enables precision or control. One example of the same is paddy transplantation, which is highly labour extensive. It has not been mechanised yet, despite the fact that high amount of labour is required in this activity. It is because that along with labour, precision is also required in the transplantation

Figure 19: Crop-wise and activity-wise level of farm mechanisation



Source: Standing committee on agricultural, animal husbandry, and food processing, 2022-23, Research and development in farm mechanization for small and marginal farmers in the country; https://sansad.in/getFile/lsscommittee/Agriculture

47 Standing committee on agricultural, animal husbandry, and food processing, 2022-23, Research and development in farm mechanization for small and marginal farmers in the country; https://sansad.in/getFile/lsscommittee/Agriculture



3

Role of the Government

3.1. Major interventions

Agriculture has been an area of prime focus for the Government of India (GoI) due to its importance in the rural economy of the country. In Budget 2024-25, INR 1.27 lakh crores have been allocated to the agriculture ministry.[48] To this end, the Government has set an ambitious target of increasing the farm power availability to 4.0 kW/ha by 2030 from the current level of 2.49 kW/ha.

To ensure holistic development across the sector, the Government is keen to provide both fiscal and non-fiscal support to farm mechanisation initiatives. Under the fiscal support, the Government is providing direct subsidy to small and marginal farmers for purchasing farm machinery under various schemes. Establishment of custom hiring centres is also being supported across the country. These custom hiring centres house the agriculture machinery which can be hired by the farmers on rental basis. Other than this, the Government is also providing training and capacity-building support through various institutions like Krishi Vigyan Kendra (KVK) and Farm Machinery Training and Testing Institute (FMTTI). Table 3 outlines the various schemes aimed at promoting farm mechanisation in India.

Table 3: Various central Government schemes for farm mechanisation promotion

Scheme	Description
Sub-mission on Agriculture Mechanization (SMAM)	The flagship scheme of GoI for the promotion of farm mechanisation is aimed at increasing the farm power availability to 4 kW/ha by 2030. Direct financial assistance of 40–50% is provided to individual farmers under the SMAM. Financial assistance of up to 80% is provided to collective bodies like Farmers Producer Organizations (FPOs) and cooperative societies for setting up farm machinery banks.
Promotion of Agriculture Mechanisation for In-situ Management of Crop Residue	Financial assistance of up to 50% is provided for the purchase of specific machinery to be used in crop residue management. State agriculture departments are the implementing agency for the scheme in targeted states.
Rashtriya Krishi Vikaas Yojna (RKVY)	Financial assistance is provided for the establishment of custom hiring centres.
Pradhan Mantri Krishi Sinchai Yojna (PMKY)	PMKY is aimed at increasing the irrigation coverage for agriculture in the country. Funds under this scheme are provided to states based on the state irrigation plan and district irrigation plan prepared by the states.
Pradhan Mantra Kisan Urja Suraksha evam Utthan Mahabhiyan (PM-KUSUM)	PM-KUSUM was launched with objective of increasing the energy efficiency for agriculture along with the adoption of renewable energy sources. It has three components which include setting up of decentralised grids, providing standalone solar pumps to farmers and installing grids connected agricultural pumps.
Mission for Integrated Development of Horticulture	It is aimed at promoting horticulture crops in the country. One of the components of the scheme emphasises horticulture mechanisation. About 60% of the assistance is provided by the centre under the scheme, while 40% assistance is provided by the state.
Bringing Green Revolution to Eastern India	The scheme was launched with the broad objective of enhancing rice productivity in eastern India. One of the components of the scheme includes providing financial assistance of up to 50% of the total cost for the purchase of agricultural machinery used for rice cultivation.
NAMO Drone Didi	This scheme was launched in 2023 to increase the penetration of drone technology in agriculture through leveraging the platform of community-based organisations. Under this scheme, 15,000 drones will be provided to women self-help groups (SHG) during 2024-25 to 2025-26. The SHG members will provide rental services to farmers for agricultural purpose.

Source: PwC analysis

Other than the schemes introduced by the centre, many state governments are also implementing their schemes for the promotion of farm mechanisation in their respective states.

48 Union Budget 2024-25; https://www.indiabudget.gov.in/

Table 4: Various state government schemes for farm mechanisation promotion

Scheme	Major highlights
Yantradoot, Madhya Pradesh	The scheme was launched in 2009 in order to promote integrated development of Custom Hiring Services in state. Under the scheme, district level officers of the Department of Agriculture Engineering demonstrate the use of farm implements to farmers in villages spread across districts. After field demonstrations, CHCs are being set up, which make farm implements available on hire at nominal prices.
Custom Hiring Centre Scheme, Jharkhand	Jharkhand is implementing custom hiring centre scheme under World Bank-funded Jharkhand Opportunities for Harnessing Rural Growth (JOHAR) project. The scheme is aimed at increasing the level of farm mechanisation in the state through a two-pronged strategy to improve the utilisation of existing farm machinery through an app and providing new machinery to community-based institutions created under the National Rural Livelihoods Mission (NRLM).
State Agricultural Mechanization Scheme, Maharashtra	The scheme is being implemented by the Maharashtra State Agricultural Department for increasing the farm power availability to 2 kW/ha. The scheme is aimed at enabling the small and marginal farmers' access to farm machinery and promote on-field demonstration and training of stakeholders.

Source: PwC analysis

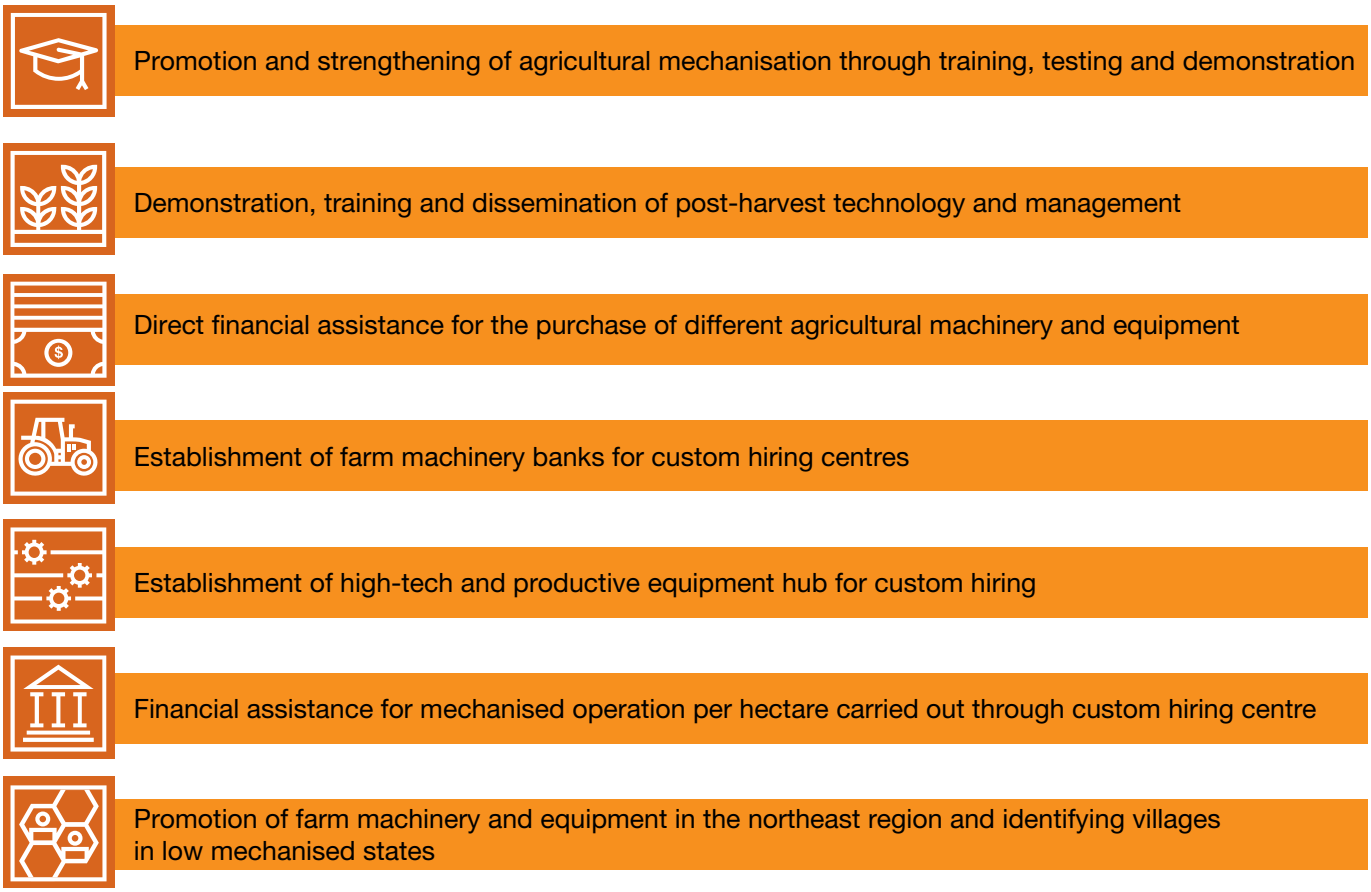


3.2. SMAM

SMAM is the flagship scheme of GoI for the promotion of farm mechanisation. It is centrally sponsored scheme, which was launched by the Ministry of Agriculture and Farmers' Welfare in 2014-15. The scheme is mainly targeted at increasing the level of farm mechanisation in the country. It has been observed that the farm power availability at the launch of the scheme during 2013-14 was 1.84 kW/ha, which rose to 2.49 kW/ha by 2022.[49] It is a significant 35% increase, implying that the scheme helped in expediting the growth of farm mechanisation in the country.

Broad objectives of this mission can be described as below:

Figure 20: Broad objectives of SMAM scheme



Source: Department of Agriculture, GoI

49 Ministry of Agriculture & Farmers Welfare, 2018, Report on monitoring, Evaluation and Impact Assessment of SMAM; https://farmech.dac.gov.in/SMAM/Evaluation%20Report%20SMAM/Final%20Report%20M&E%20SMAM%20.pdf

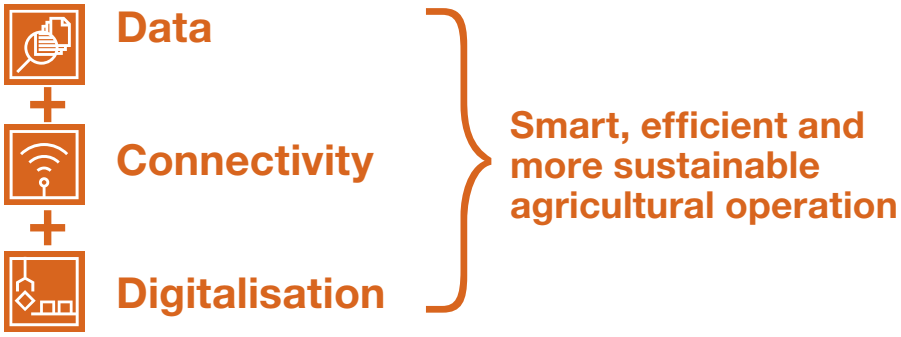


4

Emerging trends in farm mechanisation

Farm mechanisation has undergone and is seeing multiple technological advancements. With technological interventions increasing across the agricultural sector, use of drones, precision agriculture, agri robotics and artificial intelligence (AI) will help unleash the potential of the sector across the globe.

Figure 21: Emerging trends in farm mechanisation



Source: PwC analysis

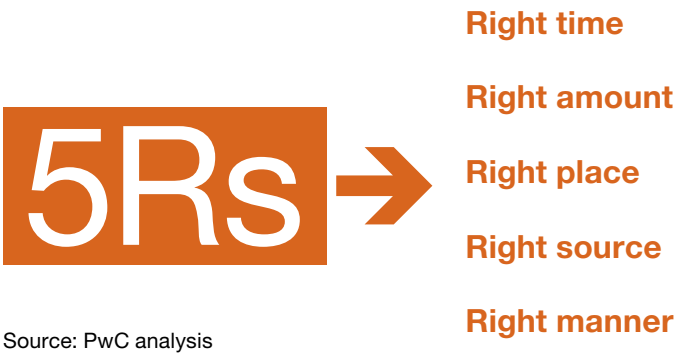
4.1. Precision agriculture

Precision agriculture uses precise amounts of various agricultural inputs like water, fertilisers, pesticides and herbicides, depending upon factors like soil, rainfall and crop type. This is an advanced agricultural practice which relies on technology and data analysis for increasing the crop productivity and reducing input costs.

Precision agriculture is gaining popularity because of its multi-pronged benefits in agriculture. Its market is expected to touch USD 23.06 billion by 2030.[50] This is the reason many new players are entering the field with even more innovations. Precision agriculture holds more importance in countries like India, which are facing scarcity of resources like water and land.

The overall concept of precision agriculture can be defined with the usage of 5Rs as follows:

Figure 22: Precision agriculture features

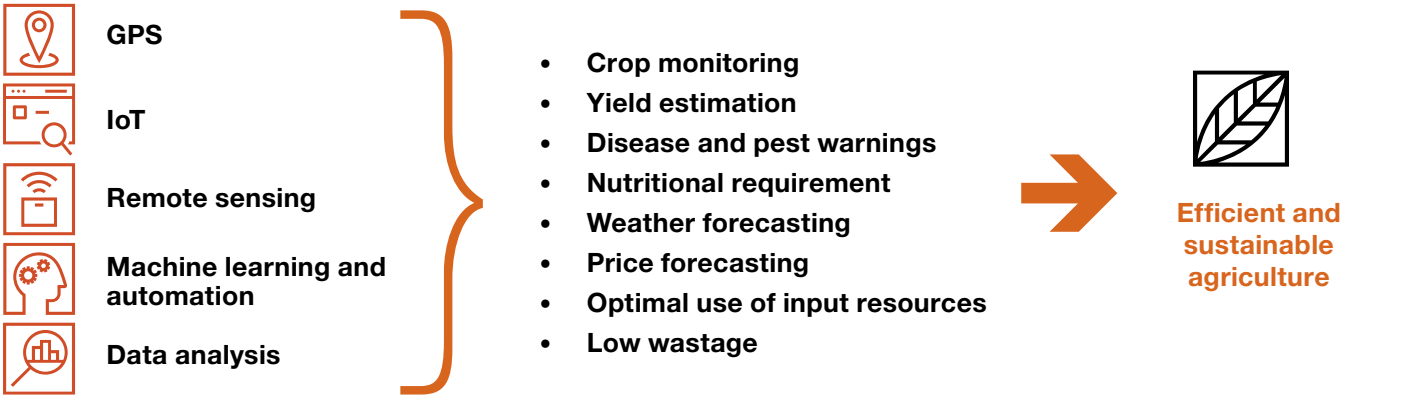


In the Indian context, precision agriculture could contribute towards making agriculture more sustainable. For example, water scarcity is going to be major challenge in north-Indian states like Punjab and Haryana. These two states are also among the highest rice producers in the country. Precision agriculture can help in the judicious use of water.

Source: PwC analysis

The global positioning system (GPS) technology played a key role in the early developmental stages of precision agriculture. It enabled farmers to accurately assess their whole field. Now, precision agriculture has come a long way where it uses sophisticated, data-based approaches to increase the overall efficiency of agricultural activities. Precision agriculture relies on tools and technologies like the GPS, internet of things (IoT), remote sensing, machine learning and automation, data analysis, drones and application control. By using these, farmers can ensure better crop monitoring, yield estimation, disease forecasting, optimal usage of inputs and low wastage.

Figure 23: Precision agriculture's role



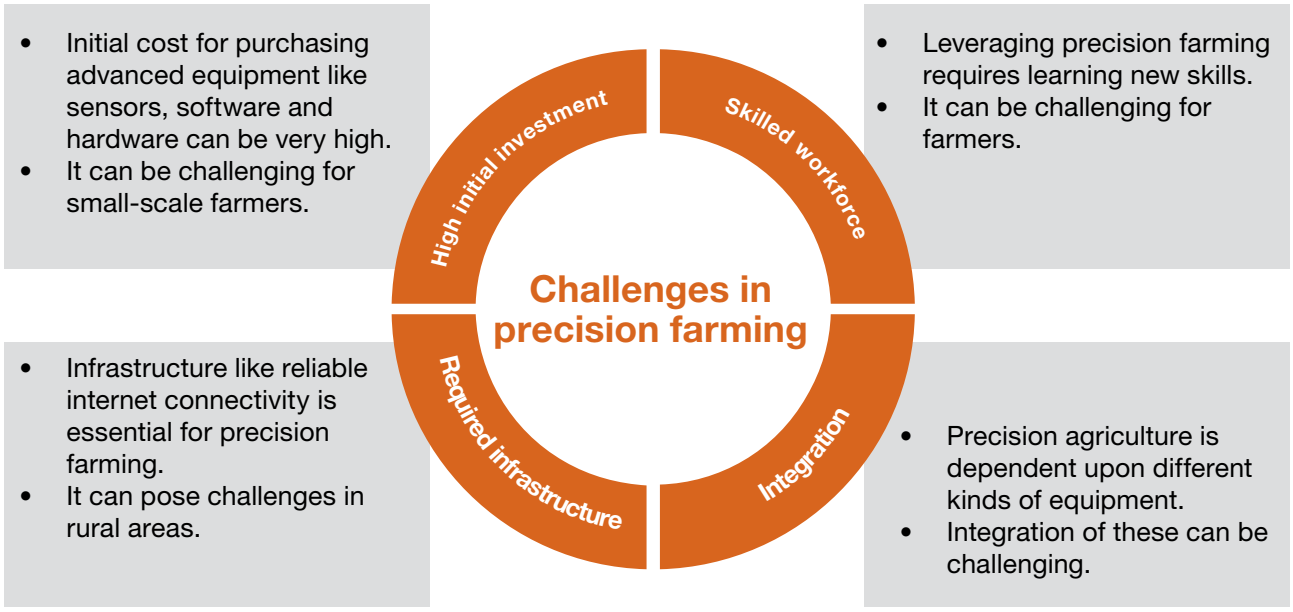
Source: PwC analysis

50 https://www.prnewswire.com/news-releases/precision-farming-market-size-worth

Challenges:

Adoption of precision agriculture is not without its share of challenges, which can be difficult to overcome. We've outlinedsome of these in Figure 24.

Figure 24: Challenges associated with precision agriculture



Source: PwC analysis

4.2. Drones

A drone is an unmanned robotic instrument that can be operated and controlled remotely. The use of drone technology in agriculture has garnered considerable interest from various stakeholders including farmers. Moreover, drone technology is a part of precision agriculture.

Although drones are increasingly being used in agriculture, there are some concerns around its use with respect to environmental and compliance regulations. However, a majority of the policymakers agree that its benefits in agriculture far outweigh its drawbacks. Adoption rate of the drone technology in agriculture varies across the globe. In recent times, adoption has picked up greatly in developed countries. It has been estimated that around 84% of the farmers in the US use drones in one or more activities in agriculture.[51] India is one of the leading importers of drones contributing 22% of the world's total drones.[52]

Some advantages of drone usage in agriculture are outlined below in Figure 26.

Figure 25: Role of drone technology in agriculture



Source: PwC analysis

51 https://roboticsbiz.com/how-the-use-of-drones-radically-transforms-agriculture/

52 https://timesofindia.indiatimes.com/blogs/voices/exploration-of-drone-industry-unlocking-the-full-potential/



Figure 26: Advantages of drone technology

Enhanced efficiency	Increased productivity	Reduction in cost	Monitoring of crops
• Drone technology can help in saving precious time by efficient completion of various agricultural activities • It can help in completion of activities like spraying fertilisers quickly and efficiently.	• Crop yields can be increased by identifying any issues and intervening timely. • Efficient and timely application of input spraying can help in increasing the yield	• Drone technology can help in reducing the overall cultivation cost by saving on high labour cost. • It will ultimately help in making agriculture more profitable.	• Drone technology can capture high-resolution pictures of large crop areas. • It can help farmers in making timely interventions by identifying issues at the initial stage.

Source: PwC analysis

The GoI's focus towards using drone technology in agriculture can be understood from the recently launched Drone Didi Scheme. The scheme was launched with an objective of providing 15,000 drones to women SHGs. The scheme envisaged that the SHGs will utilise the drones for providing rental services to farmers. Along with benefiting farmers, the scheme can also help SHG members to earn additional incomes.

Challenges:

There are multiple obstacles in the widespread use of drone technology in agriculture, hampering their adoption in countries like India. Some of these challenges have been outlined in Figure 27.

Figure 27: Challenges associated with use of drone technology in agriculture

High initial cost:	Required support infrastructure:	Skill and knowledge gap:	Small and fragmented land holdings:
Purchase of drone and related technologies can have high initial capital expenditure for small farmers.	Availability of required support infrastructure like internet connectivity can be big challenges in rural areas.	Usage of drones requires some level of skills and knowledge for efficient operation. At present, only a small number of people have the required skills.	Small and fragmented nature of landholdings in the country poses a big challenge for the usage of drone technology as drone require sufficient area for operation.

Source: PwC analysis



4.3. Agri robotics and AI

AI and robotics are the buzzwords in today's time almost in every field. The combination of AI and robotics holds immense potential to solve complex and pressing issues in agriculture and can minimise the need for human intervention. It can transform agricultural mechanisation significantly and increase efficiencies.

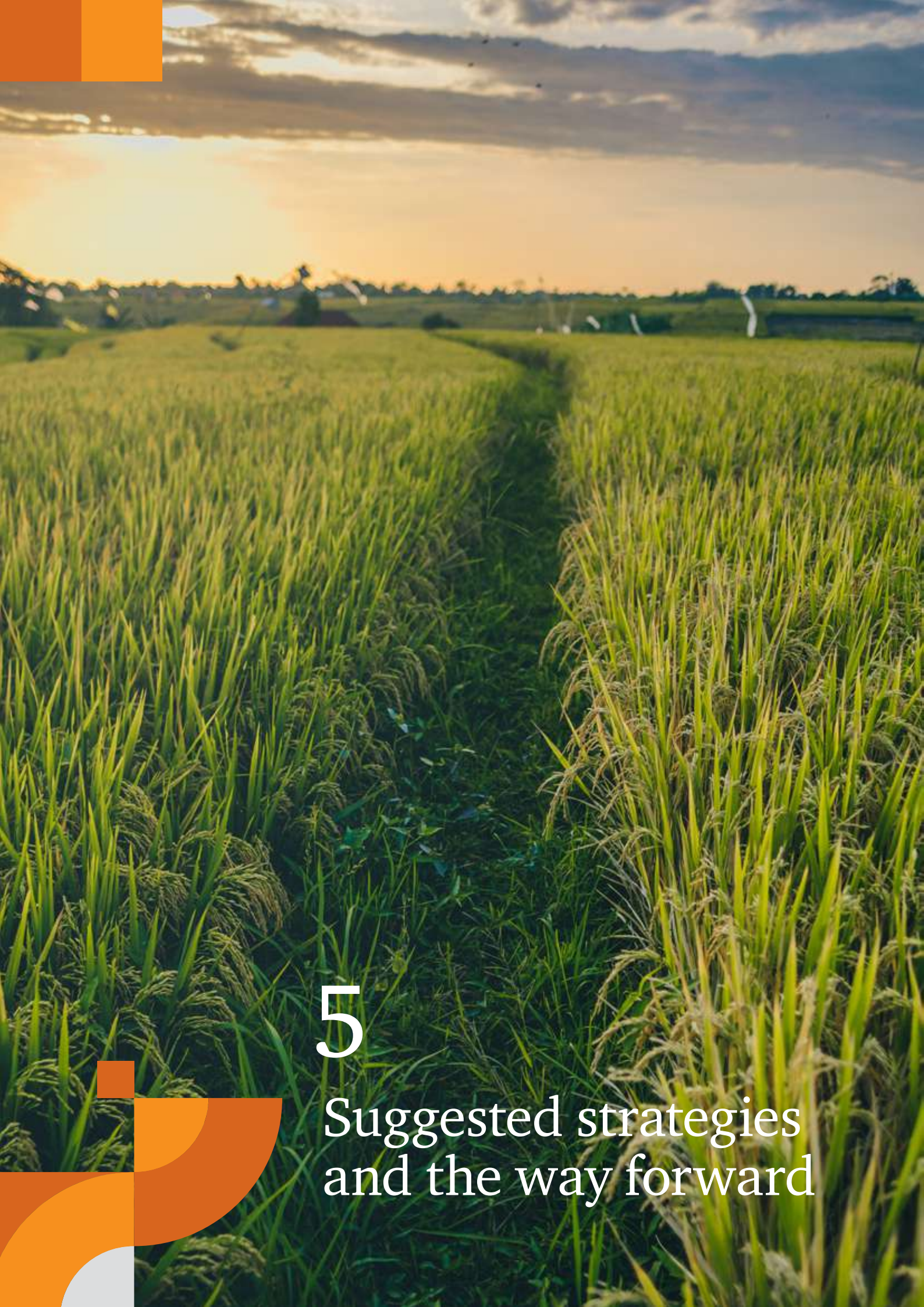
AI can be leveraged for facilitating complex decision making related to operations like plantation, weeding, irrigation and harvesting. Using AI with robotics will help in automating many agricultural activities, which will result in reducing the cost, time and human efforts. AI is already helping to collect and fine-tune data for accurate forecasting and planning. It will also be expected to play a vital role in mitigating the various risks involved in agricultural operations.

Figure 28: Role of agri robotics and AI in agriculture

Sowing and Plantation	Crop protection and growth	Harvesting and Sale
• Providing insights for accurate forecasting for sowing/plantation using AI • Use of AI and robotics in land preparation • Plantation and seed sowing using robotics with AI	• Identification of disease. • Spraying of pesticides, herbicide, fertiliser using drones • Detecting affected area through AI sensor for optimal application of inputs • Monitoring of soil and other conditions	• Utilising autonomous robotics for harvesting • Maturity assessment for horticulture crops using AI • AI-based sorting & grading of fruits & vegetables • Predicting crop yield and forecast of price using AI

Source: PwC analysis

In order to achieve the ambitious target of ensuring 4 kW/ha farm power availability, we need to take some strategic steps towards ensuring the development of farm mechanisation in the sector.



5

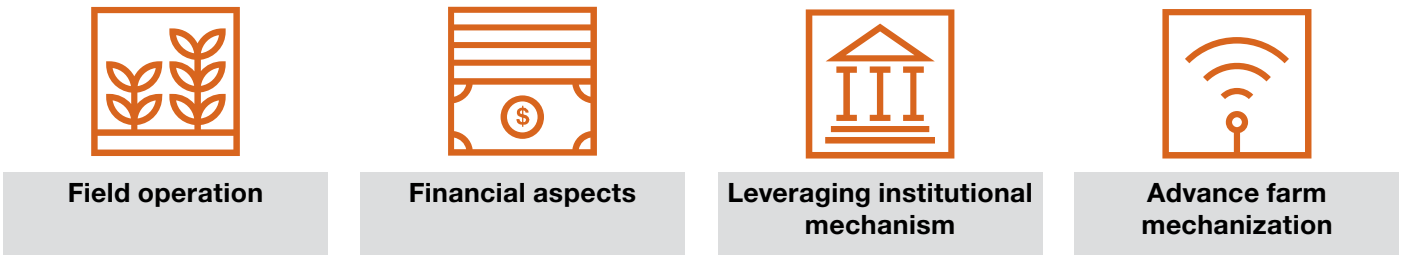
Suggested strategies and the way forward

This section talks about the strategic approaches and interventions required for further development of farm mechanisation in India. Although farm mechanisation in India has made tremendous progress over the years, it is yet to reach its potential. Therefore, to achieve the ambitious target of improving farm power availability to 4 kW/ha by 2030, it is important to devise a holistic approach involving various stakeholders which ensures progress in the right direction.

To start off, there is an urgent need to analyse the various preferences of different categories of farmers in terms of farm machinery. Farm implements related to high physical work-related activities like land preparation, harvesting have already found much traction among all categories of farmers. Farmers with medium and large landholdings usually prefer buying such machinery, while small and marginal farmers prefer renting the same. However, activities like transplantation and weeding, which require more control and precision, need to be mechanised further. Therefore, it is important to develop suitable equipment for small and marginal farmers. This will require significant research and development efforts while gaining a detailed understanding about the actuals on field requirements.

We've provided some suggestions for strategic interventions in order to ensure the holistic development of the farm mechanisation ecosystem. These interventions can be divided into four broad categories: Agricultural operation related interventions, finance and economics related interventions, promoting the adoption of next-generation trends in farm mechanisation and strengthening of institutional mechanism for training and capacity building.

Figure 29: Suggested interventions framework for development of farm mechanization in the country



Source: PwC analysis

Agricultural operation related interventions

Developing matching implements for small farms
As mentioned earlier, farm mechanisation in India is dominated by tractors. The overdependency on tractors is resulting in the lack of development of smaller and more affordable farm machinery suitable for small- and medium-sized farms in India. It has been estimated that the average annual utilisation of tractors in India is 500–600 hours.[53] It is also the norm to use a tractor for at least 1,000 hours in a year to realise its full efficiency, mainly because there is a lack of suitable farm machinery for small plot sizes. Although power tillers showed some promise initially, challenges like moveability in tough terrains and operational difficulties resulted in low adoption. Therefore, there is an urgent need to develop and promote suitable machinery for small and marginal plot size.

Women-friendly farm machinery
As mentioned earlier, migration of male family members is very high in eastern Indian states especially Bihar, Jharkhand. Thus, there is a need to develop women-friendly agricultural machinery to address the challenge of high physical labour in the absence of male members in a farming household. The drudgery involved in agricultural activities needs to be removed through the development of small and precise machinery. Policymakers have already taken significant steps in this direction. The Indian Council of Agricultural Research (ICAR) has developed a list of farm equipment suitable for use by women farmers.

Promoting the mechanisation in horticulture
India is the second-largest producer of fruits and vegetables in the world with a total area of around 272 lakhs ha for horticulture-related crops.[54] Despite having such a large area, mechanisation has mainly happened in the cereal crops like wheat and rice (60%), whereas the same is very low in horticulture-related crops. Development of small hand tools suitable for horticulture crops can be thus useful for the farmers involved in horticulture.

Figure 30: Average tractor utilisation in India vs global standard (hours in a year)



Source: https://www.cnbctv18.com/agriculture/tractorisation-in-india-high-but-agriculture-mechanisation-low

53 https://www.cnbctv18.com/agriculture/tractorisation-in-india-high-but-agriculture-mechanisation-low
54 https://icar.org.in/sites/default/files/2022-06/IH-Sep-Oct-2021.pdf



Figure 31: Promotion of mechanisation in horticulture

Mechanisation in horticulture crops is also important from the perishability point of view. As horticulture crops are highly perishable, timely completion of various operational activities through mechanisation can help in overcoming the challenge of perishability to a great extent.

It can also help in diversification through encouraging the farmers to take up horticultural crops. Diversification is an urgent need in states like Punjab and Haryana.

Source: https://pib.gov.in/PressReleasePage and PwC analysis

Finance and economics related interventions

Ensuring easy access to credit for purchase of machinery

Institutional credit to the agriculture sector in India has seen rapid growth in recent times increasing from INR 7.3 lakhs crore in 2013-14 to INR 20.390 lakhs crores in 2023–24.[55] However, majority of the credit flow to agriculture includes short-term credits, accounting for the purchase of input like seeds and fertilisers. Therefore, it is important to increase credit for purchasing farm machinery. Sensitisation of formal financial institutions is required for the same. Thus, the possibility of including a sub target, specifically for the purchase of agricultural machinery under the priority sector lending, can be explored for this.

Incentivising indigenous manufacturers

India has become one of the largest producers of tractors with a total production of 9.45 lakhs units during FY 22-23.[56] However, this cannot be said for other types of farm machinery. The total value of non-tractor farm machinery's import was USD 226 million in 2020-21.[57] Moreover, 53% of non-tractor farm implements are being imported from China at present.[58] Indigenous manufacturers find it difficult to match China's competitive pricing due to high subsidies provided by the Chinese government. Other than this, the after-sale support service for Chinese implements is also a huge challenge and farmers have to bear the brunt of it.

Therefore, it is important to urgently undertake R&D for indigenous manufacturing of non-tractor farm machinery in order to accelerate holistic farm mechanisation growth. Provisions like preference for indigenous manufacturers can be introduced in schemes like the SMAM. Also, the possibilities can be explored for bringing PLI like specific scheme for farm machinery manufacturer.

Realignment of direct subsidy schemes

There is a need to ensure effective implementation of direct subsidy schemes like the SMAM by convergence between various stakeholders. Front-ended support in terms of advisory needs to be provided to farmers along with back-ended support in the form of direct subsidy. Also, there is a need to increase awareness regarding these schemes to ensure wider reach. Formal financial institutions also need to be sensitised about the various components of the scheme.

Along with this, proper information dissemination to manufacturer will help in realigning with farmers' needs. Policymakers may also consider including emerging trends in the field for providing support under these schemes. Also, there is a need to do comprehensive impact assessment exercise for the different subsidy schemes. The schemes need to be implemented in phases where learnings from the earlier phase's impact assessment can be included in the next phase in order to ensure better implementation.

55 https://indianexpress.com/article/business/agriculture-credit-crosses-rs-20-lakh-crore-till-january-fy24-9175024/

56 https://www.thehindubusinessline.com/companies/tractor-industry-clocks-highest-ever-domestic-sales-in-fy23

57 National Council of Applied Economic research, 2023, Making India a Global Powerhouse in the Farm Machinery Industry; https://www.ncaer.org/wp-content/uploads/2023/02/NCAER-Report-Making-India-Feb-2023

58 Ibid.



Strengthening and leveraging institutional mechanism

Training and capacity building

Training and capacity building of various stakeholders is of utmost importance in ensuring optimal utilisation of farm machinery. Established institutions like FMTTI and KVK can play a pivotal role in conducting large-scale training and capacity-building exercises.

Along with the operational aspects, there is a dire need to conduct training on preventive maintenance of farm machinery. Most of the farm implements distributed to collective bodies get damaged due to lack of preventive maintenance.

Figure 32: Components of proposed training and capacity building for farm mechanisation promotion



Source: PwC analysis

Leveraging platforms by community-based organisations (CBOs) like FPOs and SHGs

Collective community-based institutions like FPOs and SHGs are envisaged to play an important role in the development of agriculture. These institutions can help in achieving the required economy of scale in agriculture. CBOs have the potential of providing strong collective platforms which can be leveraged for providing collective farm machinery to the farming community. This is already happening through institutions created under schemes like the NRLM and Formation and Promotion of 10,000 FPOs.

Collective ownership can help farmers in saving high initial capital costs which otherwise would be required for the purchase of farm machinery. It can also help CBOs in earning extra revenue through rentals. In addition, the existing CHCs platform needs to be strengthened by developing collective ownership. Participation of private players is also of great importance in order to facilitate institutional efficiency. Therefore, possibilities of public-private partnerships should be explored for benefiting small and marginal farmers.

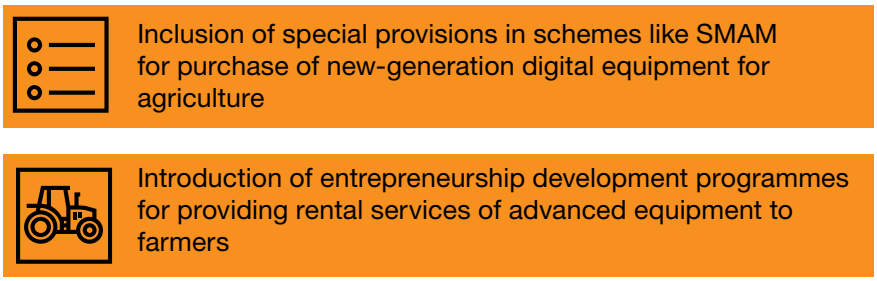
Promoting the emerging trends in mechanisation

Direct incentives for the usage of new technological advances

As mentioned earlier, emerging trends like AI and robotics and precision agriculture have the potential to revolutionise the agricultural sector. Therefore, concerted efforts are required to ensure wider adoption of these trends in India. Special provisions for the purchase of such machinery can be included in schemes like the SMAM. Other than this, policymakers can also contemplate some sort of entrepreneurship development programmes revolving around the same. These entrepreneurs can provide rental services pertaining to advanced machinery to farmers.



Figure 33: Promotion of emerging trends in mechanisation



Source: PwC analysis

Conclusion

India is a global agricultural powerhouse with about 156 million ha arable land.[59] In near future, arable land is going to become a precious resource due to its important role in fulfilling the food security need of the rapidly increasing global population. This puts India at a very advantageous position, where it can leverage this resource for the overall development of its agricultural sector.

In order to realise the potential of the sector, it is important to focus on increasing the crop yields and productivity by a significant amount. This is where farm mechanisation comes into the picture, among other factors. Increasing the level of farm mechanisation will help in the modernisation of Indian agriculture, enabling it to contribute immensely towards fulfilling global food security needs. Moreover, leveraging the full potential of the largest available arable land can help India become a global export hub for food products. Increased farm mechanisation can also help in increasing the per capita income in rural areas, helping achieve the target of becoming a developed country by 2047. As mentioned earlier, a multi-pronged approach is required to achieve the desired level of farm mechanisation in the country. Emerging technologies like precision agriculture and drones present interesting opportunities to leverage the full potential of farm mechanisation. Therefore, strategies focused on increasing the access of emerging technologies for smaller farmers should be devised, while encouraging a collaborative approach to help spread awareness and adoption of farm mechanisation.

59 FAO, Sustainable food and Agriculture, 2020; https://www.fao.org/sustainability/news/detail

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