

# FARM MECHANIZATION IN INDIA ADVANCING WITH CUSTOM HIRING —TRANSITION FROM AGROINDUSTRY TO AGROECOLOGY—

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## SUMMARY

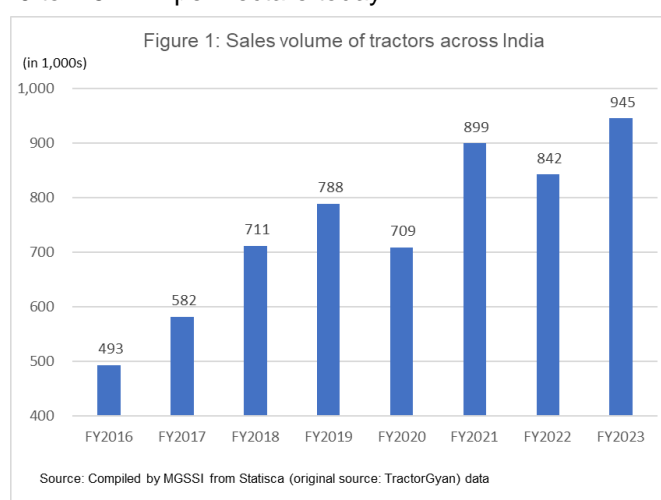
- In India, the use of tractors and combine harvesters has become more widespread in recent years. So-called “custom hiring”, the practice of sharing farm machinery, has been successful in making such equipment available to small-scale farmers.
- While farm mechanization is essential to India's future economic growth, the government is advocating a shift from agroindustry to agroecology. Thus, India is facing the need to pursue the mechanization of agriculture in parallel with the transition to agroecology.
- In Europe, the US, and other countries, agricultural machinery that contributes to agroecology has been developed and is being used in combination with conventional agricultural machinery in some cases. In India, through the practice of custom hiring, new technologies are expected to be introduced along with the spread of conventional agricultural machinery.

## 1. CURRENT STATUS OF FARM MECHANIZATION IN INDIA

### 1-1. Wider use of tractors

Agricultural operations in India are steadily becoming more mechanized. The supply of power available to farmers has increased from 0.3 kW per hectare in 1970 to 2.54 kW per hectare today.

Tractors are the drivers of this mechanization trend, and accounted for 80% of the Indian agricultural machinery market as of 2022. In fact, the trend is sometimes referred to as the “tractorization”, rather than the “mechanization”, of agriculture<sup>1</sup>. The growth of the tractor market has accelerated in recent years, with a record high of approximately 950,000 tractors sold in 2023 (Figure 1).



<sup>1</sup> [Solidaridad Japan, News and Resources, “Getting an Overview of the Agricultural Machinery Market in India” \(In Japanese\)](#), (accessed February 14, 2024; same for all subsequent footnotes and figure references)

## 1-2. Custom hiring

The tractor market is growing in India because tractors are used not only in agriculture, but also for the transport of materials as well as for general mobility, and also because of the existence of “custom hire” services. Custom hiring is a farm machine sharing practice. Farmer groups may purchase farm machinery jointly and share it within the group, or they may purchase it individually and rent it out by the hour or by the acreage to farmers who do not own such machinery, during periods when they are not using it themselves. In the latter case, the farmers who rent out the machinery are also known as “contractors”.

The Food and Agriculture Organization (FAO) of the United Nations has been advocating the introduction of custom hiring to modernize agriculture in Africa and other developing regions around the world. In response, in 2014, India launched the Sub-mission on Agricultural Mechanization (SMAM) policy to promote custom hiring.

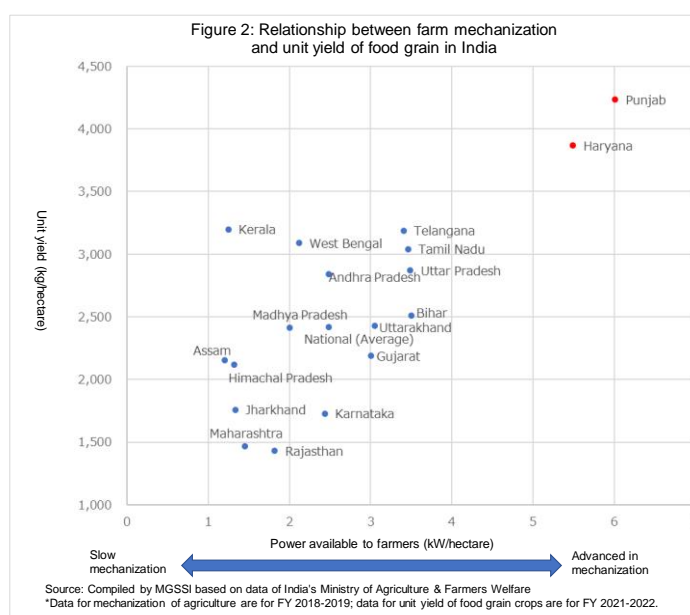
The policy focuses on making farm machinery available to small-scale farmers, and two measures have been adopted to accomplish this. One is the establishment of Custom Hiring Centres (CHCs) for the shared use of farm machinery under the umbrella of Farmer Producer Organizations (FPOs) and other organizations. According to a report on farm mechanization published by India’s Ministry of Agriculture & Farmers Welfare in July 2023, 27,828 centers were set up from FY 2014 to FY 2020, of which 9,432 were established in FY2020 alone<sup>2</sup>. The other measure is a subsidy program for farm machinery purchases that allows farmers to buy machinery at a discount of up to 50% with subsidies.

In recent years, the custom hiring practice has become popular not only for the use of tractors, but also for more expensive combine harvesters<sup>3</sup>. This is because an increasing number of rice and wheat farmers are purchasing large combine harvesters, like those used in Hokkaido in Japan, and offering their services as contractors as a side business. Some farmers have invested in multiple vehicles and travel to more than 10 states to perform custom harvesting. They claim that working as a contractor is more profitable than farming their own land.

It was a common belief that agricultural machinery was generally expensive, making it difficult to mechanize agriculture in India, where there are many low-income farmers. Today, however, custom hiring is making farm machinery more accessible, even to those low-income farmers. Farm mechanization is thus becoming less conditional on farmers’ incomes.

## 1-3. Striving for higher yields and efficiency

The growing use of agricultural machinery in India is not only due to supply-side factors such as custom hiring, but also to demand-side needs. There is an expectation that the use of farm machinery will lead to higher yields. According to the Ministry of Agriculture & Farmers Welfare, mechanization increases crop yields by 13-23%. In fact, as shown in red in Figure 2, higher unit yields are reported in Punjab and Haryana states, where mechanization has progressed more than in other regions.



<sup>2</sup> [India's Ministry of Agriculture & Farmers Welfare, "Research and Development in Farm Mechanization for Small and Marginal Farmers in the Country"](#)

<sup>3</sup> According to the report, the average price range for tractors is 400,000-1,000,000 rupees. As for combine harvesters, some are powered by a tractor and are sold separately from the tractor that cost around 600,000 rupees, but most cost no less than 1,000,000 rupees, ranging from 1,400,000 to 2,200,000 rupees.

In recent years, the use of rice transplanters has been growing more widespread. When the author of this report interviewed several farmers who had recently purchased rice transplanters, many of them said their unit yield had increased. The fact that farmers are beginning to realize the benefits of higher yields also seems to be behind the rise in farm machinery uptake.

In India, many farmers use their land for three distinct cropping seasons, such as for rice, potatoes, and pulses. When these farmers were asked about their motivation for acquiring combine harvesters, several responded that they needed to quickly finish the harvest to prepare for planting the next crop. This need for greater efficiency is also considered to be one of the factors behind the increasing use of agricultural machinery in India.

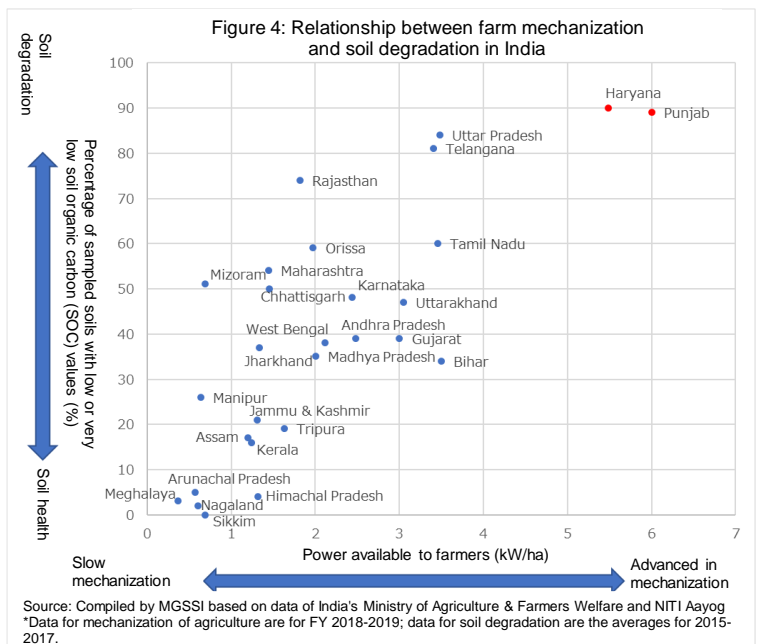
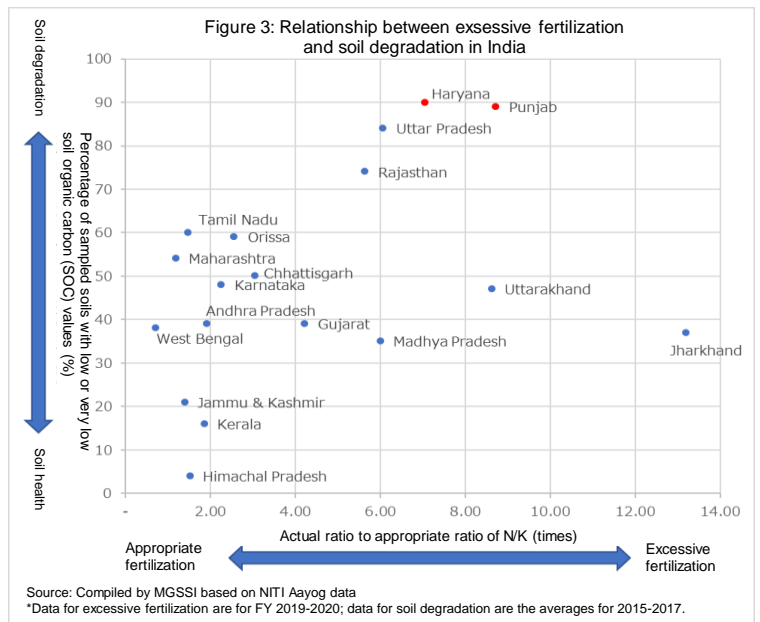
## 2. NEW REQUIREMENTS OF AGRICULTURAL MACHINERY EXPECTED IN THE FUTURE

### 2-1. Transition from agroindustry to agroecology

In the future, the requirements of farm machinery in India may not be limited to capacity for increasing yields and efficiency, but may also include the potential to contribute to environmental conservation. This is because the Indian government is advocating agroecology.

Agroecology is the concept of promoting agricultural methods that do not rely on industrial methods, but instead utilize the natural interactions of soil and soil organisms. It has become a subject of global interest. A recent event was the signing of the Emirates Declaration on Sustainable Agriculture, Resilient Food Systems, and Climate Action at COP28 in December 2023. The statement recommends a shift to agricultural practices that contribute to the conservation, protection, and restoration of the land and natural ecosystems, which is to say, agricultural practices that are considered agroecological.

Ahead of this global trend, in April 2022, NITI Aayog<sup>4</sup>, which is a policy advisory body of the Indian central government, published a report entitled “A New Paradigm for Indian Agriculture: From Agroindustry to Agroecology”. The report notes that while industrial agriculture (agroindustry), whose primary objective is to achieve higher yields and efficiency, has damaged the natural environment, agroecology is already being practiced in some areas, such



<sup>4</sup> National Institution for Transforming India Aayog. Aayog means “committee” in Hindi.

as Andhra Pradesh, as "natural farming" and is applicable to small farmers, and therefore recommends a transition to it.

In particular, the report highlights soil degradation due to excessive fertilization as an example of the damage done to the natural environment. In India, nitrogen fertilizer is inexpensive because of subsidies, and as a result, it tends to be over-applied. Such disproportionate fertilization is depleting soil health, according to NITI Aayog.

In fact, looking at the relationship between excessive fertilizer application and soil degradation, as shown in Figure 3, a certain degree of correlation is observed, indicating that excessive fertilizer application has led to soil impoverishment. The problem is particularly serious in the aforementioned Punjab and Haryana states, where advancements are being made in mechanization and high yields are being achieved.

If left unchecked, this soil degradation in the main rice and wheat producing areas could threaten food security. A long-term perspective is needed to feed India's growing population, with forecasts projecting further population growth until 2063. Against this backdrop, the government is trying to steer a course towards sustainable agriculture.

While this report does not address the impact on soil that may be attributed to agricultural machinery, such as tractors and combines, some data suggest that mechanization plays a part in soil degradation. Figure 4 combines the data on soil degradation and excessive fertilizer application used in Figure 3 with the data on mechanization of agriculture from the abovementioned report issued by the Ministry of Agriculture & Farmers Welfare. It suggests a positive correlation between increased mechanization and soil degradation. From the perspective of agroecology, it cannot be ruled out that the validity of the conventional method of mechanization could come into question in the future.

## **2-2. Balancing mechanization and agroecology in India's agriculture industry**

Nonetheless, India needs to continue to mechanize its agriculture industry, because it is essential for economic growth. The country's economic growth is based on an abundant working-age population, but 50% of this population is occupied with agriculture, preventing the country's overall income from rising. To encourage a shift of labor from agriculture to other industries, the government will focus on fostering industries that can develop strong job markets. NITI Aayog predicts that the percentage of the population engaged in agriculture will decline to 25% by 2050. Agriculture that relies on manpower is not sustainable from the viewpoint of the country's economic growth, and progress in farm mechanization that can contribute to boosting labor productivity is indispensable.

So how can India balance the mechanization of agriculture with the transition to agroecology? For the answer, India should look to other countries and regions, especially the US and Europe.

In the major Western countries, agroecological approaches are already being incorporated into the development of agricultural machinery. When soil is compacted by heavy farm machinery<sup>5</sup> or disturbed by tillers, it results in a decline in soil biodiversity and the soil becomes prone to the loss of its basic qualities and functional degradation. In recent years, various initiatives have been initiated to prevent soil compaction, such as by decreasing the air pressure of tires used for farm machinery and making tires lighter and smaller. It appears that automation technology is also being used for simultaneously operating several farm machines that have been scaled down in size<sup>6</sup>. In addition, the use of drones, which has been attracting attention for some time to improve farming efficiency and reduce costs, is beginning to attract renewed attention for their benefits to the soil, as the use of drones eliminates the need to operate heavy farm machinery on the field.

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<sup>5</sup> This is referred to as soil compaction.

<sup>6</sup> [Article by the Japan Food & Agriculture Cooperative Organization](#) (In Japanese, published in July 2018)

There are also some efforts being made to bypass the tillage process that causes soil disturbance. With conventional farming methods, residue from cover crops and other materials is mixed into the soil during the tillage process as compost, but in agroecology, the residue cover is not mixed in and is simply pushed down onto the soil surface. As a tool for this purpose, the “roller crimper” was developed by Rodale Institute<sup>7</sup>, a US non-profit organization that supports research into organic and regenerative agriculture. As shown in Figure 5, this equipment is attached to the front of a tractor and uses the tractor's power to push down crops, and can therefore be used in coexistence with conventional farm machinery.

Figure 5: Rodale Institute's roller-crimper



Source: Rodale Institute website  
<https://rodaleinstitute.org/science/articles/roller-crimper-helps-combat-herbicide-resistant-weeds/>

If new technologies can be incorporated as a component of mechanization in this way, the transition to agroecology and mechanization of agriculture can be pursued concurrently in India as well.

In India, demand for tractors and other conventional agricultural machinery is expected to continue to grow. Custom hiring, which contributes to mechanization under the current situation, is a way through which small-scale farmers will be able to access the latest farm machinery. It is hoped that new technologies critical to promoting agroecology will be more widely adopted through the increased use of custom hiring.

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<sup>7</sup> [Video of the Rodale Institute's roller crimper](#)