Report

December 2025

Powering Agriculture

UNLOCKING THE POTENTIAL OF ELECTRIC TRACTORS IN INDIA

ABOUT

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Abbreviations

2WD	Two-Wheel Drive
4WD	Four-Wheel Drive
BS IV	Bharat Stage IV Emission Standard
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CO_2	Carbon Dioxide
CY	Calendar Year
FPO	Farmer Producer Organization
FY	Financial Year
GDP	Gross Domestic Product
GHG	Greenhouse Gas
HP	Horsepower
Hz	Hertz
INR	Indian Rupee
kW	Kilowatt
kWh	Kilowatt Hour
MNRE	Ministry of New and Renewable Energy
NO_x	Nitrogen Oxides
OEM	Original Equipment Manufacturer
OPEX	Operational Expenditure
PM2.5	Particulate Matter ≤ 2.5 micrometers
PPAC	Petroleum Planning and Analysis Cell
SMAM	Sub-Mission on Agricultural Mechanization
TCO	Total Cost of Ownership
TREM	Tractor and Agricultural Equipment Emission Norms
USD	United States Dollar

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01

Agriculture and Farm Mechanization in India

India's agriculture sector is a vital part of its economy, employing a significant portion of the population. About 46 percent of India's workforce is employed in the agriculture sector. [1] This sector contributes approximately 17 percent to the national GDP.[2] Farm mechanization[i] has played a pivotal role in transforming India's agricultural sector by integrating various technologies aimed at improving productivity, operational efficiency, and farmer incomes. To support this transition to farm mechanization, both national and subnational governments have introduced several initiatives and policies to promote mechanization and make modern equipment more accessible to farmers. However, challenges such as low-income levels and small landholdings (with the average landholding size being 0.74 hectare in 2021–22) make it difficult for many farmers to access and afford modern agricultural equipment.[3] As a result, the overall level of farm mechanization in India remains relatively low, at around 47 percent, especially when compared to countries like China (60 percent) and the United States (95 percent).[4]

About 46 percent of India's workforce is employed in the agriculture sector. This sector contributes approximately 17 percent to the national GDP.

Farm mechanization drastically reduces the time and labor required for land preparation, sowing, and harvesting, thereby improving agricultural productivity, especially when facing labor shortages. A research study by Indian Agricultural Institutes highlights that the adoption of appropriate agricultural equipment has the potential to boost productivity by up to 30 percent while simultaneously reducing input costs by 20 percent, making mechanization a key driver of growth in the sector.[5]

Tractors form the foundation of India's farm mechanization journey, enabling precision farming, intercropping, and sustainable soil management through compatible implements like rotavators, ploughs, and seed drills. For small and marginal farmers, access to tractors, whether through ownership or on rent, helps save time, lower input costs, and improve yields. The impact and effectiveness of tractors and farm equipment are reflected in market trends: between 2019 and 2023, the volume of tractor sales grew approximately by a CAGR of 5.7 percent; meanwhile, it is projected to increase further by 7.9 percent CAGR between 2024 and 2029.[6] In FY2024–25, more than 92.5 percent of all tractors registered in India were classified under agricultural use, highlighting the sector's overwhelming dominance in tractor utilization.[7] This steady growth underscores the rising importance of mechanization in shaping the future of Indian agriculture.

The adoption of appropriate agricultural equipment has the potential to boost productivity by up to 30 percent while simultaneously reducing input costs by 20 percent

With the growing demand for agricultural products, the agriculture sector's contribution to India's greenhouse gas (GHG) emissions is increasing, making it the second-largest contributor among all sectors. In 2020, agriculture accounted for approximately 13.7% pf India's total GHG emissions.[8] This trend highlights the urgent need for the adoption of sustainable technologies in the agricultural sector.

The growing number of tractors in rural areas, coupled with extended operational hours, has led to a significant increase in diesel consumption. Tractors account for

i Farm mechanization includes tractors, trucks, harvesters, farm implements, and emerging technologies.

nearly 7.4 percent of India's total diesel consumption.[9] This translates to around 4 percent of the national fuel import bill.[10] This surge in consumption has resulted in considerable carbon emissions, which in turn has also contributed to various respiratory illnesses.

A study, carried out in 2016, estimated that tractors in India would emit about 25 kilotons of particulate matter (PM) and almost 300 kilotons of nitrogen oxides (NO_X) in 2020, contributing about 61 percent of the PM and 56 percent of NO_X emissions in India's off-road sector.[11]

Additionally, the high noise levels and vibrations generated by diesel tractors are becoming a growing cause of hearing impairments and musculoskeletal diseases for the tractor operators. Rising diesel prices, along with higher service and maintenance costs, significantly impact the overall economics of operating a diesel tractor. Considering the above challenges and the rising greenhouse gas emissions in the agricultural sector, the adoption of electric tractors presents a promising opportunity to tackle these issues to some extent and promote the development of sustainable agricultural practices.

This issue brief provides an overview of the Indian tractor market, including key applications, market share across various tractor segments, and their use cases. It also examines fuel consumption patterns and emissions associated with tractor usage. It outlines several benefits of electric tractors over traditional diesel models, such as lower total cost of ownership and potential health advantages. Finally, it offers recommendations to expand the adoption of electric tractors in Indian agriculture by developing a supportive ecosystem to enable their widespread adoption.

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02

Indian Agricultural Tractor Market

India is the world's largest manufacturer of tractors, accounting for approximately one-third of global tractor production.[12] The annual tractor sales surpassed 0.98 million units in the year 2024, out of which approximately 10 percent were exported. The domestic tractor industry continues to show strong growth momentum, with annual sales projected to reach 1.57 million units by CY2029.[13] India's tractor market was valued at USD 8.81 billion in 2025 and is projected to witness robust growth through 2031, registering a CAGR of 6.25 percent.[14] India's tractor market exhibits substantial growth potential, driven by the country's predominantly agrarian economy and the increasing mechanization of farm operations.[15]

In the Indian agricultural market, tractor demand typically peaks between November and January.[16] Tractor sales around the year are driven by several factors, including the onset of the monsoon, the sowing of Kharif crops (at the start of the monsoon season), preparation for the upcoming Rabi (winter season) planting season, heightened harvesting activities, and improved rural liquidity after crop harvesting period.[17]

Sales of agricultural tractors in different states of India are primarily propelled by the agroclimatic conditions and soil condition for crop yield. This correlation between states (agroclimatic zones) and tractor sales is evident in the graph below, which illustrates state-wise tractor sales for the top 10 states, based on data from the Vahan database. The numbers reveal that Uttar Pradesh leads the country in agricultural tractor sales, recording the highest number of units sold in FY2024–25. It is followed by Madhya Pradesh and Rajasthan, which also reported strong sales figures. Maharashtra and Gujarat also contribute significantly to the number of units sold, reflecting a high volume of agricultural tractor sales. Overall, the total annual sales of agricultural tractors in FY2024–25 exceeded 0.8 million units, underscoring the robust demand across key agricultural states.[18]

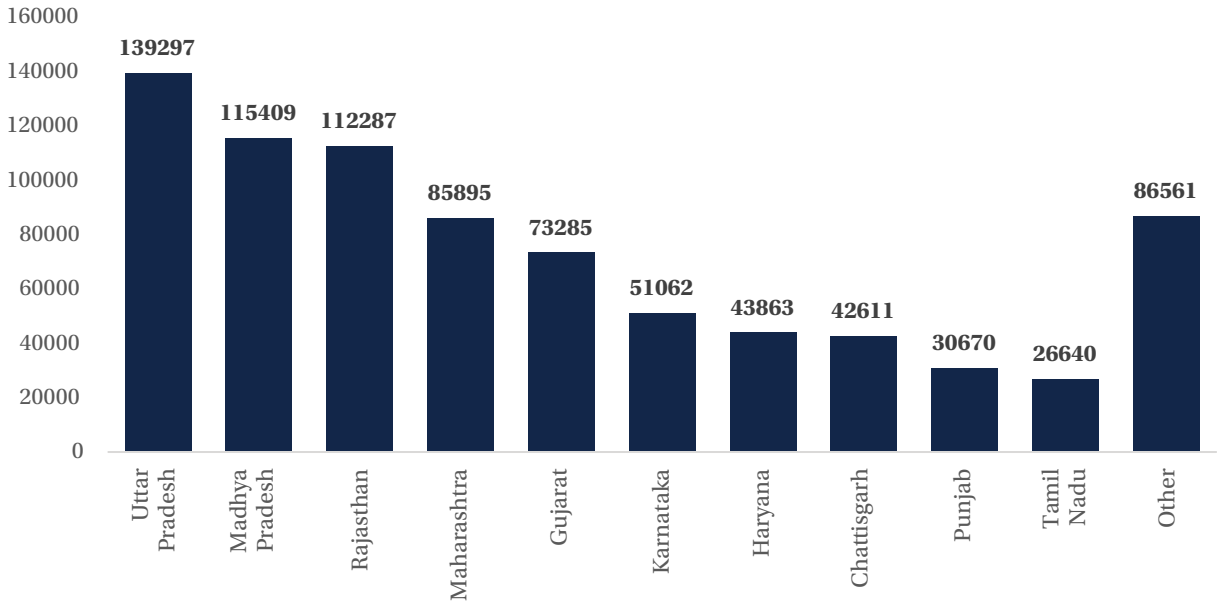


Figure 1: Agricultural Tractor Sales by States (FY2024-25)

Source : Vahan Dashboard

The Indian agricultural tractor market has matured over time, shaped by several critical factors such as cost-effectiveness, fuel efficiency, extensive service networks in rural areas, ease of maintenance, and the availability of spare parts.

More than 55 percent of the Indian tractor market is dominated by two major Original Equipment Manufacturers (OEMs): Mahindra & Mahindra Limited, including its Swaraj division, and International Tractors Limited, commonly known as Sonalika. These are followed by other key players such as Tractors and Farm Equipment (TAFE) Limited and Escorts Kubota Limited, who also hold significant market shares.[19]

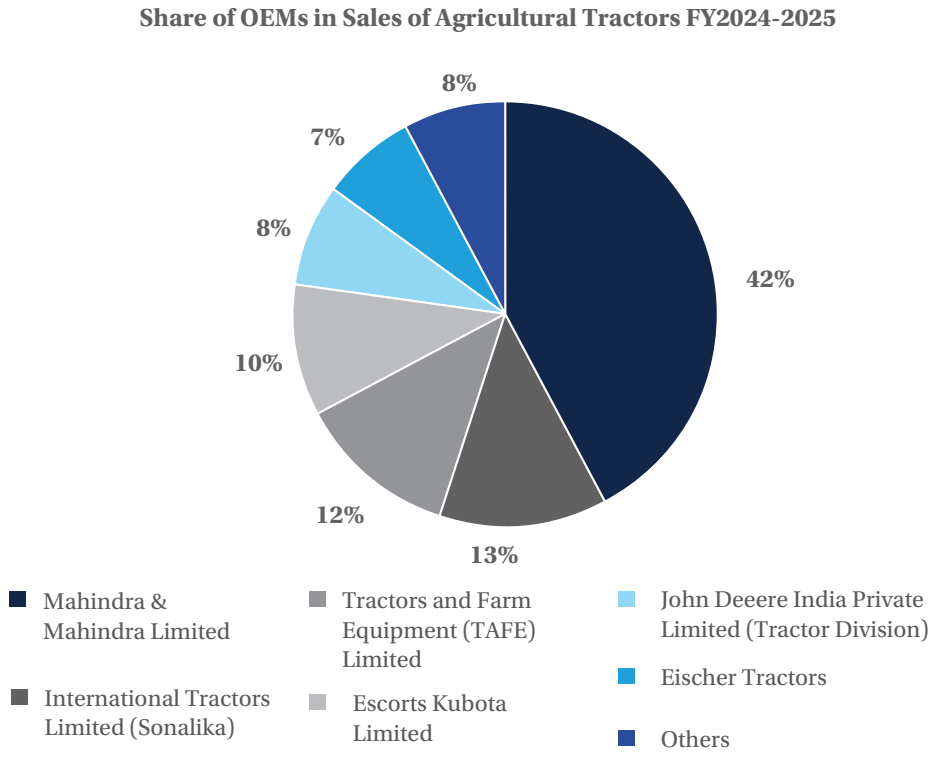


Figure 2: Sales of Agricultural Tractor by OEMs in FY2024–25

Source : Vahan Dashboard

Image: freepik.com

During multiple consultations with key stakeholders, the following valuable insights were gathered regarding the tractor landscape in India.

Insights from Stakeholder Consultations

- **Shift in Ownership Trends:** The average duration of primary ownership for tractors has declined from approximately 10 years to 5 years, reflecting changing user behavior and the rise in used tractor sales.
- **Tractor Financing Rates:** Financing through Non-Banking Financial Companies (NBFCs) for new tractors is typically available at interest rates between 13 and 16 percent, while loans for used tractors attract higher rates, around 20 to 22 percent.
- **Loan Tenure Preferences:** NBFCs and banks generally offer preferred loan tenures of about four years for new tractors.
- **Depreciation Estimates:** A 45 Horsepower (HP) tractor typically experiences an annual depreciation of INR. 30,000 to 40,000, which impacts resale value and cost calculations.
- **Importance of Service Infrastructure:** Robust repair and maintenance services are considered the backbone of the tractor industry. A reliable service network is essential to build confidence in electric tractor technology and ensure long-term viability.
- **Landholding and Ownership Feasibility:**
  i. Up to 3 acres: Owning a tractor is generally not cost-effective; shared or rental use is recommended.
  ii. 3–7 acres: Tractor ownership becomes viable; however, renting additional equipment may still be necessary.
  iii. Above 7 acres: Full ownership and self-utilization of a tractor is considered most economical.
- **Annual Usage Threshold:** If a tractor is expected to be used for 500–700+ hours per year, ownership is generally more economical than renting.

03

A Segment Wise Analysis of Tractor Market and Associated Applications

The tractor is widely regarded as a multi-utility vehicle, made even more versatile using various implements. These implements extend its functionality beyond traditional farming tasks, thus also making it valuable in a range of non-agricultural applications such as haulage and rural infrastructure development (road and building construction). Understanding its segmentation based on use-case applications provides insights into diverse roles of tractors and their future growth potential.

Over 90% of tractors are used in agricultural activities, and the primary use cases involve tillage, sowing, harvesting, and transportation of agricultural raw materials and finished products. In terms of power ratings, tractors in the range of 41 to 50 HP are the preferred choice with 51 percent of the total market share size. The rising consumer preference for this segment is due to wider applications offered in farming operations and the flexibility and affordability for small to medium landholdings.[20]

Studies show that Rajasthan, Punjab, Haryana, Maharashtra, Karnataka, and Gujarat are the largest markets for the 41 to 50 HP tractors in India.[17]

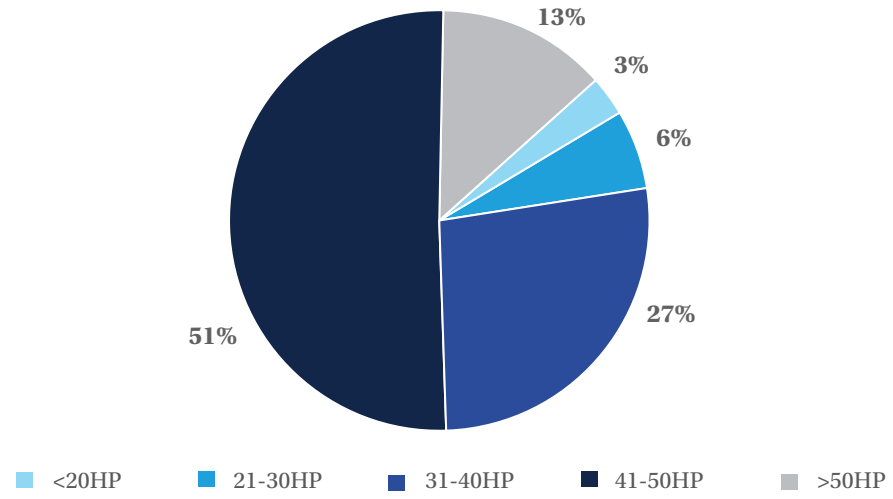


Figure 3: Market Segmentation of Tractors by Engine Power

With 27 percent of the market share, tractors in the 31 to 40 HP range are also a popular choice among the farmers, making them well-suited for small to medium-sized farms and a variety of agricultural tasks. A significant number of farmers in India are small to medium landholders and form the customer base for this range of tractors.[17] Tractors with an engine power greater than 51 HP have the third largest market share; they are suitable for farmers with bigger landholdings requiring greater level of mechanization. The largest markets for this range of tractors are Rajasthan, Punjab, and Haryana.

On the other hand, tractors with an engine power of 21 to 30 HP hold a much smaller market share of 6 percent, as they are less attractive to the customers due to their limited applications in different use cases. Finally, tractors with an engine power less than 20 HP account for only 3 percent of the overall Indian agricultural tractors market. The growth in demand for sub-20 HP tractors can be attributed to their suitability for small-scale farming operations, ease of maneuverability, and affordability for marginal and small-scale farmers. Rural transport and haulage accounts for just 4 to 6 percent of tractor use, with primary use cases involving transport of agricultural produce, carrying construction material and consumer goods in rural areas, and connecting villages to highways and railheads where commercial vehicles are uneconomical.[17]

The table below captures the tractor market share, the preferred tractors with different power variants, and the drive type for each type of use-case application.[21]

Table 1: Market Share of Tractors by Engine Power and Use Cases

Application Segment	Tractor Market Share (%) By Use Case	Predominant Power Output (in HP)	Preferred Drive Type
Agriculture	80	30–50	2WD
Construction and Infrastructure	10	50–100	4WD
Rural Transport and Haulage	5	30–50	2WD
Horticulture and Orchard Farming	3	<30	2WD/4WD
Industrial and Mining	<1	50–100	4WD

Other use cases include horticulture and orchard farming. Tractors of the 20 to 30 HP range are usually used in these cases for spraying fertilizers and pesticides; inter-row cultivation in vineyards and orchards; grass cutting and pruning-related operations; and transporting fruit baskets and equipment within farms.

In the agriculture industry, two-wheel drive (2WD) tractors are more prevalent due to their affordable price point and their ability to meet the requirements of most agricultural tasks under normal conditions. However, four-wheel drive (4WD) tractors offer a significant advantage in muddy or wet soil, where additional traction is essential. Moreover, 4WD tractors become a necessity for more demanding uses such as heavy haulage, mining, and other industrial applications.[22]

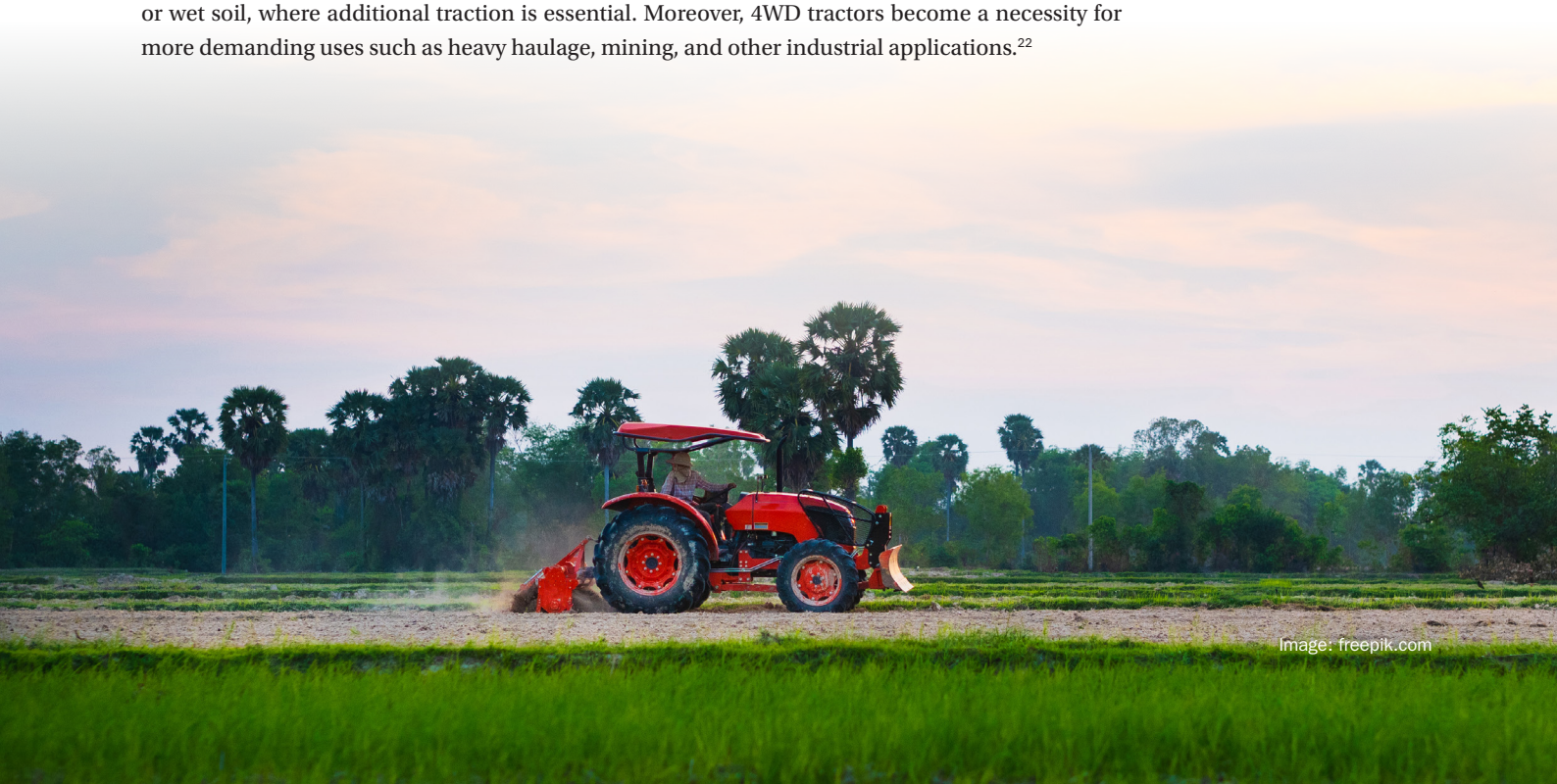


Image: freepik.com

04

Associated Emissions and Fuel Consumption

As discussed in the previous section, agriculture remains the most dominant use case for tractors in India. Tractors below 37 kW (45 HP), the most commonly used category for agricultural use case, are currently exempt from complying with TREM IV emission standards (the mandated emission standards applicable to tractors and other off-road machinery), which are equivalent to the BS IV standards for off-road vehicles.[ii] Instead, these tractors continue to follow the older TREM IIIA standards.[23] One of the key reasons for this regulatory relaxation is to keep tractor prices (CAPEX) affordable for the farming community, which largely consists of people within low-income brackets. However, this comes at the cost of lower fuel efficiency and greater exposure to harmful emissions. It is expected that, in the initial phase, stricter emission norms will inevitably increase manufacturing costs, primarily due to the higher cost of auto parts required to support the transition from TREM III to TREM V. This is likely to affect tractor affordability, ownership, and overall tractor sales in India. The current weaker emission standards, however, lead to higher emissions of pollutants such as NO_x and PM2.5, which are known to have adverse health effects on the human respiratory system.[12]

It is expected that the new TREM V emissions standards will apply to all tractor segments starting from April 2026. Major OEMs are currently in the research and development phase, working on tractors that not only comply with these standards but also remain within the existing price range.[24]

The agricultural sector is one of the largest consumers of diesel fuel in India. According to the Petroleum Planning and Analysis Cell (PPAC), agriculture accounts for approximately 13 percent of the country's total diesel consumption.[25] Notably, agricultural tractors alone contribute significantly to this demand, accounting for nearly 7.4 percent of India's total diesel usage, a figure that is slightly less than the diesel consumption of the country's entire bus fleet, which stands at 9.55 percent.[26] This heavy reliance on diesel-powered tractors imposes a substantial burden on India's diesel imports and energy security.

ii Bharat Stage Emission Standards are the government-mandated regulations in India that control air pollutants from motor vehicles, setting limits on harmful exhaust gases.

Image: freepik.com

05

Electric Tractors: An Economical and Greener Addition to Farm Mechanization

As India advances toward a greener and more sustainable future, the electrification of agricultural vehicles, especially tractors, is gaining momentum. With strong backing from national and state governments, this transition is not only a key strategy for decarbonizing the agricultural sector but also a critical step toward improving the welfare of farmers and ensuring long-term energy security. Electric tractors offer a compelling alternative to traditional diesel-powered machinery by delivering multiple benefits across economic, public health, environmental, and operational dimensions.

5.1 Significant Financial Savings

Through a series of stakeholder consultations, the NRDC team conducted a Total Cost of Ownership (TCO) analysis and arrived at the following results:

- The **total cost of ownership** is up to **50 percent lower for electric tractors than for diesel tractors**.
- **Up to 80 percent lower operating costs** compared to diesel tractors, due to cheaper energy and reduced maintenance.
    i. The energy cost per hour for an electric tractor is less than one-tenth of the fuel cost incurred by an equivalent diesel tractor.
    ii. The maintenance costs of an electric tractor are roughly half of the maintenance costs associated with a diesel tractor. Also, for diesel tractors, maintenance expenses usually rise significantly after five to six years of operation, whereas electric tractors maintain relatively consistent maintenance costs over time.
- Electric tractors offer a **longer operational lifespan** compared to diesel tractors. Typically, after five to six years of use, diesel tractors require frequent and costly maintenance, and their fuel efficiency declines significantly often prompting owners to sell them. This becomes particularly challenging considering that most tractor loans have a tenure of just four years. In contrast, electric tractors, with fewer moving parts, maintain consistent performance and efficiency over time, and require significantly less maintenance.
- Electric tractors can be **registered for commercial use** in several states **without incurring road tax or registration fees**, as many state policies for electric vehicles (EV) offer such exemptions. This enables their use beyond the agricultural season, for haulage or other commercial applications, thereby maximizing operational hours and helping achieve faster payback periods.

5.2 Health and Environmental Benefits

- **Electric tractors have zero tailpipe emissions**, thus reducing exposure to harmful pollutants like NO_x, PM2.5, and Carbon Monoxide (CO). The International Agency for Research on Cancer (IARC) classifies diesel tractor emissions as carcinogenic.[27] These emissions are linked to lung and bladder cancer, respiratory illnesses such as chronic obstructive pulmonary disease (COPD), and cardiovascular diseases.[28] Electric tractors also reduce the emissions of greenhouse gases that cause climate change.

> *In addition to emissions and fuel consumption, tractors also pose significant health risks to farming communities. A study on the health vulnerability of farmers found that individuals in rural areas are particularly susceptible to premature illness and death due to prolonged exposure to emissions from tractors while working in the farms.[29] These emissions contribute significantly to air pollution and are closely linked to serious health concerns, particularly in rural farming communities with prolonged exposure.*

- Diesel tractors typically emit noise that can reach up to 100 decibels, a level that is capable of causing damage to hearing abilities after 15 minutes of continious exposure.[30] A study highlights that **8 percent of farmers reported hearing problems**, and nearly **48 percent of tractor-driving farmers** exhibited **hearing abnormalities**.[31] In contrast, electric tractors operate at significantly lower noise levels, reducing the risk of hearing damage and creating a more comfortable working environment.

Image: freepik.com

- By effectively dampening critical vibrations in the 4–12 Hz range, the electric tractor reduces the risk of musculoskeletal disorders, particularly in the lumbar and cervical regions. In contrast, the comparable diesel tractor begins isolating vibrations only above 12 Hz, providing insufficient protection in this critical frequency range and leaving the operator exposed to significant vibrational stress.[32]
- During NRDC's field monitoring visits (discussed in Section 10), it was observed that diesel tractors can reach temperatures of 120 to 130 degrees Fahrenheit during extended operations. This is primarily due to fuel combustion in the engine located close to the operator's position, as well as the placement of the exhaust system. Such conditions create significant discomfort and heat stress for operators. Prolonged exposure to such high temperatures has been linked to health issues like **heat stress**. In contrast, **electric tractors maintain temperatures below 98 degrees Fahrenheit**, ensuring a **safer and more comfortable environment** for the operator during extended use.

5.3 Enhanced Operational Ease

- **Instant torque delivery** (ability to provide maximum rotational force immediately from a standstill) improves performance and reduces effort.
- **Modern design** makes electric tractors easier and more intuitive to operate.
- **Minimal noise and vibration** lead to a more comfortable working environment for farmers.
- The **smooth transmission, easy handling,** and the integration of advanced electronic components in electric tractors provide a simplified and user-friendly driving experience. This could encourage more women in rural areas to drive electric tractors independently for longer durations, thereby advancing **gender-inclusive transition** in the agricultural workforce.

Sameer Kwatra
Senior Director, India Program, NRDC

Empowering Small and Marginal Farmers Through Clean and Affordable Mechanization

Nearly half of India's population depends on agriculture and associated activities, with tractors serving as the backbone of farming operations. However, small and marginal farmers often face multiple challenges, as they typically rent diesel tractors at high costs. These diesel tractors emit toxic fumes, noise, and pollution, which has an adverse effect on both individual health and the environment. Compared to conventional diesel tractors, electric tractors provide greater comfort, sustainability, and long-term economic benefits, paving the way for a healthier and more resilient farming future.

Figure 4: SEWA Sister Driving an Electric Tractor on the Field

Source: NRDC, Gujarat, India (July 2025)

Women constitute more than 60 percent of India's agricultural workforce, yet very few women have access to training for operation of tractors.[33] Empowering women with tractor-driving skills can foster a gender-inclusive transformation in agriculture and enhance their earning potential.

Thakur Sonalben Jagdish
SEWA Member

Smooth, Silent, and Empowering

In our family, we own a diesel tractor that I often operate for various tasks. Today, I drove an electric tractor with a rotavator, and the experience was remarkable. It was comfortable, with no heat, no diesel fumes, and far less noise or vibration, compared to a diesel tractor, which is usually noisy, difficult to control, and tiring to operate. The smooth steering of the electric tractor made it easier to handle, and I believe this will inspire more women to learn how to operate it.

- During **peak farming seasons**, tractor usage increases significantly, prompting farmers to **store diesel on or near their farms** to minimize downtime and ensure uninterrupted operations. However, this practice **poses a serious fire hazard**, adding a layer of risk to daily agricultural activities. In contrast, **electric tractors eliminate the need for on-site fuel storage**, thereby **mitigating fire risks and promoting safer operational practices**.

5.4 Lowering Tractor Rental Costs for Farmers

In rural areas, marginal farmers with small landholdings often rent tractors for agricultural activities. The farmers pay an approximate rent of INR 1,000 per hour, which includes the cost of the implement, diesel, and an operator. Notably, the cost of diesel alone accounts for nearly 50 percent of this hourly amount.

Electric tractors present an opportunity and offer a cost advantage due to their significantly lower energy expenses. With efficient operations, owners can provide rental services at reduced rates, thus lowering input costs for marginal farmers. This not only increases their disposable income but also promotes more sustainable and inclusive agricultural practices.

Case of SEWA's Ganeshpura Farm

At SEWA's tools and equipment library in Ganeshpura Farm, various farming tools and machinery are rented out to SEWA members at subsidized rates. The total cost of hiring a tractor along with equipment, an operator, and fuel is approximately INR 700 per hour, whereas private tractor owners in the village typically charge around INR 1,000 per hour.

5.5 Integrating Electric Tractors for Efficient Use of Solar Energy

Under MNRE's PM - KUSUM (Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan) Scheme, farmers are encouraged to generate solar power for agricultural operations, reducing diesel dependence and increasing income. However, the surplus electricity generated during non-peak seasons often remains underutilized. Introducing electric tractors can effectively use this excess energy for farm operations, enhancing both energy efficiency and economic benefits for farmers.

06

Electric Tractors Landscape in India

With the growing demand for farm mechanization in the agriculture sector and the need to reduce associated emissions, electric tractors could play a crucial role in the sector's decarbonization efforts. Currently, the electric tractor industry is in its nascent stage, with various OEMs actively developing different models and working to establish proof of concept through trials and pilot initiatives. Despite multiple efforts on the part of the tractor-manufacturing industry and the government, no electric tractors for agricultural use were registered in India during the fiscal year 2024–25.[34]

Several progressive OEMs are actively developing electric tractors, with nearly ten domestically produced models currently in the market. Of these, around five models have been homologated and are available for sale, while the remaining are in the process of homologation. The number of electric tractors available for sale is expected to increase by the end of CY2025. These models, ranging from 18 HP to 75 HP, are being developed by OEMs such as AutoNxt Automation, Bullwork Mobility, Cygnus Motor, Moonrider, Montra Electric, and Shree Marut E-Agrotech.[iii]

Image: NRDC

iii Information on number of available tractor models were captured through stakeholder consultation in the initial months of 2025. This data is subjected to further change with the time.

07

Techno-Commercial Assessment of Electric Tractors: Total Cost of Ownership (TCO) Analysis

While farming is traditionally a highly cost-conscious practice, agriculture is widely recognized as a cost-sensitive sector. Thus, it is essential to thoroughly evaluate the lifetime cost economics of electric versus diesel tractors and understand their long-term impact on savings. To assess this, NRDC conducted extensive stakeholder consultations with tractor OEMs to estimate the TCO across various power segments of electric and diesel tractors over a 10-year vehicle holding period.

The following key assumptions were considered based on stakeholder consultations with FPOs, farmers and tractor OEMs for analyzing the TCO over a 10-year vehicle holding period:

- Both diesel and electric tractors operate, on average, 250 days per year
- 18 HP and 27HP tractors are assumed to operate 750 and 875 hours per year, respectively
- 45 and 55 HP tractors are assumed to operate 1,000 hours per year
- A single electric tractor battery change is considered after five years of operations

The following figure presents the TCO comparison on a per-hour basis (INR/hr) between electric and diesel tractors across these power segments.

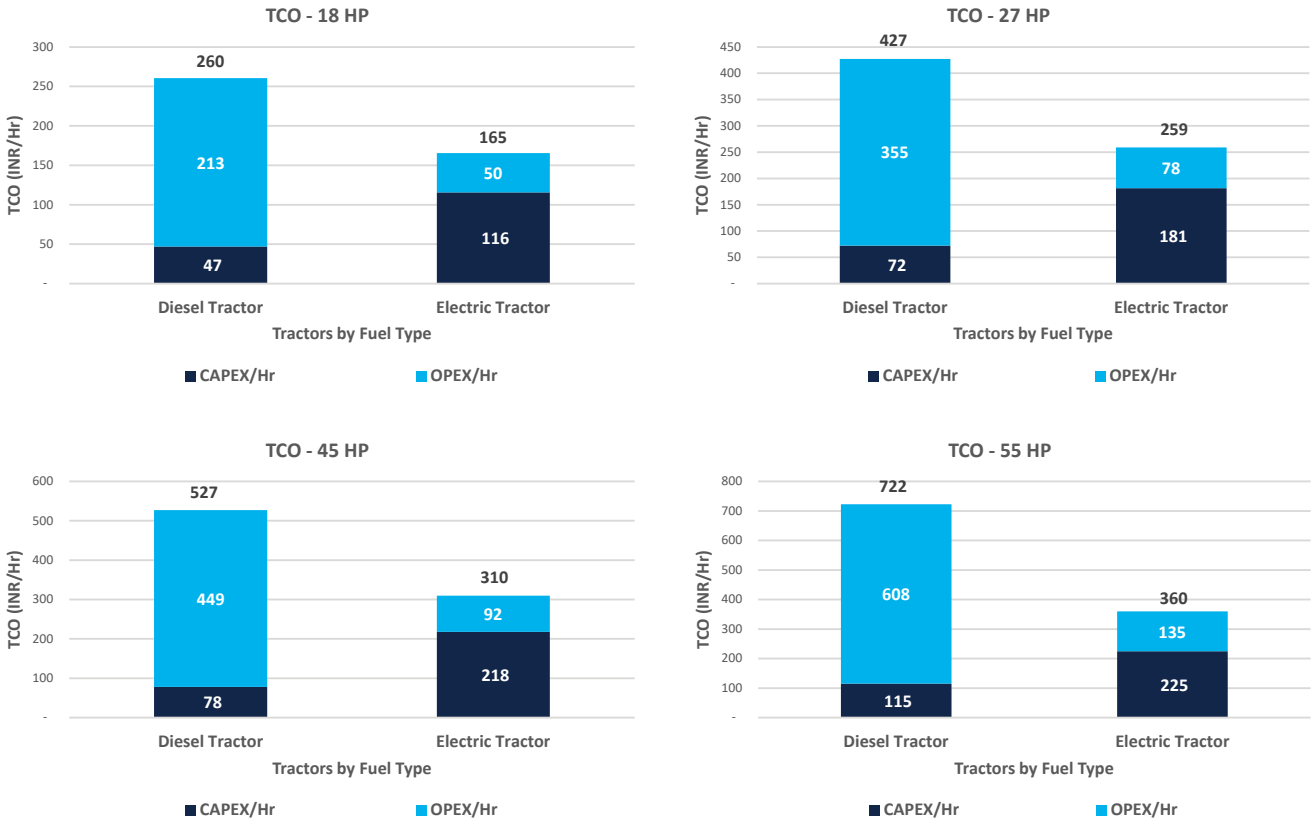


Figure 5: Total Cost of Ownership for Different Tractors by Engine Power and Fuel Type

(CAPEX: Capital Expenditure | OPEX: Operational Expenditure)

Source: NRDC Analysis, 2025

The cost analysis clearly demonstrates that electric tractors offer a significant advantage over diesel tractors, achieving more than 50 percent reduction in total ownership and operational costs.

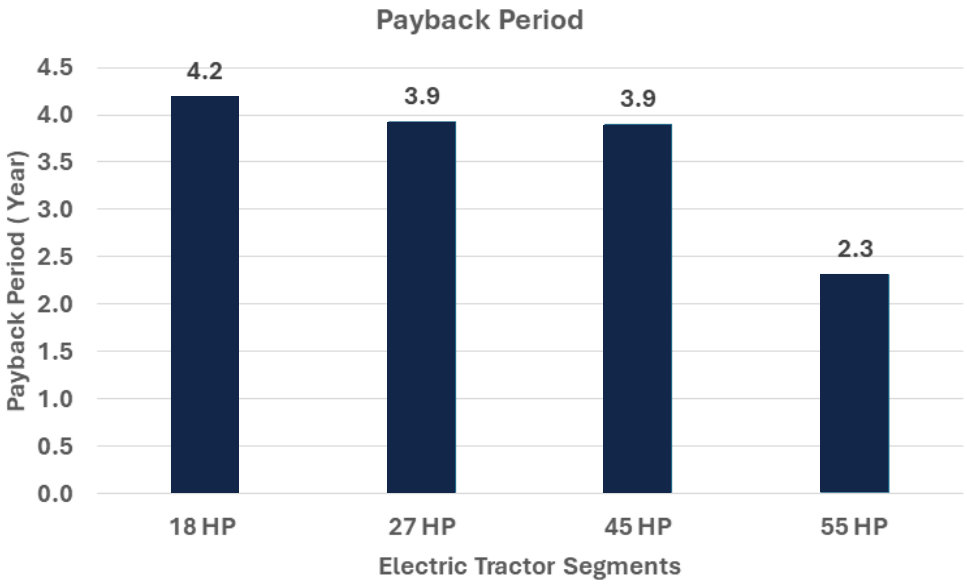


Figure 6: Payback Period for Electric Tractors

Source: NRDC Analysis, 2025

While electric tractors offer lower operational costs and a reduced total cost of ownership (TCO), their initial capital investment for electric tractors remains relatively higher. However, this gap can be substantially reduced through targeted incentives and supportive policy measures. Furthermore, the significant savings in fuel and operational expenses associated with electric tractors effectively offset their higher initial capital investment, enabling a payback period of approximately 2.3 to 4.2 years.

Image: Unsplash

08

Policy Landscape for Supporting Tractor Adoption in India

With the right financial support, electric tractors have the potential to reach cost parity with their diesel counterparts, making them a more viable and sustainable long-term option for Indian farmers. This section explores the various policies implemented at both national and subnational levels to support the adoption of agricultural tractors, including electric models.

With the increasing use of tractors in agriculture, both national and subnational governments have introduced various schemes to promote farm mechanization, including the adoption of tractors. Initially, these initiatives focused on supporting diesel-powered tractors, primarily through subsidies and financial incentives. As the transition toward clean and sustainable technologies accelerates, the Ministry of Agriculture and Farmers Welfare (MoA&FW), Government of India, has launched the Sub-Mission on Agricultural Mechanization (SMAM) to promote farm mechanization driven by renewable energy sources. Complementing this effort, the Ministry of New and Renewable Energy (MNRE) has implemented the Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM) scheme to support the de-dieselization of agriculture and encourage the integration of renewable energy technologies into farming practices. Together, these initiatives aim to enhance agricultural productivity, reduce carbon emissions, and build a more sustainable and resilient farming ecosystem in India. However, electric tractors are not yet explicitly included under this scheme, which limits their eligibility for subsidies under SMAM and PM-KUSUM. Several subnational governments have taken independent steps by offering additional incentives, such as capital subsidies and tax waivers, specifically aimed at encouraging the adoption of electric tractors. The table below outlines the key policies and schemes introduced by various government bodies to support farm mechanization and promote clean agricultural technologies.

Table 2: Schemes to Support Tractor and Electric Tractor Adoption in India

Organization/State	Scheme	Details
NABARD[35]	Refianance for Farm Mechanization	NABARD provide long term refinance to commercial banks, regional rural banks, district co-operative banks, NBFCs and NABARD subsidiaries for enabling them to finance for tractor and farm equipments.
PM Kisan Tractor Yojana[36]	Subsidy on purchase of tractors	The PM Kisan Tractor Yojana offers subsidies, ranging from 20 to 50 percent, on the purchase of diesel tractors, aimed at supporting farmers in acquiring agricultural machinery at reduced costs.
Sub-Mission on Agricultural Mechanization (SMAM)[37]	Subsidy on farm mechanization equipments	Under the central government's SMAM scheme, farmers are provided subsidies, ranging from 50 to 80 percent, for buying agricultural machinery including diesel tractors.
Haryana[38]	Tractor purchase incentive	A 50 percent subsidy on the vehicle's ex-showroom price, with an upper limit of INR 5,00,000 for the first 1,000 electric tractors sold.
Maharashtra[39]	Purchase incentive and tax exemption	A 15 percent rebate on the ex-showroom price of electric tractor, and registration fee waiver.
Andhra Pradesh[40]	Subsidy on purchase of electric tractors	A subsidy of 10 percent of the ex-showroom price of an electric tractor; however, the vehicle's price should not exceed INR 8,00,000 to avail of this incentive.

Since current national policies do not extend key incentives to electric tractors, this policy gap presents significant potential to accelerate the electric tractors adoption, especially when complemented by supportive subnational policies. Such measures would not only enhance the price competitiveness of electric tractors but also foster a supportive ecosystem among manufacturers, service providers, and early adopters, driving broader market readiness and confidence in this emerging technology.

09

Impact of Fiscal Incentives on Total Cost of Ownership

As highlighted in the previous sections, several state governments have introduced fiscal incentives to promote the adoption of electric tractors. For instance, the state of Maharashtra recently announced an upfront subsidy of 15 percent of the ex-factory price (excluding all taxes and add-ons). These subsidies had a notable impact on the TCO, with the highest reduction, of up to 7.51 percent, observed in the 45 HP tractor segment.

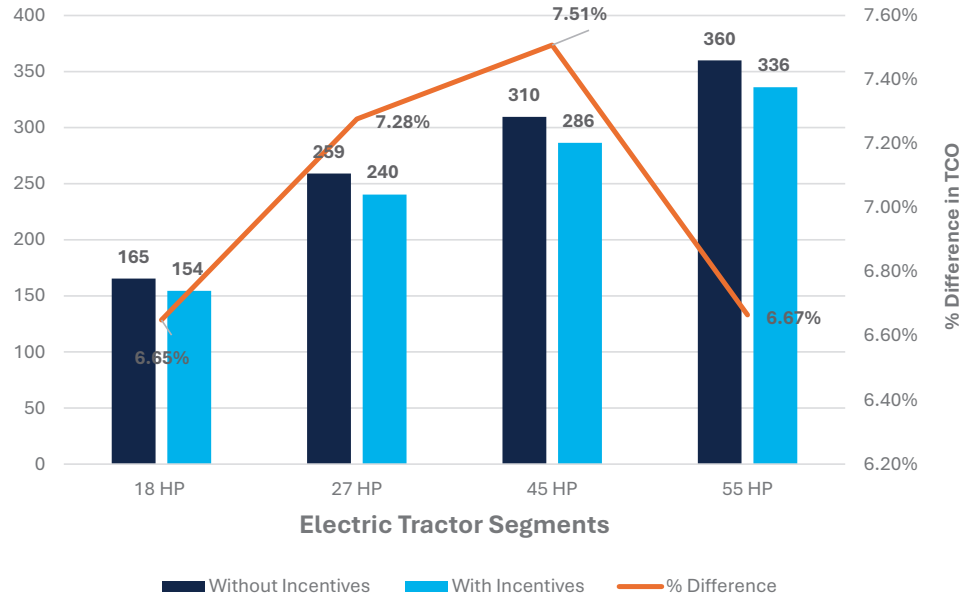


Figure 7: Impact of Fiscal Incentives on TCO

Source: NRDC Analysis, 2025

Similarly, these fiscal incentives substantially reduce capital expenditure (CAPEX) across all segments, contributing to a shorter payback period—reduced by approximately 6 to 8 months, across various categories.

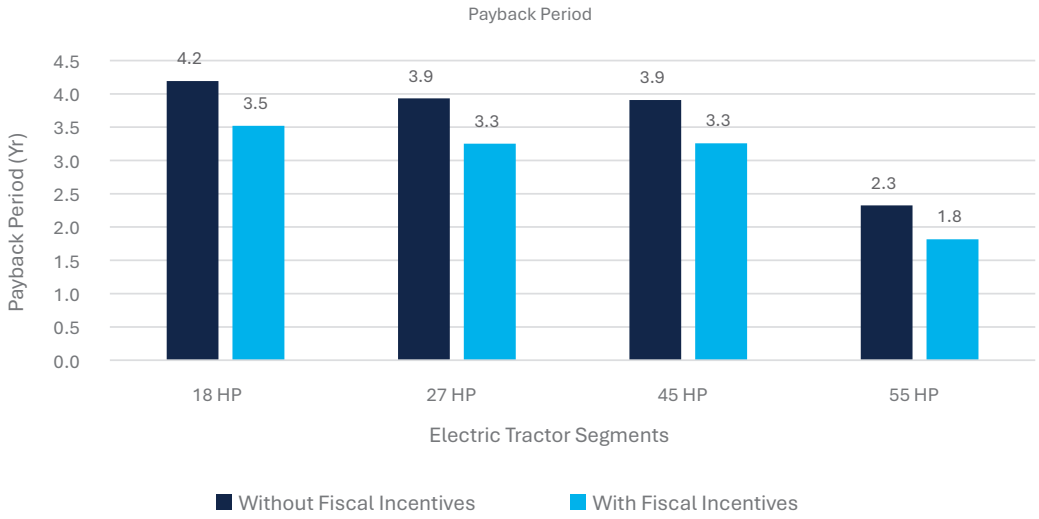


Figure 8: Impact of Fiscal Incentives on Payback Period

Source: NRDC Analysis, 2025

To showcase these benefits at the grassroots level, NRDC, in collaboration with the Self Employed Women's Association (SEWA), launched a pilot project. The details of this initiative are presented in the following section.

10

Insights from Electric Tractor Pilot at Ganeshpura Farm

To raise awareness and establish a proof of concept, NRDC, in collaboration with SEWA, curated a pilot program featuring the **45 HP AUTONXT X45C2 electric tractor**. The electric tractor was used as a replacement for the conventional diesel model, **42 HP Sonalika DI 740III**, at SEWA's Ganeshpura Farm.

Figure 9: Electric Tractor and Diesel Tractor with similar Engine Power Output at the Ganeshpura Farm

Source: NRDC, Gujarat, India (July 2025)

During this time, the electric tractor was used extensively for land preparation under challenging conditions. The pilot program demonstrated the electric tractor's capabilities and resilience in real-world farming scenarios.

Figure 10: NRDC and SEWA team Experiencing the Benefits of Electric Tractor at SEWA Ganeshpura Farm

Source: NRDC, Gujarat, India (July 2025)

Megha Desai
Senior Director, Self Employed Women Association (SEWA)

Driving a Gender-Inclusive and Youth-Oriented Transition in Sustainable Farming

In addition to making farming more affordable and sustainable, electric tractors also attract more interest among the youth and support a gender-inclusive transition. Through this pilot program, we aim to see the benefits for small and marginal farmers, gather their first-hand experiences, and identify challenges to establish a roadmap for scaling this initiative across other districts.

Operationalizing Pilot: Overcoming Power Supply and Charger Installation Challenges

Electricity serves as the primary fuel for the electric tractor and to support its charging needs, two different charging setups were installed at the Ganeshpura Farm: a 6 kW slow charger integrated with the onboard charging system, and a 13 kW fast offboard charger for fast charging.

Figure 11: Images of Charging Gun, Charging Port, and Chargers
Source: NRDC, Gujarat, India (July 2025)

The charging sessions were initiated and terminated at varying states of charge (SoC), making it difficult to determine the exact charging duration in each instance. However, based on observed patterns, the tractor battery of 38 kWh typically took around five hours to charge from 20 to 100 percent SoC using the slow charger, and approximately 2.5 hours for the same charge when using the fast charger.

Operational Details of the Pilot Program and Economical Benefits

During the initial 15-day period, the electric tractor was operated with various implements, such as a rotavator, plough, and cultivator, to prepare land parcels of different sizes. These farms belonged to multiple owners, including ones owned by non-SEWA members, which helped generate awareness about electric tractors in the area surrounding SEWA's Ganeshpura Farm.

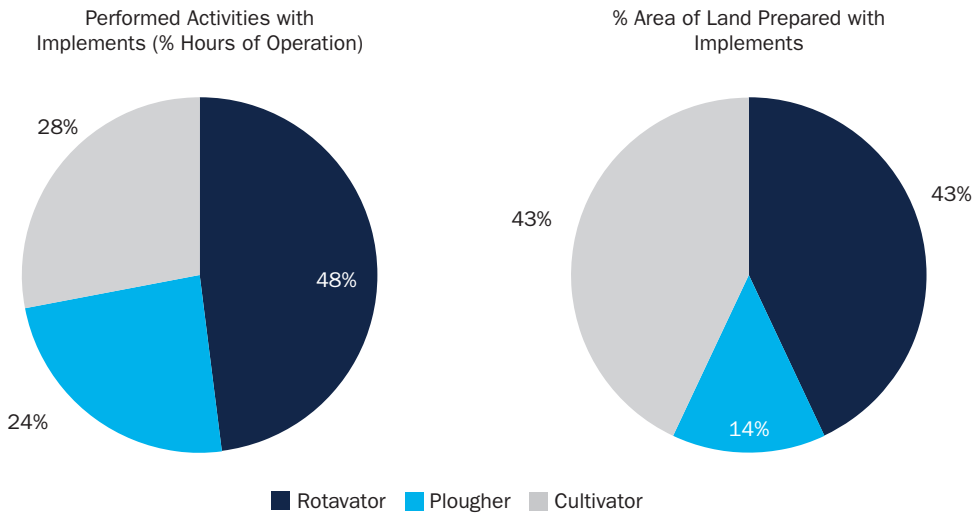


Figure 12: Details of Activities Performed with Various Farm Implements–Breakdown of Total Operating Hours and Land Area Covered

Source: NRDC Analysis, 2025

The pilot project established that the electric tractor offers significant operational cost savings, up to one-fifth of the cost incurred by a conventional diesel tractor. The table below highlights the **average operational savings** achieved per acre. These values are derived from multiple agricultural operations conducted during the pilot. Notably, few similar operations demonstrated even greater cost-effectiveness compared to the average values presented.

To calculate these savings, the energy cost was considered at INR 6.5 per kWh, while the diesel cost was set as INR 90 per litre.

Table 3: Cost Savings (per acre) with Electric Tractor Across Various Farm Implements

Implement	Total Hours of Operation (Hr)	Total Area Covered (Acre)	Average Electricity Cost/Acre (INR/Acre)	Average Diesel Cost/Acre (INR/Acre)	Savings/Acre (INR/Acre)
Rotavator	12	6	163	1000	**838**
Plougher	6	2	211	900	**689**
Cultivator	7	6	103	675	**572**
Empty Haulage	NA	29 km	INR 5.5/km	INR 12/km	**INR 6.5/km**

Source: NRDC Analysis, 2025

Popat Bhai
Caretaker at SEWA Ganeshpura Farm

Electric Tractors Demonstrate Cost Efficiency and High Performance in Field Trials

Several farmers tested the electric tractor with different implements. On a full charge, it could operate a rotavator across 4 bighas (1.6 acre) of land. A diesel tractor, in comparison, would normally consume about 4.5 liters of diesel for the same amount of work, thus highlighting the clear cost savings. Fast charging proved especially useful, enabling multiple operations in a day, while dependency on slow charging reduced the total uptime. Farmers have expressed a strong interest in getting subsidies to make electric tractors more affordable and economically viable for small and marginal farmers.

Assessing On-Ground Health Benefits of Electric Tractors

In addition ro showcasing significant financial savings in operational costs, the electric tractor also demonstrated notable health benefits. These advantages stem from the reduced heat and noise levels compared to conventional diesel tractors. To evaluate the impact of these improvements, sound pressure levels and temperature readings were recorded using a Sound Level Meter and a Digital Infrared Thermometer.

These tests were conducted under similar conditions, where both tractors were kept in neutral gear with the throttle fully engaged. Under these conditions, the electric tractor produced a noise level of 76.5 decibels (dB), while the diesel tractor generated a significantly higher noise level of 90.8 dB.

Figure 13: Comparison of Sound Pressure Level from Electric and Diesel Tractor

Source: NRDC, Gujarat, India (July 2025)

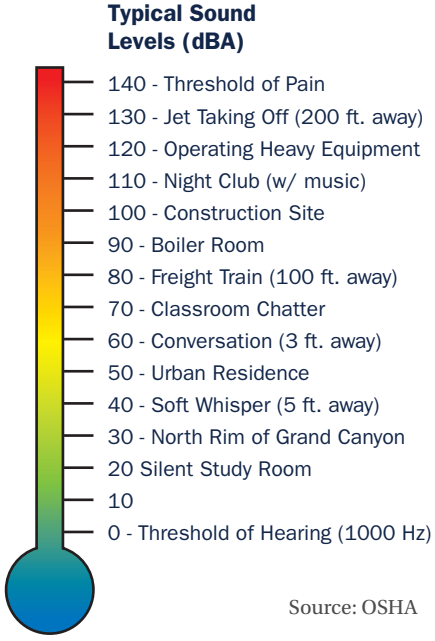
According to the World Health Organization (WHO), a noise level of 76.5 dB falls within the safe exposure range, even for prolonged durations of up to 40 hours per week.[41] In contrast, prolonged exposure to sound levels around 90.8 dB can potentially lead to hearing damage. Since decibels are measured on a logarithmic scale, the noise produced by the diesel tractor is approximately 2.7 times more intense than that of the electric tractor.

As per the National Institute on Deafness and Other Communication Disorders (NIDCD), long or repeated exposure to sounds at or above 85 dBA can cause permanent hearing loss.[42]

Similarly, to assess the heat around the operator's seat, temperature was measured after 45 minutes of continuous rotavator operation in both cases.

Note: dB (decibel) is a generic logarithmic scale for measuring sound pressure, while dBA (decibel A-weighted) is a specific measurement that adjusts the dB scale to better reflect human hearing sensitivity.

As per the National Institute on Deafness and Other Communication Disorders (NIDCD), long or repeated exposure to sounds at or above 85 dBA can cause permanent hearing loss.



Source: OSHA

Figure 14: Comparison of Temperature Around the Operator's Seat in Electric and Diesel Tractor

Source: NRDC, Gujarat, India (July 2025)

According to the U.S. government agency, Occupational Safety and Health Administration (OSHA), any workplace condition that raises a worker's core body temperature above 100.4 degrees Fahrenheit (38 degrees Celsius) increases the risk of heat stress.

A significant difference was observed in the temperature around the operator's seat. In the case of the electric tractor, the temperature ranged between 96.2 and 96.8 degrees Fahrenheit, which is close to the average human body temperature and is well within a comfortable range for working conditions. In contrast, the diesel tractor recorded much higher temperatures, reaching up to 121.8 degrees Fahrenheit around the operator's seat. Additionally, the diesel exhaust, which is located near the operator, recorded temperatures as high as 150 degrees Fahrenheit.

According to the U.S. government agency, Occupational Safety and Health Administration (OSHA), any workplace condition that raises a worker's core body temperature above 100.4 degrees Fahrenheit (38 degrees Celsius) increases the risk of heat stress.[43]

Thus, the considerably lower temperature in the electric tractor offers a safer and more comfortable working environment for prolonged operation.

Building on these findings, the NRDC team aims to conduct similar pilot programs across different geographies and agro-climatic zones to raise awareness in rural areas. These pilots are crucial, as they provide farmers with a first-hand opportunity to experience and understand the technology, helping build trust and confidence within rural communities. Through these demonstrations, the team aims to further assess the performance, economic viability, and operational reliability of electric tractors under real-world conditions. While these pilots are an important step toward mainstream adoption, several challenges are to be addressed such that they create awareness, strengthen policy and financial support, reduce upfront cost, expand model availability and ensure robust after-sales service networks. Overcoming these barriers will be key to transitioning electric tractors from pilot projects to large-scale deployment across India's agricultural landscape.

11

Challenges in the Adoption of Electric Tractors

While electric tractors offer significant economic and environmental benefits, their adoption into the agricultural sector in India remains limited due to a range of systemic and structural challenges. These barriers span across the awareness, financing, infrastructure, and policy domains. Overcoming the following roadblocks is crucial for designing targeted interventions to accelerate the transition from diesel to electric tractors in India:

- **Low Awareness and Trust:** Despite lower operating costs, farmers in rural areas often lack awareness about the performance and long-term benefits of electric tractors. Limited exposure and demonstrations and minimal user testimonials have led to skepticism and low confidence in adopting the technology.

Figure 15: NRDC Team Creating Awareness at the Grassroots Level About the Benefits of Electric Tractors

Source: NRDC, Gujarat, India (July 2025)

- **High Upfront Costs and Lack of Access to Financing:** Electric tractors are nearly twice as expensive as their diesel counterparts, and financing options are scarce or underdeveloped. This makes the initial investment unaffordable for many small and marginal farmers, despite the long-term cost savings. Currently, tractor financing falls under priority sector lending in India, due to its critical role in the agricultural sector. Nationalized banks and NBFCs also offer financing for diesel tractors at attractive interest rates. In contrast, the electric tractor industry is still in its nascent stage with a lack of proof of concept regarding their effectiveness and resale value. This uncertainty creates hesitation among financiers, making them reluctant to offer loans at competitive interest rates for electric tractors

- **Unavailability of Reliable and High-Quality Power Supply:** Rural areas face irregular electricity supply, and the lack of high-quality power infrastructure undermines the operational reliability of electric tractors for daily farming activities. OEMs have highlighted that supporting fast-charging infrastructure requires a three-phase electricity connection. However, in rural areas, three-phase power supply is typically available for only seven to eight hours a day. This limited availability could pose challenges during peak agricultural seasons when fast charging is essential to ensure uninterrupted operation of electric tractors.

- **Limited After-Sales Support:** The absence of trained technicians and dedicated service centers for electric tractors increases maintenance concerns and machine downtime, further deterring the adoption of electric tractors. On the other hand, the diesel tractors are deeply entrenched in Indian agriculture, supported by a robust ecosystem including widespread service networks.

- **Absence of Resale/Secondhand Market:** Like other electric vehicles, the resale or secondhand market for electric tractors is not yet established, raising questions about their residual value after a certain period of use. In contrast, the diesel tractor market has a well-established resale ecosystem, offering greater certainty in terms of secondhand value. This issue is further compounded by the fact that tractor ownership and usage are often associated with vulnerable groups, including small and marginal farmers, for whom asset value and financial predictability are especially critical.

- **Weak Policy and Incentive Support:** Current state EV policies do not adequately address the specific needs of agricultural electric tractors. There is limited integration of electric tractors in national and sub-national schemes, along with inadequate support for battery replacement and charging infrastructure, both of which are essential for reducing the total cost of ownership.

12

Recommendations

As India seeks to leapfrog diesel dependency in the agricultural sector, electric tractors present a transformative opportunity to enhance farmer welfare, reduce emissions, and improve energy security. Building on insights from this study and consultations with key stakeholders, the following strategic recommendations can help scale the adoption of electric tractors across the country:

- **Extend PM E-DRIVE Subsidy to Tractors**: The central government could expand the PM E-DRIVE scheme to include electric tractors, offering a subsidy of INR 5,000 per kWh, capped at INR 250,000 per tractor, for the first 1,000 units to encourage early adoption.
- **State-level Incentives**: State governments can introduce complementary subsidies or incentives to drive initial interest in electric tractor usage in their respective states.
- **Tailored Pilot Initiatives**: Pilot programs should be strategically designed to establish proof of concept for electric tractors. These initiatives can be implemented across diverse geographies and agro-climatic zones in India to generate broader awareness among farmers. Such pilots would not only demonstrate the practical benefits of electric tractors but also help build confidence and trust in this emerging technology.

To further accelerate acceptance and community-level interest, the outcomes of these pilots, such as successful case studies, operational learnings, and farmer testimonials should be widely documented and showcased through targeted outreach and knowledge sharing platforms. This approach will help build confidence, trust, and momentum for large-scale adoption of electric tractors nationwide.

Figure 16: SEWA Sisters Experiencing Electric Tractor at SEWA Ganeshpura Farm

Source: NRDC, Gujarat, India (July 2025)

Industries could play a crucial role in these pilots, as tractor usage tends to be significantly higher in industrial settings. This higher rate of utilization presents a financially attractive scenario by substantially reducing the payback period. Additionally, industries typically have better access to reliable power infrastructure, including three-phase electricity, which can support fast charging and enable uninterrupted, longer-duration operations. To further encourage adoption, the government could introduce targeted subsidies for early adopters, to help demonstrate the viability and effectiveness of electric tractors.

- **Ensure 24x7 Reliable and High-Quality Power Supply:** The government could prioritize providing uninterrupted, high-quality three-phase power supply in rural areas, especially during peak farming seasons. This would enable more stable charging schedules for electric tractors, leading to improved utilization rates, increased productivity, and uninterrupted agricultural operations.
- **Integrate with Central Schemes**: Inclusion of electric tractors under central government schemes such as SMAM, PM KISAN Tractor Yojana, and PM KUSUM (Pradhan Mantri Kisan Urja Suraksha Evam Utthaan Mahabhiyan) to ensure financial parity with diesel-powered counterparts.
- **Targeted Awareness Campaigns**: Launch targeted outreach initiatives through Krishi Vigyan Kendras, agricultural TV programs such as DD Kisan, and community radio to highlight the economic and environmental benefits of electric tractors along with available government support.
- **Facilitate Affordable Financing**: Enable access to low-interest, long-tenure loans through partnerships with NBFCs and rural development banks, supported by government-backed guarantees and risk-sharing frameworks. Collaborations between OEMs and financial institutions can play a crucial role in designing farmer-centric and attractive financing models that lower the upfront cost of adoption. Additionally, better integration with existing government schemes promoting farm mechanization can further reduce financial barriers, making electric tractors more accessible and affordable for small and marginal farmers..
- **Skill Development Initiatives**: Establish dedicated training centers to upskill the youth in rural areas in the operation, servicing, and maintenance of electric tractors, thereby also creating local employment opportunities.
- **Developing After-Sales Service Support**: The tractor market in India is highly sensitive to after-sales support, particularly the availability of spare parts in local markets. Since the electric tractors market is still in its early stages, strategic collaboration and consensus-building among OEMs is essential to develop a robust after-sales ecosystem comparable to that of diesel tractors.
- **Innovative Business Models**: Promote alternative ownership models such as pay-per-use, leasing, and Farmer Producer Organization (FPO)-led group purchases to improve affordability and scalability.
- **Rural Charging Infrastructure**: Set up solar-powered charging stations at key locations in rural areas including mandis (large marketplace for agricultural produce), cooperatives, and village hubs to ensure reliable and sustainable energy access.

13

Conclusion

The transition to electric tractors represents a pivotal step toward sustainable, efficient, and inclusive agricultural development in India. While current adoption remains limited, electric tractors offer compelling advantages, with over 50 percent lower total cost of ownership (over 10 years) to 80 percent lower operating costs, and significant reductions in noise, emissions, and health risks for communities involved in the agricultural sector.

Despite these benefits, challenges such as high upfront costs, limited infrastructure, and low awareness must be tackled through a coordinated ecosystem approach. This includes strong policy support, innovative financing, infrastructure investment, and grassroots-level engagement.

Given India's central role in global agriculture and its position as one of the largest tractor manufacturers in the world, there lies a significant opportunity to lead the global transition to electric tractors. With several OEMs emerging internationally, India can leverage its strong manufacturing base, engineering capabilities, and policy momentum to establish itself as a hub for "Made in India, Made for the World" electric tractors.

While agriculture remains central to India's economy, diesel tractors have been contributing significantly to emissions. Thus, the mainstreaming of electric tractors aligns strongly with national goals focusing on climate resilience, energy independence, and rural livelihood enhancement. Accelerating this transition will not only future-proof Indian agriculture but also make it cleaner, more resilient, and economically empowering for millions of farmers.

Image: freepik.com

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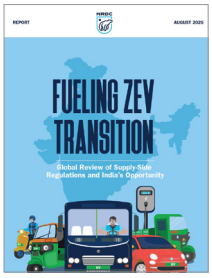
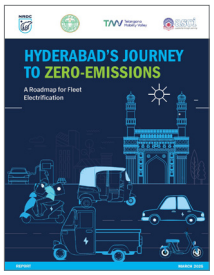
Highlighted Reports



Fueling ZEV Transition: Global Review of Supply-Side Regulations and India's Opportunity



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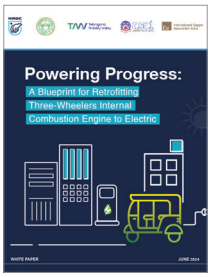
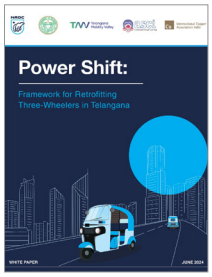
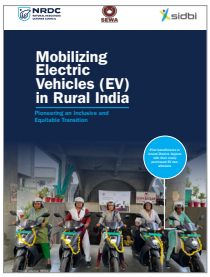


Powering Progress: A Blueprint for Retrofitting Three-Wheelers Internal Combustion Engine to Electric



Power Shift: Framework for Retrofitting Three-Wheelers in Telangana



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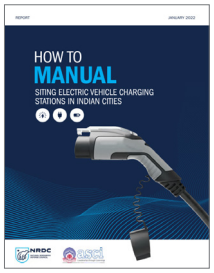

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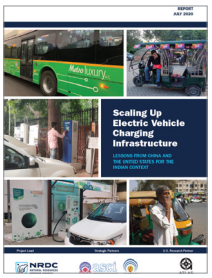

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