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ICAI MSME ECOSYSTEM

ICAI STARTUP GATEWAY

ICAI Knowledge Series on MSME & Startup

ज्ञान सागर

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UPDATES

MSME Entrepreneur Awareness Programme in Nagaland

The Ministry of MSME organized an Entrepreneur Awareness Camp and Vendor Development Programme on 30 March 2026 in Dimapur, Nagaland to promote government schemes, including the National SC-ST Hub, and support Udyam Registration.

Over 300 entrepreneurs participated, interacting with CPSEs, banks, and other stakeholders on finance, procurement, and business opportunities.

Key speakers highlighted MSME schemes, inclusive growth, women entrepreneurship, and the role of AI in creating business and employment opportunities.

Source: ww.pib.gov.in

PM Mudra Yojana: Collateral-Free Loans Up to ₹20 Lakh, "Tarun Plus" Boost for Entrepreneurs

The Government under the Pradhan Mantri Mudra Yojana (PMMY) provides collateral-free loans of up to ₹20 lakh to small entrepreneurs through banks, NBFCs, and MFIs. The scheme covers income-generating activities in manufacturing, trading, services, and agriculture-allied sectors, and is divided into four categories—Shishu (up to ₹50,000), Kishor (₹50,000–₹5 lakh), Tarun (₹5–10 lakh), and the newly introduced Tarun Plus (₹10–20 lakh) for borrowers who have successfully repaid earlier Tarun loans. It aims to support micro and small businesses, especially women and traditional enterprises, by improving access to credit. The government has also simplified the application and disbursal process through platforms like Jan Samarth to ensure faster and easier loan access.

Source: www.pib.gov.in

Government Strengthens MSMEs with Export Promotion Mission & Tech Support

The government has introduced multiple initiatives to boost the competitiveness of MSMEs in domestic and global markets. The share of MSME-related exports has steadily increased, reaching about **48.55% in 2024–25**. A key initiative is the **Export Promotion Mission (EPM)** with an outlay of ₹25,060 crore, aimed at providing a comprehensive and digitally driven framework for exports. It includes two components—**Niryat Protsahan** (financial support like credit, guarantees, and interest subvention) and **Niryat Disha** (non-financial support such as branding, compliance, logistics, and capacity building).

Additionally, the government is expanding **Technology Centres and Extension Centres**, promoting digital adoption through schemes like TEAM, supporting green technologies under MSE-GIFT with concessional finance, and strengthening MSMEs via GST rationalisation. A **Credit Guarantee Scheme for Exporters** has also been approved to provide collateral-free credit up to ₹20,000 crore, further enhancing export capacity and global competitiveness.

Source: www.pib.gov.in

Government Initiatives to Boost MSME Competitiveness

The Government has undertaken several initiatives to support MSMEs and enhance their competitiveness in global value chains. A key initiative is the Export Promotion Mission (EPM), with an outlay of ₹25,060 crore for 2025–31, which provides a unified and digitally driven framework for export promotion. It operates through two sub-schemes—Niryat Protsahan, which focuses on improving access to affordable trade finance through measures like interest subvention, export factoring, and credit support, and Niryat Disha, which enhances market readiness through support for quality compliance, branding, logistics, and participation in trade fairs. In addition, the Credit Guarantee Scheme for Exporters offers 100% collateral-free credit coverage up to ₹20,000 crore to strengthen liquidity and enable expansion into new markets. The International Cooperation Scheme further supports MSMEs by facilitating participation in global exhibitions and buyer-seller meets. Moreover, GST rationalisation has reduced input costs, strengthened supply chains, and encouraged MSMEs to scale up operations and compete effectively in domestic as well as global markets.

Source: www.pib.gov.in

MahaAgri-AI Policy 2025–2029:
Transforming Agricultural Governance through Artificial Intelligence – Policy Architecture, Financial Implications, and the Emerging Role of Chartered Accountants

Executive Summary

Rapid advances in digital technologies are fundamentally transforming governance models across sectors, including agriculture. Recognising the transformative potential of Artificial Intelligence (AI), the Government of Maharashtra has introduced the **MahaAgri-AI Policy 2025–2029**, a pioneering state-level initiative designed to integrate AI and emerging technologies into the agricultural ecosystem. The policy represents a strategic attempt to leverage digital innovation in addressing long-standing challenges faced by the agricultural sector such as climate variability, resource inefficiency, declining productivity, and market fragmentation.

The policy proposes the development of a **Shared Digital Public Infrastructure for Agriculture**, incorporating platforms such as the Agricultural Data Exchange (A-DeX), AI sandbox environments for agritech experimentation, geospatial monitoring systems, and blockchain-based agricultural traceability frameworks. These initiatives are expected to facilitate data-driven decision-making for farmers, policymakers, researchers, and agribusiness stakeholders.

The Government of Maharashtra has committed an **initial financial outlay of approximately ₹500 crore**, which will support infrastructure creation, innovation grants, research initiatives, startup incubation, and capacity-building programmes during the five-year implementation period.

Beyond technological transformation, the policy establishes a **multi-layered institutional governance framework**, including a State Level Steering Committee, a State Level Technical

Committee, and a dedicated AI and Agritech Innovation Centre. These institutional arrangements are intended to ensure effective oversight, transparent implementation, and alignment with broader sustainable development objectives.

For the accounting profession, the emergence of AI-driven agricultural policies creates new professional opportunities in areas such as financial governance, public programme audits, grant certification, agritech startup advisory, digital assurance, and impact assessment. As governments increasingly deploy technology-enabled policy frameworks, the expertise of Chartered Accountants in financial accountability, regulatory compliance, and governance oversight becomes particularly significant.

This article analyses the policy architecture of the MahaAgri-AI Policy 2025–2029, its institutional and financial framework, comparative positioning within India's emerging digital agriculture ecosystem, and the professional implications for Chartered Accountants.

1. Introduction

Agriculture remains one of the most significant pillars of India's economy, particularly in states such as Maharashtra where a large proportion of the population depends on farming and allied activities for livelihood. Despite substantial improvements in agricultural productivity over the past several decades, the sector continues to face structural constraints including fragmented landholdings, unpredictable climate conditions, rising input costs, and inefficiencies in agricultural supply chains.

In recent years, climate variability has emerged as an additional risk factor. Erratic rainfall patterns, increasing frequency of droughts and floods, and rising temperature fluctuations have significantly impacted crop productivity and farmer incomes. These challenges have highlighted the need for innovative solutions capable of enhancing resilience and efficiency within the agricultural ecosystem.

Technological transformation has therefore become an increasingly important component of agricultural policy. Artificial Intelligence, big data analytics, geospatial technologies, remote sensing systems, and digital advisory platforms are now being deployed globally to improve agricultural decision-making. These technologies enable real-time monitoring of crop conditions, predictive analysis of weather and pest outbreaks, efficient resource management, and enhanced market access for farmers.

Recognising these possibilities, the Government of Maharashtra launched the **MahaAgri-AI Policy 2025–2029**, one of the first comprehensive state-level policy frameworks in India specifically focused on the integration of Artificial Intelligence into agriculture. The policy aims to build a **technology-driven agricultural ecosystem supported by digital infrastructure, innovation partnerships, and institutional governance mechanisms**.

2. Background and Policy Rationale

Agriculture in Maharashtra contributes significantly to the state's economy and rural employment. However, the sector faces persistent challenges such as declining soil fertility, water scarcity, limited access to real-time agricultural information, and inefficiencies in agricultural markets.

Traditional farming practices often rely on historical knowledge and limited data inputs, which can restrict the ability of farmers to respond effectively to rapidly changing environmental and market conditions. The increasing complexity of agricultural risks has therefore necessitated a shift toward **data-driven agricultural governance**.

Artificial Intelligence provides powerful tools to address these challenges. AI systems can process large datasets related to soil conditions, crop health, weather patterns, irrigation practices, and market prices to generate predictive insights that support better decision-making. When combined with satellite imagery, drone monitoring, Internet of Things (IoT) sensors, and machine learning algorithms, AI technologies can significantly improve the efficiency of agricultural planning, crop monitoring, and supply-chain management.

The MahaAgri-AI Policy has been designed as a **strategic roadmap for integrating such technologies into the agricultural value chain**. By doing so, the policy seeks to enhance productivity, strengthen climate resilience, and improve the economic well-being of farmers.

3. Vision and Strategic Objectives of the Policy

The MahaAgri-AI Policy envisions the creation of a **farmer-centric, technology-enabled agricultural ecosystem** that integrates digital technologies into every stage of the agricultural value chain.

The policy pursues several strategic objectives.

Enhancing Agricultural Productivity

AI-enabled systems can analyse crop patterns, soil characteristics, and weather forecasts to provide farmers with real-time advisory services. These insights enable optimal use of fertilizers, water, and other inputs, thereby improving crop yields and reducing production costs.

Strengthening Climate Resilience

Climate variability has become a major risk for farmers. AI-based predictive analytics can assist in forecasting droughts, pest infestations, and crop diseases, enabling farmers to adopt preventive measures and reduce agricultural losses.

Improving Market Intelligence

Digital platforms powered by AI can provide farmers with real-time information regarding crop prices, demand patterns, and supply chain dynamics. Such information improves decision-making related to crop selection, harvesting schedules, and market timing.

Promoting Innovation and Startup Ecosystems

The policy also seeks to encourage agritech innovation by fostering collaboration among startups, research institutions, universities, and private enterprises.

Building Digital Agricultural Infrastructure

Another core objective is the development of shared digital infrastructure that supports agricultural data management, predictive analytics, and technology-enabled advisory services.

4. Digital Public Infrastructure for Agriculture

One of the most significant aspects of the MahaAgri-AI Policy is the creation of a **Shared Digital Public Infrastructure (DPI) for agriculture**. This infrastructure will provide the technological foundation for AI-driven agricultural governance.

Agricultural Data Exchange (A-DeX)

The policy proposes the establishment of an Agricultural Data Exchange platform that integrates datasets related to crop production, soil health, weather conditions, market

arrivals, and farmer registries. The platform will operate through a consent-based data-sharing mechanism that allows stakeholders to securely access agricultural datasets.

AI Sandbox Environment

An AI sandbox environment will allow startups and research institutions to test new agritech solutions using real agricultural datasets under controlled conditions. This approach encourages innovation while ensuring appropriate regulatory oversight.

Geospatial and Remote Sensing Systems

The policy also promotes the use of satellite imagery, drone technology, and geospatial intelligence systems for crop monitoring, yield estimation, and disaster risk assessment.

Blockchain-Enabled Agricultural Traceability

Blockchain-based traceability platforms will enable end-to-end monitoring of agricultural products from farm to market. These systems enhance food safety standards and improve the credibility of agricultural exports.

5. Institutional Governance Framework

Successful implementation of technology-driven policies requires effective governance mechanisms. The MahaAgri-AI Policy therefore establishes a multi-tier institutional structure.

State Level Steering Committee (SLSC)

The State Level Steering Committee will function as the apex policy oversight body responsible for approving major AI initiatives and providing strategic direction.

State Level Technical Committee (SLTC)

The State Level Technical Committee will evaluate the technological feasibility and commercial viability of AI projects proposed under the policy.

AI and Agritech Innovation Centre

A dedicated AI and Agritech Innovation Centre will coordinate research activities, manage digital infrastructure, and facilitate collaboration among government agencies, universities, and technology innovators.

Research Centres in Agricultural Universities

The policy also proposes the creation of AI innovation centres in State Agricultural Universities to promote research, incubation, and real-world pilot testing.

6. Financial Architecture and Funding Support

The Government of Maharashtra has allocated an **initial budget of ₹500 crore** for the implementation of the MahaAgri-AI Policy.

The funding framework includes:

- Research and innovation grants
- Pilot project funding
- Infrastructure development support
- Startup incubation programmes
- Capacity-building initiatives

Early-stage innovation projects may receive funding for concept development and prototype testing. More advanced solutions may receive financial assistance for field validation and pilot implementation.

Public-private partnerships are also expected to play an important role in attracting investment and accelerating technological innovation in agriculture.

7. Implementation Roadmap

The policy will be implemented through a **phased rollout strategy**.

Phase I: Institutional setup and development of digital infrastructure.

Phase II: Pilot implementation of AI solutions in selected districts.

Phase III: Statewide deployment and integration with national digital agriculture initiatives.

Phase IV: Policy evaluation, third-party impact assessment, and potential expansion into related sectors.

This phased implementation model allows the government to test innovations, evaluate outcomes, and refine policy strategies over time.

8. Role and Professional Opportunities for Chartered Accountants

Technology-driven public policy initiatives create several new areas of professional engagement for Chartered Accountants.

Financial Governance and Programme Oversight

Large-scale government initiatives involving technology investments require robust financial governance systems. Chartered Accountants can contribute through internal audits, performance audits, and financial oversight mechanisms.

Advisory Services for Agritech Startups

Agritech startups require professional support in areas such as financial planning, taxation, corporate structuring, and investment advisory.

Grant Management and Utilisation Certification

Government innovation programmes often involve grant funding. Chartered Accountants may provide certification of grant utilisation and ensure compliance with funding guidelines.

Digital Assurance and Data Governance

AI systems rely on large datasets and digital platforms. Chartered Accountants with expertise in information systems auditing can provide assurance services related to data governance, cybersecurity controls, and digital risk management.

ESG and Impact Assessment

AI-driven agriculture contributes to sustainability objectives such as climate resilience and rural development. Chartered Accountants can assist in measuring environmental and social impact.

9. Implementation Challenges

Despite its transformative potential, the policy may face several challenges.

- Limited digital infrastructure in rural areas
- Data privacy and governance concerns
- Need for digital literacy among farmers
- Technology adoption barriers

Addressing these challenges will require sustained investment in rural connectivity, capacity building, and responsible data governance frameworks.

10. Comparative Analysis of AI-Driven Agricultural or AI-Governance Policies Across Indian States

Parameter	Maharashtra – MahaAgri-AI Policy (2025–2029)	Telangana – AI for Agriculture Initiatives	Andhra Pradesh – Digital Agriculture & AI System	Tamil Nadu – Tamil Nadu AI Mission (TNAIM)	Gujarat – Tech-Led Agriculture Initiatives
Policy Nature	Dedicated **AI policy for agriculture**	AI pilots and data platforms for agriculture	Statewide **digital agriculture governance system using AI/ML**	Broad **AI mission for governance and economic development**	Technology-led agriculture initiatives aligned with national strategy
Launch Period	Approved in **2025**	AI agriculture pilots launched in recent years	Digital agriculture rollout planned from **Kharif 2025**	AI Mission launched as a multi-year programme	Ongoing initiatives aligned with NITI Aayog roadmap
Primary Objective	Transform agriculture through AI-driven decision systems, predictive analytics, and digital infrastructure	Use AI data exchange and analytics to improve crop productivity	Digitize the entire agricultural governance system and provide AI-based farmer advisories	Position the state as a **hub for AI innovation and governance**	Integrate frontier technologies like IoT and data analytics into farming
Technology Focus	AI, Generative AI, drones, robotics, computer vision, predictive analytics	Agricultural data exchange platforms and analytics	AI/ML-enabled advisory systems, digital crop monitoring	AI applications across sectors including governance and social development	IoT, digital crop surveys, data-driven farming

Parameter	Maharashtra – MahaAgri-AI Policy (2025–2029)	Telangana – AI for Agriculture Initiatives	Andhra Pradesh – Digital Agriculture & AI System	Tamil Nadu – Tamil Nadu AI Mission (TNAIM)	Gujarat – Tech-Led Agriculture Initiatives
Financial Support	Approx. **₹500 crore initial allocation**	Various AI projects and collaborations	Government-supported digital agriculture platform (APAIMS 2.0)	State-supported AI innovation ecosystem	State-backed digital agriculture and policy initiatives
Institutional Framework	State Steering Committee, Technical Committee, AI Innovation Centres	Partnerships with global organisations and technology platforms	State agriculture department managing digital platform	Dedicated AI mission framework for policy implementation	

"Policy Leadership of Maharashtra in AI-Driven Agriculture"

A comparative analysis indicates that while several Indian states are adopting AI and digital technologies in agriculture, Maharashtra's approach is unique because it represents a **dedicated AI policy specifically focused on agriculture**.

Other states such as Telangana and Andhra Pradesh have introduced AI-enabled agricultural platforms, while states like Tamil Nadu have launched broader AI missions covering multiple sectors. However, Maharashtra's policy stands out due to its **sector-specific focus, integrated digital infrastructure, and substantial financial commitment**.

The policy therefore positions Maharashtra as a potential leader in the development of **AI-enabled agricultural governance frameworks in India**.

11. Financial Governance and Compliance Implications of AI-Driven Agriculture Policies for Chartered Accountants

Policy Component	Nature of Financial or Governance Activity	Compliance / Regulatory Considerations	Potential Role of Chartered Accountants
Government Funding for AI Projects	**Allocation of public funds for research, pilot projects, innovation grants, and infrastructure under the MahaAgri-AI Policy**	**Budgetary approvals, utilisation of grants, adherence to government financial rules**	**Certification of grant utilisation, financial audits of funded projects, advisory on financial structuring of innovation programmes**
Agritech Startup Ecosystem	**State support for agritech startups developing AI-based solutions for agriculture**	**Startup registration, tax compliance, corporate governance, investor reporting**	**Financial advisory, tax structuring, business valuation, preparation of financial projections, compliance with Companies Act and startup regulations**

Policy Component	Nature of Financial or Governance Activity	Compliance / Regulatory Considerations	Potential Role of Chartered Accountants
Public–Private Partnerships (PPP)	Collaboration between government agencies, research institutions, and private technology providers	PPP contract governance, procurement regulations, project finance structures	Due diligence, financial modelling, structuring PPP agreements, risk assessment and project monitoring
Digital Agriculture Infrastructure	Development of digital platforms such as Agricultural Data Exchange systems and AI sandboxes	Data governance standards, cybersecurity compliance, procurement transparency	Information systems audit, assurance on digital controls, evaluation of financial risks in technology infrastructure
Innovation Grants and Subsidies	Financial incentives and grants provided to research institutions and technology developers	Grant utilisation rules, reporting requirements, monitoring of project expenditure	Independent certification of project expenditure, compliance audits, verification of milestone-based funding
Technology Procurement by Government	Acquisition of AI platforms, data analytics systems, and geospatial technologies	Public procurement procedures, vendor evaluation, transparency in tendering	Financial due diligence of vendors, audit of procurement processes, compliance verification
Impact Assessment of Policy Programs	Evaluation of outcomes such as improved productivity, climate resilience, and farmer income	Monitoring frameworks, performance evaluation metrics, accountability mechanisms	Social impact assessment, cost-benefit analysis, preparation of impact measurement reports
Data Governance and Digital Platforms	Management of large agricultural datasets used for AI modelling and analytics	Data protection standards, consent frameworks, digital governance regulations	Data assurance audits, governance advisory for digital platforms, compliance with emerging data protection norms
ESG and Sustainability Reporting	AI-driven agriculture contributes to environmental sustainability and rural development	Sustainability reporting frameworks and responsible technology governance	ESG reporting advisory, sustainability audits, impact measurement of climate-smart agriculture initiatives
Investment in Agritech Sector	Increased venture capital and institutional investment in AI-driven agricultural startups	Investment structuring, financial reporting standards, taxation implications	Investment due diligence, financial reporting advisory, valuation of agritech ventures

12. Key Professional Insights for the Accounting Profession

The expansion of AI-driven policy initiatives in agriculture signals an important transition in the nature of public sector programmes and private sector innovation. As governments increasingly invest in digital infrastructure and technology-enabled governance models, the need for robust financial accountability, transparent governance mechanisms, and professional assurance services becomes critical.

For Chartered Accountants, the MahaAgri-AI Policy creates opportunities across several emerging domains, including technology project audits, grant certification, digital governance assurance, startup advisory, and sustainability impact measurement. These roles align closely with the profession's traditional strengths in financial oversight and regulatory compliance while also expanding into new areas such as digital assurance and data governance.

The accounting profession therefore has an important role to play in ensuring that large-scale public investments in AI-enabled agriculture are implemented with transparency, efficiency, and accountability.

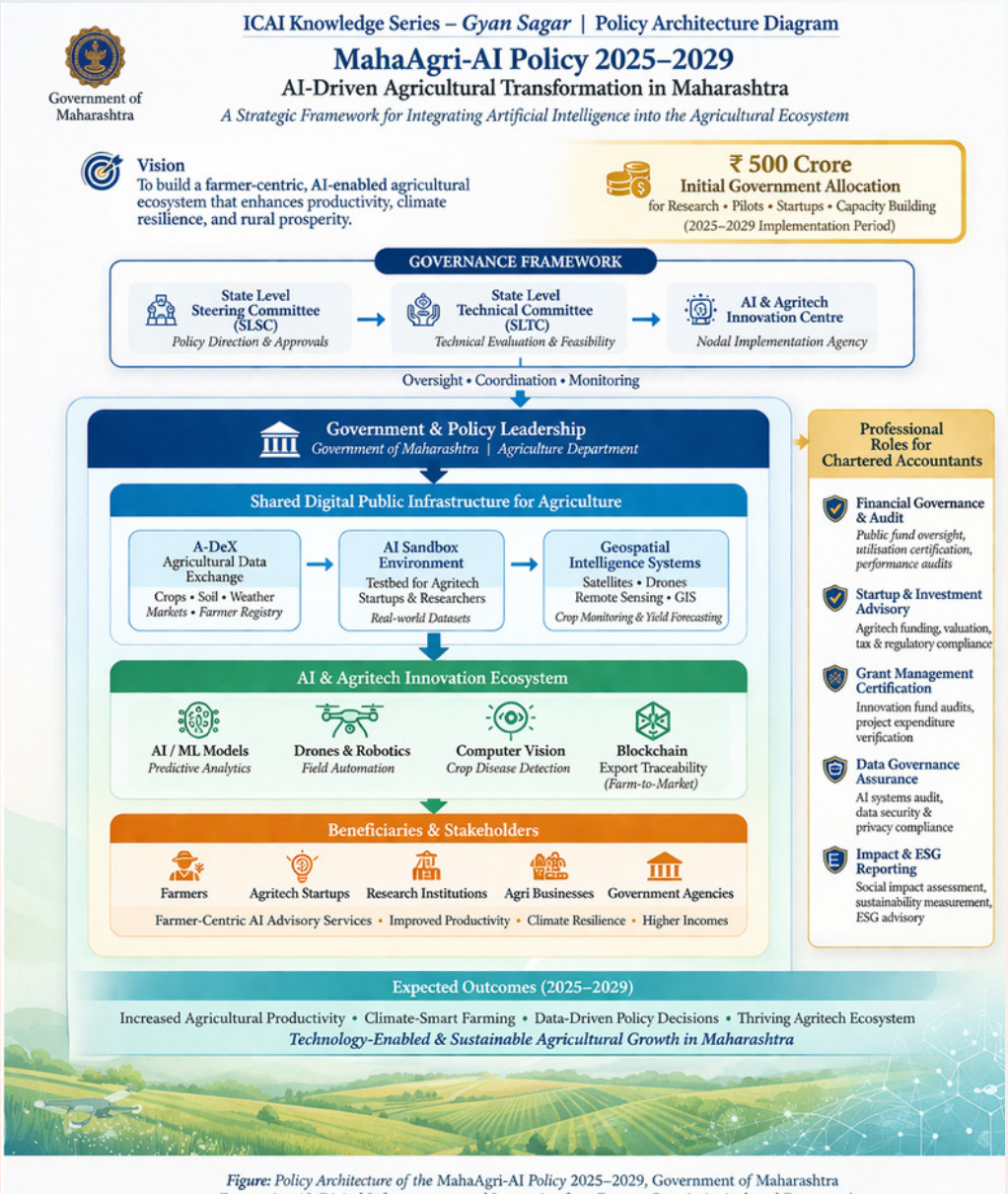
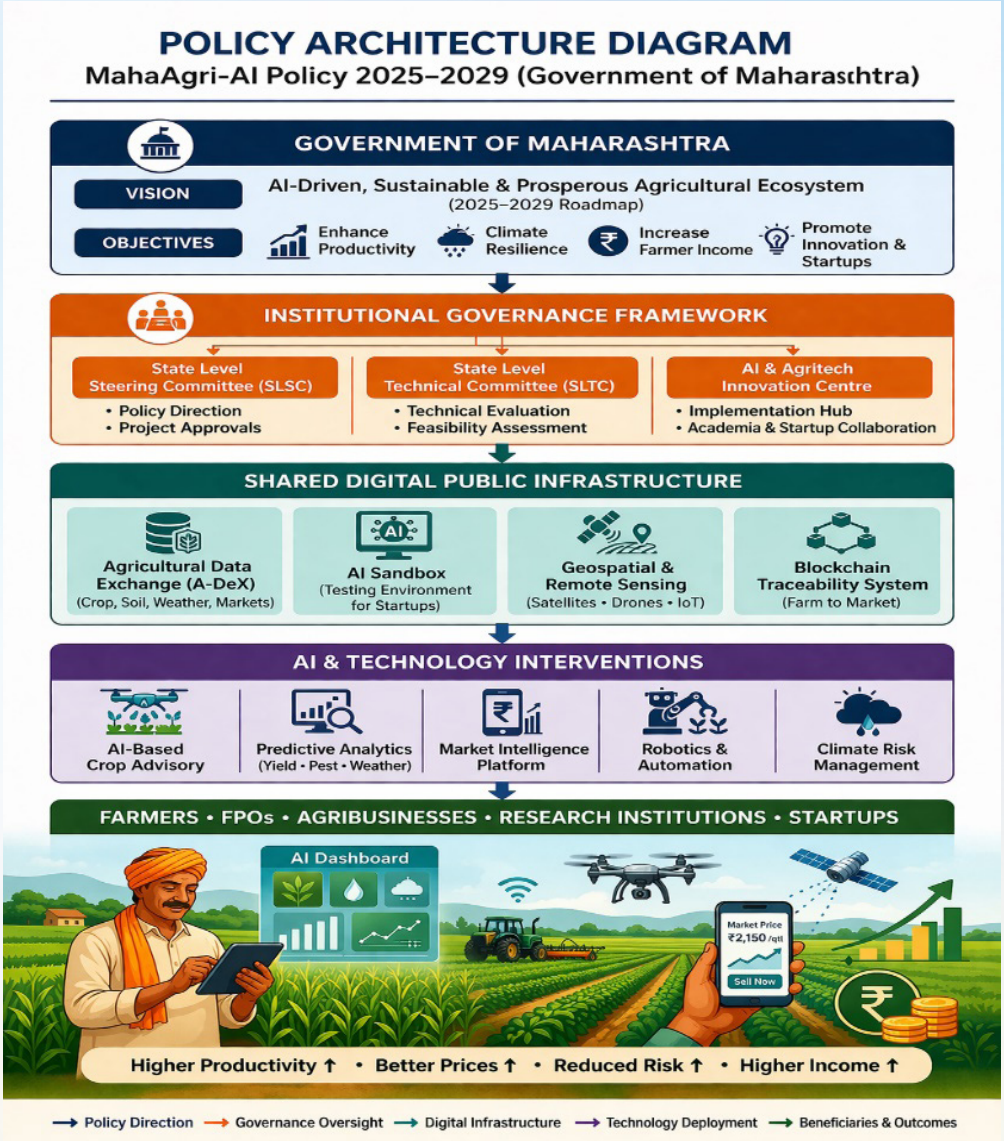


Figure: Policy Architecture of the MahaAgri-AI *Policy* 2025–2029, Government of Maharashtra
(Integrating AI, Digital Infrastructure, and Innovation for a Farmer-Centric Agricultural Ecosystem)



Conclusion

The MahaAgri-AI Policy 2025–2029 represents a significant step toward integrating advanced technologies into agricultural governance. By combining artificial intelligence, digital infrastructure, and institutional innovation, the policy aims to transform agriculture into a data-driven and technology-enabled sector capable of addressing complex challenges related to productivity, climate resilience, and market access.

Beyond its technological dimension, the policy also reflects an important evolution in public governance. Large-scale digital transformation initiatives require robust financial oversight, transparent implementation mechanisms, and credible accountability systems. In this context, Chartered Accountants have an important role to play in ensuring that investments in AI-driven agriculture are implemented efficiently, responsibly, and in accordance with sound financial governance principles.

As India moves toward a digitally empowered agricultural economy, policies such as the MahaAgri-AI Policy provide a blueprint for integrating technology, innovation, and professional expertise to promote sustainable agricultural development and improved livelihoods for farmers.

By CA. Pushkaraj Vishnu Joshi

Impact of Recent Wars on Indian MSMEs
A Strategic Analysis for Professional Business Users

1. Introduction

In an increasingly interconnected global economy, geopolitical conflicts have far-reaching implications beyond national borders. Recent wars, particularly the **Russia–Ukraine conflict** and ongoing tensions in the **Middle East**, have significantly disrupted global trade, supply chains, energy markets, and financial systems.

For India, where Micro, Small and Medium Enterprises (MSMEs) contribute nearly **30% to GDP, 45% to manufacturing output, and over 40% to exports**, the ripple effects of these wars are both direct and indirect.

India's MSME sector operates within an evolving policy ecosystem shaped by initiatives such as **Atmanirbhar Bharat**, **Make in India**, and multiple support schemes administered by the **Ministry of Micro, Small and Medium Enterprises**. Government programmes such as the **Emergency Credit Line Guarantee Scheme (ECLGS)**, **Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE)**, **Udyam Registration**, and export promotion initiatives under the **Directorate General of Foreign Trade (DGFT)** have significantly strengthened the resilience of MSMEs in recent years. However, geopolitical disruptions arising from international conflicts introduce new layers of economic uncertainty that require both policy attention and strategic adaptation by businesses.

This article presents a structured and analytical perspective on how recent wars are impacting Indian MSMEs, focusing on operational, financial, strategic, and policy dimensions.

2. Global War Dynamics and Economic Transmission Channels

Wars influence economies through multiple transmission channels:

2.1 Supply Chain Disruptions

The Russia–Ukraine war has caused **significant disruptions in global supply chains**, particularly in food, energy, and critical raw materials.

Similarly, conflicts in the Middle East have disrupted key shipping routes such as the **Red Sea and Gulf corridors**, forcing rerouting and delays.

2.2 Energy Price Volatility

India imports a large portion of its crude oil. Any geopolitical instability in oil-producing regions leads to:

- Rising fuel prices
- Increased logistics costs
- Higher production expenses

2.3 Trade Restrictions and Sanctions

Sanctions imposed on countries like Russia impact:

- Payment systems (SWIFT restrictions)
- Export-import flows
- Currency volatility

2.4 Inflationary Pressures

War-induced disruptions result in:

- Rising input costs
- Increased freight and insurance charges
- Cost-push inflation across industries

2.5 Currency Volatility and Financial Market Spillovers

Geopolitical conflicts often trigger volatility in global financial markets and exchange rates. For an economy like India that is closely integrated with international trade and capital flows, fluctuations in currency values can significantly affect import costs, export competitiveness, and foreign currency liabilities. MSMEs engaged in international trade may face increased exposure to exchange rate risks, particularly when payments are delayed or when settlement systems are disrupted due to sanctions or geopolitical restrictions.

3. Impact on Indian MSMEs

3.1 Disruption in Export Markets

Indian MSMEs are heavily export-oriented. Although direct exports to Russia and Ukraine are relatively small, MSMEs contribute significantly to these trade flows.

However, indirect impacts are more severe:

- Reduced demand from affected regions
- Payment delays due to banking restrictions
- Contract cancellations

Certain regional export clusters have experienced noticeable disruptions due to geopolitical tensions affecting shipping routes and trade flows. Industry reports and export promotion bodies have highlighted instances where exporters, particularly in food processing and agricultural commodities, faced temporary declines in export orders due to uncertainty in Middle Eastern and European markets.

According to various policy reports and economic assessments released by institutions such as the **Reserve Bank of India (RBI)**, **Ministry of MSME**, and industry bodies, global geopolitical tensions often affect MSMEs more significantly than large corporations. This is primarily due to limited financial buffers, greater dependence on single supply chains, and relatively constrained access to institutional credit and risk management tools.

3.2 Rising Input Costs and Margin Pressure

Wars have triggered a surge in:

- Raw material prices
- Energy costs
- Transportation expenses

For example:

- Dry fruit prices (import-dependent) have surged significantly due to disrupted supply chains and increased freight costs.

For MSMEs operating on thin margins, this results in:

- Reduced profitability
- Difficulty in price pass-through
- Increased working capital requirements

3.3 Supply Chain and Logistics Challenges

MSMEs rely heavily on global supply chains for:

- Raw materials
- Components
- Machinery

War-related disruptions have led to:

- Shipping delays (10–15 days increasing to 30–40 days)
- Increased freight charges
- Uncertain delivery timelines

These challenges result in:

- Production delays
- Inventory mismanagement
- Customer dissatisfaction

3.4 Demand Slowdown and Market Uncertainty

Economic uncertainty caused by wars reduces:

- Consumer spending
- Business investments
- Export demand

Recent indicators show that **India's services sector growth slowed due to Middle East war-related demand weakness**, along with rising input costs.

For MSMEs, this translates into:

- Lower order volumes
- Increased competition
- Cash flow stress

3.5 Financial Stress and Working Capital Constraints

MSMEs typically face:

- Limited access to credit
- High dependency on cash flows

War-induced disruptions aggravate:

- Delayed receivables
- Increased borrowing costs
- Liquidity crunch

Industry bodies have recommended **emergency financing support for MSMEs** to mitigate these challenges.

3.6 Sector-Specific Impact Analysis

Sector	Impact Level	Key Issues
Manufacturing	High	Raw material shortages, cost escalation
Food Processing	Very High	Export disruption, perishability issues
Chemicals & Pharma	Moderate to High	Dependency on petrochemicals
Textiles	Moderate	Demand slowdown in export markets
IT & Services	Moderate	Reduced global demand, pricing pressure
Logistics	Very High	Freight costs, route disruptions

3.7 Role of Professional Advisors and Chartered Accountants

Chartered Accountants and other professional advisors play an important role in helping MSMEs navigate periods of economic uncertainty caused by geopolitical disruptions. Professional support becomes particularly relevant in areas such as financial risk assessment, cost restructuring, working capital management, and foreign exchange exposure monitoring.

Professionals can also assist MSMEs in strengthening governance frameworks, improving financial planning, and evaluating diversification strategies for supply chains and export markets. In addition, Chartered Accountants can guide enterprises in accessing government schemes, structuring trade finance arrangements, and ensuring compliance with international payment and sanction regulations. Such professional guidance can significantly enhance the resilience and sustainability of MSMEs operating in an uncertain global environment.

4. Emerging Opportunities for MSMEs

Despite challenges, wars also create strategic opportunities:

4.1 Supply Chain Diversification

Global companies are shifting away from conflict regions, creating opportunities for Indian MSMEs to:

- Become alternative suppliers
- Integrate into global value chains

4.2 Import Substitution

Rising import costs encourage:

- Domestic manufacturing
- Local sourcing

4.3 New Export Markets

MSMEs can explore:

- Africa
- Southeast Asia
- Latin America

4.4 Digital Transformation

Wars accelerate the need for:

- Supply chain digitization
- AI-driven forecasting
- Risk management systems

4.5 Global Supply Chain Realignment

Ongoing geopolitical conflicts have accelerated a global trend toward supply chain diversification. Many multinational companies are increasingly exploring the "China+1" strategy and seeking alternative manufacturing and sourcing destinations. This evolving landscape creates potential opportunities for Indian MSMEs to integrate into global value chains as reliable suppliers and manufacturing partners. With supportive policy initiatives and improvements in logistics infrastructure, India has the potential to strengthen its position as an alternative production hub in several sectors.

5. Strategic Response Framework for MSMEs

To navigate geopolitical uncertainties, MSMEs must adopt a structured approach:

5.1 Supply Chain Resilience

- Multi-sourcing strategies
- Local supplier development
- Inventory optimization

5.2 Financial Risk Management

- Hedging currency risks
- Strengthening cash flow management
- Accessing government schemes

5.3 Cost Optimization

- Energy efficiency initiatives
- Process automation
- Lean manufacturing

5.4 Market Diversification

- Reducing dependence on single regions
- Expanding into stable markets

5.5 Technology Adoption

- AI & data analytics for demand forecasting
- ERP systems for operational efficiency

6. Policy Recommendations

India has already implemented several policy initiatives aimed at strengthening the MSME ecosystem and improving resilience in times of economic disruption. Measures such as the **Emergency Credit Line Guarantee Scheme (ECLGS)**, expansion of **Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE)** coverage, export incentives under the **RoDTEP Scheme**, and digital platforms for MSME registration and financing have played an important role in supporting enterprises during periods of economic stress. Continued policy support will remain crucial in addressing the challenges posed by global geopolitical uncertainties.

To further strengthen MSME resilience, policymakers may focus on:

- **Emergency credit support and subsidies**
- **Export incentives and trade facilitation**
- **Logistics infrastructure improvement**
- **Energy cost stabilization measures**
- **Encouraging digital adoption**

7. Conclusion

Recent wars have exposed the vulnerabilities of globally interconnected economies, particularly for MSMEs that operate with limited buffers. The impact on Indian MSMEs is multifaceted—ranging from supply chain disruptions and rising costs to declining demand and financial stress.

At the same time, India's policy initiatives aimed at strengthening domestic manufacturing and MSME competitiveness provide a supportive framework for enterprises to adapt to the evolving global economic environment.

However, these challenges also present an opportunity for transformation. MSMEs that adopt resilience strategies, diversify markets, and leverage technology will not only survive but emerge stronger in the evolving global economic landscape.

In a world marked by geopolitical uncertainty, **resilience, adaptability, and strategic foresight** are no longer optional—they are essential for MSME sustainability and growth.

-By Prof. Kapil Suri

India's Electric Vehicle Industry: An Ecosystem in Transition

1. Introduction: India's EV Industry at an Inflection Point

India's mobility story is entering a new phase. For decades, the automotive industry has grown around internal combustion engines, supported by a well-established network of manufacturers, suppliers, fuel infrastructure, and service systems. That model is now being gradually reworked as electric mobility starts to take shape across the country.

This shift is not happening in isolation. It is tied closely to broader economic and environmental realities. India continues to depend heavily on imported crude oil, which exposes the economy to global price fluctuations. At the same time, rising vehicle density in cities has made air quality a persistent concern. These pressures, combined with global climate commitments, have pushed both policymakers and industry players to explore cleaner and more efficient mobility options.

Electric vehicles have emerged as a practical response to these challenges. Over the past few years, adoption has picked up pace, though from a relatively small base. Annual EV sales have crossed 2 million units, but they still account for less than 10 percent of total vehicle sales. This tells us two things at once. The market has moved beyond experimentation, but it is still far from maturity.

What is more interesting is where this growth is coming from. Electrification has been strongest in two- and three-wheelers, especially in segments where vehicles are used daily for income generation. For these users, the lower running cost of EVs makes a clear difference. Passenger cars and larger vehicles are also entering the picture, but adoption there is slower, largely due to higher upfront costs and limited supporting infrastructure.

The EV transition is also changing how we think about the automotive industry itself. Unlike traditional vehicles, EVs sit at the intersection of multiple systems. Batteries, charging networks, software, and energy supply all become part of the same conversation. This makes the industry more interconnected and brings in players who were not traditionally part of automotive value chains.

In this evolving setup, Micro, Small, and Medium Enterprises are beginning to play an important role. Many of them are involved in components, battery assembly, charging solutions, and service networks. Their presence is especially visible in areas where adoption is happening quickly but large-scale infrastructure is still catching up. In many ways, they are helping the ecosystem take shape on the ground.

At the same time, the transition is not without its difficulties. Infrastructure is still uneven. Supply chains for critical materials remain dependent on imports. Policies continue to evolve. And while running costs are lower, upfront affordability remains a concern for many buyers. These factors mean that growth, while steady, is not uniform across segments or regions.

Looking at India's EV industry today, it is clear that this is not just about replacing one type of vehicle with another. It is about building a new system around mobility. To understand where this industry is headed, it is important to look at it as a complete ecosystem, where technology, policy, economics, and enterprise all move together.

2. The Traditional Automotive Ecosystem and Its Limitations

India's automotive industry has, for a long time, been built around the internal combustion engine. It is a mature system. Vehicle manufacturers, component suppliers, fuel retailers, and service networks are all tightly connected. Over the years, this ecosystem has scaled efficiently and supported one of the largest automobile markets in the world.

But the same system also comes with built-in limitations.

The most obvious one is its dependence on fossil fuels. India imports a large share of its crude oil requirements, which makes the entire mobility system vulnerable to global price movements. When fuel prices rise, the impact is felt immediately by consumers and businesses. For high-usage segments like commercial vehicles, this becomes a direct hit on operating margins.

There is also the environmental side of it. As cities expanded and vehicle numbers increased, emissions became harder to ignore. Vehicular pollution is now a major contributor to urban air quality issues. Regulatory responses, such as stricter emission norms, have improved engine efficiency, but they have also increased vehicle costs without fundamentally solving the core problem of fuel dependence.

Another limitation is how the value chain is structured. In the traditional model, a significant portion of value creation sits around engine manufacturing, fuel consumption, and mechanical servicing. This makes the system heavily reliant on physical components and periodic maintenance. It also slows down the pace of innovation in areas like energy efficiency and digital integration, which are becoming increasingly important globally.

From a user's perspective, the cost of ownership under this model remains uncertain. While the purchase price of ICE vehicles may be relatively stable, running costs are tied to fuel

prices, which fluctuate frequently. Maintenance costs are also higher due to the complexity of engines and moving parts. Over time, this makes long-term cost planning difficult, especially for businesses that depend on predictable operating expenses.

There is also a broader disconnect between mobility and the energy transition underway in the country. India is investing heavily in renewable energy, but traditional vehicles cannot directly benefit from that shift. This creates a gap between where energy systems are heading and how mobility is still being powered.

These limitations did not appear overnight. They have built up over time as the industry scaled. But together, they have made it clear that the existing model has constraints that are difficult to address within the same framework.

The move toward electric vehicles, in that sense, is not just a technological shift. It is a response to these structural issues. Understanding the limitations of the traditional automotive ecosystem helps explain why the transition toward EVs is not only happening, but also why it is likely to continue gaining momentum.

3. Evolution of the EV Ecosystem in India

The development of the EV industry in India has not followed a straight path. It has evolved in phases, shaped as much by economics and policy as by technology.

In the early years, electric mobility in India was limited and largely unstructured. The first visible signs of adoption came from low-speed electric scooters and e-rickshaws, especially in smaller cities. These were not driven by environmental awareness as much as by practicality. Lower running costs and simple technology made them viable for short-distance and last-mile use. At that stage, the ecosystem was fragmented, with limited standardisation and very little institutional support.

A more defined shift began around the late 2010s, when policy support started gaining momentum. Government initiatives such as the FAME scheme created initial demand by offering incentives for electric vehicles, particularly in public transport and commercial segments. This gave manufacturers the confidence to invest, while also bringing some structure to the market.

What followed was a gradual expansion across segments. Two- and three-wheelers emerged as the early leaders. Even today, they account for the majority of EV adoption in India. In FY2024–25, out of roughly 2 million EVs sold, nearly 85 percent were two- and three-wheelers.

This is not surprising. These segments operate on clear economics. Vehicles are used frequently, fuel costs are a major expense, and switching to electric brings immediate savings. For many users, especially in delivery, ride-sharing, and small transport businesses, the decision is less about sustainability and more about reducing daily operating costs.

Passenger vehicles have followed a different trajectory. Adoption here has been slower, but more visible in urban markets. A few major manufacturers have entered the space, offering electric variants, and gradually building consumer awareness. Still, EV cars account for a small share of total car sales, reflecting higher upfront costs and concerns around charging infrastructure.

The bus segment has largely been policy-driven. State transport undertakings and government procurement programs have played a key role in introducing electric buses in cities. This has helped create demand at scale, even though private adoption remains limited.

Another important shift has been the entry of new players. Unlike the traditional automotive industry, where large OEMs dominate, the EV space has seen participation from startups, technology firms, and new-age manufacturers. This has increased competition, accelerated product development, and brought in new business models.

At the same time, the ecosystem around EVs has started taking shape. Charging infrastructure, battery supply chains, software systems, and financing models are gradually developing alongside vehicle adoption. While still evolving, this supporting ecosystem is critical to sustaining long-term growth.

Overall, the evolution of the EV industry in India reflects a mix of policy push and market pull. Early adoption has been driven by segments where economics make sense, while other segments are catching up as technology improves and infrastructure expands. The transition is still uneven, but the direction is clearly established.

4. Role of Technology in Shaping the EV Industry

Technology sits at the centre of the EV transition. Unlike the traditional automotive model, where improvements were often incremental, electric mobility depends heavily on how quickly core technologies evolve and become affordable.

The most critical of these is battery technology. Over the past decade, battery costs have declined sharply, by nearly 85 percent globally. This has been one of the biggest enablers of EV adoption. Lower battery costs translate directly into more affordable vehicles and improved economics for users. Even then, the battery remains the single largest cost component in an EV, often accounting for around one-third of the total vehicle cost.

Beyond cost, battery performance has also improved. Range has increased, charging times have reduced, and reliability has become more consistent. For commercial users, this matters more than anything else. A vehicle that can run longer between charges and spend less time idle directly improves utilisation and returns.

Charging technology is another important piece of the puzzle. India's charging infrastructure is still developing, but the technology itself is evolving quickly. Fast chargers, capable of significantly reducing charging time, are being deployed along highways and in urban clusters. At the same time, slower AC chargers remain relevant for home and workplace use, especially for two-wheelers and personal vehicles. By the end of 2025, India had over 29,000 public charging points, indicating steady but still insufficient progress relative to the growing EV base.

There is also experimentation with alternative models such as battery swapping, particularly for two- and three-wheelers. This approach separates the battery from the vehicle, allowing users to replace a discharged battery with a charged one in minutes. While still evolving, it offers a potential solution for high-usage segments where downtime is costly.

Software is becoming equally important. EVs are not just mechanical products anymore. Battery management systems, vehicle diagnostics, and telematics play a key role in

performance and safety. These systems monitor battery health, optimise energy usage, and provide real-time data to both users and operators. For fleet businesses, this data can be used to improve route planning, reduce costs, and increase efficiency.

Another layer of technological change is the integration between mobility and energy. Unlike ICE vehicles, EVs can be directly linked to renewable energy sources. As India continues to expand its renewable capacity, this creates an opportunity to align mobility with cleaner energy generation. Over time, this connection could reshape how energy is produced, stored, and consumed.

At the same time, technology adoption is not uniform across the industry. While large manufacturers and well-funded startups are able to invest in advanced systems, smaller players often operate with limited access to capital and technical expertise. This creates a gap in capabilities, particularly in areas like battery quality, safety standards, and software integration.

Even with these challenges, the direction is clear. Technology is not just supporting the EV industry. It is defining it. The pace at which batteries improve, charging becomes more accessible, and systems become more intelligent will determine how quickly electric mobility moves from early adoption to large-scale mainstream use.

5. The Backbone of the Industry: Role of MSMEs in the EV Ecosystem

While large manufacturers and well-funded startups often dominate the headlines, the day-to-day functioning of the EV industry depends heavily on smaller enterprises. Micro, Small, and Medium Enterprises are present across almost every layer of the EV value chain, often working quietly in the background but playing a critical role in making the ecosystem operational.

Their involvement starts at the component level. Many MSMEs are engaged in manufacturing motors, controllers, wiring systems, sheet metal parts, and other sub-assemblies that go into electric vehicles. Unlike traditional automotive supply chains, where entry barriers are higher due to engine complexity, the EV transition has opened up space for newer players. This has allowed smaller manufacturers to enter and participate in emerging supply chains.

Battery assembly and related services are another area where MSMEs are active. While large-scale cell manufacturing is still developing in India, battery pack assembly, integration, and servicing are often handled by smaller firms. Given that the battery accounts for a significant share of an EV's cost, this segment has become an important point of value creation.

MSMEs are also visible in the rollout of charging infrastructure. Installation, operation, and maintenance of charging stations often involve local enterprises, especially in smaller cities and semi-urban areas. In many cases, these businesses act as the bridge between policy intent and on-ground execution, helping translate government schemes into actual infrastructure.

On the services side, their role becomes even more pronounced. EV servicing, repairs, fleet management support, and last-mile mobility solutions are largely handled by smaller operators. This is particularly evident in the two- and three-wheeler segments, which together account for the majority of EV adoption in India. These segments rely heavily on decentralised service networks, where MSMEs are the primary providers.

Another important contribution is in last-mile and commercial mobility. Many EVs on the road today are used for delivery, ride-sharing, and small transport businesses. A large portion of this activity is managed by small fleet operators and individual entrepreneurs. Their decisions, often driven by cost considerations rather than environmental factors, have been a key driver of early adoption.

At the same time, MSMEs operate under certain constraints. Access to capital remains uneven, especially for businesses looking to scale operations or invest in new technology. There is also variation in quality and standardisation across players, which affects consistency in products and services. Compliance requirements, particularly around safety and certification, can add to operational complexity for smaller firms.

Despite these challenges, their importance is hard to overstate. MSMEs bring flexibility, local understanding, and cost efficiency to the ecosystem. They operate close to demand centres, adapt quickly to changing conditions, and fill gaps that larger players may not address immediately.

As the EV industry expands, the role of MSMEs is likely to become even more significant. The success of electric mobility in India will not depend only on large-scale manufacturing or policy support, but also on how effectively this network of smaller enterprises is able to grow, adapt, and integrate into the broader ecosystem.

6. Infrastructure, Access, and Adoption Challenges

For all the progress made so far, the EV story in India still comes down to a few practical questions for most users. Where do I charge? How long will it take? And does it make financial sense for me right now?

Charging infrastructure sits at the centre of this. The number of public charging stations has grown steadily, crossing around 29,000 by the end of 2025. But when placed against a fast-growing EV base, the gap becomes clear. In many areas, especially outside major cities, access to reliable charging is still limited.

The distribution is uneven. Metro cities and key highways are seeing faster rollout, while smaller towns and rural regions are still catching up. This creates a situation where adoption feels easy in some pockets and difficult in others. For personal vehicles, home charging offers a partial solution. But for commercial users who depend on continuous operations, downtime due to charging remains a real concern.

This leads directly to the issue of range anxiety. Even though battery performance has improved, the lack of visible and dependable charging options makes users cautious. In many cases, the hesitation is not about actual range limitations, but about the uncertainty of finding a charger when needed.

Cost is another layer of complexity. On paper, EVs offer lower running costs, and in high-usage segments this advantage is quite clear. But the upfront price still remains higher than comparable ICE vehicles in many categories. For individual buyers, especially in price-sensitive markets, this becomes a key barrier. The long-term savings are understood, but the initial investment can still feel difficult to justify.

Awareness also plays a role. While EVs are now more visible than before, understanding of how they work, their maintenance needs, and their actual cost benefits is still uneven. Misconceptions around battery life, resale value, and safety continue to influence buying decisions, particularly outside urban markets.

There is also a clear difference between segments. Two- and three-wheelers have seen faster adoption because they operate on predictable routes and can manage with simpler charging setups. Passenger vehicles, on the other hand, require a more dependable and widespread network to build confidence among users.

From a broader perspective, these challenges are not unexpected. Infrastructure typically follows adoption, not the other way around. As more vehicles come on the road, investment in charging and support systems tends to accelerate. That shift is already visible, with both public and private players increasing their presence in this space.

At this stage, the EV transition in India is less about proving viability and more about improving accessibility. The fundamentals are in place, but scaling adoption will depend on how quickly infrastructure gaps are addressed and how effectively cost and awareness barriers are reduced.

7. Policy and Regulatory Environment

The growth of the EV industry in India has been closely tied to policy support. Unlike traditional automotive segments, where market forces played a larger role, the early momentum in EVs has come largely from government intervention. Without that push, adoption would have been much slower.

The central government's approach has focused on two things. Creating demand and building supply-side capacity.

On the demand side, schemes like FAME have been central. They offered direct incentives to reduce the upfront cost of electric vehicles, especially in segments like two-wheelers, three-wheelers, and public transport. These incentives helped bridge the gap between EV prices and traditional vehicles, making the shift more practical for both individual users and fleet operators. Over time, a significant portion of early EV adoption, particularly in commercial segments, has been supported by these schemes.

Tax measures have also played a role. The reduction of GST on EVs to 5 percent, along with exemptions in road tax and registration in many states, has improved affordability. There are also provisions such as interest deductions on EV loans, which indirectly support adoption by lowering financing costs.

On the supply side, policy has focused on encouraging domestic manufacturing. Production-linked incentive (PLI) schemes for advanced batteries and auto components aim to reduce dependence on imports and build local capacity. This is particularly important given that a large share of critical battery materials is still sourced from outside India.

State governments have added another layer to this framework. Many states have introduced their own EV policies, offering additional incentives, setting adoption targets, and supporting charging infrastructure. This has created regional variation, where some states have moved faster than others based on how actively policies are implemented.

At the same time, regulation is gradually evolving beyond incentives. Safety standards for batteries, certification requirements, and guidelines for charging infrastructure are being strengthened. These are important for building long-term trust in the system, especially as adoption scales.

There is also a visible shift in how policy is being framed. In the early phase, the focus was on subsidies and initial adoption. Going forward, the emphasis is likely to move toward localisation, standardisation, and long-term sustainability of the ecosystem. This includes areas like battery recycling, grid integration, and reducing reliance on incentives over time.

That said, policy implementation is not always uniform. Delays in subsidy disbursement, changing eligibility criteria, and differences across states can create uncertainty for both manufacturers and consumers. For smaller players, especially MSMEs, navigating these changes can be challenging.

Even with these issues, the direction remains clear. Policy has acted as a strong enabler of the EV transition so far, and will continue to shape its pace and structure. The next phase will depend on how smoothly the shift is managed from incentive-driven growth to a more self-sustaining market.

8. Supply Chain, Raw Materials, and Manufacturing Realities

As the EV industry expands, one of the biggest questions is not just about demand, but about how well the supply side can keep up. Unlike traditional vehicles, electric mobility depends heavily on a different set of materials, components, and manufacturing processes. This shift brings both opportunity and risk.

The most critical dependency lies in battery materials. Lithium, cobalt, nickel, and other minerals are essential for EV batteries, and India currently imports almost all of its lithium requirements. This creates a structural vulnerability. Any disruption in global supply chains or price fluctuations can directly impact battery costs and, in turn, vehicle prices.

This dependence has become more visible in recent years, especially with global supply chain disruptions and geopolitical factors influencing access to key materials. It has also highlighted how concentrated the battery ecosystem is globally, with a few countries dominating mining, processing, and cell manufacturing.

To address this, India has started taking steps toward localisation. Initiatives such as the Production-Linked Incentive (PLI) schemes for advanced chemistry cells are aimed at building domestic manufacturing capacity. Several large projects, including planned gigafactories, are expected to come up over the next few years. These developments are important, but they will take time to reach scale.

At present, much of the value addition within India happens at the level of battery pack assembly and vehicle manufacturing. Cells and critical components are still largely imported, which limits how much cost reduction can be achieved domestically. Over time, deeper localisation will be necessary to make the ecosystem more resilient.

The broader manufacturing landscape is also evolving. India already has a strong base in automotive manufacturing, and this provides a starting point for the EV transition. However, the shift from mechanical systems to electronics and energy storage requires new capabilities.

Motors, power electronics, battery management systems, and software are becoming more important than traditional engine components.

This transition also has implications for employment and skills. While EVs create new opportunities in areas like battery production and electronics, they reduce dependence on engine-related manufacturing. This means the workforce needs to adapt. Reskilling and training will play a key role in ensuring that the transition remains inclusive.

Recycling is another area that is gaining attention. As EV adoption increases, managing end-of-life batteries becomes important both from an environmental and supply perspective. Recovering materials through recycling can reduce import dependence over time, but the ecosystem for this is still in its early stages.

Overall, the supply chain for EVs in India is still developing. The direction is clear, with policy support and investment flowing into the sector. But building a stable and self-reliant ecosystem will take time. The pace at which India can reduce its dependence on imports and strengthen domestic capabilities will have a direct impact on the long-term viability of the EV industry.

9. Financing, Investment, and Business Model Dynamics

One of the less visible, but critical, aspects of the EV transition is financing. While the technology and policy side often gets attention, the pace of adoption on the ground is closely tied to how easily vehicles, infrastructure, and businesses can access capital.

At the consumer level, the biggest hurdle remains the upfront cost. Even though EVs offer lower running expenses, the initial purchase price is still higher in many segments. This creates a gap that financing needs to bridge. Banks and NBFCs have started offering EV-specific loans, and policy measures such as interest deductions have made them more attractive. But risk perception is still evolving, especially around factors like resale value and battery life.

For commercial users, the equation is different. Fleet operators and small businesses tend to look at total cost of ownership rather than just purchase price. In many cases, EVs already make financial sense here. For example, operating costs for electric three-wheelers can be almost half of their diesel counterparts, which significantly improves margins over time.

This has led to the emergence of new business models. Leasing, battery-as-a-service, and pay-per-use structures are becoming more common. Instead of owning the battery, which is the most expensive component, users can pay for usage separately. This reduces upfront cost and shifts the financial burden away from the buyer. For high-utilisation segments like delivery fleets, this model works well.

On the infrastructure side, financing becomes even more complex. Setting up charging stations requires capital investment with uncertain utilisation in the early stages. While demand is growing, revenue models are still stabilising. Investors are exploring different approaches, including partnerships with utilities, cross-subsidisation with existing fuel businesses, and long-term asset-based returns.

From an industry perspective, investment activity has increased significantly. Both domestic and global players are putting capital into vehicle manufacturing, battery production,

and charging infrastructure. This reflects confidence in long-term growth, but also raises competition. New entrants, including startups, are entering the market alongside established automotive companies.

At the same time, access to finance is not uniform across the ecosystem. Larger companies and well-funded startups are better positioned to raise capital, while smaller enterprises often face constraints. For MSMEs, challenges around collateral, documentation, and risk assessment can limit access to formal financing, even when business potential is strong.

There is also a shift in how financial viability is evaluated. Traditional metrics based on fuel consumption and maintenance are being replaced by models that consider energy efficiency, utilisation rates, and lifecycle costs. This requires both lenders and businesses to adapt their approach to financial planning.

Overall, financing is both an enabler and a bottleneck. The economics of EVs are improving, but the structure of funding needs to evolve alongside. As business models mature and risk perception stabilises, access to capital is likely to improve, which in turn will support faster and more widespread adoption.

10. Persistent Challenges in the EV Industry

Despite steady progress, the EV industry in India is still dealing with a set of challenges that go beyond technology or policy. These are structural issues that affect how quickly and how evenly the transition can scale.

One of the most immediate concerns is cost. While running expenses are lower, upfront prices continue to be a barrier in many segments. This gap is narrowing as battery costs decline, but for a large section of consumers, especially in price-sensitive markets, the initial investment still feels high. As a result, adoption tends to concentrate in segments where usage is high and savings are visible.

Infrastructure, although improving, remains uneven. Charging networks are expanding, but their availability is still limited outside major cities and key routes. For users who do not have access to home or depot charging, this creates uncertainty. It also affects segments like passenger vehicles, where convenience plays a larger role in decision-making.

Supply chain dependence is another ongoing challenge. A significant portion of critical battery materials continues to be imported, exposing the industry to global price movements and geopolitical risks. While localisation efforts are underway, building a fully integrated supply chain will take time.

There are also concerns around standardisation and quality. The EV market has seen rapid entry of new players, especially in the two- and three-wheeler segments. While this has increased competition and innovation, it has also led to variations in product quality and safety. Incidents related to battery performance and thermal issues have highlighted the need for stronger standards and consistent enforcement.

From a market perspective, awareness and trust are still evolving. Many consumers remain uncertain about battery life, resale value, and long-term reliability. These concerns are gradually being addressed, but they continue to influence buying decisions, particularly outside early adopter segments.

At the same time, the industry is also dealing with competitive pressures. As more players enter the market, differentiation becomes important. Pricing, performance, range, and service quality are all areas where companies need to compete. For smaller firms, this can be challenging, especially when operating with limited resources.

On the positive side, the industry does have clear strengths. Policy support remains strong, demand is growing, and the underlying economics in certain segments are already favourable. There is also significant opportunity in areas like domestic manufacturing, battery recycling, and integration with renewable energy.

The challenge, therefore, is not a lack of direction, but the pace of execution. The EV transition in India is well underway, but it is still in a phase where multiple gaps need to be addressed simultaneously. How these challenges are managed over the next few years will determine whether growth remains gradual or accelerates into large-scale adoption.

11. The Road Ahead: Building a Scalable and Sustainable EV Ecosystem

The direction of India's EV industry is no longer uncertain. The shift has started, and the question now is not whether it will happen, but how quickly and how smoothly it can scale.

In the near term, growth is likely to remain uneven across segments. Two- and three-wheelers will continue to lead, driven by clear cost advantages and high utilisation. Commercial applications such as delivery fleets, shared mobility, and small transport businesses are expected to expand further. Passenger vehicles will grow more gradually, as affordability improves and charging infrastructure becomes more reliable.

A key factor shaping this next phase will be cost. Battery prices have already seen a significant decline over the past decade, and further improvements are expected. As costs come down and production scales up, the gap between EVs and traditional vehicles will continue to narrow. Once this difference becomes marginal, adoption is likely to accelerate more rapidly across segments.

Infrastructure development will also play a defining role. Charging networks need to expand not just in number, but in reliability and accessibility. The focus will have to move beyond major cities to smaller towns and highways, where gaps are still visible. At the same time, a mix of solutions, including fast charging, home charging, and battery swapping, will be required to support different use cases.

Localisation will become increasingly important. Reducing dependence on imported materials and components is essential for long-term stability. Initiatives around domestic manufacturing, battery production, and recycling will shape how resilient the ecosystem becomes. Over time, a stronger local supply chain can also help bring down costs and create employment.

The role of MSMEs will remain central in this phase. As the ecosystem expands, smaller enterprises will continue to support manufacturing, services, infrastructure, and last-mile operations. Their ability to adapt quickly and operate close to demand centres will be important in bridging gaps that larger players may not address immediately.

Policy will also need to evolve. The initial phase of the EV transition has been supported by incentives and subsidies. Going forward, the focus is likely to shift toward creating a stable

and self-sustaining market. This means gradually reducing dependence on incentives while strengthening areas such as standards, financing access, and infrastructure support.

There is also a larger opportunity to align EV growth with India's renewable energy expansion. As the share of clean energy increases, the environmental benefits of EVs become stronger. Over time, this integration between mobility and energy could reshape how both sectors operate.

At its core, the EV transition is not just about vehicles. It is about building a system that is more efficient, less dependent on imports, and better aligned with long-term sustainability goals. The progress so far shows that the foundation is in place. The next phase will depend on execution, coordination, and the ability to scale without losing balance between growth and affordability.

12. Conclusion

India's EV journey is still unfolding, but its direction is now clearly established. What began as a policy-driven push has started to evolve into a broader shift in how mobility is produced, delivered, and consumed. The transition is gradual, uneven across segments, and shaped by real-world constraints, but it is no longer at a stage where it can be seen as experimental.

A few patterns stand out. Adoption has been strongest where the economics make immediate sense, particularly in high-usage and commercial segments. At the same time, areas like passenger vehicles are moving forward more cautiously, influenced by cost, infrastructure, and user confidence. This unevenness is not a weakness. It reflects how transitions of this scale typically take shape, starting where the value is most visible.

The industry itself is becoming more interconnected. Vehicles are now linked with energy systems, software, infrastructure, and finance in ways that did not exist in the traditional automotive model. This has expanded the scope of participation, bringing in new players and creating opportunities across the value chain, especially for smaller enterprises.

At the same time, the challenges are real. Infrastructure gaps, supply chain dependencies, and affordability constraints continue to influence the pace of adoption. Addressing these issues will require coordination across policy, industry, and finance. It is not a problem that can be solved by any one stakeholder in isolation.

Looking ahead, the success of the EV transition in India will depend less on individual breakthroughs and more on how well the ecosystem comes together. Cost reduction, infrastructure expansion, localisation, and access to finance will all need to move in parallel. If managed well, this shift has the potential to reduce dependence on imports, improve urban air quality, and create new economic opportunities.

In that sense, electric mobility is not just a change in vehicles. It is part of a larger transition in how India approaches energy, industry, and sustainability. The progress so far shows that the foundation is in place. The next phase will determine how effectively that foundation can be scaled into a system that is both efficient and inclusive.

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-By CA. Paritosh Anand

QUIZ

1. **Which type of AI model generates new content such as text, images, or code?**
   - A. Predictive AI
   - B. Generative AI
   - C. Diagnostic AI
   - D. Descriptive AI
2. **Which business technology integrates finance, HR, inventory, and operations into a single platform?**
   - A. CRM System
   - B. ERP System
   - C. AI Chatbot
   - D. Web Portal
3. **Which digital metric helps businesses measure the effectiveness of online marketing campaigns?**
   - A. Return on Investment (ROI)
   - B. Gross Margin
   - C. Net Working Capital
   - D. Cash Flow Ratio
4. **Which AI-driven technology helps detect fraud and anomalies in financial transactions?**
   - A. Pattern Recognition
   - B. Cloud Migration
   - C. Data Compression
   - D. Web Scraping
5. **Which business intelligence tool is commonly used for creating interactive dashboards and visual analytics?**
   - A. Microsoft Power BI
   - B. Notepad
   - C. FTP Server
   - D. HTML Editor
6. **Which concept refers to storing business data and applications on remote servers accessible via the internet?**
   - A. Cloud Computing
   - B. Edge Devices
   - C. Local Networking
   - D. File Transfer
7. **Which AI capability allows machines to identify objects, faces, or patterns in images and videos?**
   - A. Computer Vision
   - B. Natural Language Processing
   - C. Data Mining
   - D. Business Intelligence
8. **Which type of data analysis focuses on understanding why a business event occurred?**
   - A. Descriptive Analytics
   - B. Diagnostic Analytics
   - C. Predictive Analytics
   - D. Prescriptive Analytics
9. **Which startup metric measures the cost of acquiring a new customer?**
   - A. Customer Acquisition Cost (CAC)
   - B. Customer Lifetime Value (CLV)
   - C. Net Profit Margin
   - D. Working Capital Ratio
10. **Which strategic approach helps MSMEs leverage technology to improve efficiency, customer experience, and business models?**
    - A. Business Digitization
    - B. Digital Transformation
    - C. Financial Automation
    - D. Process Documentation

Answers: 1.B 2.B 3.A 4.A 5.A 6.A 7.A 8.B 9.A 10.B

MSME & Startup Committee, ICAI

ICAI Bhawan, P.B. No.7100, Indraprastha Marg, New Delhi- 110 002, India

Phone 011-30110569 • **Email:** msme@icai.in/ startup@icai.in

MSME Website https://msme.icai.org/ • **Startup Website:** https://startup.icai.org/