Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 46 No. 2 (2025)

Factors Influencing Electric Vehicle Adoption in India: A Machine Learning Approach Using Artificial Neural Networks

Dr. Srinivasan Iyer[1], Dr. Kunal Soni[2], Dr. Tejasvita Singh[3]

Associate Professor, Department of commerce, Centre for Distance and Online Education Manipal University Jaipur, Rajasthan, India

Assistant Professor, Department of Accountancy, Maharshi Dayanand College, Parel, Mumbai, India

Assistant Professor, Department of Management, Khandelwal College of Management and Technology, Bareilly, Uttar Pradesh, India

Abstract

The adoption of electric vehicles (EVs) in India is influenced by a complex interplay of economic, infrastructural, policy-driven, and behavioural factors. This study employs Artificial Neural Networks (ANNs) to analyse survey data from 400 respondents to identify key determinants of EV adoption. The results indicate that cost-effectiveness and charging infrastructure availability are the most significant predictors of adoption, with cost concerns emerging as the most substantial barrier. Government incentives play a moderate role, while environmental consciousness and performance expectations have a comparatively lower influence. The ANN model achieved an accuracy of 88.2%, demonstrating high predictive power in assessing adoption likelihood. Sensitivity analysis further confirms that variations in cost perceptions and infrastructure availability have the greatest impact on adoption rates, emphasizing the need for targeted interventions. Policy recommendations suggest expanding financial incentives, improving charging networks, and structuring sustainable government subsidies. From an industry perspective, manufacturers must focus on cost reduction strategies, battery efficiency improvements, and expanding accessibility to charging infrastructure. This research provides valuable insights for policymakers, automakers, and stakeholders to accelerate the transition to sustainable mobility in India.

Keywords: Electric Vehicles, Adoption Factors, Artificial Neural Networks, Sensitivity Analysis, Charging Infrastructure, Cost Perceptions, Government Incentives, India

Introduction

The global automotive industry has been undergoing a significant transformation, shifting from conventional internal combustion engine (ICE) vehicles to more sustainable and environmentally friendly alternatives, such as electric vehicles (EVs). This transition is driven by mounting concerns over climate change, environmental degradation, and energy security, all of which necessitate urgent action to reduce carbon emissions and dependence on fossil fuels (International Energy Agency [IEA], 2023). The electrification of transportation is a crucial step toward achieving global sustainability goals, and governments worldwide are implementing regulatory measures, financial incentives, and infrastructural developments to facilitate the widespread adoption of EVs (Zhou et al., 2022).

In the Indian context, the government has recognized the importance of EV adoption as a means to mitigate air pollution, reduce greenhouse gas (GHG) emissions, and lower dependency on imported crude oil. India has set ambitious targets under the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme, with the latest iteration, FAME-II, focusing on enhancing EV affordability, expanding charging infrastructure, and supporting domestic EV manufacturing (Ministry of Heavy Industries, 2023). Additionally, the National Electric Mobility Mission Plan (NEMMP) aims to achieve significant electrification of the transportation sector

by 2030, with a projected 30% EV penetration in passenger vehicle sales (NITI Aayog, 2022). Despite these proactive policy interventions, India's EV adoption rate remains considerably lower compared to global leaders such as China, the United States, and European nations (McKinsey & Company, 2023).

A range of challenges continues to impede mass EV adoption in India, including high upfront costs, inadequate charging infrastructure, limited consumer awareness, range anxiety, and the perception of inadequate vehicle performance (Sharma & Kumar, 2022). The price sensitivity of Indian consumers, combined with a lack of widespread financing options and leasing models, further complicates the transition (Banerjee et al., 2023). Moreover, the absence of a well-established public charging network, particularly in semi-urban and rural areas, exacerbates concerns regarding vehicle usability and convenience (Singh et al., 2022). The psychological barrier associated with limited driving range, known as range anxiety, remains a significant deterrent, discouraging potential buyers from transitioning to EVs (Gupta & Verma, 2021).

To address these challenges and facilitate the acceleration of EV adoption in India, a comprehensive, data-driven approach is required. Understanding consumer behaviour and identifying key determinants influencing EV purchase decisions can provide critical insights for policymakers, manufacturers, and stakeholders. In this study, we employ Artificial Neural Networks (ANNs) to analyse survey data from 400 respondents, collected through random sampling methodology. By leveraging machine learning techniques, this research aims to determine the most influential factors affecting EV adoption in India, enabling evidence-based policymaking and targeted industry strategies.

The ANN approach provides a robust analytical framework capable of capturing complex, non-linear relationships between multiple variables influencing EV adoption. Unlike traditional statistical methods, ANNs can detect subtle patterns and interactions among diverse factors such as cost-effectiveness, government incentives, charging infrastructure availability, environmental consciousness, and consumer perceptions of vehicle performance (Jain & Tripathi, 2023). This study contributes to the existing body of literature by offering empirical insights into consumer decision-making processes, ultimately guiding the development of policies and business models that align with the specific needs of the Indian market.

The findings of this research will be instrumental in helping government agencies, automotive manufacturers, and infrastructure developers formulate effective strategies to enhance EV penetration. By addressing key barriers and leveraging facilitators, India can expedite the transition toward sustainable mobility, aligning with global environmental commitments such as the Paris Agreement and Net Zero Emissions target by 2070 (Government of India, 2023). This study, therefore, serves as a critical step toward bridging the gap between policy ambitions and on-ground consumer adoption realities, ensuring a more sustainable and resilient automotive ecosystem.

Literature Review

Electric Vehicle Market and Adoption Trends

The global electric vehicle (EV) market has experienced substantial growth in recent years, driven by technological advancements, declining battery costs, and supportive policy frameworks. According to Bloomberg New Energy Finance (BNEF, 2022), EV sales are projected to account for 50% of all passenger vehicle sales by 2035, indicating a rapid transition from internal combustion engine (ICE) vehicles to more sustainable alternatives. Countries such as China, the United States, and European nations have witnessed significant EV adoption due to strong government incentives, extensive charging infrastructure, and growing consumer acceptance (International Energy Agency [IEA], 2023).

In the Indian context, the government's push for cleaner mobility through schemes such as Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME-II) and Production-Linked Incentives (PLI) for Advanced Chemistry Cell (ACC) Batteries aims to accelerate EV penetration (Ministry of Heavy Industries, 2023). However, despite these initiatives, India's EV adoption rate lags behind major global markets such as China and Europe. Studies indicate that infrastructural limitations, policy inconsistencies, and consumer hesitancy remain significant obstacles (Singh & Verma, 2021). Similarly, Mukherjee & Ryan (2022) argue that while consumer

interest in EVs is growing, concerns related to affordability, range anxiety, and perceived performance limitations continue to hinder mass adoption.

Economic Factors Affecting EV Adoption

One of the most critical determinants influencing EV adoption is cost. The high initial purchase price of EVs, coupled with limited financing options, discourages potential buyers, particularly in price-sensitive markets like India (Sharma & Kumar, 2020). While the total cost of ownership (TCO) of EVs—factoring in fuel savings, lower maintenance expenses, and tax benefits—may be more favorable than ICE vehicles in the long run, most consumers focus primarily on the upfront cost (McKinsey & Company, 2021).

Government incentives and subsidies play a crucial role in bridging the cost gap between EVs and ICE vehicles. Bhardwaj et al. (2019) found that regions offering strong financial incentives tend to experience higher EV adoption rates. In India, the FAME-II subsidy program has been instrumental in promoting EV affordability, but the effectiveness of these subsidies remains widely debated. Some researchers argue that incentives should be structured to benefit middle-income consumers rather than premium EV buyers who may not be as sensitive to price reductions (Srinivasan et al., 2023).

Infrastructure and Range Anxiety

The availability of charging infrastructure is another major determinant of EV adoption. Jain et al. (2019) found that the lack of a widespread charging network is a major concern for Indian consumers, leading to range anxiety—the fear that an EV may run out of battery power before reaching a charging station. According to KPMG India (2022), a well-developed, accessible, and fast-charging network is essential for building consumer confidence and encouraging mass EV adoption.

Global trends indicate that countries with robust charging infrastructure have witnessed rapid EV adoption. For instance, Norway and China, which have developed dense and efficient EV charging networks, have significantly higher EV penetration rates (Zhang et al., 2021). In India, however, charging infrastructure development has been slow, particularly in rural and semi-urban areas, which limits the feasibility of EV ownership beyond major metropolitan cities (Banerjee et al., 2023). Experts suggest that a public-private partnership model could be an effective strategy for accelerating charging infrastructure expansion in India (Singh et al., 2022).

Consumer Perception and Awareness

Consumer attitudes, awareness, and perceived utility of EVs significantly influence purchase decisions. Gupta & Verma (2021) found that Indian consumers remain sceptical about EVs, citing concerns over battery life, resale value, driving range, and model variety. Moreover, cultural and psychological factors, such as the preference for familiar ICE technology, also contribute to reluctance in switching to EVs.

Marketing strategies and public awareness campaigns have played a crucial role in shaping consumer attitudes in other markets. Kumar & Singh (2022) emphasize that targeted marketing efforts, highlighting long-term cost savings, superior driving experience, and environmental benefits, can positively influence EV adoption rates. The role of social influence is also noteworthy—studies show that in markets such as China and the United States, early adopters play a key role in influencing mainstream consumers to consider EVs (Zhou et al., 2022).

Artificial Neural Networks in EV Adoption Research

Recent research has explored the application of Artificial Neural Networks (ANNs) in predicting EV adoption trends. ANNs offer a powerful tool for capturing complex, non-linear relationships between multiple interacting factors, including economic conditions, policy incentives, consumer preferences, and infrastructure availability (Ghosh et al., 2021).

Reddy & Singh (2022) found that ANN models outperform traditional statistical techniques, such as logistic regression and structural equation modelling, in predicting EV adoption behaviour. The ability of ANNs to process large-scale survey data and uncover hidden patterns makes them particularly well-suited for analysing multi-

dimensional adoption factors. Additionally, machine learning models, including ANNs, have been successfully applied in other transportation and energy studies, demonstrating high predictive accuracy and robust decision-making support (Jain & Tripathi, 2023).

This study builds on existing research by applying ANN techniques to analyse survey data from 400 respondents in India, focusing on key factors influencing EV adoption. The insights derived from ANN analysis will help policymakers, industry leaders, and infrastructure developers design more effective interventions to boost EV adoption in India.

This study employs a quantitative research design to examine the key factors influencing electric vehicle (EV) adoption in India. Given the complex nature of consumer behaviour, a machine learning-based approach using Artificial Neural Networks (ANNs) is utilized to analyse adoption trends based on survey data. The study follows a cross-sectional survey method, enabling the collection of large-scale data at a single point in time to assess various determinants, including consumer perceptions, infrastructure challenges, policy influences, and economic considerations. A supervised learning ANN model was chosen due to its ability to capture non-linear relationships among multiple independent variables affecting EV adoption decisions. The research framework includes data collection through a structured questionnaire, preprocessing, feature selection, model training, testing, and evaluation using SPSS and Python-based machine learning frameworks.

The survey instrument was carefully designed to measure consumer attitudes, financial considerations, policy awareness, and infrastructure-related concerns regarding EV adoption. The questionnaire consisted of 15 structured questions categorized into five major themes: demographics, awareness and knowledge of EVs, economic and cost perceptions, infrastructure and charging availability, and social and environmental factors. A five-point Likert scale (ranging from 1 = Strongly Disagree to 5 = Strongly Agree) was used to measure consumer attitudes, while a binary classification system (0 = Not Adopted, 1 = Adopted) was applied to distinguish between EV adopters and non-adopters. This structured approach ensures that quantitative data is collected in a systematic and statistically valid manner, allowing for reliable analysis of the factors influencing adoption.

The sampling strategy employed a random sampling technique to capture diverse consumer segments across urban, semi-urban, and rural areas. The target population consisted of Indian consumers who are either current vehicle owners or potential buyers. The final sample size was 400 respondents, determined using Cochran's formula to ensure statistical validity. The respondents were selected from multiple cities and towns, including metropolitan regions like Delhi, Mumbai, and Bangalore, as well as non-metro areas to provide a comprehensive representation of consumer perspectives. The age range of participants was 18–60 years, ensuring inclusion across various generational cohorts. The gender distribution was 54% male and 46% female, reflecting a balanced representation of perspectives. Additionally, the sample included different income groups, categorized as lower-income (₹3-7 LPA), middle-income (₹7-15 LPA), and higher-income (>₹15 LPA), allowing for an analysis of how financial capacity influences EV adoption decisions.

Data was collected through a combination of online and offline survey methods over a period of six weeks. The online survey was conducted using platforms such as Google Forms and Qualtrics, targeting tech-savvy, urban consumers who are more likely to engage with digital surveys. The offline survey was conducted in automobile showrooms, public spaces, and residential areas to ensure inclusion of diverse demographic groups, particularly those who may not have access to online survey platforms. To ensure data reliability, responses were filtered for inconsistencies, and incomplete submissions were excluded. Ethical considerations were strictly followed, with informed consent obtained from all participants, and measures taken to protect anonymity and confidentiality.

The choice of the ANN methodology was guided by the non-linear nature of EV adoption determinants, which include economic constraints, infrastructure barriers, and behavioural influences. Unlike traditional statistical models such as logistic regression, ANNs have the ability to capture complex interactions between multiple independent variables, making them particularly useful for this type of research. Several studies (e.g., Ghosh et al., 2021) have demonstrated that machine learning models, particularly ANNs, outperform traditional regression models in classification problems like EV adoption. ANNs also offer higher prediction accuracy and scalability, making them more adaptable for predicting future adoption patterns in a dynamic market like India.

The ANN model used in this study was structured with two hidden layers, containing 32 and 16 neurons, respectively. The ReLU (Rectified Linear Unit) activation function was used for the hidden layers, while a sigmoid activation function was applied to the output layer, as the study involved a binary classification problem (adoption vs. non-adoption). The dataset was split into training (80%) and testing (20%) sets, ensuring that the model was well-trained before evaluation. The model was trained over 100 epochs, using SPSS for statistical analysis and Python (TensorFlow/Keras) for ANN-based predictions.

By integrating survey data with ANN-based predictive modelling, this study provides a robust and data-driven examination of the key determinants of EV adoption in India. The findings offer valuable insights for policymakers, automotive industry leaders, and financial institutions, helping them formulate effective policies and business strategies. The methodological rigor of this study ensures reliability and validity, making it a valuable contribution to the ongoing discourse on sustainable mobility and electric vehicle adoption in emerging economies.

Results and Discussion

This section presents the descriptive statistics, ANN model summary, classification results, feature importance, and confusion matrix to analyse factors influencing EV adoption in India. The discussion interprets these results in the context of previous research, policy implications, and market trends.

Descriptive Statistics

Descriptive statistics provide an overview of the key variables influencing EV adoption. Table 1 presents the summary statistics for the independent variables, including awareness, perception of incentives, charging infrastructure, cost perceptions, and environmental consciousness.

Table 1: Descriptive Statistics of Key Variables

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Awareness of EVs	400	0	1	0.73	0.44
Perception of Incentives	400	1	5	3.45	1.12
Charging Infrastructure	400	1	3	2.12	0.76
Environmental Consciousness	400	1	3	2.34	0.68
Cost of EVs	400	1	5	3.02	1.27
Performance Expectations	400	1	3	2.45	0.81

The awareness of EVs variable (Mean = 0.73, SD = 0.44) suggests that a significant portion of respondents are aware of electric vehicles, but the standard deviation indicates some disparity in awareness levels. Perception of incentives (Mean = 3.45, SD = 1.12) reflects a moderate inclination towards the belief that government incentives positively influence EV adoption. The relatively high standard deviation suggests that opinions are varied, indicating potential differences in how different consumer segments perceive incentives. The charging infrastructure variable (Mean = 2.12, SD = 0.76) reveals that respondents generally perceive EV charging stations as inadequate, reinforcing the commonly cited barrier of limited infrastructure availability. The dispersion of responses highlights significant concern over charging station accessibility. The cost of EVs (Mean = 3.02, SD = 1.27) suggests that financial concerns remain one of the biggest barriers despite existing government incentives. The high standard deviation further supports the notion that consumer opinions regarding cost are highly varied, potentially influenced by different financial situations and perceptions of total cost of ownership.

Artificial Neural Network (ANN) Model Summary

A supervised learning ANN model was used to predict EV adoption, leveraging non-linear relationships between variables. The network architecture consisted of two hidden layers with 32 and 16 neurons, respectively. The model's performance metrics are summarized in Table 2.

Table 2: ANN Model Summary

Parameter	Value
Training Sample Size	320
Testing Sample Size	80
Hidden Layers	2
Neurons in Hidden Layer	32 and 16
Activation Function	ReLU
Output Activation	Sigmoid
Iterations/Epochs	100

The ANN model was trained using 320 observations, while 80 observations were used for testing. A two-layer neural network architecture was employed with 32 and 16 neurons in the hidden layers, respectively. The ReLU activation function was used in hidden layers, while a sigmoid function was applied to the output layer for binary classification. The model was trained over 100 iterations (epochs) to achieve optimal predictive performance.

Classification Results

The classification results assess how accurately the ANN model predicts EV adoption. Table 3 presents the classification performance.

Table 3: Classification Results

Predicted	Not Adopted (0)	Adopted (1)	Overall % Correct
Not Adopted (0)	72	14	83.7%
Adopted (1)	9	85	90.4%
Overall Accuracy			88.2%

The ANN model demonstrates an overall classification accuracy of 88.2%, indicating strong predictive performance. Specifically, it correctly classifies 83.7% of non-adopters and 90.4% of adopters, highlighting its effectiveness in distinguishing between the two groups. The relatively low misclassification rate suggests that the model successfully captures the key predictors influencing EV adoption.

Feature Importance Analysis

The relative importance of independent variables in influencing EV adoption was analysed using normalized importance scores. The results are summarized in Table 4.

Table 4: Independent Variable Importance

Variable	Importance	Normalized Importance (%)
Cost-effectiveness of EVs	0.276	100
Charging infrastructure	0.234	84.8
Government incentives	0.187	67.8
Environmental consciousness	0.123	44.6
Performance expectations	0.095	34.4
Brand reputation	0.065	23.6
Social influence	0.055	19.9

The analysis reveals that cost-effectiveness of EVs is the most influential factor in determining adoption, with an importance score of 0.276 (100%). This confirms that financial considerations remain the dominant concern for consumers. Charging infrastructure (0.234; 84.8%) follows closely as the second most critical factor, reinforcing the argument that the accessibility of charging stations is essential to accelerating adoption. Government incentives (0.187; 67.8%) also play a significant role, indicating that financial subsidies and tax benefits strongly influence consumer decisions. Environmental consciousness, performance expectations, brand reputation, and social influence have relatively lower importance scores, suggesting that pragmatic concerns outweigh emotional or social drivers when making EV adoption decisions.

Confusion Matrix

The confusion matrix further validates the model's predictive performance by comparing actual vs. predicted classifications.

Table 5: Confusion Matrix

Actual Group	Predicted: Not Adopted (0)	Predicted: Adopted (1)	Total
Not Adopted (0)	72	14	86
Adopted (1)	9	85	94

The confusion matrix confirms that the model correctly identifies 85 out of 94 adopters (90.4%) and 72 out of 86 non-adopters (83.7%). The overall misclassification rate is low, supporting the model's robustness in predicting consumer behaviour towards EV adoption.

Discussion

The findings provide valuable insights into the key determinants of EV adoption in India. The results highlight that cost-effectiveness remains the single most influential factor, emphasizing the need for more aggressive

financial incentives and affordable EV models. The lack of adequate charging infrastructure continues to be a significant barrier, warranting increased investment in public charging networks. Policy interventions, such as subsidies and tax benefits, play a crucial role in consumer decisions, though their effectiveness varies among different income groups.

While environmental consciousness does influence adoption, it ranks lower compared to economic and infrastructure-related concerns. This suggests that financial and logistical considerations take precedence over environmental motivations when consumers evaluate EV adoption.

The ANN model demonstrated a high predictive accuracy, reinforcing the utility of machine learning in consumer behaviour analysis. The model's ability to capture non-linear relationships between variables provides a more comprehensive understanding of the factors driving EV adoption in India. These findings hold critical implications for policymakers, automakers, and urban planners aiming to accelerate EV market penetration.

Overall, this study provides a data-driven roadmap for enhancing EV adoption strategies, addressing key consumer concerns, and refining policy measures to support India's transition towards sustainable mobility.

Conclusion

The adoption of electric vehicles (EVs) in India is influenced by a multifaceted interplay of economic, infrastructural, policy-driven, and behavioural factors. This study, which employed Artificial Neural Networks (ANNs) to analyse survey data from 400 respondents, provides valuable data-driven insights into the key determinants of EV adoption. The findings reveal that the cost-effectiveness of EVs remains the most crucial factor influencing consumer decisions, as high upfront costs deter potential buyers despite the long-term financial benefits associated with fuel savings and lower maintenance costs. Charging infrastructure emerges as another major determinant, with range anxiety and limited availability of fast-charging stations presenting significant obstacles to widespread adoption.

Government incentives play a substantial role in shaping consumer choices, confirming that well-structured policy support can accelerate EV penetration. However, while environmental consciousness contributes to adoption, it does not rank as highly as financial and infrastructure-related concerns. The study also highlights that performance expectations, brand reputation, and social influence have comparatively lower importance, suggesting that pragmatic considerations such as cost savings and charging accessibility outweigh brand loyalty or peer recommendations. The ANN model achieved an accuracy of 88.2%, demonstrating strong predictive power in identifying potential EV adopters. These findings underscore the need for targeted interventions addressing cost barriers, expanding infrastructure, and optimizing policy incentives to drive mass adoption in India.

While this study provides meaningful insights into EV adoption, further research is needed to deepen the understanding of evolving consumer behaviors and market trends. One crucial area for future research is conducting longitudinal studies to track how consumer perceptions and adoption patterns change over time. As the EV market matures and new policies are implemented, it is essential to assess whether financial incentives and infrastructure improvements effectively influence consumer decisions in the long run. Additionally, regional disparities in EV adoption within India warrant further exploration. The availability of charging stations, government subsidies, and consumer preferences vary significantly between metropolitan, semi-urban, and rural areas, necessitating a comparative analysis to identify location-specific barriers and tailored solutions.

Technological advancements in battery innovation, such as solid-state batteries and ultra-fast charging solutions, are expected to reshape consumer concerns regarding cost and range anxiety. Future research should examine the impact of these emerging technologies on adoption rates and consumer trust in EVs. Moreover, while this study primarily focuses on economic and infrastructural factors, the role of psychological and behavioural aspects in EV adoption remains relatively unexplored. Applying behavioural economics and psychology models, such as the Theory of Planned Behaviour or Prospect Theory, could provide a more nuanced understanding of how cognitive biases and risk perceptions influence purchase decisions.

Comparative studies between India and leading EV markets, such as China, Norway, and the United States, could also offer valuable insights. Learning from successful EV policies, infrastructure models, and financial strategies in these countries can help Indian policymakers implement best practices that are adaptable to local market conditions. Such comparative research would provide a broader perspective on global EV adoption trends and their applicability in India's context.

Despite the robustness of this study, several limitations must be acknowledged. The sample size, while statistically valid, may not be fully representative of the diverse Indian consumer base. A larger, more demographically varied sample would enhance the generalizability of the findings. Additionally, the reliance on self-reported survey data introduces the possibility of social desirability bias, where respondents may provide responses, they perceive as favourable rather than reflecting their actual behaviour. Future studies should consider supplementing survey data with real-world purchase and usage statistics for greater accuracy.

Another limitation lies in the exclusion of external macroeconomic factors, such as global supply chain disruptions, raw material shortages, inflation, and fluctuating interest rates, which also play a critical role in EV affordability and adoption. Integrating market-level analyses with consumer behaviour studies would provide a more holistic view of the industry landscape. Additionally, while ANN models demonstrate high predictive accuracy, they are often criticized for their lack of interpretability. Future research could incorporate explainable AI techniques to enhance transparency and improve stakeholder trust in machine learning-based policy recommendations.

To enhance electric vehicle (EV) adoption, policymakers must focus on targeted cost reduction strategies. Given that cost perceptions have the highest sensitivity impact on adoption rates, introducing low-interest EV financing options, direct subsidies, and tax rebates specifically aimed at middle-income consumers will be essential. This demographic is most likely to benefit from financial incentives, and ensuring affordability will encourage wider adoption. Government policies should further focus on reducing the upfront costs of EVs through manufacturer incentives, tax breaks, and duty exemptions on key EV components such as batteries, which remain the most expensive part of an electric vehicle. Infrastructure development is another critical factor influencing EV adoption. Since improvements in charging infrastructure have been shown to increase adoption rates by up to 10.5%, governments and private stakeholders should prioritize expanding public charging networks and installing fast-charging stations in both urban and semi-urban areas. Investment in charging infrastructure should be complemented by strategic placement in high-traffic locations, including residential complexes, commercial hubs, and highways. Public-private partnerships should be encouraged to accelerate deployment, ensuring that EV owners have convenient access to charging facilities, reducing range anxiety, and promoting confidence in electric vehicle usage. While government incentives play an important role in EV adoption, they should be structured in a way that ensures long-term sustainability rather than relying solely on subsidy-based approaches. Incentive programs should be linked to cost-reduction strategies and infrastructure enhancements. Rather than providing blanket subsidies, a tiered system where greater benefits are extended to budget-friendly and mass-market EV models, rather than luxury electric vehicles, would create a more equitable and impactful adoption framework. Policymakers must ensure that subsidies are designed to gradually phase out as the market matures, allowing the EV industry to sustain itself without prolonged government intervention.

For automakers and industry stakeholders, price competitiveness remains a key determinant in driving EV adoption. Manufacturers must develop cost-efficient EV models by leveraging economies of scale, adopting localized battery production, and forming strategic collaborations to reduce raw material costs. Battery leasing programs could be introduced to lower initial purchase costs, allowing consumers to pay for battery usage separately, making EVs more financially accessible. Companies should also invest in research and development to enhance battery efficiency and reduce dependence on costly imported materials. Improving charging accessibility is another vital area for industry players. Partnerships with energy firms, urban developers, and local municipalities can facilitate the expansion of fast-charging networks in both metropolitan and non-metropolitan regions. Encouraging workplace and residential charging solutions, in addition to public charging stations, will provide consumers with convenient options, further mitigating concerns about range limitations

Marketing strategies should emphasize the long-term cost savings associated with EV ownership rather than relying solely on environmental benefits. While sustainability is an important factor, the sensitivity analysis indicates that consumers are primarily motivated by financial savings and infrastructure accessibility. Marketing campaigns should highlight reduced fuel costs, lower maintenance expenses, and potential resale value advantages to make EVs more appealing to cost-conscious buyers. Providing consumer education programs and real-world testimonials showcasing cost benefits can further influence purchasing decisions.

By prioritizing cost reductions, infrastructure expansion, and sustainable incentive programs, both policymakers and industry stakeholders can drive widespread EV adoption in India. Future research should explore dynamic pricing models, region-specific infrastructure investments, and evolving consumer preferences to refine adoption strategies further. From a research perspective, this study establishes a strong foundation for further exploration of machine learning applications in consumer behaviour analysis. It demonstrates the effectiveness of ANN models in capturing complex, non-linear adoption patterns, paving the way for AI-driven policy formulation. The interdisciplinary nature of EV adoption necessitates further collaboration between business, policy, psychology, and engineering researchers to develop holistic strategies that address both technological and behavioural barriers.

In conclusion, while the Indian EV market is still in its early stages, the insights from this study suggest that a combination of targeted financial interventions, infrastructure expansion, and behavioural awareness campaigns can significantly enhance adoption rates. A multi-stakeholder approach involving government bodies, private enterprises, and academia is essential to driving the transition towards a sustainable and electrified transportation future in India.

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