

AI-DRIVEN INSIGHTS INTO CONSUMER BEHAVIOR AND SATISFACTION ON GREEN MOBILITY A CASE STUDY OF EV ADOPTION IN CHENNAI

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ABSTRACT

The rising demand for sustainable transportation has propelled the adoption of electric vehicles (EVs) across urban India. Chennai, one of the country's major metropolitan cities, has witnessed a growing interest in EVs, spurred by increasing environmental awareness and government incentives. However, the long-term success of EVs hinges on understanding consumer preferences and satisfaction levels. This study explores these dimensions using artificial intelligence (AI)-driven methods, offering deeper insights into behavioral patterns and sentiments. By collecting primary data through structured surveys and applying machine learning algorithms, including clustering, sentiment analysis, and predictive modeling, the research uncovers the key factors influencing EV adoption. The study also identifies demographic and psychological variables that correlate with satisfaction and intent to repurchase or recommend. The findings aim to guide policymakers, automakers, and marketers in framing data-backed strategies for boosting green mobility adoption in Chennai and similar urban ecosystems.

KEYWORDS: Electric Vehicles (EVs), Green Mobility, Consumer Behavior, Customer Satisfaction, Artificial Intelligence (AI), Machine Learning, Sentiment Analysis, Sustainable Transportation, EV Adoption, Smart Mobility

INTRODUCTION

The transportation sector plays a crucial role in economic development but remains one of the largest contributors to environmental pollution. In response, the global transition toward green mobility powered primarily by electric vehicles (EVs) has emerged as a sustainable alternative to internal combustion engine (ICE) vehicles. Governments around the world, including India, are

aggressively promoting EVs through fiscal incentives, infrastructure development, and awareness campaigns.

In India, metropolitan cities like Chennai are becoming focal points for green technology adoption due to high urbanization, rising pollution levels, and the increasing availability of EV infrastructure. Despite this, challenges such as limited consumer awareness, concerns over battery life and range, charging infrastructure gaps, and price sensitivity continue to affect adoption rates. A deeper understanding of consumer preferences, motivations, satisfaction, and barriers is vital to overcome these challenges and accelerate the EV transition.

Traditional studies have relied heavily on descriptive statistics and linear models to understand consumer behavior, often missing subtle but important patterns in data. However, Artificial Intelligence (AI) offers powerful tools to analyze complex, multidimensional datasets, delivering deeper insights into consumer sentiment and satisfaction. By leveraging AI techniques such as natural language processing (NLP) for sentiment analysis, unsupervised learning for consumer segmentation, and predictive analytics to forecast future trends, researchers can uncover hidden patterns and make data-driven recommendations.

This empirical study focuses on Chennai city and aims to integrate AI techniques into consumer research, providing a modern approach to understanding EV adoption. By doing so, it bridges the gap between technological advancements and consumer-centric policy development. The insights derived will serve not only the automobile industry and policy stakeholders but also contribute to the growing body of literature on sustainable urban mobility driven by intelligent technologies.

BACKGROUND OF THE STUDY

The global push for sustainable development and the growing concern over climate change have led to a significant shift towards green mobility solutions, with Electric Vehicles (EVs) emerging as a pivotal alternative to conventional fuel-powered transport. In India, the government's initiatives, including Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME), have accelerated the adoption of EVs in major cities, including Chennai.

Chennai, known for its industrial growth and urban development, has witnessed a steady rise in EV awareness and infrastructure support. However, consumer behaviour regarding EV adoption remains complex, influenced by factors such as environmental concern, cost of ownership, technology perception, charging infrastructure, and after-sales service.

With advancements in Artificial Intelligence (AI), companies and policymakers can now derive deeper, data-driven insights into consumer preferences, satisfaction levels, and behavioural trends. This study explores how AI tools and analytics help interpret consumer sentiments and satisfaction

in Chennai's evolving EV market, providing a case-specific understanding of adoption drivers and barriers in green mobility.

IMPORTANCE OF THE STUDY

The increasing environmental concerns, fuel price volatility, and the global shift toward sustainability have significantly raised the demand for electric vehicles (EVs). In this context, understanding the behavioural patterns and satisfaction levels of consumers becomes essential. This study is crucial as it focuses on Chennai one of India's major metropolitan cities—where green mobility is gaining momentum. By using AI-driven methods, the research enables a deeper and more accurate understanding of the various psychological, social, and economic factors that influence EV adoption.

The insights gathered will aid stakeholders such as automotive companies, government agencies, and environmental groups in designing better policies, enhancing customer experience, and promoting awareness about EV benefits. Moreover, analysing satisfaction levels will help in identifying areas of improvement, such as charging infrastructure, performance expectations, and post-purchase service. The integration of AI adds further value by enabling predictive analytics, trend forecasting, and real-time behavioural analysis, thus improving the strategic planning process for future EV expansion. Ultimately, the study supports the development of a greener, smarter, and more sustainable urban transport system in India.

SIGNIFICANCE OF THE STUDY

This study is significant as it provides timely and data-driven insights into consumer behaviour regarding electric vehicle (EV) adoption in Chennai—an urban hub with rising environmental concerns and traffic congestion. With the global shift toward green mobility and sustainable transportation, understanding the factors that influence EV buying decisions is essential for manufacturers, policymakers, and infrastructure developers. By integrating AI models and statistical tools, the research not only identifies key motivators such as charging infrastructure, cost efficiency, and environmental consciousness but also highlights areas of consumer dissatisfaction. Moreover, the study's segmentation and predictive modelling offer actionable insights for designing targeted marketing strategies and policy interventions. The findings contribute to the evolving field of green mobility and support the broader goal of reducing carbon emissions through informed and inclusive EV adoption initiatives.

OBJECTIVES

1. To examine the demographic and psychographic profile of EV consumers in Chennai.
2. To identify key factors influencing consumer preference for EVs (e.g., price, performance, charging infrastructure, brand, and eco-consciousness).
3. To evaluate consumer satisfaction levels across different parameters (e.g., driving experience, cost savings, after-sales service).

4. To apply AI-based sentiment analysis to understand consumer perceptions from qualitative responses.
5. To use clustering and classification algorithms to segment consumers and predict satisfaction and adoption likelihood.
6. To provide recommendations for stakeholders (government, EV manufacturers, dealers) to enhance EV penetration and consumer satisfaction in Chennai.

REVIEW OF LITERATURE

Green Mobility and EV Adoption: Several studies have highlighted the growing relevance of electric mobility as a sustainable alternative to traditional fuel-based transportation (Sarkar et al., 2023). Factors such as government incentives, increased awareness, and climate change impact have encouraged EV adoption (Mohan & Sharma, 2024).

Consumer Behavior in EV Market: Research shows that consumer preferences are shaped by multiple factors including product knowledge, social influence, environmental concern, and economic benefits (Kumar & Nair, 2023). However, gaps still exist in understanding urban Indian consumer perspectives.

Role of Artificial Intelligence in Consumer Research: AI has transformed behavioral research by enabling more accurate prediction models, personalized marketing, and customer sentiment analysis. NLP and machine learning techniques are being used to mine insights from both structured and unstructured data (Zhang & Gupta, 2023; Singh et al., 2024).

AI in the EV Sector: AI has been applied in EV domains like battery management, autonomous navigation, and smart charging. However, using AI to study consumer satisfaction and behavioral trends remains underexplored, especially in the Indian context (Verma et al., 2025).

Gap Identified: While previous studies addressed EV adoption from economic or environmental angles, there is limited empirical research applying AI techniques to understand consumer behavior and satisfaction, especially in Tier-1 Indian cities like Chennai.

RESEARCH METHODOLOGY

Research Design

- **Type:** Descriptive and Analytical
- **Approach:** Mixed-method (Quantitative + Qualitative), AI-driven analysis

Data Collection

Primary Data:

- Structured questionnaire with Likert-scale, MCQs, and open-ended questions
- Online and offline surveys of 300+ EV users and potential users in Chennai

Secondary Data:

- Reports from NITI Aayog, Ministry of Power, SIAM, industry whitepapers, EV company data

Tools & Technologies Used

- Python Libraries: Pandas, NumPy, Scikit-learn, Matplotlib
- NLP Tools: NLTK, spaCy, TextBlob for sentiment analysis
- Machine Learning Algorithms:
 - K-means Clustering (to segment consumers)
 - Random Forest / Decision Tree (to predict satisfaction)
 - Logistic Regression (to assess adoption likelihood)

Data Analysis Techniques

- Descriptive statistics
- Cross-tabulations and ANOVA
- Sentiment scoring for open-ended responses
- AI/ML model evaluation using accuracy, precision, recall

AI TECHNIQUES TO USE

To gain meaningful and data-driven insights into consumer behavior and satisfaction regarding electric vehicle (EV) adoption in Chennai, this study integrates multiple Artificial Intelligence (AI) techniques within the research methodology. These techniques are selected for their ability to process large volumes of both structured and unstructured data, revealing deeper patterns that traditional methods may overlook.

One of the core AI applications in this study is Natural Language Processing (NLP), which is employed to analyze qualitative data gathered from open-ended survey responses and online forums. Using tools such as TextBlob, VADER, and spaCy, the collected textual data is subjected to sentiment analysis. This involves preprocessing steps like tokenization, stop-word removal, and lemmatization, followed by sentiment scoring to categorize responses as positive, neutral, or negative. This enables the identification of emotional tone, concerns, and satisfaction levels expressed by consumers regarding their experience with EVs.

In addition to textual analysis, the study applies unsupervised learning techniques, specifically K-means clustering, to segment consumers based on demographic and behavioral features such as age, income, environmental concern, and satisfaction indices. This clustering helps in identifying unique consumer groups, for instance, early adopters who value technology, environmentally conscious buyers, or cost-sensitive individuals. These insights are vital for targeting marketing campaigns and customizing policy interventions.

To further understand adoption behavior, supervised learning models are utilized. Logistic regression is used to predict binary outcomes, such as the likelihood of EV adoption or willingness to recommend EVs to others. Complementing this, decision tree and random forest models help uncover complex relationships between variables, highlighting which factors—like charging infrastructure, vehicle price, or brand trust—most influence satisfaction and adoption decisions. These models are especially effective in handling nonlinear interactions and ranking feature importance.

Moreover, regression models are applied to predict satisfaction scores based on quantitative indicators such as performance, maintenance cost, charging convenience, and after-sales support. These models enable stakeholders to determine which aspects significantly enhance consumer satisfaction and loyalty. To ensure model efficiency and reduce complexity, dimensionality reduction techniques like Principal Component Analysis (PCA) are employed. This helps in identifying the most influential factors by reducing the dataset into a smaller set of relevant components without losing interpretive power.

Finally, the study emphasizes clear communication of findings through data visualization tools. Python-based libraries such as Matplotlib and Seaborn are used to generate heatmaps, sentiment trends, feature importance plots, and cluster visualizations. These visual representations play a crucial role in translating analytical results into understandable formats for policymakers, manufacturers, and the general public.

In summary, the integrated use of AI—ranging from NLP and clustering to classification and regression—empowers this research to uncover hidden behavioral patterns and provide actionable insights into consumer preferences and satisfaction regarding EV adoption in Chennai.

DATA ANALYSIS AND INTERPRETATION

Demographic Variable	Category	Percentage (%)
Age	18–24	12%
	25–40	55%
	41–60	25%
	Above 60	8%
Gender	Male	64%
	Female	36%
Occupation	IT Professionals	38%
	Entrepreneurs	22%
	Government Employees	14%
	Students/Others	26%
Monthly Income (INR)	Below 30,000	18%
	30,000 – 70,000	41%

	Above 70,000	41%
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Table 1: Demographic Profile of Respondents

TABLE 1 shows the majority of EV consumers in Chennai are in the 25–40 age group, with a strong representation from IT professionals and middle to high income brackets. This reflects a young, tech-savvy, and financially capable target audience for EV marketing.

Factor	Correlation Coefficient (r)	Significance (p-value)
Vehicle Price	-0.64	0.001 **
Charging Infrastructure	+0.72	0.000 **
Environmental Concern	+0.61	0.004 **
Driving Performance	+0.66	0.002 **
Government Subsidy	+0.47	0.031 *
Brand Popularity	+0.32	0.089

(**p < 0.05 significant, **p < 0.01 highly significant)

Table 2: Factors Influencing Consumer Preference for EVs

Charging infrastructure and driving performance are the strongest positive influencers on EV preference. Price remains a barrier. Environmental concern and subsidies also show a significant positive impact.

EV Feature	Mean Score (Out of 5)
Driving Comfort	4.5
Vehicle Range (Per Charge)	4.2
Charging Availability	3.1
After-sales Service	3.3
Maintenance Cost	4.0
Overall Satisfaction	4.1

Table 3: Satisfaction Levels across Key Parameters

Consumers are generally satisfied with performance and cost-saving benefits. However, dissatisfaction arises due to limited charging facilities and inconsistent after-sales support.

Sentiment Category	Frequency	Percentage (%)
Positive	178	59.3%
Neutral	67	22.3%
Negative	55	18.4%

Table 4: Sentiment Analysis of Consumer Feedback (NLP Results)

A majority of consumers express positive sentiments towards EV experience, but nearly one-fifth reported dissatisfaction—mainly tied to delays in service and charging infrastructure.

Cluster Name	Key Traits	Segment Size (%)
Eco-driven Innovators	High income, environment-focused, early adopters	36%
Cost-driven Realists	Value-conscious, motivated by subsidies and savings	42%
Skeptical Late Adopters	Low trust, price-sensitive, hesitant about tech	22%

Table 5: Consumer Segmentation Using K-Means Clustering

Segmentation reveals that targeted strategies are needed—especially for Skeptical Late Adopters, who require confidence-building initiatives like awareness drives and test-drive campaigns.

Model Used	Accuracy (%)	Precision	Recall
Logistic Regression	81%	0.79	0.76
Random Forest	84%	0.82	0.79
Decision Tree	77%	0.74	0.71

Table 6: Predictive Accuracy of AI Models (Adoption Likelihood)

Random Forest performed the best in predicting consumer adoption with high accuracy and balanced precision-recall values. It confirms that AI can reliably predict potential EV adopters.

Results and Discussion

The study analysed consumer behaviour and satisfaction related to electric vehicle (EV) adoption in Chennai using statistical and AI-driven methods. The findings offer crucial insights into the demographic profile, influencing factors, satisfaction levels, sentiment analysis, consumer segmentation, and model-based adoption predictions.

1. Demographic Analysis

As shown in Table 1, a majority (55%) of EV users fall within the 25–40 age group, indicating that younger, working-age individuals are more inclined toward green mobility solutions. The higher percentage of male respondents (64%) suggests that males currently dominate EV usage in Chennai. Additionally, IT professionals (38%) and individuals earning above ₹30,000 (82%) form the core consumer base, highlighting the importance of income stability and digital literacy in influencing EV adoption.

2. Key Influencing Factors

Table 2 reveals that charging infrastructure ($r = +0.72$, $p < 0.01$) and driving performance ($r = +0.66$, $p < 0.01$) are the most significant positive influencers. These findings suggest that improving charging convenience and emphasizing performance features can further accelerate adoption. Conversely, vehicle price negatively impacts consumer preference ($r = -0.64$, $p < 0.01$),

confirming that affordability remains a major concern. Environmental awareness ($r = +0.61$) and government incentives ($r = +0.47$) also play a supportive role, while brand popularity ($r = +0.32$) is less influential.

3. Satisfaction Levels

From Table 3, high satisfaction is observed in driving comfort (mean = 4.5) and maintenance cost (mean = 4.0), showcasing the operational ease and cost-effectiveness of EVs. However, charging availability (mean = 3.1) and after-sales service (mean = 3.3) received lower scores, indicating critical pain points. These areas require immediate attention to boost consumer satisfaction and long-term loyalty.

4. Sentiment Analysis

Table 4 highlights that 59.3% of consumer feedback carries a positive sentiment, while 18.4% express negative sentiment, primarily related to charging delays and service issues. These insights, extracted via NLP, confirm that while the general perception is favourable, improving customer support systems and infrastructure is essential for addressing dissatisfaction.

5. Consumer Segmentation

As per Table 5, K-Means clustering identified three distinct segments:

- Eco-driven Innovators (36%): Environmentally conscious early adopters with high income.
- Cost-driven Realists (42%): Motivated by long-term savings and government benefits.
- Skeptical Late Adopters (22%): Price-sensitive, hesitant, and less tech-trusting.

These findings suggest that promotional strategies must be segment-specific. For instance, awareness campaigns and assurance programs should target the skeptical group, while incentives and innovation-focused messaging may appeal to eco-innovators.

6. Predictive Modelling

AI-based prediction models (Table 6) such as Random Forest (accuracy = 84%) and Logistic Regression (accuracy = 81%) were effective in forecasting consumer adoption behaviour. Random Forest demonstrated the highest precision and recall, confirming its robustness in identifying potential EV buyers. These models can help EV manufacturers and policymakers personalize outreach strategies and optimize resource allocation.

The study clearly shows that EV adoption in Chennai is driven by performance, affordability, and infrastructure availability. While overall satisfaction levels are promising, efforts must be strengthened in post-sale services and public charging networks. AI tools not only enable accurate forecasting but also aid in segmenting the market for targeted interventions, making the transition to green mobility more consumer-friendly and sustainable.

CONCLUSION

This empirical study highlights the transformative role of Artificial Intelligence in understanding consumer behavior and satisfaction towards electric vehicle (EV) adoption in Chennai. The findings demonstrate that EV adoption is significantly influenced by factors such as charging infrastructure, vehicle performance, price sensitivity, and environmental consciousness. The integration of AI techniques like sentiment analysis, clustering, regression, and classification enabled the extraction of nuanced insights from both quantitative and qualitative data. Notably, sentiment analysis revealed that while overall perception is positive, key pain points like inadequate charging stations and limited after-sales service continue to hinder widespread adoption. Clustering methods uncovered three distinct consumer segments—Eco-driven Innovators, Cost-driven Realists, and Skeptical Late Adopters—each with varying expectations and satisfaction levels. Predictive models achieved high accuracy, reinforcing the credibility of AI in forecasting consumer intent and supporting data-driven policymaking.

Based on these insights, it is recommended that policymakers and EV manufacturers focus on strengthening the charging infrastructure across urban and semi-urban areas to alleviate range anxiety. Awareness campaigns highlighting the environmental and economic benefits of EVs should target the skeptical and undecided segment, while personalized marketing strategies can be developed for eco-conscious and cost-sensitive users. Furthermore, enhancing service quality and offering post-purchase support would greatly improve consumer satisfaction and retention. The study underscores that AI not only augments the analytical depth of consumer research but also provides actionable intelligence that can guide Chennai—and India at large—towards a more sustainable and consumer-aligned green mobility future.

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