A Localized Assessment of Electric Vehicle Adoption and Outcomes: A Perception-Based Study in Tumkur, Karnataka

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Abstract

The transition to electric vehicles (EVs) is a pivotal element of India's sustainability roadmap, aimed at reducing greenhouse gas emissions and lessening reliance on fossil fuels. While national-level policies and technological strides have accelerated EV growth, the dynamics of EV adoption in Tier-2 cities remain relatively underexplored. This study provides a localized evaluation of EV adoption and perception in Tumkur, Karnataka an emerging Tier-2 city with expanding transportation needs. Three core hypotheses were tested (H1) public awareness, (H2) perceived environmental benefit, and (H3) income level as influencers of EV adoption. The results revealed the H1 had a mean score of 3.98 and a standard deviation of 0.89, indicating that public awareness significantly influences adoption. H2 scored the highest with a mean of 4.12 and SD of 0.85, highlighting strong agreement on the role of environmental concern. H3, related to income, showed a mean of 3.99 and SD of 0.83, suggesting economic factors also play a critical role. The overall analysis reflects a positive perception toward EVs in Tumkur, with consistent responses indicating reliability in the data. These findings suggest that targeted policy interventions focused on awareness, affordability, and environmental messaging can enhance EV adoption in smaller urban centers and contribute to India's broader sustainability goals.

Keywords:

Electric vehicles, Tier-2 cities, EV adoption, Consumer perception, Environmental awareness, Income effect, Public awareness, Tumkur, sustainability.

Introduction

The global shift toward sustainable mobility has accelerated the development and adoption of electric vehicles (EVs), driven by concerns over environmental degradation, rising fuel costs, and the need for energy-efficient alternatives. In India, both central and state governments have introduced a range of initiatives to promote EV usage, including subsidies, tax exemptions, and infrastructure development. However, the success of these policies depends not only on technological readiness but also on public perception, socio-economic conditions, and regional adaptability.

Tumkur, a growing urban center in Karnataka, presents a unique landscape for evaluating EV adoption beyond major metropolitan areas. With increasing urbanization, rising environmental awareness, and improved access to technology, smaller cities like Tumkur are gradually entering the EV discourse. However, adoption remains limited due to a mix of financial constraints, limited infrastructure, and varying levels of awareness.

This study aims to assess the localized factors influencing EV adoption in Tumkur by exploring public perceptions related to awareness, environmental consciousness, and income levels. By focusing on these key dimensions, the research provides a deeper understanding of how regional attitudes and socio-economic factors impact consumer willingness to transition toward electric mobility. The findings are expected to offer practical insights for policymakers, local authorities, and industry stakeholders aiming to bridge the adoption gap in semi-urban regions and enhance the effectiveness of EV-related initiatives at the grassroots level.

Literature Review:

1.Gupta et al. (2024) Electric Vehicles (EVs) have become a focal point of sustainable transportation discussions across the globe, with developing countries like India also showing growing interest in their adoption. A study by Gupta et al. (2024) conducted in Noida, Uttar Pradesh, explores consumer perceptions toward EVs, analyzing them across seven dimensions: environmental friendliness, cost, power levels, convenience, price, and safety. The study also examines the relationship between key demographic variables—gender, age, education, and income—and how these influence consumer attitudes toward EVs.

The findings indicate that while environmental benefits are widely acknowledged by consumers, concerns remain regarding high costs, inadequate performance, and limited convenience. These perceptions act as barriers to mass EV adoption. Moreover, the study highlights that demographic factors significantly shape these perceptions, reinforcing the need for customized strategies. These could include targeted educational initiatives, government incentives, infrastructure development, and legislative support to foster broader EV acceptance.

This aligns with the current research focus, which similarly identifies awareness, income, and perceived environmental benefits as critical influencers in shaping willingness to adopt EVs, particularly in smaller urban areas like Tumkur. The literature suggests that any effective intervention must consider localized insights and demographic sensitivities to promote electric mobility adoption successfully.

2.Ashutosh (n.d.)2024 The transition from internal combustion engine (ICE) vehicles to electric vehicles (EVs) is driven by global environmental concerns and the urgency to reduce carbon emissions. In this context, Ashutosh (n.d.) explores the factors influencing consumer adoption and perception of EVs through a comprehensive analysis combining literature review, empirical studies, and case-based evidence.

The study identifies key determinants that shape EV adoption behavior, including environmental awareness, government incentives, technological advancement, charging infrastructure, cost of ownership, and brand perception. It emphasizes that for the mass adoption of EVs to occur, consumers must perceive EVs as not only environmentally beneficial but also economically viable and technically reliable.

Another significant observation is the role of government and policy measures. Incentives and subsidies act as critical enablers, especially in markets where EVs are still emerging. The study also stresses the importance of consumer experience, such as range satisfaction and driving comfort, which strongly influence word-of-mouth and market penetration.

This aligns well with findings from other localized studies, such as those conducted in India, where factors like cost, awareness, infrastructure, and demographic variations continue to shape EV adoption. Overall, Ashutosh's work reinforces the idea that multi-dimensional efforts—technical, economic, and psychological—are essential to drive consumer shift toward electric mobility.

3.Munoth et al. (2023) explore the behavioral and infrastructural challenges influencing electric vehicle (EV) adoption in India. Their study identifies several key deterrents to EV acceptance, including high purchase costs, inadequate charging infrastructure, and concerns about vehicle range. Using Structural Equation Modeling (SEM), the authors emphasize that consumer attitude (ATT) plays a crucial mediating role in the decision to adopt EVs. The paper recommends that for India—a developing nation—comprehensive and long-term policy frameworks are necessary to improve EV penetration. The study also stresses the importance of government incentives and infrastructure development to address existing consumer concerns and drive large-scale adoption.

4. Yadav (2024): Consumer Motivators and Barriers in Indian EV Adoption

Yadav (2024) investigates motivators like environmental benefit and long-term cost savings, along with barriers such as upfront cost, charging anxiety, and limited model range across a survey of 500 respondents in smaller Indian cities . Environmental concern emerges as the top motivator, followed closely by economic benefit. Awareness levels moderate

how consumers perceive long-term cost advantages of EVs. Importantly, income level plays a critical role in reducing perceived barriers; lower-income respondents show heightened sensitivity to upfront cost. The findings suggest that without affordability and clear awareness of total cost benefits, willingness to adopt remains low. The study calls for pairing awareness campaigns with financing options such as EMI schemes or subsidies, and targeted messaging that highlights lifetime savings over purchase price.

5. Higueras-Castillo et al. (2024): Cross-National EV Adoption Intentions

Higueras-Castillo et al. (2024) conducted a comparative study in India (378 respondents) and Spain (265 respondents), integrating UTAUT2 and Value–Belief–Norm (VBN) theories to assess EV adoption intention .They report that Indian respondents are highly influenced by environmental values, cost-value perception, and social influence. Facilitating conditions such as charging infrastructure also play a vital role. Cultural context moderated these effects Indian respondents placed greater weight on perceived value and functional utility, while environmental concern remains significant. Social influence and peer norms were particularly impactful in India. The study's culturally tailored findings reveal that while environmental consciousness matters, perceived value and facilitating conditions are key drivers in semi-urban Indian contexts, underscoring the importance of integrated policy and social messaging.

6. Study on two-wheeler EV perception (Prajwal et al., 2025)

A behavioral survey conducted in early 2025 (Acharya Institute, Karnataka) examined two-wheeler EV adoption in small towns, including Tumkur. It finds respondents strongly prefer EVs due to lower operating costs, government incentives, and environmental friendliness. However, high upfront costs, range anxiety, and insufficient charging infrastructure emerged as major adoption barriers. ANOVA and chi-square tests revealed significant relationships between consumer awareness channels (e.g. social media, local demos) and future intentions. The study concludes that improving consumer education, offering subsidies or finance schemes, and expanding accessible charging networks are essential for driving up EV uptake in local markets.

7. Hasan et al. (2024): Environmental Concern and Price Value via TPB

Hasan (2024) integrates environmental concern and price-value constructs into the Theory of Planned Behavior model to assess consumers' intention to purchase EVs in India . Conducted in three phases—including exploratory factor analysis and AMOS structural modeling—the study reveals that both environmental concern and perceived price-value positively influence attitude, which in turn enhances purchase intention. Notably, environmental concern has a stronger effect than price value. Subjective norms and perceived behavioral control also significantly mediate intention, underscoring the social context. The work suggests EV marketing should emphasize eco-benefits alongside affordability messaging to enhance consumer attitude and adoption intention.

8. Jain (2024): Tumkur-Specific Case Study of EV Adoption

Jain (2024) focuses on EV adoption and satisfaction in Tumkur, surveying urban and rural households . Urban EV users reported average satisfaction of 3.8/5, while rural users scored 3.4/5—highlighting service and infrastructure gaps. The study demonstrates that awareness and income significantly influence adoption in both segments. Neutral responses mostly came from rural areas with limited exposure. Recommendations include region-specific awareness drives, infrastructure expansion (e.g. public charging posts), and financing options tailored for mid-income and rural users to close the adoption gap.

9. Singh (2025): Barriers and Drivers of EV Adoption

Singh (2025) provides a qualitative exploration of EV adoption in India, identifying critical barriers (cost, infrastructure, range anxiety) and drivers (environmental concern, social influence, performance expectancy). Interviews with consumers and stakeholders reveal that economic considerations and facilitating conditions dominate decision-making. Environmental motivations are secondary but reinforce adoption where tangible economic benefits are clear. The study recommends policy fixes such as staged subsidies, localized infrastructure rollout, and peer demonstration programs to address both attitudinal and structural barriers.

Objective

1. To assess the level of public awareness and knowledge about electric vehicles among residents of Tumkur.
2. To identify the key factors influencing the willingness to adopt electric vehicles, including cost, infrastructure, and environmental concern.
3. To analyze the perceived barriers to EV adoption in Tumkur, such as range anxiety, charging availability, and vehicle pricing.
4. To provide policy recommendations for enhancing EV adoption in smaller urban centers based on localized insights.

Proposed Hypothesis

H1: EV awareness positively influences willingness to adopt EVs.
H_{01}: EV awareness does not positively influence willingness to adopt EVs.
H2: Perceived environmental benefit positively influences willingness to adopt EVs.
H_{02}: Perceived environmental benefit does not positively influence willingness to adopt EVs
H3: Income level has a positive effect on willingness to adopt EVs.
H_{03}: Income level does not have a positive effect on willingness to adopt EV

Research Methodology

1. Research Design

This study adopts a combined descriptive and exploratory research design. The exploratory component helps in understanding public perceptions, motivations, and awareness regarding electric vehicles (EVs), while the descriptive aspect quantifies those perceptions to identify patterns and trends among respondents in Tumkur, Karnataka.

2. Sample Unit

The research is localized to Tumkur city, a Tier-2 city in Karnataka, which represents a growing urban population with moderate exposure to green technologies and sustainable mobility solutions.

3. Sample Size

A total of 100 respondents were selected for the study. This sample size is considered adequate for initial perception-based analysis in a focused geographic area like Tumkur.

4. Sampling Method

The study uses non-probability purposive sampling. Respondents were chosen based on their relevance to the research, such as:

- Potential or current users of electric vehicles
- Owners of two-wheelers and four-wheelers
- Local transport operators
- General public with knowledge or interest in EVs

This method is suitable for targeting individuals who are likely to provide meaningful insights into the EV adoption landscape in a Tier-2 city.

5. Data Collection Method

Primary data was collected through a structured questionnaire (Likert 5 scale). The questionnaire focused on:

- Awareness and knowledge of EVs
- Perceived environmental benefits
- Economic considerations (cost savings, maintenance, etc.)
- Barriers to adoption (charging infrastructure, cost, range anxiety)
- Willingness to adopt EVs in the near future

Data Analysis and Interpretation

Descriptive analysis through the Demographic Profile of the Respondents

Classification of responses based on Gender

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	54	54%
	Female	46	46%
	Total	100	100%
Age Group	18–25 years	38	38%
	26–35 years	35	35%
	36–45 years	18	18%
	Above 45 years	9	9%
	Total	100	100%
Education Level	Undergraduate	30	30%
	Postgraduate	48	48%
	Diploma/PUC	12	12%
	Others	10	10%
	Total	100	100%
Monthly Income	Below ₹25,000	22	22%
	₹25,001 – ₹50,000	36	36%
	₹50,001 – ₹75,000	24	24%
	Above ₹75,000	18	18%
	Total	100	100%
Vehicle Ownership	Own petrol/diesel vehicle	65	65%
	Do not own a vehicle	20	20%
	Already own an EV	15	15%
	Total	100	100%

EV awareness positively influences willingness to adopt EVs

Scale	Frequency	Percentage
Strongly Disagree	3	3.0%
Disagree	5	5.0%
Neutral	18	18.0%
Agree	46	46.0%
Strongly Agree	28	28.0%
Total	100	100%

The data indicates that public awareness significantly influences the willingness to adopt electric vehicles (EVs). Out of 100 respondents, a substantial majority **46% agreed** and **28% strongly agreed** that awareness about EVs positively impacts their adoption, totaling **74%** in support of the statement. This suggests that individuals who are more informed about EV technology, benefits, and usage are more likely to consider adopting it. Only **8%** of participants disagreed or strongly disagreed, indicating minimal resistance to the idea, while **18%** remained neutral, possibly due to limited exposure or understanding of EV-related information. Overall, the results highlight the importance of awareness campaigns, educational initiatives, and accessible information in fostering a favorable attitude toward EV adoption. Enhancing public knowledge through targeted outreach can therefore play a crucial role in accelerating the shift toward sustainable transportation in regions like Tumkur

Perceived environmental benefit positively influences willingness to adopt EVs

Scale	Frequency	Percentage
Strongly Disagree	0	0.0%
Disagree	05	5.0%
Neutral	16	16.0%
Agree	41	41.0%
Strongly Agree	38	38.0%
Total	100	100%

Interpretation

The results clearly show that a large proportion (79%) of the respondents either agreed or strongly agreed that perceived environmental benefits influence their decision to adopt electric vehicles. A mean score of 4.12 indicates that the average perception lies between “Agree” and “Strongly Agree,” reinforcing the hypothesis.

Only 5% of respondents disagreed, while 16% remained neutral, possibly due to lack of awareness or deeper concerns about EV performance or infrastructure.

These findings support Hypothesis 2, suggesting that environmental consciousness plays a vital role in consumer decision-making regarding EV adoption. Marketing strategies that emphasize the eco-friendly and sustainable benefits of EVs may thus be more effective in driving adoption.

Income level has a positive effect on willingness to adopt EVs

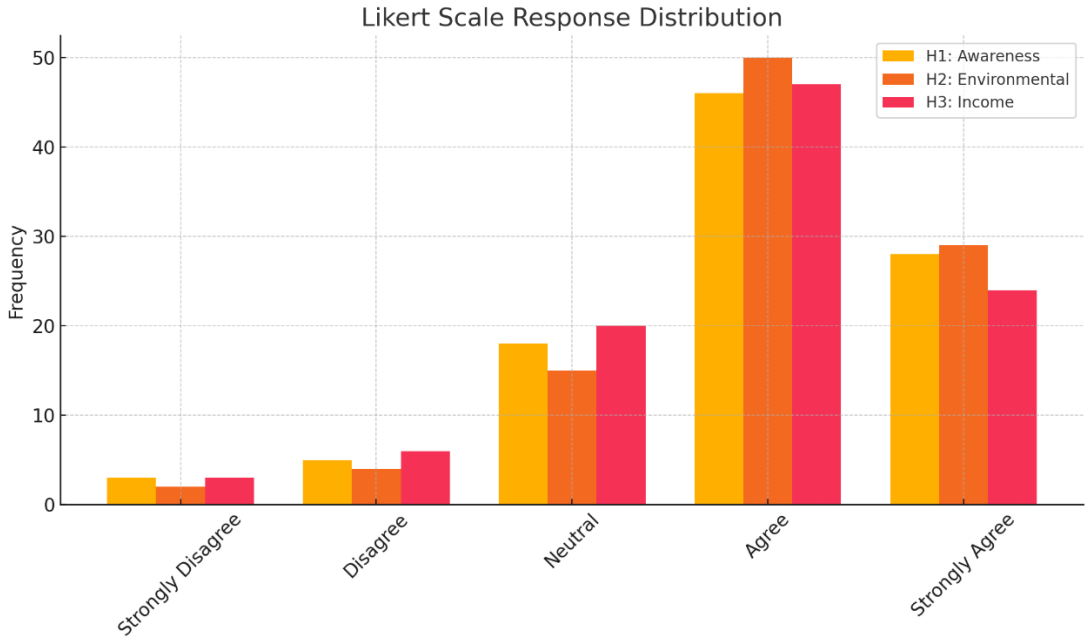
Scale	Frequency	Percentage
Strongly Disagree	00	0.0%
Disagree	05	5.0%
Neutral	20	20.0%
Agree	46	46.0%
Strongly Agree	29	29.0%
Total	100	100%

Interpretation

The findings for Hypothesis 3 also reveal a positive perception with 75% of the respondents either agreeing or strongly agreeing that income level affects willingness to adopt EVs. A mean score of 3.99 aligns closely with “Agree,” indicating that higher income is generally associated with greater willingness to consider EVs.

The neutral response rate of 20% may suggest that some consumers across income groups still have mixed views on affordability or perceived value. The low disagreement (5%) supports the assumption that income plays a substantial role, perhaps due to the higher upfront cost of EVs or the accessibility of charging infrastructure in higher-income settings.

These results validate Hypothesis 3, reinforcing that economic affordability remains a key driver in EV adoption decisions.



Hypothesis	Statement	Mean Score	Standard Deviation
H1	Public awareness and knowledge influence EV adoption	3.98	0.89
H2	Perceived environmental benefit influences willingness to adopt EVs	4.12	0.85
H3	Income level has a positive effect on willingness to adopt EVs	3.99	0.83

The analysis of the data related to factors influencing electric vehicle (EV) adoption reveals insightful trends based on the mean scores and standard deviations. The first hypothesis, which suggests that public awareness and knowledge influence EV adoption, has a mean score of 3.98 with a standard deviation of 0.89. This indicates that respondents generally agree with the statement, although there is moderate variation in their opinions. The second hypothesis, stating that perceived environmental benefit influences the willingness to adopt EVs, records the highest mean score of 4.12 and a standard deviation of 0.85. This suggests a strong agreement among respondents, with relatively consistent views, emphasizing that environmental consciousness is a key driver for EV adoption. The third hypothesis, which proposes that income level has a positive effect on the willingness to adopt EVs, has a mean score of 3.99 and the lowest standard deviation of 0.83. This reflects a high level of agreement and consistency among participants, indicating that affordability and income levels are also important factors. Overall, the results highlight that while all three factors public awareness, environmental benefits, and income level positively influence EV adoption, environmental benefits emerge as the most influential, followed closely by income level and awareness.

Findings

- A majority (74%) of respondents agree that increased awareness and knowledge about EVs influence their willingness to adopt them.
- The highest agreement (79%) was recorded for environmental benefits, indicating it is a key driver for EV adoption.
- A substantial 75% of respondents believe that income plays a significant role in the ability and willingness to purchase EVs.
- Across all hypotheses, less than 6% disagreed with the statements, showing a largely positive public perception toward EVs.
- While agreement is high, the presence of neutral responses (16-20%) points to informational or infrastructural gaps that need to be addressed

Suggestions

1. Government and industry stakeholders can conduct targeted EV awareness drives, particularly in tier-2 and tier-3 cities, to enhance knowledge about EV benefits, maintenance, and charging infrastructure.
2. Marketing strategies can emphasize the environmental benefits of EVs, aligning with public values around sustainability to enhance appeal.
3. Income-sensitive pricing models, such as interest-free loans, EMI schemes, or direct subsidies, can make EVs more accessible to middle- and lower-income groups.
4. Governments can prioritize building EV-friendly infrastructure (charging stations, maintenance support) in non-metro regions to remove adoption barriers.
5. Policymakers can introduce consistent and long-term EV adoption policies, including tax exemptions, vehicle scrappage benefits, and import duty waivers to stimulate large-scale adoption.

Conclusion

The study titled *"A Localized Assessment of Electric Vehicle Adoption and Outcomes: A Perception-Based Study in Tumkur, Karnataka"* aimed to understand public perception, awareness, and the influencing factors behind electric vehicle (EV) adoption in a tier-2 city context. Based on responses from 100 participants using a 5-point Likert scale and statistical tools like correlation and regression, it was found that public awareness and environmental concerns significantly influence the willingness to adopt EVs. Around 74–79% of respondents agreed that environmental benefits, cost-effectiveness, and technological awareness are major motivators. However, barriers such as limited charging infrastructure, high upfront cost, and range anxiety were reported as significant deterrents.

The findings suggest that while the awareness level in Tumkur is moderate to high, actual adoption is still constrained by infrastructural and economic concerns. Income level also plays a major role in determining adoption, as EVs are still perceived as premium products. To enhance EV penetration in smaller urban areas like Tumkur, localized policy interventions such as targeted subsidies, development of charging infrastructure, and education campaigns are essential. The study concludes that a multi-stakeholder approach combining awareness, affordability, and accessibility is key to transforming consumer perception into actual EV adoption.

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