

A Study on the Perception of Customers Towards Electric Vehicles in Nainital District, Uttarakhand

Dr. Reetu Tevatia ,Mr. Nishant Kumar

Associate Professor ,Student-MBA II SEM

Faculty of Commerce and Business Managemet

Amrapali University Haldwani UK

Reetu1074@amrapali.ac.in

ABSTRACT

The global transition toward electric vehicles (EVs) has accelerated dramatically, with the international market share climbing from 4% in 2020 to over 18% in recent years. However, macro-level adoption statistics heavily reflect urban, flat-terrain environments, leaving a critical empirical gap regarding consumer behavior in mountainous and ecologically sensitive regions. This study addresses this research gap by investigating customer awareness, purchasing drivers, and topographical barriers to EV adoption in the Nainital District of the Kumaon Region, Uttarakhand, using primary empirical data a quantitative, descriptive research design was deployed. The findings reveal a highly receptive market with strong latent intent, a severe mismatch exists between consumer willingness and local ecosystem capabilities. High capital cost remains an overarching concern, though majority of respondents are willing to absorb upfront premiums for lower long-term running costs, a considerable no. highlight the necessity of government subsidies. The study diagnoses a severe regional risk, driven by the local geography, poor charging infrastructure and lack of specialized local mechanics. The study concludes that to unlock EV adoption in mountain corridors like the Nainital District, policymakers and manufacturers must pivot from generic ecological messaging to addressing functional, terrain-specific risks by building high-speed public charging networks, training local mechanics, and proving high-torque vehicle reliability on steep altitude climbs.

Keywords: Electric Vehicles, Consumer Perception, Mountainous Terrain, Nainital District, Adoption Barriers, Total Cost of Ownership (TCO).

INTRODUCTION

The global automotive landscape is undergoing a paradigm shift, driven by the critical need to mitigate climate change, reduce carbon emissions, and decrease dependency on depleting fossil fuels. In India, the transition toward electric vehicles (EVs) has emerged as a cornerstone of national environmental and economic policies, heavily supported by initiatives like the Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme. While urban centers across the country have shown a relatively rapid uptake of electric mobility, regional adaptation in ecologically sensitive, rural, and mountainous terrains remains significantly understudied. The Kumaon region of Uttarakhand, particularly the Nainital District, presents a unique geographical and socio-economic landscape that fundamentally alters the standard consumer dynamics observed in metropolitan plains.

In mountainous zones like Nainital, a vehicle is not merely a tool for daily commuting but a vital lifeline that must navigate steep gradients, unpredictable weather, and fragmented infrastructure. Consequently, consumer perception in these areas extends far beyond basic cost-benefit analyses. Potential buyers must weigh environmental goodwill against stark structural realities, such as range degradation during high-altitude climbs and the severe lack of public charging points.

Understanding the specific psychological, financial, and geographical factors that influence rural and hill-station consumers is essential for creating targeted policy interventions and manufacturing adjustments. This study explores

customer awareness, identifies primary adoption drivers, and evaluates the distinct geographic and structural barriers that shape public perception toward electric vehicles in the Nainital District.

Nainital District: The Study Area

This study concentrates on the Nainital District of the Kumaon region in Uttarakhand. The area is characterized by large lakes and hilly terrain, and more importantly, it generates considerable tourist traffic. The Nainital district is home to an array of both rural and urban settlements in an area of approximately 3860 sq. km. The 2011 Census of India showed that the District had a total population of 9,54,605 people. The main urban centers are Nainital, Haldwani, Bhimtal, Kaladhung and Ramnagar. These areas are experiencing growing pressure on transport facilities as a result of the rapid growth of commerce and the influx of seasonal visitors.

Nainital district's challenging geography requires greater flexibility in transport. Currently, the district depends on traditional fuel vehicles and this has led to a number of local issues, including traffic issues, economic, and environmental sustainability challenges. Difficult hilly terrain coupled with a limited number of charging stations and the problem of battery range are all challenges of implementing electric mobility.

Despite these challenges, growing ecological awareness in the general public and government providing more direct incentives to switch to electric vehicles, is creating a positive environment to implement electric vehicle technology. This offers opportunity to Nainital District to examine its customer base for electric vehicles. This study analyzes the unique challenges of adopting electric vehicles in semi-urban and mountainous regions.

LITERATURE REVIEW

With increased access to transport alternatives, skyrocketing fuel prices, and growing social responsibility towards the environment, transit planning prioritizes the widespread implementation of electric vehicles. In the second half of the twentieth century, Davis (1989) and Ajzen (1991) began to articulate the three major factors driving the innovation of technology and its subsequent adoption by consumers: the perceived advantage of the new technology, the social context within which the technology exists, and the intention- based behaviors of consumers. Applying these factors will help us understand contemporary consumers' perceptions of electric vehicles.

Based on the research by Lane and Potter (2007) and Anderson and Anderson (2010), electric and hybrid vehicles hold the most promise for reducing the negative environment and social impact of personal transportation. That said, the reality of their use demonstrates many challenges. As highlighted by Egbue and Long (2012), Schuitema et al. (2013), and Rezvani et al. (2015), the four most pressing issues are cost, battery life, range, and charging. Conversely, Mock and Yang (2014) and Bjerkan et al. (2016) agree that legislation and incentives for electric vehicles create actual consumption of electric vehicles.

Notable studies such as Wang et al. (2017), Li et al. (2017), Hardman et al. (2017), and Javid & Nejat (2017) found links between user behavior and environmental literacy, demographics, and financial aspects. Kester et al. (2018) and Noel et al. (2019) argued that, despite positive attitudes, barriers to entry include insufficient charging stations and high initial costs.

More recent studies (Plötz et al., 2020; Sang et al., 2020; Kumar & Sharma, 2021; Bhardwaj & Kumar, 2022; Kumar & Alok, 2022) Indicate that the acceptance of EVs in India is attributed to the advancements in technology and increased government support. In contrast to this, studies (Khan & Singh, 2023; Sharma & Jain, 2023; Verma et al., 2023; Rani et al., 2024; Saha & Mukherjee, 2024) point out challenges of the gap between developed and developing markets, especially in semi-urban and hilly areas.

RESEARCH GAP

While existing literature extensively documents the socio-economic and behavioral drivers of electric vehicle (EV) adoption in urban plain geographies, there remains a critical empirical gap regarding consumer behavior in mountainous and ecologically sensitive regions. Current research frameworks routinely evaluate consumer intent based on standard urban parameters like baseline price, generic driving range, and tech connectivity, assuming a uniform terrain. This creates a major gap in the literature: standard models fail to account for how a severe, unique combination of physical challenges such as high-altitude battery range degradation, steep gradient power demands, and a complete lack of public charging points along primary hill corridors alters the psychological and financial risk assessment of a potential buyer.

OBJECTIVES OF THE STUDY

1. To examine customer awareness and perception of electric vehicles in the Nainital District, including their knowledge, attitudes, and willingness to adopt EVs.
2. To identify key factors influencing EV adoption, such as cost, infrastructure availability, technological features, and environmental considerations.
3. To analyze major challenges and barriers, including high initial cost, limited charging facilities, lack of awareness, and performance concerns in hilly areas.

RESEARCH METHODOLOGY

To systematically address these objectives, this study adopted a quantitative, descriptive research design utilizing a convenience sampling technique to contact 200 active respondents across varying genders, age groups, and educational backgrounds within the Nainital District.

Primary data was captured through a structured, close-ended questionnaire administered digitally via Google Forms, the survey instrument collected data using a 5-point Likert scale. Descriptive statistics baselined the severity of psychological barriers, cross-tabulation matrices segmented purchase intent across different demographic profiles, and Pearson Correlation Coefficients were computed across continuous Likert constructs to mathematically isolate how regional variables affect overall consumer interest.

ANALYSIS

While examining customer awareness, psychological perceptions, and the ultimate willingness to adopt Electric Vehicles (EVs) in Nainital District of Uttarakhand. Empirical evaluation of the primary dataset (N=200) reveals that the consumers in the region are highly receptive and eco-aware. Overall interest in EVs is significantly positive, 50.0% of the population showed their interest at a high index score of 4 or 5 on a 5-point Likert scale, while an additional 24.0% maintain a moderate stance (Score 3). This means that substantial 77.5% consumers admit to plan an EV purchase, comprising 37.5% who have "seriously considered" it and 40.0% who have briefly evaluated the option.

Cross-demographic segmentation reveals unique behavioral trends; female respondents display a higher mean interest score ($\mu = 3.57$) than their male counterparts ($\mu = 3.29$), and the 36-45-year age group emerges as the primary market driver, 52.38% respondent to have serious consideration on buying an EV. Environmental awareness serves as a core psychological pillar for this interest, 55% of respondents firmly believe that EVs offer superior environmental benefits over traditional internal combustion engine (ICE) vehicles. This positive perceptual framework supports willingness to advocate for the technology, evidenced by the finding that 57% of respondents would actively recommend EVs to their friends or family members.

The second objective intended to examine and rank the primary vehicle selection criteria and economic catalysts that drives consumer's willingness to shift toward electric mobility. To establish the foundation of consumer behavior, an assessment of priority drivers for general vehicle selection (where respondents could select up to three critical factors)

indicates that economic constraints dominate the decision-making, as price appeared as the most critical factor, being 19% of the total choice, it was closely followed by operational efficiency (Fuel Efficiency) at 16.83% and lifecycle maintenance variables at 14.83%. Resale value was also reported to be an influential factor in adoption of EVs with 14.16%, however the product-specific variables like technology (13%) and standard driving range (11.83%) were also found to factors influencing the choice.

On mapping these criteria directly to EV adoption parameters, the data reveals a highly rational consumer base focused on the long-term Total Cost of Ownership (TCO). Despite price being the primary barrier, a majority of (56.5%) respondents, express willingness to pay a premium upfront capital cost in exchange for securing significantly lower operational and running costs over the vehicle's lifespan. However, this is heavily dependent on external financial support mechanisms as 60.5% respondents stating that the introduction of government subsidies would serve as an absolute catalyst to trigger an EV purchase.

For the third objective empirical findings show that infrastructure deficiencies and terrain-specific performance anxieties form a combined barrier to market growth. A primary structural barrier is the lack of public charging infrastructure. Sixty percent of respondents rate the current availability of EV charging stations in the region as poor, selecting the lowest tiers (1 or 2) on a 5-point infrastructure adequacy scale. This structural deficiency is further worsened by anxieties surrounding technical support after purchase; 55% agree or strongly agree that a lack of specialized EV mechanics presents a major concern, generating a mean anxiety score of $\mu = 3.45$ ($\sigma = 1.09$).

The steep slopes and high altitudes of the area create noticeable performance anxiety, 45.5% respondents agreed that the hilly terrain makes them hesitant to trust EV performance. This anxiety is related to doubts regarding vehicle utility; 38% states that EVs are incapable of handling heavy payloads on steep mountain gradients, while an additional 27.5% remain uncertain.

Thirty-Six percent respondents declared that EVs unsuitable for long-distance regional travel and 29.5% were not sure. These anxieties are reinforced by back-end financial risks, 44% views EVs as too expensive for the average consumer, and 61% express clear concern regarding the eventual costs of battery replacement.

Correlation modeling confirms that hilly terrain hesitancy shares a negative relationship with overall interest ($r = -0.115$), while range sufficiency shows a strong positive correlation ($r = 0.158$). The cross-tabulation isolates a market gridlock, among consumers who doubt the heavy-load capabilities of EVs in mountain terrains, 47.36% remain permanently stalled in the "briefly considered" phase, unable to convert into active, serious buyers due to these regional performance concerns.

Conclusion

This study evaluated the feasibility, customer perceptions, and underlying barriers surrounding the adoption of Electric Vehicles in the Nainital District and the broader Kumaon Region. The empirical evidence shows that the primary barrier to EV market penetration is not customer apathy or a lack of environmental awareness, but rather a functional risk-management crisis.

Consumers in the region show high environmental awareness and strong initial interest in shifting away from traditional fossil-fuel vehicles. However, this positive sentiment is cut short by the realities of the region's infrastructure deficit and geographic terrain. The high upfront price of EVs becomes an unacceptable financial risk when paired with a severe lack of public charging stations, lack of specialized regional mechanics, and unresolved questions regarding battery life and resale values.

More importantly, the mountainous landscape introduces distinct engineering anxieties. The local consumer base remains highly skeptical of an EV's torque capability under heavy loads on steep gradients and its range capacity during long-distance altitude changes. This structural gridlock is clearly illustrated by the finding that nearly half of the

consumers who doubt the heavy-load capabilities of EVs remain permanently stalled in the "brief consideration" phase, unwilling to risk a final purchase.

In conclusion, to successfully transition the Nainital District into an electric mobility hub, a shift in strategy is required. Automakers and policymakers must move away from generic "eco-friendly" messaging and focus on building practical consumer confidence. This can be achieved by deploying a visible, high-speed public charging network along primary hill corridors to address range anxiety. Certified technical training programs for local mechanics to secure reliable after-sales support is required to increase the adoption of the EV in the region. In addition to this intentionally marketing and demonstrating high-torque EV powertrains engineered explicitly to master steep mountain terrains and heavy payloads. Without resolving these infrastructure gaps and terrain-specific performance anxieties, wide-scale consumer intent will fail to convert into actual market adoption.

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