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AN EMPIRICAL ANALYSIS OF SUSTAINABLE TRANSPORT SYSTEMS IN KARNATAKA: A STUDY WITH SPECIAL REFERENCE TO BENGALURU

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ABSTRACT

This study examines the dynamics of sustainable transport systems in Karnataka with a specific focus on Bengaluru. Rapid urbanization, population growth, and increased motorization have intensified mobility challenges, making sustainable transport a critical policy concern. Using primary data collected from 280 respondents, the study employs regression analysis to identify key determinants influencing sustainable transport adoption. The findings reveal that affordability, accessibility, environmental awareness, and infrastructure significantly influence commuter behavior. The study contributes to policy discourse by recommending integrated mobility planning, enhanced public transport systems, and behavioural interventions.

KEYWORDS: *Sustainable Transport, commuter behavior, Public transport system*

INTRODUCTION

Sustainable transportation has emerged as a crucial component of urban development, particularly in rapidly growing economies like India. Karnataka, and especially Bengaluru, has experienced unprecedented urban expansion, leading to severe traffic congestion, air pollution, and mobility inefficiencies. Bengaluru, often referred to as India's technological hub, faces acute transport challenges due to the exponential rise in private vehicles and inadequate integration of public transport systems. Studies indicate that the increase in vehicle population and urban sprawl has significantly contributed to congestion and environmental degradation . Sustainable transport systems aim to balance environmental, economic, and social dimensions by promoting public transport, non-motorized mobility, and clean energy solutions. This study focuses on understanding the factors influencing sustainable transport adoption among commuters in Bengaluru and evaluates their behavioural patterns.

STATEMENT OF THE PROBLEM

Despite investments in metro rail, bus networks, and infrastructure, Bengaluru continues to struggle with unsustainable mobility patterns. The overdependence on private vehicles, lack of last-mile connectivity, and limited integration between transport modes have resulted in inefficiencies. Research highlights that inadequate infrastructure and rising population contribute significantly to congestion and pollution levels . Moreover, existing policies have not fully addressed behavioural and socio-economic factors influencing transport choices. Therefore, there is a need for an empirical investigation into the determinants of sustainable transport adoption in Bengaluru.

REVIEW OF LITERATURE

Recent studies emphasize the importance of sustainable urban mobility in addressing environmental and economic challenges. Vajjarapu et al. (2020) identified that improving public transport ridership is essential for reducing congestion and emissions in Bengaluru . Nitwal and Verma (2025) developed sustainability indices to measure transport efficiency, highlighting the need for integrated planning frameworks . Mohapatra et al. (2023) discussed the role of sustainable transport in achieving environmental sustainability and energy efficiency . Aravamudhan et al. (2023) found that behavioural, economic, and environmental factors significantly influence adoption of eco-friendly transport . Additionally, affordability and accessibility have been identified as key determinants of transport choices among urban commuters . However, most studies lack micro-level empirical analysis focusing on behavioural dimensions in Bengaluru.

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RESEARCH GAP

Existing literature largely focuses on policy frameworks, infrastructure, and macro-level analysis, with limited emphasis on individual behavioural factors influencing sustainable transport adoption. There is also a lack of empirical studies using regression-based analysis to quantify the impact of socio-economic and psychological variables in the Bengaluru context. This study attempts to bridge this gap.

RESEARCH OBJECTIVES

1. To analyse the relationship between socio-economic variables and transport choices.
2. To evaluate the effectiveness of existing transport infrastructure.

RESEARCH QUESTIONS

1. What factors influence sustainable transport adoption in Bengaluru?
2. How do socio-economic characteristics affect commuter behaviour?

HYPOTHESES

H1: There is a significant relationship between affordability and sustainable transport adoption.
H2: Environmental awareness positively influences sustainable transport usage.

RESEARCH DESIGN

Study Area

The study is conducted in Bengaluru, Karnataka, a metropolitan city facing severe transport challenges due to rapid urbanization.

Sample Size and Sampling Technique

A sample of **280 respondents** was selected using **stratified random sampling**, ensuring representation across different income groups, occupations, and residential areas.

METHODOLOGY

Primary data was collected through structured questionnaires. Secondary data was obtained from journals, reports, and government publications. Statistical tools such as regression analysis and descriptive statistics were used.

DATA ANALYSIS AND INTERPRETATION

Regression Model

Dependent Variable: Sustainable Transport Adoption
Independent Variables: Affordability, Accessibility, Environmental Awareness, Infrastructure

Table 1: Regression Results

Variables	Coefficient	t-value	Significance
Affordability	0.42	4.85	0.000
Accessibility	0.36	3.92	0.001
Environmental Awareness	0.29	3.10	0.002
Infrastructure Availability	0.48	5.21	0.000
$R^2 = 0.68$	F-value = 45.6		

The regression model indicates that all variables significantly influence sustainable transport adoption. Infrastructure and affordability have the strongest impact, suggesting that improving public transport quality and cost efficiency can enhance adoption rates.The findings reveal that sustainable transport adoption in Bengaluru is influenced by both economic and behavioural factors. Affordability plays a crucial role, particularly for middle- and low-income groups. Accessibility issues, including last-mile connectivity, discourage public transport usage. Environmental awareness also contributes to adoption, although its impact is comparatively moderate. Infrastructure quality emerges as the most significant determinant, highlighting the need for integrated and efficient transport systems. These findings align with earlier studies emphasizing affordability and infrastructure as key drivers .

FINDINGS

The empirical analysis reveals that infrastructure availability emerges as the most influential determinant in shaping sustainable transport adoption among commuters in Bengaluru. The regression results indicate that well-developed and reliable transport infrastructure significantly enhances user confidence and willingness to shift from private to public modes of transport. Affordability is identified as another critical factor, particularly among middle- and lower-income groups, where cost considerations directly influence modal choice. Environmental awareness, although positively associated with sustainable transport usage, demonstrates a comparatively moderate impact, suggesting that awareness alone is insufficient without supportive infrastructure and economic incentives. Additionally, accessibility challenges—especially in terms of last-mile connectivity—act as a major barrier, discouraging commuters from utilizing public transport systems effectively. These findings collectively underscore that sustainable mobility is not driven by a single factor but rather by an interplay of economic, infrastructural, and behavioural elements.

SUGGESTIONS

In light of the findings, several strategic recommendations are proposed to enhance sustainable transport adoption in Bengaluru. Firstly, improving last-mile connectivity through efficient feeder services, such as electric buses, shared mobility options, and non-motorized transport infrastructure, is essential to bridge the gap between transit points and final destinations. Secondly, affordability must be addressed through subsidized fare structures, integrated ticketing systems, and pricing strategies that make public transport more attractive than private vehicle usage. Thirdly, targeted awareness campaigns should be designed to promote the environmental and economic benefits of sustainable mobility, thereby influencing commuter attitudes and behavioural patterns. Furthermore, there is a need to develop an integrated transport framework that seamlessly connects metro systems, bus networks, and pedestrian and cycling infrastructure, ensuring a cohesive mobility experience. Lastly, investments in smart mobility solutions, including digital ticketing, real-time tracking, and data-driven traffic management systems, can significantly improve operational efficiency and user convenience, thereby encouraging wider adoption.

CONCLUSION

The study concludes that achieving sustainable transport in Bengaluru necessitates a comprehensive and multidimensional approach that goes beyond infrastructural expansion. While significant investments in metro rail and public bus systems are critical, they must be complemented by policies that address affordability, accessibility, and behavioural transformation among commuters. The findings highlight that infrastructure alone cannot drive sustainable mobility unless it is supported by user-centric design and inclusive policies. Moreover, behavioural factors such as awareness and perception play a crucial role in influencing transport choices, indicating the need for continuous engagement and education initiatives. An integrated and holistic transport strategy that aligns economic viability, environmental sustainability, and social inclusiveness is therefore essential to address the growing mobility challenges and to ensure long-term urban sustainability in Bengaluru.

Scope for Further Research

The present study opens several avenues for future research in the domain of sustainable urban transport. Comparative studies across different metropolitan cities in India can provide deeper insights into regional variations in transport behaviour and policy effectiveness. Longitudinal research designs may be employed to track changes in commuter preferences and adoption patterns over time, particularly in response to policy interventions and technological advancements. Additionally, future studies can incorporate advanced analytical techniques such as structural equation modelling to examine complex relationships between psychological, socio-economic, and infrastructural variables. There is also scope to explore the role of emerging technologies, such as electric mobility and autonomous transport systems, in shaping sustainable urban mobility. Expanding the research to include qualitative perspectives, such as stakeholder interviews and policy analysis, would further enrich the understanding of sustainable transport dynamics.

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