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Consumer Satisfaction And Service Quality Assessment Of The Kochi Water Metro System: A Case Study In Ernakulam District, Kerala

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Abstract: Water-borne transportation is becoming more broadly accepted, efficient, economical and sustainable mode of urban mobility, especially for places with natural waterways. It brings down emissions, improves connectivity, reduces traffic congestion and promotes balanced regional growth. Kochi, a coastal metropolis in Kerala, holds strategic significance due to the existence of the historic Kochi port and the vast backwater network and is one of the primary maritime commerce hubs in India. The presence of extensive navigable water channels has made Kochi a distinctive place for effective marine public transportation. Considering this, Kochi Water Metro, which incorporates environmentally friendly, contemporary, electric-powered catamarans with integrated multi-modal urban transport design, is an innovative milestone in India's mobility infrastructure.

The main aim of this study is to evaluate customer satisfaction with the Kochi Water Metro by examining key factors of service quality, including accessibility, comfort, cleanliness, safety, fare affordability, employee behaviour, timely service and digital ticketing convenience. The results indicate overall favourable consumer opinions, especially in terms of hygiene, staff assistance and safety. However, the research highlights the need for improvement in terms of seating comfort, service frequency and first- and last-mile connectivity. The study demonstrates the potential of the Kochi Water Metro to transform into a reliable, inclusive and sustainable public transportation system that will substantially reduce traffic, enhance urban living conditions and promote green mobility.

Index Terms **-** Consumer Satisfaction, Green Mobility, Kochi Water Metro, Public Transportation Systems, Service Quality, Urban Mobility, Water-Borne Transportation.

I. INTRODUCTION

The rise of urban mobility and transportation system plays a significant role in the economic and social development of urban areas. In Kochi, one of the most important projects in recent years is the Kochi Water Metro. It is a pioneering initiative aimed at improving the public transportation network by using the city's extensive water channels. The Water Metro project is designed to improve the interconnection between islands and mainland. It aims to provide a substitute to the congested road network, offering an efficient and sustainable solution for daily passengers. Among the different routes of the water metro, Vyttila to Kakkanad route is specifically noteworthy. This route is a major transportation, IT and business hub of Ernakulam, representing two key places that stand to gain from enhanced connectivity.

The study employs a combination of primary and secondary research methods to collect relevant data. Survey and structured interviews were conducted with passengers who aboard the Water Metro and at major terminals. Secondary data includes previous research, official records and service reports, which will supplement the primary data. A sample size of 128 passengers with different demographic feature is selected to ensure that the study captures a range of commuter experience.

In depth understanding of consumer satisfaction level is essential for evaluating the efficacy of the Water Metro service and for identifying areas for improvement. This research seeks to investigate the passenger satisfaction along the Vyttila to Kakkanad Water Metro route. By inspecting passenger's expectations, experience and perceptions this study aims to evaluate the service quality provided including aspects such as comfort, convenience, punctuality and safety. The research will also survey how several demographic factors, including age, gender, occupation, income and travel frequency, effect the level of commuter satisfaction. Moreover, the study aims to expose any challenges faced by passengers, namely delays, overcrowding, accessibility issues or safety concerns, and how these factors influence the overall consumer experience.

The result of this study offers actionable knowledge for stakeholders, policymakers and transportation authorities involved in the operation and development of Water Metro, promoting better delivery of services and a stronger multimodal transportation network in Kochi. The suggestions derived from the research aims to make the Vyttila to Kakkanad route more reliable, efficient and user-friendly, ultimately enhancing overall passenger satisfaction and encouraging more people to choose water- based transportation system. By concentrating on Vyttila-Kakkanad route, the study will provide a detailed evaluation of the Water Metro's performance in one of the pivotal parts of Kochi's metropolitan transportation network. The findings will not only benefit passengers but also provide support for developing future policies and make improvements for a better Water Metro project. Overall, this research will help in promoting sustainability and effectiveness of public transport in Kochi.

II. SIGNIFICANCE OF THE STUDY

Research on the level of consumer satisfaction in the Kochi Water Metro service, with a special emphasis on Vyttila-Kakkanad route, is crucial as it provides valuable insights into the effectiveness of an eco-friendly and innovative public transport system. This route being a major passageway, directly affect the daily travelling experience of workers, residents, and tourist in the rapid growing region of Kochi. This study seeks to explore how well the water-based transportation system meets the needs and expectations of its consumers. The Kochi Water Metro is a unique innovative idea developed to provide an alternative transportation mode reducing traffic issues and encouraging sustainable urban mobility.

This study will explore the perceptions of consumers who frequently use the Vyttila to Kakkanad route, which connects important residential, business and commercial hubs in Kochi. The prime objective of this study is to measure the customer satisfaction level related to various factors of Water Metro service. Punctuality, comfort, cleanliness, fare affordability, efficiency of booking system and quality of customer service are the major aspects under investigation. Studying these factors help to understand areas for improvement and provide a detailed picture of the passenger experience. This will support transit authorities, service providers and policymakers to understand areas for improvement, ensuring better service quality and higher promotion. This research highlights the potentiality of the Water Metro to tackle traffic problems, reduce pollution and contribute to future transportation goals leading to sustainable urban mobility. Additionally, the result could also serve as a model for similar projects in other cities.

III. REVIEW OF LITERATURE

The rich heritage and culture of an area indicate its distinctive history and development over the period of time. Kochi, a metropolitan port city on the Malabar coast of India bordering the Arabian sea, is a part of Ernakulam district in the State of Kerala. It has grown from a small coastal settlement to economic and tourism centre of Kerala. After Independence, Kochi underwent enormous development and demographic changes; it

became a metropolitan port city with massive maritime and economic significance and became a logistics transport centre **(Munoth et al., 2025).** Kochi is identified as the 'queen of Arabian sea', the city is also the financial capital of the state, thus becoming a popular commercial and trading hub. At present, Kochi is making progress, with the addition of wider bridges, highways, flyovers, ro-ro services, metro services, airports and the latest achievement in the growth story of Kochi is the Water Metro. These developments in transportation encourage the easier and smoother mobilization of the people in Kochi **(Prasad & TB, 2023).**

Since Kochi is the largest and one of the most densely populated cities in Kerala, this geography is unique and highlights the significant role of water-based transport in providing transportability for these island communities. There is no doubt that the water channels connect the islands and the villages with the main land. The city has an extensive background in the fishing industry and has dependent on water transport since the early days of settlement. Thus, the waterways have always been an important structure in a city like Kochi **(Joshy et al., 2023).** In our country, limited amount of research has been conducted on water borne transport due to its relatively uncommon usage. However, it is critical for cities with access to waterways to encourage and enhance this affordable and sustainable mode of transportation.

Coastal cities around the world are places of high vulnerability. The problems are acute in developing countries where the challenges posed by the urbanisation and climate change increase the existing risks. Kochi is located at the centre of an increasingly urbanizing coastal and estuarine area. It is characterised by crisscrossing rivers and canals connected to a backwater system. Waterways used to play a prominent role in the socio-economic and cultural development of the city. They not only promoted the commerce and economy but also connected communities, supported a rich and diverse ecosystem and provided livelihood opportunities. However, poor planning and management of the industrialization and urbanization processes resulted in the ignorance and greater exploitation of this resource over the years, weakening its ability to support both ecology and connectivity. In the recent years, due to increasing recognition of climate change, and need for both reduction and adaptation, there has been a renewed interest in investing in waterways to improve connectivity in the area **(Aziz et al., 2018).**

Kochi, has a water-based transportation system that offers significant travel time reduction compared to road transport. Despite this advantage, the passengers of the water transport system in Kochi have not met expectations. With the road infrastructure and public transportation nearing saturation, there is an urgent need to prioritize and promote the utilization of water transport for the city's future. Studies reveal that there is a shift towards water transport and this shift is because of the modifications in factors such as passenger comfort, waiting times and the travel fare. Significantly, these aspects were identified as the most significant considerations for individuals when making decisions about their transportation mode **(Nirannanilathu & Gupta, 2024)**. When we consider other modes of transportation, water-based transportation has the least negative impacts. Nearly fifty percent of Kochi is surrounded by water and has the capacity to develop more water transportation routes. Through these routes we can access the main centers of the city **(Ann & Sujith, 2021).**

After being neglected for several years, water transportation has re-emerged in the transportation sector due to increasing traffic congestion, excessive consumption of energy, and environmental crises. The first water metro system in India, an integrated electric ferry transit system, was initiated by Kochi, making it the first in Asia. The recently developed public transportation system is aimed to serve commuters as well as recreational passengers. However, commuter data shows that passengers are still hesitant even though recreational users have embraced the system. **(Jayakodi et al., 2025).**

Kochi Metro Rail Limited (KMRL) launched the ground-breaking and innovative Kochi Water Metro, India's first integrated water-based public transport system, with the objective of offering convenient, effective and sustainable transportation alternative **(George et al., 2025).** The Water Metro has become a revolutionary

urban mobility initiative, improving connectivity while simultaneously mitigating traffic congestion on roads. The project's sustainable practices have reduced carbon footprint, leading to environmental sustainability. Economic benefits have accrued through increased tourism, employment opportunities and improved local livelihoods. The Water Metro's adaptability to local conditions and changing needs further emphasize its sustainability. The Kochi Water Metro serves as a beacon for equitable and sustainable transportation solutions. It serves as a framework for policymakers, providing practical lessons in project implementation, especially its integration with existing modes of transport improves overall urban mobility **(Joseph & Elias, 2024).**

IV. OBJECTIVES OF THE STUDY

1. To evaluate the passenger satisfaction with the Kochi Water Metro service along the Vyttila-Kakkanad route.
2. To assess the quality of the service provided by the Kochi Water Metro System.
3. To study the key factors influencing passenger preference and satisfaction with the Kochi Water Metro service when compared with other modes of transport.
4. To identify the travel frequency and usage patterns of the passengers of the Kochi Water Metro across different demographic groups.

V. RESEARCH METHODOLOGY

This research aims to get an in-depth understanding of the passenger satisfaction and service quality of the Kochi Water Metro service on the Vytilla-Kakkanad route in the Ernakulam district of Kerala. The sample of the study consist of 128 passengers who frequently use the Kochi Water Metro Service along the Vytilla-Kakkanad route. A mixed method approach, combining quantitative and qualitative research method is employed to explore the consumer preferences and behaviours. For the study a random sampling technique is employed to ensure representativeness. Both primary and secondary data were used for the study. Primary data were collected from water metro passengers through a structured questionnaire and face to face interviews. Secondary data sources include journals, articles, research papers, websites, official reports and publications. In-depth interviews and focus group discussions were also conducted to gather qualitative insights about the consumer satisfaction and service quality of the Kochi Water Metro service. For analysing the data, statistical methods like percentage analysis, frequency distribution and tabular method are employed.

VI. RESULT AND DISCUSSIONS

This research provides a comprehensive insight about the consumer satisfaction and service quality of Kochi Water Metro. Data was collected from 128 passengers who frequently travel along the Vytilla-Kakkanad route. This collected data was analysed to understand the objectives of the study. This section provides a detailed picture of overall passenger satisfaction, experience and behaviour, factors influencing consumer preference and the quality of service provided by Kochi Water Metro.

1. Overall Passenger Satisfaction with the Kochi Water Metro Service

Passenger perception is a crucial indicator for measuring service performance of the Kochi Water Metro. Understanding this aspect helps in examining how effectively the Water Metro satisfies consumer expectations. This study aims to assess the passenger satisfaction level with the Kochi Water Metro service by evaluating the comfort level, reliability, and convenience along the Vyttila-Kakkanad journey. Satisfaction with seating arrangements was used to evaluate comfort, service frequency of the Water Metro was used to evaluate reliability, and the ticketing process to evaluate convenience. This section provides a comprehensive

outline of the passenger experience by examining these factors. This will highlight both the strength and weakness of the Water Metro System.

Table 1: Overall Passenger Satisfaction with the Kochi Water Metro Service

Variable	Category	Percentage (%)
Seating Comfort	Very Comfortable	38.29
	Neutral	47.65
	Uncomfortable	5.46
	Very Uncomfortable	8.60
Service Frequency (Reliability)	Frequent	32.03
	Neutral	51.57
	Infrequent	10.94
	Very Infrequent	5.46
Ticketing Process (Convenience)	Simple	45.31
	Neutral	38.28
	Complicated	10.94
	Very Complicated	5.47

Source: Primary Data

Responses from the passengers indicate favourable satisfaction level with respect to comfort, reliability, and convenience. 38.29% of the respondents consider seating comfort as very comfortable, 47.65% rated it as neutral. This shows that many of the passengers feel sufficiently accommodated but still some have greater expectations. 14.06% of the passengers expressed discomfort (uncomfortable & very uncomfortable). About service frequency, 32.03% of respondents claim the service is frequent, 51.57% are neutral, and 16.4% claim it is infrequent or extremely infrequent. This indicate that increased operational frequency and better scheduling consistency could improve perceived reliability.

Convenience is evident from the assessment of ticketing system, which is rated as simple by 45.31%, neutral by 38.28% and 16.41% feel that ticketing system are complicated or very complicated. This implies that although the ticketing system is generally easy to use, less tech-savvy or new passengers might need clarification or assistance. Overall passengers of the Kochi Water Metro are generally satisfied with comfort, reliability, and convenience. To enhance overall consumer satisfaction, targeted improvements in service frequency, seating comfort and ticketing process has to be made.

2. Service Quality Dimensions, including Punctuality, Cleanliness, Staff Behaviour and Infrastructure

Service quality greatly influences passenger satisfaction and continuous ridership. Service quality of the Kochi Water Metro on the Vyttila-Kakkanad route was assessed by investigating the perception of passengers about four major factors of the services. They are vessel cleanliness, service punctuality, staff assistance and safety and security measures. This section offers insights into the strength of the services and areas where improvements could be made to improve the commuter experience.

Table 2: Service Quality of the Kochi Water Metro Service

Variable	Category	Percentage (%)
Cleanliness of Vessels	Excellent	59.38
	Very Good	28.12
	Poor	12.50
Punctuality of Service	Very Satisfied	32.81
	Neutral	53.12
	Dissatisfied	5.47
	Very Dissatisfied	8.60
Staff Assistance (Behaviour)	Good	52.34
	Average	41.41
	Poor	3.91
	Very Poor	2.34
Safety & Security Perception	Good	55.47
	Neutral	32.81
	Poor	7.03
	Very Poor	4.69

Source: Primary Data

The findings indicate that respondents have a favourable opinion about the service quality of Water Metro. 59.38% of the respondents are of the opinion that vessel cleanliness is excellent, 28.12% rated it as very good and 12.5% were dissatisfied. Similarly, respondents have a positive opinion about punctuality of the service. 32.81% reported high levels of satisfaction, 53.12% neutral and 14.07% dissatisfied. Another strong aspect is staff behaviour, with 52.34% evaluating staff assistance as good, 41.41% as average, indicating polite behaviour as well as efficiency on board. Only 6.25% reported poor or very poor staff support.

Safety and security perception is another important aspect which shows satisfaction related to infrastructure. Only 11.72% feel that safety is poor or very poor, 55.47% believe it as good and 32.81% remain neutral. This suggests that most customers have trust in the service's safety and security. Overall, these metrics indicate that Water Metro's internal environment: cleanliness, punctuality, staff assistance and safety, is operating well and improving the customer experience. On the other hand, neutral responds about safety and punctuality imply that passengers anticipate long-term consistency prior to providing higher satisfaction ratings.

3. Factors Influencing Commuter Preference and Satisfaction

This study aims to explore the major factors influencing consumer preference and satisfaction with the Kochi Water Metro service. It is crucial to understand these aspects since passenger's decisions and behaviours are influenced not only by availability of services but also by many operational factors such as fare affordability and satisfaction, ease of station access and service frequency. These elements directly influence consumer's perceptions about the value and effectiveness of Water Metro, as an alternative form of public transportation system. This section examines how well these aspects fulfil commuter requisites and expectations and highlight areas where improvements should be made to improve travel experience.

Table 3: Factors Influencing Commuter Preference and Satisfaction

Variable	Category	Percentage (%)
Fare Satisfaction	Satisfied	50.78
	Neutral	41.41
	Dissatisfied	7.81
Fare Reasonableness	Yes	69.53
	No	30.47
Ease of Access to Stations	Accessible	40.62
	Neutral	48.43
	Inaccessible	2.34
	Very Inaccessible	8.61
Service Frequency	Frequent	29.69
	Neutral	52.34
	Infrequent	10.94
	Very Infrequent	7.03

Source: Primary Data

Findings from the research indicate that 50.78% of respondents are satisfied, 41.41% are neutral and 7.81% are dissatisfied. This indicates that fare significantly influences commuter preference. In addition, 69.53% of the passengers feel that the fare on the Vyttila-Kakkanad route is reasonable, suggesting that affordability is a strong positive factor affecting ridership. While 40.62% believe that stations are accessible, 48.43% are neutral, and 10.95% reported difficulties in accessing the stations. This indicates that although most consumers find the route convenient, some still struggle with last-mile connectivity.

Another important factor that influences passenger decisions are service frequency. 29.69% of the respondents consider the service to be frequent, 52.34% are neutral, and 17.97% reported it to be infrequent or very infrequent. This implies that even while the service is valued for its cleanliness and fare cost, daily passengers may not use it frequently due to its frequent operations. Overall, the findings indicate that while accessibility and operating frequency continue to be areas that need improvements to strengthen user preferences and promote everyday usage, ticket affordability and appropriate pricing greatly boost passenger satisfaction.

4. Usage Patterns of the Passengers and Travel Frequency across various Demographic Groups

By investigating the demographic components like age, gender, and income, it is possible to understand which population section use the service more regularly and which group use it less. At the same time, examining the frequency of travelling reveals whether the Water Metro is mainly utilised for daily commuting, infrequent travel, or occasional trips. This is crucial for understanding target groups, determining the profile of an average user, and understanding service reach for future growth, enhancement, or promotional initiatives.

Table 4: Usage Patterns of the Passengers and Travel Frequency

Variable	Category	Percentage (%)
Age Group	Below 18	7.03
	18–24	78.91
	25–34	3.12
	35–44	11.72
	Above 45	6.25
Income Group	Below ₹15,000	50.00
	₹15,000–₹25,000	29.69
	₹25,001–₹35,000	7.81
	₹35,001–₹45,000	5.47
	Above ₹45,001	7.03
Gender	Female	71.09
	Male	28.91
Travel Frequency	Daily	9.37
	2–3 times a week	12.50
	Once a week	10.94
	Rarely	67.19

Source: Primary Data

Demographic statistics indicate that younger passengers are the leading users of the Kochi Water Metro, with 78.91% of the respondents falling in the age category of 18-24, 3.12% fall in the age group of 25-34, 11.72% in 35-44 age group, more than 45 (6.25%) and 7.03% are below the age of 18. Coming to income distribution, 50% of the passengers earn less than ₹15,000, 29.69% earn between ₹15,000-25,000, 7.81% earn ₹25,001-35,000. Only 7.03% earn more than ₹45,001, while 5.47% earn ₹35,001-45,000. Gender related data reveals that 71.09% of the respondents are women and 28.91% are men, indicating that women consider the Water Metro as a safe and convenient form of transportation. Overall, the existing user base of Water Metro service is mainly young, female and low-income group.

Usage patterns reveal that majority of the consumers at present do not use the Water Metro as their prime or daily form of transportation. 10.94% of the passengers travel only once a week, 12.5% use Water Metro 2-3 times a week and (67.19%) of the respondents travel rarely. It was found that only 9.37% consists of daily travellers. These findings reveal that while the Water Metro is valued for its comfort, cost, and safety, it is mainly used for occasional or unexpected travel rather than daily travelling. Improving integration with other modes of transportation, increasing service frequency and focussing on promotional efforts may increase regular commutation and encourage long-term adoption.

VII. SUGGESTIONS AND RECOMMENDATIONS

• Inclusivity can be enhanced by improving accessibility for individuals with disabilities and elderly passengers. Installing additional ramps and designated priority seating areas would help passengers with mobility challenges. Additionally, handrails, tactile paving and audible announcements can ensure easier navigation for everyone.

• Introduction of fare concessions for students, senior citizens, and low-income earners can promote affordability and wider usage, while promoting social equity in public transportation services.

• Increasing operational frequency can minimize wait times and improve service efficiency. Reducing wait times can increase ridership and increasing service frequency, will reduce congestion at terminals and improve consumer satisfaction.

• Upgrading seating and onboard facilities can boost passenger comfort and overall travel experience. User-friendly cushioned seating, more legroom, shaded waiting areas, improved ventilation and clean restroom facilities can contribute to overall satisfaction and retention.

• Digital screens, audio announcements, clear multilingual instructions and mobile app integrations will contribute to seamless navigation and ease of use.

• Identifying and resolving passenger grievances through feedback collection and service quality improvements can enhance passenger satisfaction leading to better retention and increased use of the Water Metro system.

VIII. CONCLUSION

The present study investigated the commuter satisfaction and service quality of the Kochi Water Metro by emphasising on comfort level, reliability, convenience, service quality, usage patterns and influencing factors. The findings reveal that passengers, especially young and low-income groups, have accepted the Kochi Water Metro as a novel, emerging and sustainable form of urban transportation. The increased levels of passenger satisfaction regarding cleanliness, staff assistance, fare affordability and safety, have made Water Metro successful in offering a safe, affordable, and user-friendly travel experience.

However, to enhance overall passenger happiness and to promote broader adoption, several areas need to be improved strategically. Passengers' opinion regarding service frequency are still divided; many reported neutral opinions or worries about infrequent schedules, pointing out the need for more frequent and well-planned trips during peak-time. A group of commuters also confront difficulties getting to stations, which point to the need for better last-mile connectivity and integration with other transportation modes. Additionally, the demographic profile suggests that older age groups and travellers with better incomes use the service less frequently, suggesting the chances for targeted promotion and awareness.

Overall, the study comes to the conclusion that Ernakulam might gain largely from Kochi Water Metro as a reliable and sustainable urban mobility solution. With improvement in service frequency, infrastructure and multimodal integration, Kochi Water Metro can grow into a popular public transportation alternative. This would significantly reduce traffic, improve passenger convenience, and create a better sustainable urban transportation ecology. The insights from this research may support and help policymakers, operators and planners for improving service quality, operations and strengthening the Kochi Water Metro's future expansion and adoption.

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