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Integrated Urban Transportation Policy: A Study of Kochi Metro and Vyttila Mobility Hub in Kerala, India

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ABSTRACT

Integrated infrastructure has been considered the key to the development of the urban transport system. Studies have rarely focused on the benefits and issues related to the urban integrated transport system, including mobility hubs. The present study attempts to analyze different aspects concerning the urban integrated infrastructure with a special focus on the Kochi Rail Metro and the Vyttila Mobility Hub in Kerala. The study reveals that 41 percent of commuters rely on Hub and Metro for occupation-induced traveling, followed by education (28 percent) and health (20 percent). It is revealed that the existing fare of Kochi Metro does not appear to be attractive to passengers. Almost 90 percent of passengers consider fares as not reasonable. Most of the commuters of Metro Train services and Mobility Hub share the view that these are 'inclusive'. The most noteworthy aspect of Metro and Hub is that they are eco-friendlier and sustainable. However, as an integrated infrastructure mode, it has to travel a long way yet. The study shows that the metro rail services must be accessible and affordable to the people. The study suggests that metro authorities need to make policy decisions to rationalize the fare rates in accordance with different parameters to attract more passengers to the Metro services. As the commuters from the city area are averse to using the metro services, steps need to be taken to encourage the urban passengers to use the metro services.

Keywords: Green transport, inclusive transport, integrated infrastructure, mobility hub, sustainable transport

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INTRODUCTION

It is true that the pace with which urbanization escalates has become unprecedented in recent times, thanks mainly to the increase in diversification of economic activities, growing change in the employment scenario, and the desire of the people to enjoy modern amenities and services (Cohen, 2006). Urbanization has gone to such an extent that in the coming decades, it is expected that 90 percent of world population growth will occur in cities of developing economies (Singh, 2016). India has also experienced rapid urbanization over the past. For instance, the urban population in India surged to 377 million in 2011 from 286 million in 2001 (Revi et al., 2012). Nevertheless, theoretically, India has not been urbanized and will not be urbanized in the near future. However, Kerala, a state situated in the southern tip of India, with 48 percent of its population living in urban areas, has become almost urbanized or nearing it to be urbanized. Despite all benefits it bestows on the inhabitants, urbanization creates an array of socio-economic issues, especially in the absence of a proper, comprehensive, and imaginative urban plan and its execution (Bibri, 2019).

One important aspect of urban planning is its public transport infrastructure to ensure smooth, cost-friendly, and reliable movement of people and commodities across different centers of urban dwellings (Gebre & Gebremedhin, 2019). In the absence of reliable and comfortable public transport facilities, commuters will be forced to depend on the private mode of transport, increasing traffic congestion, economic cost, and pollution (Seetharaman, 2018). One important lacuna of urban transport in India is the apparent absence of integrated transport infrastructure, which facilitates people to choose between different modes of transport in accordance with their preferences. Moreover, integrated infrastructure would provide ample opportunities to switch to a more convenient and economical mode of transportation in the event of people being fed up with a specific mode of transport. It has well been acknowledged that China's accomplishment in the sphere of economic growth over the last years owes much to the initiatives that China is said to have taken in the establishment of integrated infrastructure (Ness, 2008). In India, small attempts have been made towards this but in vain. Hence, in India, there exists a wide gap between the demand and supply of infrastructure (Agrawal, 2020).

In Kerala, an important step toward integrated infrastructure has been made with the inauguration of the Vytiila Mobility Hub in Kochi in Ernakulam District. In this Hub, three modes of transport, viz. road, rail, and water, meet together, making people able to switch over to one another depending on their interests. Established in 2015, the Hub has made significant changes in the landscape of integrated urban transport in the city of Kochi. The hallmarks of the Hub are the Water Metro and Rail Metro services which help not only the daily commuters but also the tourists visiting Kochi. In this background, it is important to look at the different experiments implemented to

augment and enhance the quality of urban integrated transport infrastructure in terms of sustainability and inclusiveness in Kochi. The objective of this paper is to dwell on this aspect. This paper is broken into two parts: while the first part deals with certain theoretical notes, including issues that hover around infrastructural bottlenecks and growing congestion in cities, the second part dwells on a study based on the commuters of Kochi metro and users of Vyttila Mobility Hub.

The Objectives of the Study

The present study is partly exploratory and partly descriptive. It attempts to present the current scenario and problems plaguing urban transport in India. As a case study, it intends to throw light on commuters' perception towards the Kochi Metro Rail and the mobility Hub constructed in Kochi, Kerala. The specific objectives of the present study are:

1. To examine the present scenario of the urban transport system in India along with some specific problems plaguing the sector.

2. To analyze the opinion of commuters towards the urban metro rail service and the integrated mobility hubs.

Theoretical Background

Urbanization increases the travel demand of people in two ways: (1) expanded city size leads to an increase in trip length; that is, as the limit of urban area expands, people have to perform lengthy journeys to reach the other end of urban areas which is often called 'trip length,' and (2), as more and more cities are formed people from villages start finding employment opportunities in cities, and they make daily up and down trip to cities to participate in employment activities. For instance, in cities with more than ten million populations in India, studies have shown that the average travel distance has been enhanced from 9 to 12 kilometers (Roychowdhury, 2013). Apart from the two ways mentioned above through which urbanization fastens travel demand, an increase in per capita income appears to have been increasingly contributing to the demand for travel as it tends to increase the economic and social dealings of people and, on account of this, people tend to perform more journeys. Putting it differently, 'Per capita trips' get increased as the income level goes up; that is, per capita trips could be considered as an increasing function of the level of income of the travelers (Pucher & Renne, 2003). People travel mostly for employment and education; roughly 75 percent of travel is made for these reasons. In recent times, especially in Kerala, due to increasing awareness of health issues and lifestyle diseases that affect people, health has become an essential factor driving people's travel needs. The growing interest of people in entertainment or infotainment activities and inclusive tourism also appear to be playing important roles in determining travel demand. Since efficient urban public transport contributes to economic progress in terms of increasing mobility of people, enhancing the quality of time spent on work, and reducing fuel consumption, it

has multiplier effects not only on the urban economy but also on the economy as a whole (Jain & Dhiman, 2017).

Urban transport in India has been beset with a number of issues ranging from growing congestion fueled by an increasing number of vehicles and limited road expansion to poor performance of public transport in terms of quality as well as quantity of services (Singh, 2014). These problems, in fact, tempt urban commuters to shift to private vehicles aggravating the problem again, thus creating a vicious circle of urban transport issues. Besides, the growing number of private vehicles has cost the environment badly by way of degrading the quality of air and increasing the consumption of fossil fuels by private vehicles (Adams & Requia, 2017). Moreover, private vehicles take up more road space per traveler compared to public transport. Apart from these, private vehicles emit more pollutants per passenger also. Hence, for sustainable and inclusive urban transport, a shift to public transport has become indispensable. Urban public transport needs to be given high priority in urban planning. While sustainable transport decarbonizes the transport sector, inclusive transport strives to encompass all sections of urban travelers by ensuring access to transport to all (Ogryzek et al., 2020). Having discussed the theoretical background, we now move on to the issues and the future of urban transport in India.

The Way Ahead for Urban Transport in India

The growing demand for travel in urban areas, the mounting problems of pollution caused by carbon-emitting vehicles, and the increasing traffic congestion eating into the precious peak time, productivity, and pocket of urban commuters and dwellers have all manifested to such an extent that policymakers and urban planners now start thinking in terms of reshaping the urban transportation policies to incorporate concerns of not only the growing demand for travel but also its sustainability and inclusiveness (Richardson, 2005). For this to happen, in line with its envisagement, it is imperative that support from all stakeholders, including urban commuters and travel service providers, matters a lot. The success of such a plan invariably depends on this joint effort for a common cause of making the urban travel experience sustainable and inclusive. It calls for developing Green Travel Habits or Sustainable Travel Behavior among urban commuters and stakeholders of urban development (Howrath & Polyviou, 2012). It is obvious that global greenhouse gas emission has become an increasing function of unsustainable travel behavior. Studies have thrown light on the fact that traffic congestion owing primarily to unsustainable and irresponsible transportation on roads not only results in increased fuel use but also aggravates the problem of carbon dioxide emissions, leading to colossal environmental damage (Bharadwaj et al., 2017).

Growing travel demand, obviously, has become a reality that, given the present circumstances, can hardly be arrested without causing irreparable damage to the prospects of economic growth and

development (Ecola & Wachs, 2012). It is true that as an economy develops and jobs get diversified, the demand for travel naturally escalates, and if public transport fails to meet these requirements of increasing travel demand by ensuring comfort and effective travel choices, the demand for private modes of travel would unequivocally move up. It will exacerbate urban road congestion, leading to loss of income and labor hours for those who reside in urban areas and those who commute daily to and from cities, seeking gainful employment avenues. In these circumstances, the immediate way to tackle growing urban travel demand could be found in attempts to contain travel demand itself, although it may seem to be a highly implausible one.

One way to contain the travel demand is to implement well-thought-out and comprehensive urban planning methods wherein instead of developing industries and job centers first, laying roads and rails and then allowing business clusters to be developed around such transport infrastructure. Simply put, investing in Social Overhead Capital like roads, railways, and power must invariably precede investment in other sectors, technically called Directly Productive Activities (Thirlwall, 2011). It would make a substantial reduction in the travel demand as 90 percent of travel demand comes from job, education, and health-related reasons. Therefore, self-contained industrial and service clusters and townships around such clusters coexisting with adequate housing, education, and health facilities are developed so that people rarely need to travel to distant places to avail of these services, and consequently, the need to commute to and out of the urban centers can be effectively contained (de Abreu e Silva, 2014). In other words, if people live closer to their job centers with all amenities and comforts, the need for travel would be immensely reduced (Cao & Chatman, 2016). Nevertheless, unarguably, it is easier said than done. That said, now the problems of the urban transport system in India continue to remain unabated with a number of impediments. Here, an attempt has been made to list some of the important problems the transport system has been confronting within Indian cities.

Allocation of Road Space

Although it is advisable to rely on non-motorized transport modes of conveyance in view of growing environmental concerns and traffic congestion, for travels that go beyond 6 to 7 kilometers, non-motorized modes of transport cannot be relied upon (Ahmed & Monem, 2020). Since this is the case, the most important and advisable non-motorized mode of transport is definitely public transport as it consumes less energy per passenger, emits fewer pollutants, and takes comparably less road space per passenger (Kii & Hanaoka, 2003). Now, the compelling question is how to pursue people to prefer public transport in place of private vehicle modes of conveyance. The answer to this question lies in allocating road space in favor of passengers rather than vehicles (Zheng & Geroliminis, 2013). However, unfortunately, road space allocation in the

traffic regulation gives priority to vehicles rather than passengers, and as a result, a bus carrying 40 to 45 passengers may have to be slow or take another route in case of traffic regulations, while single-passenger cars may be given priority on the roads. It has now become a practice in many junctions that passenger waiting shelters are constructed a few meters away from the junction, forcing bus passengers to walk or catch autos to reach the other side of the road or junction to board the next bus. This improper location of passenger amenity centers and bus waiting shelters may dissuade passengers from preferring public transport in place of private vehicles.

Congestion Charging and High Parking Fees

Since urban public transport aims at reducing the use of personalized motors, certain fiscal and other regulations can be resorted in dissuading people from choosing private vehicle mode of transport. Two such options emerge at this juncture: Congestion charging and levying high parking fees. Congestion charges are special payments that need to be paid to enter the city roads during peak hours which may prevent people from using their vehicles during peak hours. High parking fees, of course, work as a disincentive for many to venture into roads frequently and often unnecessarily. However, the over-exercise of these two measures would invite many other economic issues, such as a decline in the demand for cars (Simicevic et al., 2013). It will have a certain backlash effect on economic growth and employment generation, especially in the context of the current economic slowdown that has been primarily experienced in the car manufacturing sector in India. Notwithstanding the adverse economic fallout of congestion charges on economic growth in general, it has been acknowledged that congestion charging policy reduces the demand for private car use in both trips and distance, thereby reducing atmospheric pollution (Van Amelsfort & Swedish, 2012).

Non-Motorized Green Modes of Travels

Generally speaking, most roads, especially rural and urban roads in India and Kerala, are not friendly towards pedestrians and cycle riders. For instance, in Bangalore, an Information technology hub center and the capital of Karnataka, a southern State in the Indian Union, out of the 684 fatalities, 276 victims were pedestrians, and it may sound quite unfortunate that 60 percent of them were crossing the road while being hit by the vehicles (Devare, 2019). It is really disheartening to note that while the number of vehicles, especially cars, gets increasing, the size and the length of the roads and the parking areas remain the same, eating indiscriminately into the space available for pedestrians (Mattioli et al., 2020). It has continued to be a lacuna of urban transport infrastructure planning, especially in developing economies. In short, pedestrians and non-motorized users are prone to road accidents as they share the same space on the road with motorized modes of transport (Abdulrazzaq et al., 2012). It causes (1) declines in the speed of motorized transport as they need to take care

of these green travelers, which increases pollution per vehicle and consume more fuels, and (2) pedestrians and cycle riders are likely to be hit by speedy motorized riders, and this has a disincentive effect on the use of non-motorized modes of transport. Hence, a greener urban transport policy has to incorporate these concerns, and while designing roads, ample space must be segregated for pedestrians and cycle riders. Kochi Metro has already made available cycles for the use of its passengers (Nair, 2019). After alighting from the metro train at certain specialized stations, they can avail of cycles to move to their final destinations.

Accessibility and Premium Services

How many waiting points can be arranged per km of traveling, and what facilities can users enjoy at the waiting points? Smooth and attractive public transport must address this question. A standard procedure goes like this: One access point in the range of half km in city centers and one to two km in outer areas. Apart from this hard and fast rule, the common rule is that access points must be accessible to commuters at an easy distance. Making people walk more may make public modes unattractive to commuters. At the same time, too many access points take too much time to travel, and therefore while deciding on access points, these aspects must be considered (Bell, 2019). To attract car users to public transport, the services in public transport must have good quality in terms of comfort and journey time (Redman et al., 2013). Kochi Metro, one of the focal points of the present study, has been quite attractive to the passengers in terms of comfort, ensuring timely availability, and reaching destinations. It has been designed in such a manner as to ensure world-class comfort and access points at different locations in the suburban areas of Kochi City. It is indeed obvious that high-end travelers may not like rush buses, and they require a high-comfort journey that reaches their destination at the right time. Premium services must ensure these things because, regardless of fares, high-end users consider the quality of services. Kochi Metro, like many other urban rail transport models, offers all premium services to its passengers, hoping that this would motivate car users to get rid of congested road traveling and start enjoying the ride on Metro trains.

Some Initiatives Towards Popularizing Integrated Infrastructure

Since the present study pertains to the integrated infrastructure policy and the steps that have been taken towards the starting of Vyttila Mobility Hub and Kochi Metro in the State of Kerala, it would be imperative to dwell on some of the leading initiatives towards the popularization of the use of integrated infrastructure. This popularization attempt has been called for since this opens up a new window of travel experience for commuters accustomed to using either rush buses or private modes of transport. Hence, it turns out to be a herculean task to attract the urban commuters to the world of the journey that unfolds before them with the establishment of an integrated transport transit point at Vyttila. Some steps need a brief explanation.

Green Mobility Zone

Green Mobility Zone is an important initiative toward making urban transport eco-friendly. In Kochi, under the stewardship of Kochi Metro Rail Limited (KMRL), works on Green Mobility Zone has already been commenced. Non-Motorized Mode of Transport has gained wide currency in the sphere of transportation in Kochi City, although certain steps remain to be completed for its cent percent fulfillment. Under this, pedestrian-friendly roads and cycle tracks are being planned to make non-motorized transport a new experience for the urban commuters in Kochi. France Development Agency (FDA), a credit agency for the KMRL, has offered financial assistance to the initiatives of Non-Motorized Transport in Kochi, a program worth 239 crores of rupees. As per this scheme, places adjacent to Metro stations in Kochi will be converted to Green Spaces, and cycle tracks will be laid in available places so that Metro users can make use of cycles to reach the places after alighting from the Metro Trains. Electric and CNG Buses (Compressed Natural Gas Buses), Kerala State Electricity Board Charging Stations, subsidies for E-Autos, and Solar Boat Services are some of the other schemes in the pipeline. Green Transport Corridor from Muzaris at Kodungalur to Eramallur, a program that costs Rs.580 crores, is also being envisaged by the Government. Trams to connect places where the metro is apparently absent are also being planned along with E-Bus Corridor schemes.

Water Metro

The construction of the first Water Metro in India has already commenced in Kochi. Water Metro, an associate of Kochi Metro, is expected to connect 16 places in Kochi with modern luxury boat services. Seventy-six boats and 41 Boat ports are being constructed. Cochin Shipyard is looking after the works of boats under the scheme of Water Metro. It is expected to boost tourism in the Middle part of Kerala State. Since the State is blessed with the presence of water streams suitable for water transport, Kochi Water Metro can do wonders in this respect. Commuters to nearby places, especially to certain sub-urban places, find the water metro the most convenient mode of transport, particularly in terms of costs and travel time.

Kochi One Card

Another new experiment that has been underway is Kochi One Card, a unified ticketing system, which helps its holders to travel in Buses, Metro, and Boats with the same ticket. Travelers can use this Kochi One Card even for shopping in associated shopping malls and merchant houses.

Having discussed certain issues and initiatives toward making an integrated urban transport system a reality in Kerala, we now turn to the crux of the paper where, based on primary data, the opinion of commuters regarding different attributes of the integrated transport infrastructure will be examined.

MATERIALS AND METHODS

The study mainly uses primary data for the analysis. A sample survey was executed to unearth the perceptions of users of Vyttila Mobility Hub and metro travelers. The population of the study covered the commuters of the metro rail services in Kochi who also used to frequent the Vyttila Mobility Hub to board buses and water metro. From different metro stations, one station located in the Vyttila Mobility Hub was chosen to select the sample for the study. From a list of regular commuters, a sample of 200 commuters was chosen at random. The contact information, including phone number and email id, was collected, and respondents were contacted using different modes of communication. A pilot survey was conducted with passengers using the mall intercept method. The data were collected using telephonic surveys, sometimes and in some conditions, using face-to-face interview methods. No scale data was used in the study. However, categorical data like place of origin, gender of commuters, and the purpose of the journey were collected from the respondents. Likert scale was used to analyze the opinion and perception of commuters with different aspects like the comfort of the journey, the fare of metro rail service, green transport, and inclusiveness of the metro and mobility hub.

RESULTS AND DISCUSSION

Gender Wise Ridership

Of the total commuters chosen at random, 69 percent were females, and only 31 percent were males (Figure 1). One plausible reason for this female-centric ridership is that male commuters have alternative modes of transport like motorcycles, scooters, and cycles, and therefore, they do not use the metro and hub. Therefore, females still dominate the commuters in both metro and Vytilla Mobility Hub. Unsurprisingly, this revelation of ridership by gender that more women use Kochi Metro compared to their male counterparts corroborates the findings of many other studies on the gender-wise use of Metros (Sullivan, 2013).

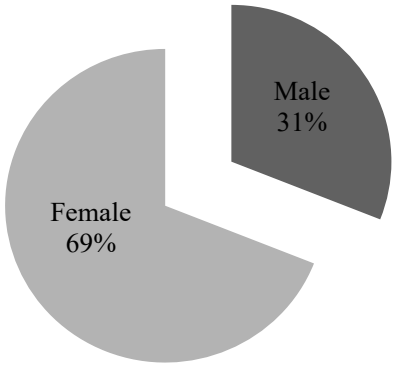

Figure 1. Gender wise ridership

Purpose of Journey

It has been well acknowledged that as people get access to places and jobs, the problem of unemployment could be reduced to a certain extent. The role of a cheap, comfortable, and reliable public transport system to facilitate people to get accommodated in jobs has remained unquestionable (Bastiaanssen et al., 2021). A glance at Figure 2 reveals that most commuters (41 percent) relied on Hub and metro for occupation-induced traveling, followed by education (28 percent) and health (20 percent). It corroborates the fact

that public transport facilities elsewhere in the world are primarily used for job and education-related activities. Nevertheless, it is interesting to note that health has also become an important reason, driving the travel need of people. Growing demand for specialized health services and the availability of health infra in relatively large cities have become a force in driving the need for urban transport.

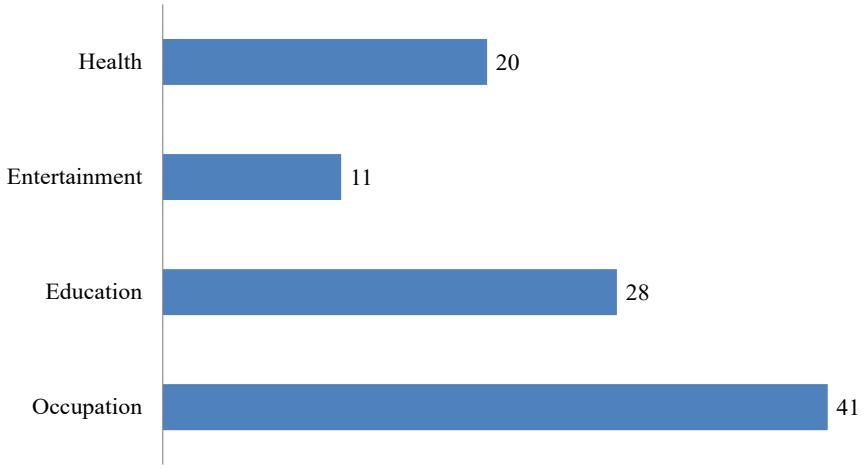

Figure 2. Purpose of journey

Gender-wise distribution of purpose journey clearly reveals that among the male commuters, for almost half, the occupation has been the main purpose for which they use metro rail and mobility hub facilities, while only 9.68 percent rely on the metro for education activities (Table 1). In contrast to this, among the female, while 36.23 percent depend on the metro for education purposes, only 37.68 percent consider occupation as the purpose of the journey. Drawing on inferences arrived from the Chi-square analysis, and it is obvious that gender has been significantly associated with the purpose of the journey.

Table 1
Purpose of journey-gender-wise distribution

Purpose of Journey	Gender	
	Male (%)	Female (%)
Occupation	48.39	37.68
Education	9.68	36.23
Entertainment	9.68	11.59
Health	32.26	14.49
	100	100

Note. p value is .024

Origin of Location of Commuters

Studies have shown that rural-urban linkage has had an influence on ameliorating poverty in developing economies (Von Braun, 2007). Transportation linkage has played a vital role in materializing the rural-urban linkage. Access to cheap, reliable, and comfortable transportation often attracts rural people to urban areas to engage in gainful employment activities (Sharma, 2019). It is obvious that Kochi city is a destination for many people from at least three neighboring districts: Thrissur, Kottayam, and Alappuzha, besides people from the Ernakulum district. However, instead of the district-centric origin of the commuters, it is worthwhile to note that 26 percent of the commuters come from semi-urban areas, while 20 percent come from long-distanced areas (Table 2). It is interesting to note that 22 percent of the commuters come from rural areas of other districts. It shows that more than city-bound commuters, people from other areas use the mobility hub and metros more frequently. It is evident that 68 percent of metro travelers come from semi-urban, rural areas of other districts and long distant places.

Table 2
Place of origin of commuters

Where are you from?	Percentage (%)
Urban centre	19.0
Urban peripheral	13.0
Semi-urban	26.0
Rural areas of district	22.0
Long distance traveler	20.0
Total	100.0

To analyze whether there is any association between the place of origin of commuters and their purpose of the journey, a Chi-square analysis has been executed (Table 3). Commuters from rural areas in the district and urban peripheral areas mainly travel and use the Kochi Metro and Vyttila Mobility Hub to perform their occupation-induced journeys, whereas commuters from the urban center travel in the Kochi Metro mainly for education-induced work. It is worthwhile to note that long-distance

Table 3
Place of origin of commuters and the purpose of the journey

Purpose of Journey	Urban Centre (%)	Urban Peripheral (%)	Semi-Urban (%)	Rural Areas of District (%)	Long Distance Traveler (%)
Occupation	25.00	51.43	40.00	55.56	38.46
Education	53.57	25.71		33.33	7.69
Entertainment		2.86	20.00	11.11	46.15
Health	21.43	20.00	40.00		7.69
Total	100.00	100.00	100.00	100.00	100.00

Note. p value is .00

travelers mainly use it for entertainment purposes, followed by occupation-induced journeys. Since the *p* value in the Chi-square analysis turns out to be less than .05, it could be concluded that the origin of the place of commuters and the purpose of the journey are associated with each other, meaning both influences each other.

Kochi One Card

KMRL (Kochi Metro Rail Limited) has introduced the 'Kochi One Card,' a multi-purpose debit card-like devise that would tie up the passengers to a number of services connected to the Kochi Metro. Although many promotional adventures and offers in the form of discounts have been given by the KMRL to popularize it among the commuters, only a few, that is close to 23 percent of commuters, really hold it (Figure 3). It is observed that commuters are indifferent to the holding and use of these kinds of debit cards, which have been designed for specific purposes.

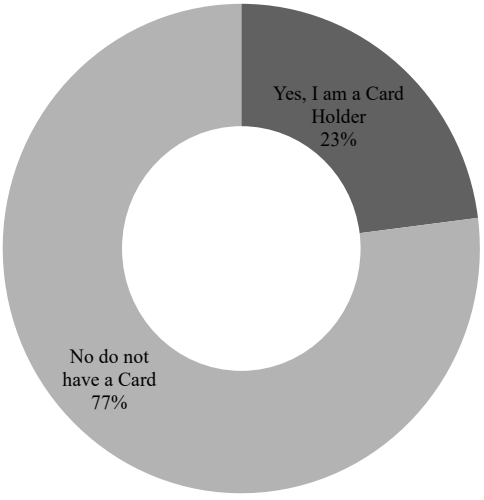

Figure 3. Do you have Kochi One Card?

Opinions About the Fare Structure of Metro

Fare is something that most commuters take into account while making a choice regarding the mode of transport. Since most commuters of public transport are either low-income earners or middle-income groups, the fare determines the success of the Kochi Metro and the existence of the mobility Hub. Quite unfortunately, it is revealed that the existing fare of Kochi Metro does not appear to be attractive to passengers. A little more than 55 percent of the respondents of this study opine that the fare is high, and almost 35 percent believe that the fare is 'very high.' Put together, almost 90 percent consider fares as either high or very high (Figure 4). It points toward the fact that the future of the Metro lies in reducing the fare to attract more passengers—only this way the Metro services can be made more financially viable.

Now, we look into the association between the purpose of the journey and the opinion about the fare rate of the Kochi metro (Table 4). Among the occupation and education-induced travelers, respectively, 63.41 percent and 60.71 percent opine that fare is 'high,' and those who rely on the Kochi metro occasionally for entertainment purposes also have the view that fare is too high. The Chi-square analysis done to find out the association between the purpose of the journey and the opinion about the fare rate has turned out to be significant at a five percent level, showing that the purpose of the journey influences the opinion of people about the fare rate of metro services. It

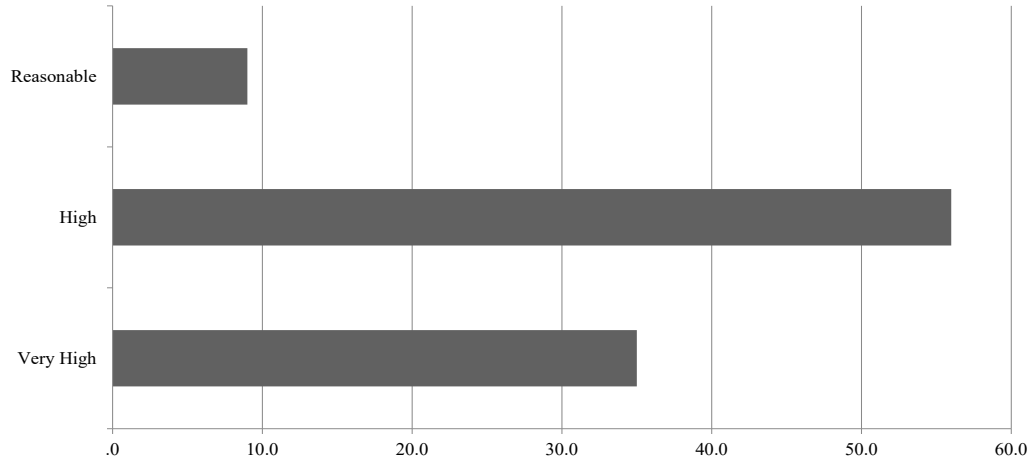

Figure 4. Opinion about the Metro fare

Table 4
Opinion about the fare rate and the purpose of journey

Opinion About the Fare Rate	Purpose of Journey			
	Occupation (%)	Education (%)	Entertainment (%)	Health (%)
Very high	34.15	21.43	72.73	35.00
High	63.41	60.71	27.27	50.00
Reasonable	2.44	17.86		15.00
Total	100	100	100	100

Note. p value is .025

calls for making differential treatment in the determination of fare rate considering the purpose of the journey performed by commuters of Kochi metro, which may even make the service more popular and justifiable.

Opinion About the Comfort of Travel

Next, comfort is another factor influencing the passenger, especially somewhat high-class passengers who otherwise would have used their private vehicles. It is obvious that Metro trains provide reasonable comfort to passengers. The present study also corroborates this. It is evident that 42 percent opine that they are satisfied with the comfort aspect, and 15 percent are very much satisfied, implying that 57 percent are satisfied with the comfort being offered by Metro Services (Table 5). Only 13 percent of commuters have expressed dissatisfaction over the quality of the comfort of Metro Services.

Having discussed the opinion about the comfort level of Metro services, we now move on to analyze the gender-wise

Table 5
Opinion regarding the comfort of the journey

Level of Satisfaction	Percentage (%)
Very much satisfied	15.0
Satisfied	42.0
No opinion	27.0
Dissatisfied	13.0
Very much dissatisfied	3.0
Total	100.0

analysis of opinions regarding the comfort level. It is interesting to note that males are dissatisfied with the comfort level while an overwhelming percentage of females (around 50 percent) opine that they are satisfied with the comfort of travel offered by the metro services. Further, to understand the association between gender and the opinion about comfort level, a Chi-square analysis has been done, and it unequivocally reveals that gender has an influence in determining the opinion of people about the comfort level of travel in the metro (Table 6).

Table 6
Gender-wise distribution of opinion regarding the comfort of travel

Opinion Regarding the Comfort of Travel	Male (%)	Female (%)
Very much satisfied	12.903	15.942
Satisfied	25.806	49.275
No opinion	29.032	26.087
Dissatisfied	22.581	8.696
Very much dissatisfied	9.677	
Total	100	100

Note. p value is .012

Hub as an Integrated Transport Infrastructure

The Mobility Hub undoubtedly could be reckoned as a step towards materializing the objective of establishing integrated transport infrastructure on a wide scale in Kerala. In this respect, the study enquired about its acceptance among commuters as a model of integrated infrastructure. Quite the opposite to our theoretical perceptions, commuters opine that as an integrated infrastructure mode, Vyttila Mobility Hub has yet to travel a lot (Table 7). Drawing on a Likert Scale presentation of the statement that Hub is an integrated transport infrastructure, only a meager 16 percent strongly agree with the view that Hub is an integrated transport infrastructure, where almost 40 percent ('Disagree' and 'Strongly Disagree' taken together) do not subscribe to this view. From this, it could be understood that commuters do not appear to be getting the complete advantage of it being a destination of integrated infrastructure. Problems lie more in getting the bus services on a satisfactory scale. However, a cause of the sigh is that the

Table 7
Hub as an integrated transport infrastructure

Hub as an Integrated Transport Infrastructure	Percentage (%)
Strongly agree	16.0
Agree	37.0
No opinion	7.0
Disagree	25.0
Strongly disagree	15.0
Total	100.0

percentage of people who strongly disagree with the view that Mobility Hub works as an integrated public infrastructure mode is slightly high compared to other opinions.

The study attempts to analyze whether there is any association between the sector of employment and the opinion about the statement that a Hub is an integrated transport infrastructure. The study considers commuters from three sectors: the private sector, the government sector, and the informal sector. Among the commuters working in the private sector, more than 47 percent agree with the view that the hub is an integrated infrastructure, whereas only 33.33 percent and 30.3 percent, respectively, from the government sector and informal sector, agree with this view (Table 8). The Chi-Square test executed to understand the association between the sector of employment and the opinion of commuters regarding the status of the hub as an integrated infrastructure has turned out to be significant at a five percent level, showing that both are associated with each other.

Table 8
Hub as integrated infrastructure and the sector of employment of commuters

Hub as an Integrated Infrastructure	Sector of Employment		
	Private Sector (%)	Government Sector (%)	Informal Sector (%)
Strongly agree	8.82	18.18	21.21
Agree	47.06	33.33	30.30
No opinion	2.94	18.18	
Disagree	32.35	21.21	21.21
Strongly disagree	8.82	9.09	27.27
Total	100	100	100

Note. p value is .019

Inclusiveness of the Transport System

Inclusiveness is an attribute of modern public transport systems. Inclusiveness of transport system is understood to mean whether the system is tailor-made to cater to the needs of all people irrespective of their physical and social disabilities. In fact, it is apparent that most modern public transport systems appear to have been more inclusive. In the present study, most commuters of Metro Train services and Mobility Hub share the view that these are inclusive or mostly inclusive (Table 9). It is further interesting to note that only a negligible three percent opine that Metro and Mobility Hub are not inclusive.

Having observed the opinion of commuters regarding the inclusiveness of the Kochi metro and mobility hub, we now turn to analyze whether the gender status of commuters has any association with the opinion regarding inclusiveness. The present

Table 9
Inclusiveness of the metro train and the Vyttila Mobility hub

Inclusiveness	Percentage (%)
Yes, inclusive	32.0
Mostly inclusive	44.0
Rarely inclusive	21.0
Not at all inclusive	3.0
Total	100.0

Table 10
Gender-wise opinion about the inclusiveness of metro and mobility hub

Is Metro Inclusive?	Gender	
	Male (%)	Female (%)
Yes, inclusive	25.81	34.78
Mostly inclusive	25.81	52.17
Rarely inclusive	38.71	13.04
Not at all inclusive	9.68	
Total	100	100

Note. p value is .001

study shows that females outnumber males in expressing the view that the metro and mobility hub is inclusive (Table 10). Even an overwhelming percentage of women, to the tune of a little more than 52 percent, share the view that metro and mobility hub is 'mostly inclusive.' It is obvious that this view of inclusiveness from the perception of commuters, particularly females matter a lot. On the other hand, it is surprising to note that 38.71 percent of males consider it 'rarely inclusive.' Further, it needs to be pointed out that the Chi-square test done to reveal the association between the gender status of commuters and their opinion about the inclusiveness of metro and mobility hubs has become significant at a five percent level revealing that gender plays a significant role in shaping the opinion regarding the inclusiveness of metro and mobility hub.

Green Metro and Mobility Hub

Metros are supposed to be eco-friendly as it causes little harm to the environment by way of not polluting the air (Thawadi & Ghamdi, 2019). Many of the metro cities and transport in such cities have adopted the green mode of operations. For instance, most buses in New Delhi, the capital of India, have become CNG-driven (Krelling & Badami, 2016). The most noteworthy aspect of Metro and Hub is that they are eco-friendlier and sustainable. It is remarkable to observe that 32 percent of the respondents regard Kochi Metro and Mobility Hub as sustainable and eco-friendly, while 56 percent consider both as mostly sustainable (Table 11). Only a meager 12 percent share the view that Kochi Metro and Mobility Hub remain not at all sustainable and eco-friendly. The view of an overwhelming majority of respondents shows that Kochi Metro and Mobility Hubs have continued to be the greener modes of transport infrastructure.

Now looking into the gender dimension of the opinion of commuters about the sustainability of Kochi Metro and Mobility, the study finds that females have high regard and optimism regarding the sustainability and eco-friendly nature of mobility hub and metro services. An overwhelming majority, to the tune of 63.77 percent of females, opine that metro and hubs are

Table 11
Sustainability of services

Sustainability	Percentage (%)	Cumulative Percentage (%)
Yes, sustainable and eco-friendly	32.0	32.0
Mostly sustainable	56.0	88.0
Not at all sustainable and eco-friendly	12.0	100.0
Total	100.0	

mostly sustainable, whereas among the males, only 38.71 percent share this view (Table 12). The Chi-square test conducted to know the association between gender dimensions of commuters and the opinion regarding sustainability has turned out to be significant at a five percent level showing unequivocally that gender has an influence in shaping the opinion of commuters regarding the sustainability and eco-friendly nature of metro and mobility hub.

Table 12
Gender-wise distribution of opinion regarding the sustainability of the metro and the hub

Is it Sustainable and Eco-friendly?	Gender	
	Male (%)	Female (%)
Yes, sustainable and eco-friendly	32.26	31.88
Mostly sustainable	38.71	63.77
Not at all sustainable and eco-friendly	29.03	4.35
Total	100	100

Note. p value is .001

CONCLUSION

This paper has made a twofold attempt to dwell on the current status and experiments of the urban public transport system in a developing economy like India. It first chose to present the scenario of the urban transport system in India along with some specific problems plaguing the sector. Secondly, it chose Vyttila Mobility Hub and Kochi Metro, two frontrunners in urban infrastructure in Kerala, a State in the southern tip of India, as a case to analyze the customer's perception regarding newer experiments towards modernizing urban transport infrastructure. It is viewed that the allocation of road space has been improperly designed in the sense that the public transport system has been given the least priority on the road compared to private vehicles. It is really disheartening to note that while the number of vehicles, especially cars get, increased the size and the length of the roads and the parking areas remain the same. It has continued to be a lacuna of urban

transport infrastructure planning, especially in developing economies. Hence, a greener urban transport policy has to incorporate these concerns, and while designing roads, ample space must be segregated for pedestrians and cycle riders. The study also revealed that to attract car users to public transport, the services in public transport must have good quality in terms of comfort and journey time.

Coming to the second objective, it is observed that the Vyttila Mobility Hub, established in 2015, is an important step toward the establishment of integrated infrastructure in Kerala. As the meeting point of three modes of transport: road, rail, and water, meeting together enables passengers to switch to alternative modes of transport as per their requirements. This study looks at the sustainability and inclusiveness of Kochi Metro and Mobility Hub. The study has found that Females dominate the commuters in both metro and Vytilla Mobility Hub. Of the total commuters chosen at random, 69 percent were females, and only 31 percent were males. The study reveals that most commuters (41 percent) relied on Hub and metro for occupation-induced traveling, followed by education (28 percent) and health (20 percent). Obviously, 26 percent of the commuters come from semi-urban areas, while 20 percent are from long-distance areas. It is worth interesting to note that 22 percent of the commuters come from rural areas of other districts. It is revealed that the existing fare of Kochi Metro does not appear to be attractive to passengers. A little more than 55 percent of the respondents of this study opine that the fare is high, and almost 35 percent believe that the fare is very high. Put together, almost 90 percent consider fare as not reasonable. It is obvious that Metro trains provide reasonable comfort to passengers. The present study also corroborates this. Most commuters of Metro Train services and Mobility Hub share the view that these are inclusive or mostly inclusive. The study shows that the metro rail services must be accessible and affordable to the people. As commuters express dissatisfaction with the fare structure, it appears important for metro authorities to make policy decisions to rationalize the fare rates. As the commuters from the city area are averse to using the metro services, steps need to be taken to encourage the urban passengers to use the metro services.

Limitations of the Study, Policy Input, and Suggestions for Future Research

Although all possible efforts have been taken to complete the study, certain factors like the absence of sufficient time, unwillingness on the part of the respondents to reveal their opinion, and the lack of time on the part of respondents to give information accurately on the queries contained in the interview schedule and questionnaire have put limitations on the execution of the study. Obtaining passenger information seemed difficult as passengers were busy boarding the train. We also attempted to collect information about traveling along with some passengers wherever possible.

Metro and integrated transport mobility hubs are a new development in

the urban transport sector in Kerala. As urbanization has been increasing in Kerala at an unprecedented rate, there has been a growing need for urban metro services and integrated mobility hubs. Many such projects have been in the offing as well. The study shows that the metro rail services must be accessible and affordable to the people. As the commuters express dissatisfaction with the fare structure, it appears important for metro authorities to make policy decisions to rationalize the fare rates in accordance with the time of journey performed by the travelers. As the commuters from the city area are averse to using the metro services, steps need to be taken to encourage the urban passengers to use the metro services.

As is well known, the integrated urban infrastructure is a new area that offers a lot of scope for further research. More in-depth analysis can be done by researchers on the issue of inclusiveness, comfort, and sustainability of metro rail services and mobility hubs using qualitative methods like focus group discussions. Moreover, viability studies can also be conducted using the data on revenue generation and expenditure of the metro and mobility hub. As the metro service is an eco-friendly and non-pollutant transport service, the qualitative improvement it creates in the environment can also be studied using tools in environmental economics. Moreover, a study on the nature and pattern of using private modes of transport before and after the coming up of Metro services can also be conducted by researchers interested in the area of urban transport.

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