

# A Collection of theses on Sustainable Public Transport



PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS (PIDE), ISLAMABAD

Edited by Saba Anwar

# A COLLECTION OF THESES ON SUSTAINABLE PUBLIC TRANSPORT



© Pakistan Institute of Development Economics, September 2024.

The report is designed by Afzal Balti,  
Graphic Designer at the Pakistan Institute of Development Economics, (PIDE). Islamabad.

## **Acknowledgement**

Dr Nadeem Ul Haque, Vice Chancellor, PIDE, deserves all the credit for the idea and unwavering encouragement that brought this volume to life.



# TABLE OF CONTENTS

- |            |  |            |   |
|------------|--|------------|---|
| <b>11</b>  | Impact Of Metro Bus System on Female Mobility in Islamabad-Rawalpindi  | <b>190</b> | Sustainable Urban Planning Transportation Policy for Islamabad and Rawalpindi         |
| <b>53</b>  | Analysis Of Affordability and Accessibility of Public Transport to Women and Disabled Persons in Islamabad   | <b>212</b> | Private School Van Service in Islamabad: Implications for Urban Transport Regulations |
| <b>107</b> | Bus Rapid Transit: Mode Shift and Environmental Impact Analysis. A Case Study of Rawalpindi-Islamabad Metro Bus Service.                                   | <b>262</b> | Bike-sharing: A Global Perspective and a Sustainable Mobility Solution for Pakistan   |
| <b>137</b> | Quantifying The Environmental Impact of Mass Transit System Using Remote Sensing and Survey Based Approach: Before Implementation and After Implementation | <b>275</b> | Electric Vehicles in Pakistan: Policy and Challenges                                  |
| <b>156</b> | Understanding Public Mobility to Design a Green Transport System for Islamabad   |            |   |



# Collection of Theses on Sustainable Public Transport

## Preface

The analysis of transport institutions in Pakistan suggests that transportation solutions predominantly stem from the dissemination of knowledge from developed nations to developing ones, mainly facilitated by international development organizations. In the absence of any local research, this dissemination led to a discrepancy between imported transport policies and local requirements (Imran, 2010). This necessitates local research aimed at formulating policy interventions to address the escalating rates of car ownership and the declining air quality index. To fill the research gap within the transportation domain, this publication consolidates dissertations focusing on public transportation services in twin cities, encompassing impact evaluation of existing infrastructure, discussing requisite regulatory frameworks and recommending some alternative sustainable solutions like shared bus services to the highly budgeted metros. The proposed recommendations offer valuable insights applicable to any transportation policy framework.

In recent years, in several major cities, billions of rupees were spent on transport infrastructure such as roads, highways and motorways. The severity is evident as almost 80.35 % of the PSDP comprised of infrastructure projects alone in 2020 (Haque et al, 2020). And this expenditure was not aligned to the accessibility view of urban transport planning. Resultantly, no city in Pakistan provides citywide bus service (Haque and Rizwan, 2020). Recently the Bus based Rapid Transit was introduced in some major cities with huge budgets of around PKR 40 billion, exceeding the total transport budget of that city, and catering to mere 5-10 % of the population. Travelling in those elevated and air-conditioned buses one wonders was this the best solution, what was the professional assessment of the possible alternative solutions for public transport and does this solve the accessibility issues at all for a resource constraint economy (Haque and Rizwan, 2020). Now the local governments are grappling with the sustainability of these motorways and escalated infrastructures as the economic feasibility of these projects is tied to huge governmental subsidies. The subsidy per rider is around PKR 54.19 against the ticket of PKR 20 in case of Metro Bus Service (MBS) amounting to PKR 2 billion annually.

With an overall focus on the impact of the MBS on female mobility in Islamabad-Rawalpindi, **Tayyeba Khalil** explored female experience (before and after the provision) of PMBS related to accessibility, tangibility, affordability, safety, reliability, and change in social and economic activity. The overall finding of this research indicates that the metro bus service in Islamabad-Rawalpindi has brought an improvement in the service quality of public transportation for female passengers of all the three groups – working women, students and casual travelers, leading to ease in mobility of the female population which was absent previously.

The National Transport policy of Pakistan (2018) highlights the importance of transport sector as a driver of socioeconomic progress. However, it makes no mention of problems being faced by disabled persons who face social exclusion in the wake of unavailability of

public transport and accessible infrastructure. The developed countries have established world class transportation facilities that ensures inclusion of all segment of society including children, women, elderly and disabled persons. Following the footsteps of developed world, mass transit system is being pursued in various metropolitan cities of Pakistan to ensure inclusion of people including women and disabled persons in providing them safe, cheap and time saving travel. However, **Zain Ul Abideen** finds that MBS system is not ensuring accessibility to women and disabled persons to greater extent owing to poor planning, inaccessible infrastructure and its operation on specific route. Disabled persons cannot access the Metro Bus owing to inaccessible entrances, footways and malfunctioning of lifts and elevators. Moreover, the attitude and non-cooperative behavior of people also contributes to social exclusion of females and disabled persons. Likewise, disabled persons implored that captains of Uber & Careem refused to take accept their ride as their wheelchair would damage their vehicles. Thus the non-cooperative behavior and negative attitude of people also contributes to social exclusion. The BRT is safer for females yet the provision of CCTV cameras, complaint mechanisms, quotas and waiting areas for disabled persons can lead to an inclusive transport system.

Understanding mode shifts helps urban planners and policymakers make informed decisions about transportation infrastructure development. It allows them to allocate resources effectively and design transportation systems that cater to the needs of the population. **Rehana Ali Naqvi** used logistic regression method to analyze the survey data associated with the metro bus service in Islamabad- Rawalpindi, twin cities in Pakistan and examine mode shift behavior for shift to metro service for public transport, own transport and taxi users. Factors that are statistically significant in affecting model shifts to metro bus service include trip distance, travel cost and travel time of commuters. From the survey data of metro bus service, it is found that 18% of metro passengers were former public transport users and own transport and taxi users together comprised 17% metro travelers. In the prior studies, the modal shift was 50% from bus and train users and 27% from car users (Knowles, 1996). The new metro in Athens has attracted 53% of bus passengers and 16% of former car travelers (Golias, 2002). In the Madrid subway project, 50% of passengers were former bus users, and 26% of passengers used to travel by car (Monzon, 2000). Finally, 69% of Tramlink passengers were bus users and 19% of passengers were former auto travelers in Croydon (Copley et al. 2002). The comparisons among Pakistan metro bus and other cities indicate that mode shifts to newly introduced metro from public transport closely is lower in Pakistan. Also, women travelers are more likely than men to use metro in Pakistan. Lastly the study found that metro bus service has replaced around 700 public vehicles from the route of metro bus. It is estimated that approximately 800 metric tons of carbon emissions are reduced from the city so far.

A sustainable transportation system is a key to a sustainable city. The majority of sustainability indices show that existing urban travel habits are unsustainable. Concerns about excessive traffic congestion, air pollution, and energy concerns prompted policymakers to place a greater emphasis on MBS to alleviate environmental and traffic challenges (Deng & Nelson, 2013). **Muhammad Hamza Saeed** uses remote sensing and a survey-based technique to assess the environmental benefits of the Murree Road MBS. MBS

has a substantial influence on decreasing environmental emissions, according to the research. The environmental conditions have improved since the start of MBS at Murree Road, according to the NDVI and LST techniques employed in this study. Before the commencement of MBS at Murree Road, the average LST in this region was 36.50516, but it began to decline from 2016 to 2018, with the average LST temperature falling to 27.46416, 25.64227, and 19.54895. This demonstrates that LST at Murree Road has reduced by 16.95621, or almost 17 °C, following the deployment of MBS, which is a significant shift in temperature dynamics. However, in 2019, the LST temperature increased from 19.54895 to 23.28982, possibly due to an increase in the number of cars in the investigated area, or reduction in rainfall during that year. A survey of the users revealed that MBS has been used more frequently by middle-aged people (26-32). The elderly was in small numbers since accessing entry and departure points, both below and above ground, was difficult for them. The females were unwilling to answer the questions.

Although the introduction of EVs alone is not the only or entirely solution to attaining a clean and green environment in the nation, taking these actions will help us move closer to an environment with less emissions. The aim of this study is to help implement a green transportation system in Islamabad and Rawalpindi. In this study **Farzana Rubab** compares the financial and environmental costs of using electric, diesel, and solar buses. It also assesses the viability of using suitable electric vehicles (EVs) for Islamabad and Rawalpindi's public transit systems and considers several technological choices. Solar and electric buses are superior to diesel bus while considering overall environmental footprint and impacts. As both solar and electric buses have almost zero emission technology during operation. At present moment or initially, cost-feasibility is positive for diesel bus due to low prices of vehicle in comparison with solar or electric bus and cost-feasibility is negative for electric and solar bus due huge capital expenditure (CAPEX) requirement in the beginning. In a long run, social feasibility will be positive for electric and solar bus. As human being's attitudes towards environment friendly appliances, equipment and machines are quite optimistic. Behaviors of humans towards energy efficient and environmentally friendly solutions are increasing day by day as shown in upcoming few examples such as, preferring wind or solar energy sources over thermal, replacing old conventional lights with LED. These positive behaviors depict that people will move or prefer electric or solar bus over the diesel bus. Therefore, in the future, social feasibility of diesel bus will be negative. The detailed analysis and study of both fossil fuel and electric vehicles differentiate the use of both vehicles. The electric vehicles are expensive but their prices are coming down. With new Chinese automotive brands, the prices have become equal to or less than fossil fuel vehicles. Electric vehicles also have less maintenance cost, low fuel cost depends on the source of electricity production, and completely environment friendly, and also have a more safety factor. Although fossil fuel vehicles are cheap but have a high maintenance cost, more fuel cost and burning of fuel leaves behind the dangerous carbon, Sulfur, and fine particulate matter which are destroying the environment, endangers the human lives, and economy of Pakistan. It is concluded from this study that using the electric car in Pakistan can be very useful, cost-saving, environment saving, fuel-saving, and life-saving as well. The increasing population and increasing number of cars on roads are creating serious problems for the nation. As the world is moving towards renewable sources of energy so, it is the responsibility of our government to invest in using



the new technology resources to save the lives and environment of Pakistan. In the light of the current automotive market, new electric car manufacturing is encouraged and a tax-free import of electric vehicles is allowed.

**Saadia Khizar** highlights the concept of shared mobility and bus transport system. Shared mobility is defined as the optimal utilization of a vehicle/vehicles of any kind. It means allowing several people or goods to travel in the same transport at the same time to reduce individual kilometer travelled. For sustainability and less environment emissions, it is better to allow one vehicle on road than 10 individual cars. Creating a public transportation system based on shared mobility could result in the sustainable growth of our country's transport sector. Countries like India and China are moving forward by creating shared mobility-based transport of all form, from cars to minibuses. Pakistan too can create such a system and this study will, similarly, try to prove that theory. Statistically, around 200+ buses or minibuses 30–40-seater are currently operating in Islamabad and Rawalpindi under the indirect authority of various government or semi government universities but are not operating at full utility as they cater to student or university demand only other than that, the bus is either vacant or non-operational. This study plans to create efficient and effective use of already available recourse, Public and Semi-Public Institute's owned Buses used for individual transport (operational university buses), to empower the population of two cities by increasing their mobility. Increasing the utility of these buses by employing them for our public transport system is a sustainable idea like any ride sharing system. The routes of this study were determined based on common patterns and travel density of each union council of twin cities. The study included designs based on both inter and intracity transportation system where minor trip generator was mostly intercity and major trip generator were intracity. The revenue earned from the implementation of this bus transport system can be used for enhancing and updating the transport sector in the future. One of the future benefits of this plan is decrease in the traffic congestions and improved road condition, not to mention, the decrease in parking issues.

A study on traffic congestion in Beijing revealed that school trips are the major contributor to traffic congestion in peak hours (Lu et al., 2017) Similar pattern has been observed with respect to school trips in India and Sri Lanka (Dias et al., 2022; Singh & Vasudevan, 2018). Therefore, it is pertinent to study school transport issues, particular modes and travel behavior. In terms of mode choice, while being unregulated and privately operated school vans were found to be the most opted for mode choice for school trips in Kandy, Sri Lanka (Dias et al., 2022). **Alishba Naeem Ansari** postulates that Likewise, in Islamabad, school vans are privately operated and unregulated, second most used mode of transport among private school children (Zafar et al., 2015). Although school vans fill the gap in provision of school transport, the issues of quality and safety along with problems of multiplicity of operators pose governance challenges and negative externalities. Hence, despite safety, overcrowding and comfort concerns, many children in both government and private schools rely on these private vehicles for commute. This research investigated parents and children's views and behavior of this mode of transport and engaged school management as one of the stakeholders and incorporated their views as well. The major safety concern remains the use of CNG cylinders. Exploring school transport regulations in other countries, the study

identifies that urban transport regulations are not entirely enforced on privately operated school vans. The school vans in other countries are required to at least register with the regional transport authority if they comply with school transport safety standards. In Pakistan, no such requirement is there for anyone engaged in this business. There is a need for rules and regulations that set safety standards as a school transport vehicle, driver registration and vetting as a school transport driver, seating space management and regular vehicle fitness inspection. Also, there is no data available on school transport vehicle related accidents in Pakistan, the gravity of the situation is yet not understood among policy makers. Although the CDA traffic engineering cell is responsible for conducting transport studies due to human and capital resource constraints these studies are not being conducted frequently.

As the global landscape transitions towards the fourth generation of ridesharing, Pakistan is initiating its journey, initially adopting the third generation. **Saba and Zainab** posit that however, by progressively integrating bike-sharing systems across different cities and educational institutions, Pakistan can expedite its transition to the fourth generation. Though there is a complete disconnect and our cities rely heavily on motorbikes instead of bicycles and there are hardly any properly designed bicycle tracks (Haque and Rizwan, 2020), the implementation of bike-sharing systems in public universities and schools would be a transformative force in Pakistan specially addressing the first and the last mile mobility issues. This shift holds immense potential to alleviate congestion, promote the transition from private vehicles to public transport, and reduce reliance on conventional fuels like petrol. While initial investment is required, successful implementation promises ease of traffic congestion during peak school hours.

Around the globe, governments have been facilitating the transition by adopting measures such as providing financial incentives and subsidies for EVs, expanding charging infrastructure networks, and supporting R&D for battery technology advancements. They have also been encouraging the EV industry through subsidies and regulations, which include tax incentives, grants, and rebates to make EVs more affordable for consumers. Government regulations and targets for reducing greenhouse gas emissions have played a significant role in the transition to EVs. Many countries have set ambitious goals to phase out the production and sale of internal combustion engine vehicles in the coming years. These targets have further accelerated the adoption of electric vehicles globally. **Saba and Aamina** discuss the coherence between the electric vehicle policy and the challenges in EV adoption in Pakistan.

Saba Anwar

# CHAPTER 1

## IMPACT OF METRO BUS SYSTEM ON FEMALE MOBILITY IN ISLAMABAD-RAWALPINDI

Tayyeba Khalil and Dr. Faheem Jehangir Khan (2017)

### Abstract

This study explores the role of public transport system in female mobility in Pakistan. Based on a micro-study, using a mix method approach, this research assesses the impact of the Metro Bus System (MBS) on female mobility in the twin cities of Islamabad-Rawalpindi. Primary data is collected from three groups of female passengers – working women, students, and casual travelers – to evaluate whether the MBS has brought an improvement in the service quality of public transportation for them.

The findings of this study suggest that the metro bus service in Islamabad- Rawalpindi has improved the service quality of public transportation for female passengers leading to their ease in mobility. The analysis of service quality dimensions, such as reliability, tangibility and affordability, safety and assurance shows that the MBS has effectively addressed the concerns of female population regarding public transportation environment. It has significantly improved female mobility in the twin cities by providing a respectful and hassle-free transportation. Despite some limitations such as difficulty in accessibility of metro bus stations, limited inter-connectivity, and congestion problems and unavailability of seats during peak hours, it can be concluded that the MBS has effectively addressed issues such as uncertainty and insecurity for female passengers to a greater extent. This research suggests extension of metro bus network and feeder buses to improve accessibility and inter- connectivity, and running female exclusive buses during peak hours considering congestion and safety issues.

### 1 Introduction

Public transport or mass transit system provides mobility services to the public using shared vehicles. Besides providing daily commuting facilities to the citizens, it also plays an important role in providing several externalities of transportation including traffic congestions on roads, accidents and reducing environment pollution. Globally, the Metro Bus Systems (MBS) are used to provide public transport facilities to citizens in order to fulfill their daily commuting needs. The MBS is considered as a preferred way of mass transit in terms of safety, comfort and reliability (International Association of Public Transport, 2014). It has been established in major cities of 148 countries around the world, including Pakistan (International Association of Public Transport, 2014).

Metro service was first introduced in London, England in 1890 as a rapid mean of mass transit. China has established the world's largest metro system in Shanghai with a length of more than 500 km and around 3.3 million people use metro service every day (International

Association of Public Transport, 2014). The MBS in Tokyo is considered as the world's busiest system. In Asia, more than 70 million people travel through metro system per day. It is considered to be half of the world's total travelling population per day (International Association of Public Transport, 2014). A safe, reliable and affordable public transport system offers services to general public including those who cannot afford private transportation. This may also encourage female mobility leading to their increased participation in education and labor force (Imran, 2009).

In order to overcome growing congestion problems in major urban cities, the government of Punjab initiated the MBS projects to revamp the public transport sector. The need for MBS was felt to provide an affordable and reliable public transport facility to ensure safety and security the commuters. To provide safe, efficient and comfortable public transportation system, the government of Punjab established the Punjab Mass Transit Authority (PMA). An efficient public transport provides an essential service to citizens, especially to the poor. A safe public transport system can play a role in increasing the size of the labor market by providing greater access to employment opportunities for those who cannot afford or prefer private transportation.

Like males, female population in Pakistan also need to use public transport facility to travel to work, market and/or to visit relatives or to access public services such as education and hospitals. Females are more dependent on public transport as compared to males because of the use of other transport like motor-bikes and personal vehicles is restricted by norms of society. Yet females in Pakistan face challenges while using public transport due to lack of safe and secure transport system. The MBS was established to provide a safe, reliable, affordable and easily accessible modern public transport system to a larger population of the twin cities. According to the available literature on public transport and female mobility, the security and safety needs of female commuters are somewhat different from those of male commuters. The social and cultural context and some specific physical characteristics of public transit environment put constraints on the mobility of female population. This research will study these patterns in the case of Pakistan Metro Bus.

To provide safe, efficient and comfortable urban transportation system and reduce the growing congestion problems in Punjab, the PMA has initiated projects, including Lahore Metro Bus System (LMBS), Pakistan Metro Bus System (PMBS), and Multan Metro Bus System (MMBS). Apart from these, Rapid Mass Transit Systems (RMTS) are under construction in Karachi and Peshawar. The RMTS are also planned and approved for Faisalabad and Quetta by the Punjab and Baluchistan governments respectively.

The Pakistan Metro Bus System (PMBS) operates between Islamabad and Rawalpindi. Based on the experience of the Punjab government and the feasibility study conducted by the Capital Development Authority (CDA), the federal and provincial governments joined hands to launch a Metro Bus project to connect the twin cities and alleviate the traffic congestion problem on this corridor. The line was inaugurated on June 04, 2015 and has achieved highest ridership of 151,000 per day. The PMBS serves the metropolitan areas of Islamabad and Rawalpindi, spans over approximately 22.5 kilometers running from Saddar, Rawalpindi to Pakistan Secretariat, Islamabad. The PMBS is equipped with e- ticketing, intelligent

transportation system wand – automated fare collection and electronic video and audio bus scheduling system (AFC-BSS) system – CCTV security on service stations and inside metro buses, and automated escalators and elevators for passengers’ convenience. It consists of 24 stations; 10 in Rawalpindi and 14 in Islamabad. Table 1.1 presents the average ridership at every station of the Islamabad-Rawalpindi MBS on daily basis.

The PMA is in the process to starting operation of integrated public transport system (feeder routes) in Rawalpindi. In phase-I of the project, the PMA has planned six feeder routes to the existing Pakistan Metro Bus System. The total number of buses that will be operated on these routes are 78 mini buses (8 meter long). The feeder routes are planned such that to have fare, operation and physical integration with Metro Bus Line. In integrated public transportation system, the passengers will not need to pay two times while transferring from one bus or route to other but will pay discounted fare (Punjab Mass Transit Authority).

**Table 1.1 Average Ridership at Every Station of PMBS on Daily Basis**

STATION	SADDAR TO SECRETARIAT	SECRETARIAT TO SADDAR	TOTAL
SADDAR	1379	0	1379
MARRIR CHOWK	9658	4	9662
LIAQAT BAGH	13151	1276	14427
COMMITEE CHOWK	5367	1323	6690
WARIS KHAN	4360	884	5206
CHANDANI CHOWK	4007	711	4718
REHMANABAD	4316	740	5056
SIXTH ROAD	4142	3033	7175
SHAMSABAD	2601	933	3534
FAIZABAD	933	11489	12422
IJP ROAD	346	16	362
POTOHAR ROAD	1027	97	1124
KHYABANA I JOHAR	10712	2434	13146
FAIZ AHMED FAIZ	736	233	969
KASHMIR HIGHWAY	5600	4535	10135
CHAMAN ROAD	578	796	1374
IBNE SINA ROAD	200	43	243
KATCHERY STATION	398	1358	1756
PIMS	187	37	224
STOCK EXCHANGE	1034	7622	8656
7 <sup>TH</sup> AVENUE	326	50	376
SHAHEED-I-MILLAT	557	10225	10782
PARADE GROUND	39	11335	11374
SECRETARIATE	0	4431	4431
TOTAL			1,35,221

*Source: Govt. of Punjab, "Security and Safety for Metro Bus System in Rawalpindi and Islamabad (Saddar to PM Secretariat)," Punjab Metro Bus Authority (2014): P31*

As one of the purposes of PMBS is to provide a safer and reliable transport system to the female commuters, in accordance with the modern transport needs, this study offers a comprehensive analysis of the public transportation experience that influences female mobility in Pakistan. Further, it is about time to evaluate the quality, effectiveness and maintenance of metro bus projects, and to explore whether the PMBS has made an impact in the context of women mobility.

## 1.1 Background of the Study

In Pakistan half of its total population lives in urban areas which makes Pakistan the most urbanized country in Asia and the Pacific (Zhang *et al.*, 2014b). Nearly two third of this urban population lives in 10 major cities of Pakistan. With the passage of time the already highly dense but walkable urban centers are getting overcrowded due to population growth. In Pakistan, a low-income family may not afford a private vehicle. Therefore, most of urban population travels through public transport for their daily commuting (Adeel *et al.*, 2014b). During 2010 and 2016, the transport volume by road and rail has increased substantially; growing up from 438,131 to 622,967 million passenger-km/year (JICA, 2006). A study conducted by Japan International Cooperation Agency (JICA) indicates that the demand for public transport in Pakistan is rapidly increasing (see table 1.2). Following the economic growth scenario of 7-8 percent for Pakistan, indicated in the Medium Term Development Framework (MTDF, 2005-10), the future transport demand was estimated to grow to three folds the present demand as shown in the table below.

*Table 1.2 Number of Passenger Transport Demand in Pakistan*

Year	Passenger	
	Number of passengers (million/year)	Passenger-Km (billion-km/year)
2005	780	154
2015	1455	293
2025	2497	517

*Source: JICA, NTRC & MOC, Pakistan Transport Plan Study in the Islamic Republic of Pakistan, Final Report, 2006.*

In Pakistan, mobility has been largely a gender phenomenon. In a sociocultural context of Pakistan, mobility of female population through public transport is often associated with safety and respect. As a result, the mobility of female population becomes restricted (Adeel *et al.*, 2014a). In such a scenario, female commuters would prefer a transport facility which is accessible, comfortable and above all which can provide safety and privacy. Due to the lack of affordability of private vehicles, vast population relies on the public transport system for their routine mobility. However, the present condition of public transport system in Pakistan does not fulfil the needs of female population. It does not provide easy accessibility, safety,

privacy and hassle-free environment during travel. Table 1.3 shows a comparison of percentage use of different types of transportation in major cities of Pakistan and India before MBS.

Numerous factors have contributed to the upward trend of private vehicle use and the declining or static role of public transport in most cities. The most important factor is continuous investment in roads, which left few or no funds for public transport provision in most cities of the developing world. Badami (2005) mentioned that urban transport policy in India has been biased in favor of private transport modes. Imran and Low (2007) reported how scarce resources in Pakistani cities are deployed in road development at the expense of public transport and non-motorized transport. They found that road investment policies are not the result of any industrial development in Pakistan, and that private vehicles did not come to Pakistani cities until after World War II happened in developed world countries. These policies developed primarily due to involvement of international development institutions and their consultants, which favored roads instead of the inherited railway that passed through most of the cities. They concluded that heavy investment in roads left no money for public transport in Pakistani cities.

**Table 1.3 Types of Transportation in Major Cities of Pakistan and India**

CITIES	TRIPS		
	Private Transport % (Motorized)	Public Transport % (Motorized)	Non-Motorized Transport %
Lahore	24	16	60
Karachi	27	23	50
Delhi	18	40	42
Mumbai	18	60	22
Kolkata	5	78	17

*Source: Imran (2009)*

A large number of people travel between the two cities, Islamabad and Rawalpindi, every day for job and education. Before the introduction of the Pakistan Metro Bus System in Islamabad-Rawalpindi, the public transport system – mainly consisted of buses, vans and Suzuki pickups – owned by the private business community were the only mean of transportation in the twin cities.

Due to lack of an organized public transport system and lack of standards provided by mini bus transportation, people had to rely on one or the other form of private transport facilities. Before the launch of PMBS, around 210,000 different types of vehicles piled at three corridors which connect the twin-cities (Punjab Mass Transit Authority, 2014). This volume of traffic can carry around 525,000 commuters daily. According to an estimate, around 158,000 passengers travel between the two cities, while around 135,000 daily passengers concentrated on the corridors from where the existing PMBS route passes (Punjab Mass Transit Authority, 2014).

Considering these huge numbers of commuters, the Punjab government felt the need of a

mass transit system to combat traffic congestion and noise and air pollution caused by the heavy traffic due to increased use of vehicles. The aim of the rapid mass transit system was to provide a safe, affordable and easily accessible urban public transport system. The PMA was established for the construction, operationalization and maintenance of MBS. It aims to ensure an efficient public transport system especially for low income population, and safe and reliable transportation for female population which would increase their participation in the labor force.

The public transport policies, so far, in Pakistan shows deep structural problems about female passengers. Pakistan needs a range of transport policies to meet the transport needs and travel patterns of female passengers. The policymakers and transport professionals are aware of this social dimension of public transport but the needs to address the needs of female passengers and travel patterns have not been the priority of policy makers. It is important for policymakers to acknowledge the social dimensions of public transport and cultural constraints on female mobility while formulating transport policies. The study provides basis for the new public policy initiatives in public transport sector by providing an in-depth understanding of public transport as a gender phenomenon which was completely neglected previously while formulating public transport policies. The study explains that without taking public transport as a gender phenomenon, every new public transport policy will ignore half of the public (female population) and their needs and concerns. The study informs the policy debate on public transport about the concerns, needs and problems of female population which were previously neglected. The findings of the study would help policies makers in making new policies as well as make changes in existing transport policies. The study presents its findings to Punjab government and Punjab Mass Transit Authority. PMA would take the findings of this study to improve the existing service quality of MBS and also use the findings of study in future projects of Mass Transit system.

Table 1.4 presents the chronology of public transport planning and policy in Pakistan. It separates the historical overview of public transport planning and policies in Pakistan into two periods: (a) 1947-1990, and (b) 1991 forward. The period represents public transport policies and development after independence from British India in 1947 to 1990 and symbolizes the aspirations of the newly-independent country. The 1991 forward period was particularly concerned with exploring how public transport policy accommodated within a sustainable development context. Overall, the table gives a historical view of public transport planning viewed with the help of government transport planning and policy documents and published scholarly papers.

After independence railway was the sole mean of public transportation in Pakistan. In 1951 for the first time the Motor Vehicle Act 1939 was amended and the *Road Transport Board* was created in Pakistan (Imran, 2009). This was the first step toward the road transport system in Pakistan.

In 1957 under first five year plan the *West Pakistan Road Transport Board* (WPRTB) was created to complement the railway with road transport in public transportation. After two years, in 1959, *Karachi Road Transport Corporation* (KRTC) was established to promote bus based



public transport system in Karachi Metropolitan area (National Planning Board Islamabad, 1957).

Under second five-year plan government for the first time gave priority to the road transport system in Pakistan. The government started to initiate construction of roads. The second plan encourage private transport companies to participate in public transportation (Planning Commission, 1960). The *Master Plan for Greater Lahore* (MPGL) was introduced under which a mass transit system was introduced in the form of circular railways to improve public transport system in Lahore city (Punjab Housing and Physical Planning Department, 1971).

After the second five-year plan, the transport system was deregulated in 1970s. This provide an opportunity for private sector to compete with government owned companies but government gave priority to public own vehicles in route permits. In 1977 *Punjab Road Transport Corporation* (PRTC) and the *Punjab Urban Transport Corporation* (PUTC) were created in Punjab to provide efficient public transport services (Punjab Housing and Physical Planning Department, 1977). The PRTC and PUTC were closed after operational for a couple of years in 1979.

Under the *National Transport Policy* (1991) government decided to provide limited subsidized transport facility to low income population. On the other hand the policy decided to promote private sector to provide middle class with quality transport facilities (National Transport Research Centre, 1991). Under the *Prime Minister Transport Scheme* in 1991 the incentive package which includes duty free on import of taxis and buses, loans on low interest rates and special registration numbers for public transport vehicles were given by government (Ministry of Communication - Pakistan, 1991). In 1996 under *Awami Train and Bus Project*, a bus and train mixed transport system was introduced in Rawalpindi and Islamabad to reduce the traffic congestion (NTRC, 1996). The *National Integrated Transport Policy 1998* focused on land use and integrated transport system to reduce the accessibility (Transport Policy of Pakistan, 1998). In 1999, the *Transport Sector Development Policy* was made by the federal government with the help of the World Bank. The policy emphasized on deregulation and privation of public transport system in Pakistan (Transport Sector Development Initiatives, 2001). In 1999, the *National Transport Strategy* was formulated by the *Small and Medium Enterprise Development Authority* (SMEDA) under the Ministry of Industries and Production which was approved by the federal government (National Transport Strategy, 1999). This was the first policy approved by the government, whereas all others were drafts which were never approved by the government.

In 2000, the Planning Commission of Pakistan prepared a transport policy which emphasized on road transport system and encouraged private sector in public transport. The *Ten Year Perspective Development Plan* (2001-2011) and the *Medium Term Development Frame Work* (MTDF 2005-2010) of the Planning Commission focused on bus based transport system for all the metropolitan areas of Pakistan. In 2003, an effort was made by the federal government with the help of the Asian Development Bank (ADB) on the project assessment of critical current transport sector needs.

In 2000, *Integrated Development Plan* (2001-2021) was prepared by the Punjab government.

This plan focuses more on road development rather than on public transport development (Lahore Development Authority, 1997). In 2005, the Punjab government gave task to *Martin and Voorhees Associates* to prepare a *Mass Transit Framework* (MTF) for major urban areas in Pakistan. The commission proposed a rail based rapid mass transit system for Lahore city (Govt. of Punjab, 2006). In 2005, the Punjab government prepared a Medium Term Development Framework (2006-09) under which a commission was made to prepare transport policy for province (Punjab MTF, 2006).

In 2012, the Planning Commission of Pakistan prepared a transport policy draft. The policy draft was not approved due to changing priorities of the new government (Pakistan Tourism Policy, 2012). Today, the transport sector is the 7th pillar in Vision 2025, but it mainly focuses on development of road infrastructure rather than improving public transport facilities. Moreover, after the 18th Constitutional amendment the subject of transportation has devolved to provinces.

The review of public transport planning and policy in Pakistan provides a fascinating example of the ways in which policy paradigms have developed historically and have been gradually changed and then maintained over time. Despite the unquestionable benefits that public transport planning and policy can bring to Pakistan, there have been many shortcomings in the development and implementation of public transport policy.

From the beginning, there was an issue with investing, managing, and operating public transport in Pakistani cities. Historically, the provincial governments in Pakistan have owned and operated intercity and urban public transport services.

However, over the years, the government, according to the guidelines of the World Bank, advocated to encourage the private sector in operating public transport.

**Table 1.4 Chronology of Public Transport Planning and Policy in Pakistan**

YEAR	POLICY/PLANNING	PROJECTS
1951	Amendment of Motor Vehicle Act 1937	Creation of road transport board
1955-60	First Five Year Plan	The West Pakistan road transport board and Karachi road transport corporation was established.
1960-65	Second Five Year Plan	Master plan for greater Lahore & private sector was encouraged in transport.
1970s	Deregulation of Public Transport system	PITC and PUTC were established in Punjab.
1991	National Transport Policy	Different transport facilities for low and middle- income population.
1991	Prime Minister Transport Scheme	Duty-free on import of taxis and buses, loans on low interest rates and special registration numbers for public transport vehicles.
1996	Awami Train and Bus Project	Bus and train mix transport system was introduced.
1998	National Integrated Transport Policy	Emphasized land use and transport integration to reduce need to travel and maximize public transport accessibility.
1999	Transport Sector Development Policy	Deregulation and privatization of public transport.
2001-11	Ten Year Perspective Development Plan & Medium Term Development Frame Work	Focus on transport system for metropolitan areas. Development of an efficient public transport system based on buses linked to mass transit system with light train.
2001-21	Integrated Development Plan by Punjab Govt.	Focuses on infrastructure/road development. 94.8% funding for infrastructure development and remaining 5.2 for transportation.
2005	Mass Transit Framework by Punjab Govt.	Rail based rapid mass transit system for Lahore city
2015	Vision 2025 (Transport sector is 7 <sup>th</sup> Pillar)	More Focuses on infrastructure/road development

The decline of state-owned public transport services created a vacuum that was filled by private operators in accordance with these guidelines. Initially, the market was open to private operators in parallel with public-owned public transport. However, the availability of public transport has not grown at the same rate as the urbanization in Pakistani (Sohail *et al.* 2006).

In the early 1990s, a change occurred in relations between the private sector and the government. The *Transport Sector Development Initiative (TSDI)* and the *Small and Medium Enterprise Development Authority (SMEDA)* transport policies were developed to promote these stronger public-private relations. The government wanted more involvement by the private sector in the development and operation of public transport. The introduction of

franchised public transport in different cities of the Punjab province is an example of these relationships. All policies to provide adequate and reliable public transport in Pakistani cities have failed badly in the presence of continuous demand, high-density mixed land use patterns, and a long history of private sector involvement in the provision of public transport.

A voluminous literature is available on public transport systems and its utility for female passengers, but there has been limited work done in the context of Pakistan. The literature on public transport examines the concerns of (both male and female) passengers in public transportation about safety, accessibility, reliability and affordability significantly influence their travelling decisions. The relationship between female safety and public environment has received much attention in the literature. However, the experience of female passengers about the utility and safety in transit environment has received less attention. Even less is known about the experiences of female population in Pakistan. This study aims to fill this gap by identifying the needs and perspectives of female passengers about their safety, accessibility, reliability and affordability in public transport system in Pakistan.

Keeping this in view, this research will examine the female utility of Pakistan Metro Bus System (PMBS), Islamabad-Rawalpindi and its impact on female mobility.

## 1.2 Objectives of the Study

The aim of this study is to investigate the role of public transport system in female mobility in Pakistan. In this context, the objective of this research is to examine the utility and impact of Metro Bus System in female mobility in Islamabad-Rawalpindi. This research seeks to explore female experience (before and after the provision) of MBS. Following research questions will guide this study:

- Has Metro Bus System brought an improvement in the service quality of public transportation for female passengers?
- How the female travelers perceive Metro Bus System in term of accessibility, safety, affordability, and reliability?
- Has Metro Bus System responded to the concerns of female population regarding public transportation environment?

## 1.3 Significance and Scope of the Study

In a sociocultural context of Pakistan, mobility of female population through public transport is often associated with safety and respect. As a result, the mobility of the female population becomes restricted (Adeel *et al*, 2014a). In such a scenario, female commuters would prefer a transport facility which is accessible, comfortable and above all which can provide safety and privacy. Due to the lack of affordability of private vehicles, vast population relies on the public transport system for their routine mobility. However, the present condition of public transport system in Pakistan does not fulfil the needs of female population. It does not provide easy accessibility, safety, privacy and hassle-free environment during travel.

The MBS claims to address these gender-related mobility issues. In this context, this study offers an in-depth understanding of the impact of PMBS on female mobility in Islamabad-Rawalpindi. The scope of this study is to document the needs, reservations and safety concerns of female passengers regarding public transport system from empirical evidences as well as interviews with representatives of women commuters and to examine the extent to which these needs and reservations can be addressed by the concerned organizations and policymakers through the Metro Bus System.

No known study has so far examined the impact of metro bus in Islamabad-Rawalpindi on female mobility. This research seeks to inform future policy decisions by identifying issues and possible ways forward related to the provision of public transportation in urban centers and its role in female mobility.

## **2 Findings and Discussion**

This section presents the Profile of respondents, research findings and discussion relating to the impact of MBS on female mobility in Islamabad-Rawalpindi. At the end, the section presents key findings of this study.

Most of the participants belonged to the lower and/or middle-income class. A large number of passengers own a vehicle at home. Many of them were using that before the service provision of the Metro Bus System in the twin cities. Around 76% of working women (age above 30 years), 64% working women (age below 30 years), 42% students and 54% casual travelers have vehicles at home, but they prefer to use PMBS. When asked why, the majority in all groups indicated satisfaction about safe and comfortable travel. A vast majority also indicated that they have started to use public transport more frequently after PMBS despite having private vehicles. However, to reach the nearest PMBS station, many female passengers need a drop using a private vehicle or other public transport facility. A clear majority of unmarried females also indicated that they now use Metro Bus regularly without any male companion. Table 4.1 presents the profile of the research participants.

The findings and discussion, based on the analysis of the primary data, are arranged under the following themes:

1. Accessibility
2. Automated System and Tangibility
3. Affordability, Reliability and Responsiveness
4. Safety and Assurance
5. Ease in Mobility

**Table 2.1 Profile of Research Participants**

PROFILE	WORKING WOMEN		STUDENTS	CASUAL TRAVELERS
	ABOVE 30 YY	BELOW 30 YY		
AGE GROUP	31-58 Years	22-30 Years	15-28 Years	18-52 Years
MARITAL STATUS	Married: 96% Unmarried: 4%	Married: 32% Unmarried: 68%	Married: 4% Unmarried: 96%	Married: 36% Unmarried: 64%
EDUCATION	Post Grad 20%	Post Grad 64%	Post Grad 24%	Post Grad 34%
	Graduates 28%	Graduates 36%	Graduates 42%	Graduates 24%
	FA/FSc 12%	FA/FSc 0%	FA/FSc 20%	FA/FSc 26%
	Illiterate 40%	Illiterate 0%	SSC/Matric 14%	SSC/Matric 6%
				Illiterate 10%
FAMILY SIZE AND STRUCTURE (on average)	7.0 members' family.  86% living in a nuclear family system	5.0 members' family.  92% living in a nuclear family system	5.0 members' family.  84% living in a nuclear family system	6.0 members' family.  70% living in a nuclear family system
SOURCE OF FAMILY INCOME	Employed 84% Business 14% Other 2%	Employed 90% Business 8% Other 2%	Employed 66% Business 14% Other 20%	Employed 72% Business 18% Other 10%
FAMILY MONTHLY INCOME	Min 20k Max 200k	Min 19k Max 200k	Min 13k Max 150k	Min 14k Max 200k
(on average)	Mean: 55k	Mean: 45k	Mean: 65k	Mean: 65k
VEHICLE OWNERSHIP	Yes: 76% No: 24%	Yes: 64% No: 36%	Yes: 42% No: 58%	Yes: 54% No: 46%

Since this research focuses on the impact of Metro Bus System on female mobility in the twin cities of Islamabad- Rawalpindi, the discussion presents the perceptions and experiences of female passengers about the MBS in comparison with other public transport facilities used.

## 2.1 Accessibility

Accessibility refers to the easy access of public transport to all categories of commuters. A public transport system scores high in accessibility when its route covers large residential neighborhoods. The influential zone in term of accessibility is defined as 1 km or the walking distance from home to station. To assess the ease in accessibility of the Pakistan Metro Bus System in Islamabad-Rawalpindi, this research measures (a) the accessibility or distance to nearest PMBS station, (b) connectivity to desired destination, (c) transport timings to passengers' convenience, (d) and affordability in terms of financial expense. To measure the

impact, accessibility of the PMBS was compared with other public transport facilities currently or previously utilized by the female passengers (*see Annex 1a*).

## 2.2 Accessibility to Metro Station

To measure the accessibility to the nearest PMBS station, respondents were asked (question 7, 8, 9 and 13 of the interview) to name the nearest PMBS station, indicate the estimated distance from their residence or place of work, and specify mode adopted to reach the nearest station. The findings suggest that slight majority of students (54%) enjoy easy access – within 5-10 minutes distance – to PMBS station, while it takes 15-20 minutes to most of the working women (58%) and casual travelers (74%) to reach the nearest station. Due to lack of easy accessibility, most of the PMBS female passengers have to take other means of transport – including other public facility or private vehicles – to reach the nearest PMBS station, whereas some reach MBS station by walk.

“I have to walk for about 15-20 minutes from my home to the Metro Bus station and then again 10-15 minutes from the Metro Bus station to my office.” (*A working woman*)

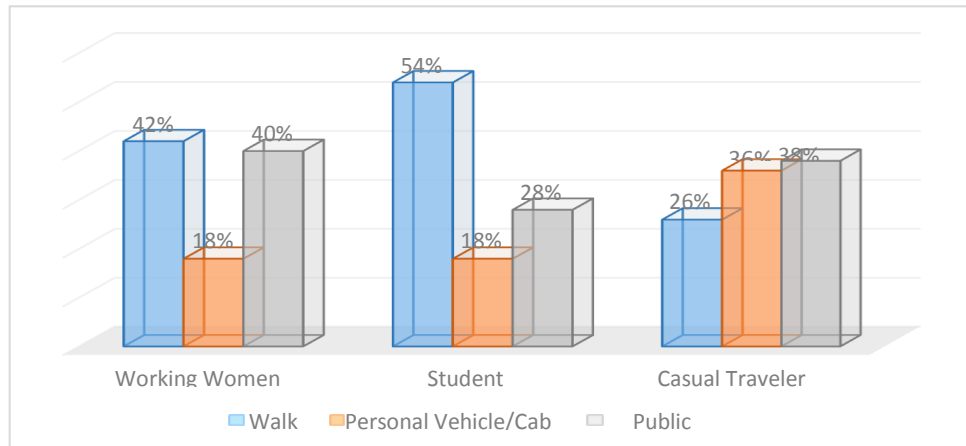
“Varan transport system [private company] was much better if I compare it with the metro bus. I live in Sector G-11... (For Varan) I had to walk for a minute from my house to catch the Varan bus. Whereas now, I have to travel via van or sometime use taxi and spend around Rs. 100 to reach the Metro Bus station... Then I have to walk for 10-15 minutes from metro station to my office.” (*A working woman*).

Figure 2.1 presents the different ways or means used by female commuters to reach to PMBS station from their homes. It shows that majority of commuters get to the stations by walk which means PMBS is easily accessible or at walking distance for majority of the commuters. Some commuters use personal vehicles to reach the metro stations, whereas a number of female commuters still use other public transport means to get to the nearest metro bus stations or from stations to their desired destinations.

“I work in Melody (civic center, G-6, Islamabad), so I have to either walk for 15 minutes from Shaheed-e-Milat station or take a cab which costs me additional Rs. 50... I still prefer using metro bus because it is more safe and respectable transport than public transport van.” (*A working woman*)

“It would have been more helpful had metro bus route covered more areas. The metro authority should extend the service to more areas to facilitate female who still face the humiliation at other public transport every day.” (*A casual traveler*).

**Figure 2.1 How to Reach the PMBS Station**



The findings indicate that despite difficulty in accessibility of PMBS, female commuters mostly prefer to travel on it as compared to other public transport facility because it provides a safe, reliable, affordable and comfortable transportation. Whereas other transport facilities are easily accessible but either they are not safe and comfortable or not always affordable. Respondents, especially students, indicated that their parents also encourage them to use metro bus and avoid other public transportation. “My parents believe that metro is much safer and reliable... hence I don’t need accompany. My father drops me to the Saddar metro station and later pick me upon my return from college... Many of my college fellows also use metro”, said a college student.

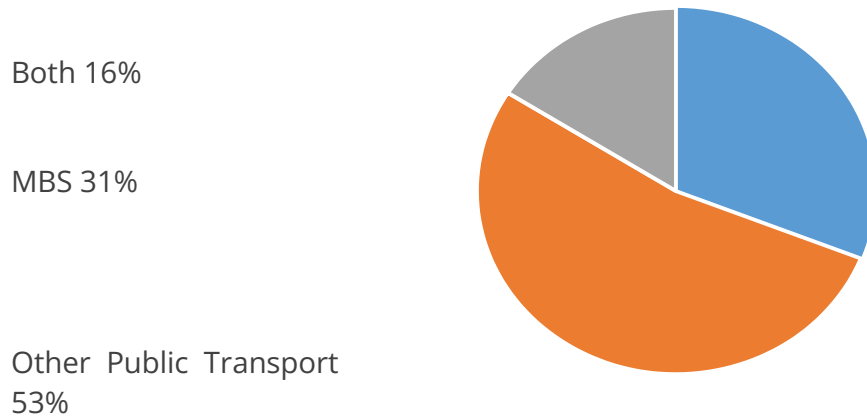
While comparing the accessibility of PMBS station to other public transport facilities available, a vast majority of participants indicated that other public transport facilities were more easily available round the clock. Majority of the respondents confirmed that they walk for 5-10 minutes to access a public transport van, Suzuki pickup or taxi. Das *et al.*

(2013) suggest that the influential zone for an easily accessible transport mean is 1- kilometer or walking distance from home to station. Applying this standard to access PMBS in Islamabad-Rawalpindi, the findings suggest that people living in 1-kilometer influential zone or at walking distance are comparatively low than those who have to cover long distance to reach the PMBS station.

Figure 2.2 presents the comparison of ease of accessibility between PMBS and other public transport facilities. Overall, it indicates that 53% of female commuters perceived that other public transport (van or Suzuki pickup) are more easily accessible, whereas 31% believed that PMMB is more accessible as compare to other public transport. Only 16% of female commuters confirmed that both PMBS and other public transport are equal in term of ease in accessibility. Respondents indicated that people living closer the metro bus route can access the facility easily but majority of respondents are living in areas far away or their desired destination are at distance from PMBS station.



**Figure 2.2 Ease in Accessibility**



**Box 1: More Metro Bus Routes and Feeder Buses**

I work in a call center in Islamabad. I travel between *BharaKahu* – which is a suburban area of the city – and my office in Blue Area, Islamabad. Metro bus offers travelling only on specific route from Saddar to Secretariat, while many others like me still have to travel on vans, pay more for low standard service and face social difficulties too.

It is unfair that I, along with many other female travelers, still facing the same problems while government has turned a blind eye to our situation. Government should start new metro bus routes or start feeder buses like in Lahore. *(A working woman)*

When probed what can be done to improve the accessibility of passengers, a number of participants demanded feeder buses – like in Lahore and Multan MBS – to facilitate the commuters. “Shahbaz Sharif promised feeder buses for the people of Islamabad and Rawalpindi, but he gave that facility to Lahore and Multan first... Feeder buses are essential to help people [PMBS passengers] of Rawalpindi to access the metro station, especially for those who live or work far from the metro bus route”, said a casual traveler. Similarly, a young student expressed her experience, “I have to beg my brother or father every morning to give me a drop at the Chandni Chowk metro bus station so that I can reach my university (in Islamabad) on time... it would be more convenient if I have access to a feeder bus on walking distance.”

### 2.3 Connectivity

To measure the connectivity, participants were asked (question 10 and 11 of the interview) to compare the route connectivity and route convenience to get around different destinations of PMBS and other public transport. The findings of the study suggest that majority of travelers get to their desired destinations – mostly home, education or work place – via Metro Bus, however the interconnectivity of other public transport facilities were considered more reliable if travel is required for other parts of the city. Research participants confirmed that PMBS route covers limited areas of the twin cities due to which people have to take next journey on other public transport facility to get to their desired destinations.

Again, a number of respondents demanded feeder buses and opening of more routes of the metro bus so that the public can reach other than limited destinations.

As compared to PMBS, a vast majority of respondents from all three groups of participants suggested that other public transport facilities are more interconnected. In term of coverage of areas or destinations, the findings suggest that a large percentage of respondents say that PMBS route covers limited area and destinations since other public transport covers almost all areas of the twin cities. "I mostly use metro bus to visit the Centaurus Mall. My daughter uses metro bus every day for her university... but we have to use our own car or Careem (cab service) if we have to go to other parts of the city... The coverage (of metro bus) is obviously limited and we hope the Chief Minister will expand the metro bus service to other parts of the city soon", said a casual traveler.

## 2.4 Automated System and Tangibility

Operations and maintenance is one of the biggest challenges for any project to sustain its services. This section presents findings and discussion related to respondents' perceptions and experiences about tangibility and use to automated systems installed at the metro bus stations and inside the metro buses.

## 2.5 Tangibility

Tangibility refers to the facilities such as the elevators, escalators, air conditions, free Wi-Fi service, cleanliness and maintenance of stations and buses, and seating space at the metro stations and inside the metro buses, and availability of comfortable seating. The respondents were asked (questions 14 to 22 during interviews) about the working of elevators, escalators, Wi-Fi, air-condition, cleanliness at stations and inside buses, availability of seats at stations and inside buses and about comfortable seating system.

The findings indicate that overall PMBS scores high (above 90%) against tangibility. Most of the respondents from all three groups were satisfied with the available facilities at the bus stations and inside buses, and indicated that the facilities were well maintained and working properly. There were zero complaints about the working of the air conditioning inside the buses, while a few participants highlighted issues related with the working of elevators and escalators.

This high satisfaction of passengers about the air conditioning, elevators and escalators was mainly due to their past or current experiences about other public transport which lack all these facilities. Respondents indicated that it was very difficult for them to wait for van or Suzuki along road sides where there were no seating space and shelter from rain and sun. Inside other public transport they have to bear heat during summers. They can use elevators and escalators to reach station. Passengers can now travel in an air- conditioned public transport system.

"Unlike other public transport, the metro bus is a respectful transport facility... I used to wait for the van for hours, mostly along road side with males all around and dust... sometimes in direct sunlight and rain... I now prefer to take Metro bus despite that I have to walk for 12

minutes to reach this station." *(A working woman)*

"I enjoy the air condition a lot. It is too hot outside... What else you want? I enjoy a comfortable travel in just Rs. 20... I remember travelling in non-AC vans with disgusting seats and smell... Cannot think of using that again." *(A working woman)*

Interestingly, only a small number of participants were actually using the free Wi-Fi available during travel. A large number of commuters were not using it. So when asked whether the Wi-Fi works properly inside the bus during travel or not, most of the respondents did not answer since they never used this facility. More students (around 36%) than working women (14%) and casual travelers (24%) used Wi-Fi, of which a majority confirmed that Wi-Fi works properly.

When asked why passengers don't use free Wi-Fi, many respondents indicated that they already have a 3G connection, some indicated that they don't trust free Wi-Fi service, while others say they cannot use while standing in the bus, and a few were hesitant to use mobile phone in public. A small group of respondents, mostly casual travelers, either did not know about the availability of free Wi-Fi or had no cell phones with Wi-Fi function.

"I don't need to use it (the free Wi-Fi) in public. I already have a 3G package from my mobile service provider. I mostly use it at home or at my college." *(A college student)*

"Really? I did not know about it (the free Wi-Fi service). Let me get connected." *(A casual traveler)*

"I don't use it usually, especially when I am standing and don't find a seat (inside the metro bus)." *(A working woman)*

## 2.6 Cleanliness and Maintenance

Cleanliness and maintenance of public transport system is another indicator to evaluate the tangibility. After more than three years, since the metro bus started its operation in the twin cities, this research explores whether PMBS stations and buses are clean and well maintained.

The participants were asked (question 18 of interviews) about their views and experiences about the cleanliness at the metro bus stations. The content analysis indicates excellent conditions at the metro bus stations. A clear majority from all the three groups of respondents confirmed this. Around 78% working women, 68% students and 74% casual travelers considered excellent cleanliness at the metro stations. Similarly, 20-30% of respondents from all groups ranked the cleanliness conditions as good. A few interviewees thought it is normal, while there was not a single respondent who had complaint in this aspect.

"O yes! It is very clean. I never found any litter at the metro bus station or inside the bus. People sometimes throw things on the floor such a juice pack or plastic bag, and sometimes a toffee wrapper, but the (metro bus) staff is very efficient to clear that." *(A casual traveler)*

"It is good, but not up to the mark... I would blame people (passengers) for this, not the staff. The stations and buses are well maintained. I think they clean it every day, but people throw

litter ... some young visitors write their names inside the bus or on the walls of the station. Such people must be fined." (A university student)

The comparison of cleanliness at stations with other public transport was not possible because according to the respondents there were no proper station system exist at other public transport facilities.

### **Box 2: Nice and Clean Environment, but Lacks Interconnectivity**

I work in a travel agency... I feel good while travelling on the metro bus every day. It is a nice and clean environment, both at the station and inside the bus. Even driver and staff are there standing in clean uniforms. It is much better than other public transport services, but the route coverage is very limited. It suits me because my office is in Saddar Rawalpindi, but it may not suit everyone. So, people are bound to take a ride on other public transport services... whether they like it or not. (A working woman)

Continuing the interview discussions, the participants were asked (question 19 of questionnaire) about their views and experiences about the cleanliness inside the metro bus. Again, the content analysis indicates excellent to good cleanliness conditions inside the metro buses. Around 94% working women, 90% students and 96% casual travelers rated the cleanliness inside the metro bus as good and excellent. "I am travelling on metro bus since it was started... It is still like new. Seats are clean. Windows are clean. The floor is clean. The poles are clean... I would give the credit to the (metro bus) staff and its management. They are very keen in maintaining everything", said a working woman. Similarly, a young doctor told "I used to travel on taxi for work. It was expensive and in poor condition... Now I travel on metro bus. Although I have to walk a little to reach my hospital (PIMS, Islamabad), but it is a clean ride, air conditioned and cheap."

When participants were asked to compare the cleanliness inside the metro bus with other public transport they used, a clear majority indicated poor to very poor conditions of other public transport facilities. Around 70% working women, 56% students, 72% casual travelers indicated poor to very poor conditions of cleanliness in other public transport facilities. When probed if this (cleanliness) is the main driving factor for passengers' preference for metro bus, only a few said yes, while most of them valued safety and reliability.

"Who doesn't like clean environment? I do, but this is not the only reason I use metro bus... It is safe. It is reliable." (A working woman)

"Private vans are disgusting. Their seats are grimy and door handles are filthy. There is sweating smell inside the van and you cannot avoid it... Metro buses are so clean. I love travelling on it." (A university student)

## 2.7 Seating Space

There is a common sitting area at the metro bus stations and a designated seating area for females inside the metro buses. Inside the bus, there are around 12 seats and a small area where females can stand, while holding the pole or plastic handles. When respondents were asked about their views about the seating space (question 20-22 of interview questionnaire), a clear majority indicated issues with seating space inside the metro bus. Participants indicated that there was limited reserved seats for female passengers as compared to the space allocated for male passengers. Around 58% of working women, 76% students, and 86% casual travelers expressed dissatisfaction and indicated that they face a lot of problem while riding the metro bus, especially during peak hours.

"The seating space is too small. A lot of female passengers ride these buses every day, but there are only 12 seats available for us, and a small area to stand. Most of us have to travel the whole journey while standing." (A *university student*)

"This is what bothers us (females) a lot... Sometimes the male compartment is empty, but we cannot use it. Sometimes there is no space for standing, so we have to cross the yellow line and stand just next to the exit door or front glass, which can be extremely dangerous... The driver often yells at us to mind the line, but there is no space for us otherwise." (A *university student*)

A majority of female passengers indicated that they do not find seats during morning, afternoon and evening times if they start their journey from any stop other than Saddar or Pak Secretariat (both ends). In addition to congestion problem, most of the participants also highlighted the lack of proper separation of female-male compartments. During rush hours, the male passengers sometimes get into the female side and even sit on the reserved seats for female passengers, or some young males try to stand just next to females.

"I am a regular user of metro bus system since it has been launched... I hardly find a seat inside the bus... In most journeys, I have to remain stand throughout my travel from home to college and from college to home." (A *college student*)

"Space is an issue. Although there are CCTV security inside the buses, but males standing just next to me always bother me a lot. There is no physical (female-male) separation of compartments... There should be!" (A *working woman*)

Probing what can be done to overcome this problem, a number of respondents demanded more seating space with a clear physical separation of compartments and running female only metro busses after every interval during peak hours. "I would not even mind sitting on the floor in a female only (metro) bus, but cannot do this right now even I am too tired... There are males everywhere, watching and observing us all the way... a female only bus would be a blessing", said a working woman. Similarly, a young female college student said "The (metro bus) authority should increase the reserved seats for female passengers or run female only buses during peak hours at least."

When probed if females finding a seat in the metro bus is more problematic than other public transport, respondents believed that it is difficult to find a seat in metro bus than other public

transport facility. Exploring the reasons behind this, the findings suggest that the passenger can only ride other public transport when seat is available whereas in the metro bus passengers can ride even if seats are not available. In the latter case, they don't have to wait for long duration of time such as for a van with empty seats.

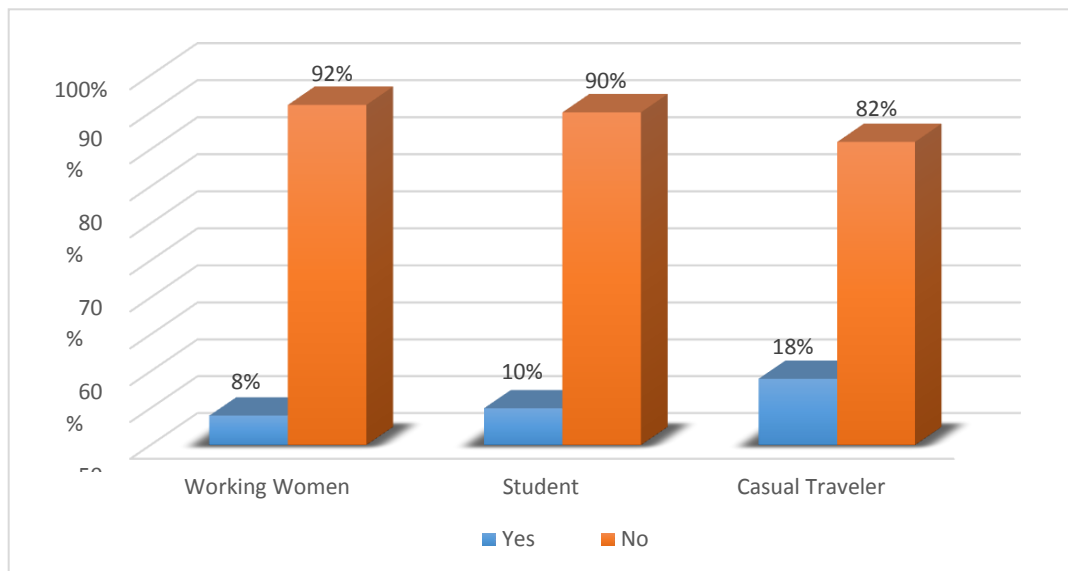
In addition to the above, on the question about seating space at the metro bus stations, around 49% of passengers said they find seat at stations while waiting for bus, and 46% said they do not need a seat at the station because the buses arrive quite frequently; after every three minutes. On the question about comfortable seating system, a clear majority (84%) of respondents said that seats inside the metro bus are comfortable.

## 2.8 Use of Automated System

The automated system refers to the use of electronic technology such as the token system, use of token at the automated entrance and exit gates, and use of escalators and elevators at the metro bus stations. The installation of technology at the PMBS stations was meant to improve the services and make the travel experience more effective and efficient. The research participants were asked (questions 14 and 15 of interview) about the use of automated systems separately. The overall findings in this context suggests that most of the respondents, above 90%, were able to use automated facilities easily and indicated that the electronic technology was working properly at the stations. In contrast, only a few respondents indicated difficulties using an automated ticket system, but added that staff at the metro stations were quite helpful. "I always find it difficult to use my token (ticket) at the entrance and exit gates, but staff is always there to help me pass through", said a casual traveler.

However, a large number of respondents also highlighted that they never used the elevators and Wi-Fi, and hence cannot be sure if that facility works properly or not. A small number of participants, mostly regular travelers from all groups, indicated that they initially face difficulty in using the automated token and escalators, but now they don't experience any difficulty. "It was a bit difficult at the beginning, but later I learnt once I went through it (the entry/exit gates) a couple of times... Metro bus staff is always there to help you, so you won't hear anyone saying they bought the ticket but were not able to ride the bus", said a university student. The behavior of staff members at station and during travel also creates concerns for passengers. Female passengers prefer technological solutions at mass transits and replace staff with automated machines at stations and in buses (Tharasher & Schnell, 1974). The findings suggest that there was proper deployment of trained staff at the entry and exit gates of the metro bus station to guide and help passengers. A working woman said "Initially I faced difficulty at the entrance and exit gates... (but) there were female staff members who guided me how to use the token... the fixed token system is very good initiative from metro bus. There is no conductor (ticket collector) inside the bus."

**Figure 2.3 Difficulty in Using Automated Token**



Overall, findings indicate that the passengers from all three groups were quite satisfied and comfortable with the automated electronic system and considered it a good initiative from PMBS (see annex 1b). Figure 4.3 shows the difficulty in using the automated token system at the PMBS. More than 90% of working women and student were comfortable using the automated system, while around 82% of casual travelers faced no difficulty. Around 18% of casual travelers experienced some difficulty, perhaps because they were not frequent riders of metro bus while working women and students were regular travelers.

## 2.9 Affordability, Reliability and Responsiveness

Affordability in the context of public transport refers to the ability of passengers to pay out-of-pocket for a journey to work, education, market or to access other destinations for social activities. Affordability of public transport impact the mobility of common man, especially from a poor and low-income family to a large extent. Absence of an affordable public transport system constrains the choices of the public for job and education to those which are accessible at walking distance. An expensive public transport may limit the mobility, especially of females. Similarly, reliability such as waiting and travel time, and information about the schedule of public transport matters for commuters. A reliable service enables the commuters to plan their journey and reach destination on time. Finally, responsiveness in the context of public transportation signifies how responsible and customer friendly the service is. In this section, findings and discussion is presented on affordability, reliability and responsiveness of PMBS in the twin cities (see Annex 1c).

## 2.10 Affordability

To examine the affordability, the respondents were asked (question 23 of interview questionnaire) about the affordability of public transport system, both PMBS and other public transport options. A consensus finding suggests that the PMBS provides an affordable public transport system which was previously absent in Pakistan.

Table 2.2: Affordability of Metro Bus versus Other Public Transport Facilities

	RESPONDENTS		
	Working Women	Student	Casual Traveler
Affordable Metro Bus	Yes 100%	Yes 100%	Yes 100%
Affordable Past/Other Transport Facility	Yes 70% No 30%	Yes 60% No 40%	Yes 62% No 38%
Metro vs Past/Other Public Transport Facility	100% say MB is more affordable than other Public Transport	100% say MB is more affordable than other public transport	100% say MB is more affordable than other public transport

When asked similar question about the affordability of other public transport facility previously or currently used, a majority believed that it is affordable, while a minority group indicated that other public transport is not affordable. When probed reasons behind the response of the minority group, the findings suggest that respondents were mostly indicating private cab service as other public transport facility. Nevertheless, when respondents were asked to compare the affordability of metro bus versus other public transport facilities, a consensus response came up in favor of PMBS (see table 4.1). Majority of respondents said that though other public transport is affordable too, but as compared to PMBS, other public transport is bit costly and also do not provide facilities which PMBS provides in just RS. 20.

"The van conductors and drivers ask for whatever they want and we either have to give it or argue with them every day... This does not happen in metro bus. We know it is a Rs. 20 for one-way travel." (A casual traveler)

"Van or Suzuki (pickup) is affordable, but definitely not cab or riksha. In fact, van is also sometimes expensive if you have to travel for a longer journey within the city... Metro bus is certainly much cheaper and comfortable than any other (public transport) service." (A working woman)

"Metro bus is undoubtedly a great relief for me, both in terms of time and money... I enjoy my rides to college every day. My elder sister used to travel on private cab for her college, which was expensive and lacks security and cleanliness." (A college student)

The government provides a subsidized journey to passengers. Majority of respondents considered that although other public transport is not always expensive, but as compared to other public transport PMBS is more affordable. Apart from this a section of respondents said that the other public transport may charge less but they do not pay the worth of that



fare. They do not provide a safe, reliable and comfortable transportation like people enjoy in the metro bus which provides all facilities in cheap fare.

### **Box 3: Experience of PMBS versus Other Public Transport**

I am a Personal Assistant in the Ministry... Before the metro bus, I used to spend around Rs. 15,000 every month on taxi fares. Travelling every day with a stranger in the cab, which is mostly dirty and smelly was awful. And it was expensive too... It was not affordable at all, but I had to do it to avoid (other shared) public transportation... If I were a man I would have bought a motorbike or travelled through van to save money... Thanks to Metro service, I now enjoy a decent travel and save a good amount of money." *(A working woman)*

It is important to note that a significant number of female passengers were using cab or riksha for their daily commuting purpose, either to reach the metro station or to their desired destinations from the metro station. A number of respondents, especially working women, were paying thousands of rupees per month in addition to the metro ticket to complete their journeys. Hence, most of them demanded feeder buses and opening of new routes of metro buses in the twin cities.

The analysis also suggests that the affordability factor was linked with the safety, reliability and comfort female passengers enjoy at the PMBS. "It (metro bus) is just not cheap, it is also safe and comfortable", said a working woman. Moreover, some female passengers indicated that they had to quit their jobs or discontinue their training/education because of the lack of a respectable public transportation system in the twin cities, but they now continued after the start of PMBS.

## **2.11 Reliability**

The reliability refers to the frequency of arrival of the metro buses, time taken to complete the journey and information mechanism about bus schedule, route map and information related to bus schedule and fare. The respondents were asked about the frequency of arrival of buses, availability of proper information mechanism, about routes and time taken by buses to get to desired destinations (question 24 to 27 of interview).

**Table 2.3: Waiting Time for Metro Bus versus Other Public Transport Facilities Used**

	RESPONDENTS		
	Working Women	Student	Casual Traveler
Waiting Time for Metro Bus	3 minutes: 98% 5 minutes: 2%	3 minutes: 99% 5 minutes: 1%	3 minutes: 98% 5 minutes: 2%
Waiting Time for Other Transport Facility – Van/Suzuki/Can/Careem	5 minutes: 30% 10 minutes: 58% +10 minutes: 12%	5 minutes: 40% 10 minutes: 50% +10 minutes: 10%	5 minutes: 25% 10 minutes: 10% +10 minutes: 65%
	RESPONDENTS		
	Working Women	Student	Casual Traveler
Waiting Time for Metro Bus	3 minutes: 98% 5 minutes: 2%	3 minutes: 99% 5 minutes: 1%	3 minutes: 98% 5 minutes: 2%
Waiting Time for Other Transport Facility – Van/Suzuki/Can/Careem	5 minutes: 30% 10 minutes: 58% +10 minutes: 12%	5 minutes: 40% 10 minutes: 50% +10 minutes: 10%	5 minutes: 25% 10 minutes: 10% +10 minutes: 65%

Exploring the waiting time female passengers experience while using the metro bus, the findings suggest that a vast majority get place in the metro bus within three minutes, while a few sometimes have to wait for a bus with space during peak hours (see table 4.2). “I hardly wait for two minutes... by the time I reach the bus gate from the entry point I find a bus there... and even if I miss one, I am confident to catch the next bus in just three minutes”, said a student. The respondents from all three groups indicated that the PMBS is a highly reliable mode of public transport as compared to other public transport options. The consensus response indicated that the metro buses come on their schedule and passenger usually do not have to wait for the metro bus for more than three minutes.

“My daughter is admitted in PIMS hospital and I have to visit her every day... I leave my car and take the metro bus. It was not possible before metro bus to travel between the twin cities this frequently and hassle free... Thanks to the government, it is now not only convenient, but fast and reliable as well.” (A casual traveler).

Female passengers who previously or currently using other public transport indicated that they have/had to wait for more than 10-20 minutes to catch a van, and even when the van comes they have to look for a space to fit in. People fear more during their waiting for vehicle at station or their journey from and to home than during travelling. Shen at el in his study found that 42% of incidents either take place near vicinities or 36% at transit stations during waiting (Smith, 2008). Some respondents highlighted that the lack of proper stations and designated seating system and uncertainty in van’s arrival create more fear and sense of insecurity.

“There is no van station system in other public transport. You have to stand at the roadside and wait for the van to come... It used to be very tough moments for me to wait for the van, especially when I was alone... We (females) quite often face eve teasing from male fellows waiting for the van standing nearby or passing through... Thanks to the Chief Minister (Punjab)... I don’t face such disturbing experiences anymore.” (A university student)

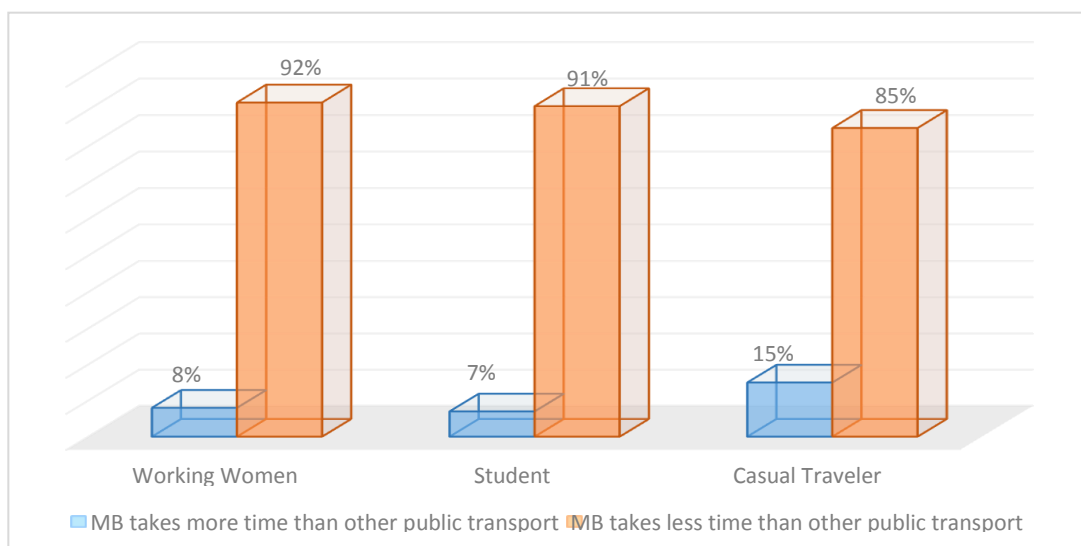
A clear majority of the respondents indicated that before metro bus service they had to pay more money to travel on other public transport, and then they had to make a journey of few kilometers in hours. The respondents highlighted that other public transport service is a hassle as compared to metro bus. The commuters have to change more vehicles and pay for every new journey. Apart from affordability, changing of vehicles to reach desired destination create a sense of insecurity and discomfort, and often make females more vulnerable to harassment and victimization. In contrast, PMBS provides a safe, secure and reliable transportation in just RS. 20.

“I am very glad to get rid of the van journey... Public transporters are ‘mafia’... habitually humiliating and intimidating commuters. I had to change two vans to reach my work place every day... It took me over an hour and costing between Rs 80 to Rs 100. After the metro bus, I take a comfortable and safe journey just in Rs 20.” (A working woman)

Exploring how much time it takes to reach a desired destination using a metro bus versus other public transport facility, findings suggest that metro bus covers distance in shorter duration than other shared public transport facility such as van or Suzuki.

A clear majority of respondents from all groups – 92% working women, 90% students, and 82% casual travelers – indicated that metro bus provides a faster journey as compared to other shared public transport (see figure 4.4). “The metro bus departs and completes its journey within its specified time, while van takes times to fill empty seats. It gives a sense of certainty and you can get to your office on time”, said a working woman. A university student said “Metro bus is highly recommended for those who go to work or for education... I precisely know how much time the metro bus takes, so I plan my journey accordingly. Once I ride the bus, I know exactly when I will reach my station... not worries related to delays.”

“Metro bus does not only save my money, but save my time too. I am a regular traveler between Islamabad and Rawalpindi... I used to spend hours in vans, but now I can get to the Pak Secretariat from Saddar in just 53 minutes in just Rs 20.” (A working woman)



**Figure 2.4 Time Taken to Reach Desired Destination**

The figure 2.4 shows the responses of passengers about time taken by PMBS and other public transport. The bar chart clearly shows that above 90% respondents said that PMBS takes less time as compare to other shared public transport such as van or Suzuki pickup. In contrast, a small number of participants from all groups believed that metro bus takes more time. This small percentage of respondents were those who just travel from one station to other subsequent station. The discussion indicates that a small journey may takes more time on metro bus as compared to van because passengers have to walk into the station using staircase, get into the line to buy a token, pass through the gates to enter the main hall and wait for the bus. In contrast to this, a majority confirmed that van or Suzuki takes more time in longer journey within the city. Van and Suzuki have no proper timings of departure, no binding to complete the journey within specific time, and no fine to observe delays.

"The vans plying on Murree Road take more than an hour from Centaurus to reach Liaqat Bagh... It costs Rs 60... have to change 2 vans... while the metro bus takes me there within 30 minutes and for just Rs 20." (A casual traveler)

"I have come to Islamabad to visit my sister... Before the metro bus, I used to come on a motorbike with a relative or had to take taxi... I had to bother some male member of the family to drop me there. Now, it's so easy, I can travel alone and with no delay." (A casual traveler)

Exploring whether timely information was shared about the schedule of metro buses and other public transport which would enable the commuters to plan their journey and reach destination on time, a consensus positive response came up for the PMBS, whereas almost every participant confirmed that there was no proper system of information sharing available for other public transportation.

Regarding information of bus schedule and route map (in question 26 and 27) a vast majority gave positive response. Participants indicated that metro bus provides a proper information system regarding bus schedule, route map and fare. Metro route maps were displayed everywhere at the PMBS stations and inside the metro buses. There was also an electronic video and audio system for up-t-date information about the bus stations and schedule of the buses. In contrast, above 95% respondents indicated that other public transport lack any information system about bus schedule, route map and fare. Probing if there was some information shared ever about change in travel fares, most of the respondents replied that it did not happened in recent past so they don't know precisely yet whether there is any such mechanism exists or not.

## 2.12 Responsiveness

To assess the responsiveness of the metro bus management towards its customers, participants were asked whether they ever made a complaint with the PMBS staff and what was the outcome. The findings suggest that a majority of the respondents either never felt the need to register a complaint or they did not know if there was any such facility available to register a complaint. In contrast, a few respondents indicated that they did register a complaint with the PMBS management at the metro bus station. The behavior of staff members at station and during travel also creates concerns for passengers. Female

passengers prefer technological solutions at mass transits and replace staff with automated machines at stations and in buses (Tharasher & Schnell, 1974). However, most of them (around 13 respondents) confirmed that the metro bus staff were reluctant and did not cooperate to address the issue. "I left my hand bag in the metro bus I was traveling in... I missed the bus so I rushed to the ticket counter and asked them to recover it... They did make a call, but they did not put enough effort", said a casual traveler. In contrast, a few complainants were satisfied with the PMBS management.

"I use metro bus every day to attend my college... I was harassed by a small group of boys for a couple of days. My female companions encouraged me to make a complaint, so I did... The PMBS security acted immediately... detained those boys, took their pictures and ID cards, took a written confession, and gave them a warning... Later the security officer shared all the details with me and asked me to get back to them if something else happen again... I never saw those guys on my bus since then." (A university student)

## 2.13 Safety and Assurance

Safety and security is one of the main concerning factors for female commuters and their families while using public transport. Literature suggest that female commuters feel insecure while traveling on public transport due to social and physical characteristics of transit settings. Due to the lack of safe and reliable public transport system females have to adjust their mobility and travel patterns, and sometimes avoid certain means of public transport such as van, Suzuki or taxi. This situation is perhaps more threatening to a particular category of young female commuters, who were more exposed to harassment and victimization. While conducting interviews of 150 female commuter travelling on PMBS, 80% of respondent said that they were using other public transport such as van/Suzuki because there was no other option. While travelling on these shared public transport facilities they were exposed to harassment at stops and while travelling. To explore what impact PMBS made in this context, respondents were asked (question 29 to 33 of interview questionnaire) about the safety and security at the metro bus stations as well as inside the metro buses. The behavior of the metro bus staff and satisfaction of passengers regarding safety measures were also investigated. The findings indicate that a vast majority of the respondents (up to 98%) considered the PMBS a safe and secure public transportation system. Respondents were satisfied with the measures taken for safety and security of commuter, especially females. The findings suggest that the environment of metro bus stations, presence of female staff at the ticket counters and waiting areas, and separate seating space for female commuters offer a sense of safety and security. Only a few interviewees expressed that they still sometimes feel insecure, primarily due to the eve teasing behavior of male travelers.

A number of respondents also highlighted concerns about the safety of their belongings during riding the bus. "I am always worried about the safety of my belongings while traveling. I know there are CCTV cameras everywhere, but it would be difficult to find the thief... due to congestion inside the bus", said a working woman. Interestingly, almost 50% of the female commuters, mostly casual travelers, were not aware of the CCTV security cameras installed at the metro stations and inside the metro buses, but they were still feeling safe and secure

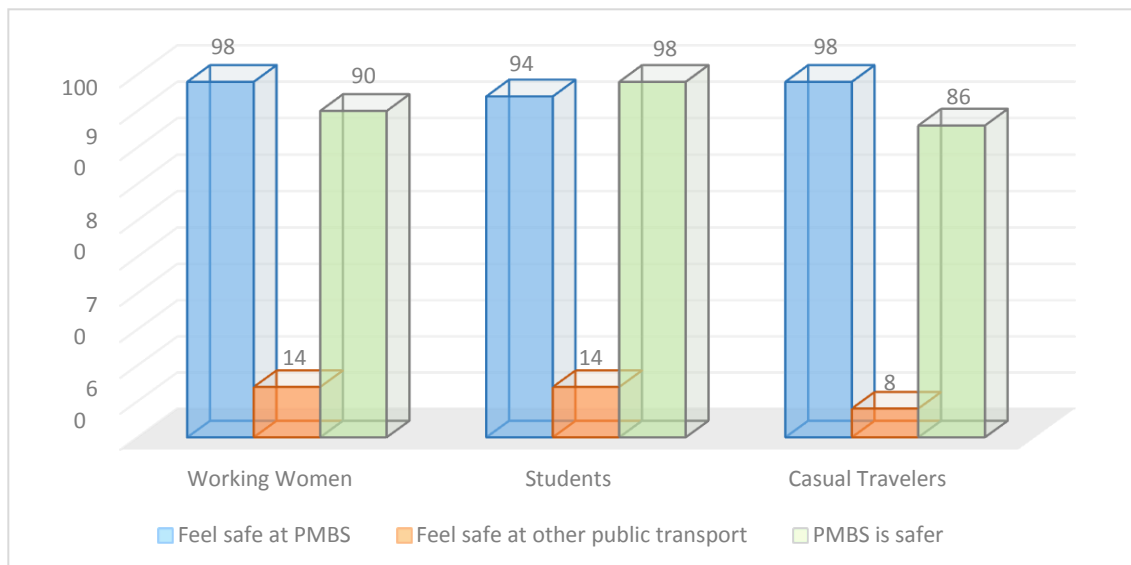
because of the presence of security staff, closed and sheltered stations, and designated seating for female commuters inside the bus.

"It (metro bus) is safe! I feel confident while using metro bus for my daily commute to work. My husband used to drop me to my work place, but now he only picks and drops me at the Faizabad station... There are other females around, female security staff, and security cameras too... Male commuters are aware of the security too... that is why they behave well."  
(A working woman)

"At metro while travelling I feel safe and secure... Now we can commute with dignity and respect... Metro is a step toward modernization towards development. I feel it is a good improvement... Government should have done this much earlier... Now it is time to expand this service to other parts of Rawalpindi and Islamabad."  
(A working woman)

Above 90% of the respondents who used or still using van/Suzuki confirmed that the PMBS was a relief from daily harassment females faced at other public transport. Exploring whether female commuters feel safe using other transport facilities, a clear majority from all groups expressed their insecurities: only around 14% working women, 14% students and 8% casual travelers were satisfied about the safety using other transport facilities (see figure 4.5). When probed, the respondents indicated that they were referring to Careem and Uber cab service, and not the shared public transportation. The findings suggest that lack of proper waiting areas and security, and absence of schedule were the factors adding to the vulnerability, harassment and victimization of female commuters travelling at other public transport.

**Figure 2.5 Comparison of PMBS with other public transport in term of safety**



The findings suggest that harassment was more common among students and young working female or casual travelers as compared to elder women. A majority of the students were victims of eve teasing and comments passing by males while using other public

transport, which was very limited at the PMBS. "Metro bus is a relief from that harassment and victimization we used to face", said a university student. On the other hand, elder working women and casual travelers have same views about PMBS and other public transport in term of safety and security.

"I have always faced the worst while using public transport... I always faced disrespect and humiliation while travelling on public transport... The Metro Bus has given relief from daily humiliation and harassment... I am fully satisfied with the Metro Bus service. It has given female a sense of confidence and security." (A working woman)

"I faced eve teasing and foul language in vans many times, but never got courage to raise my voice because I had to travel on same the route on a regular basis. I didn't want to get myself noticed... Metro bus gives a relief from daily humiliation at public transport." (A university student)

"Metro bus had given me relief from the daily teasing remarks and eve teasing along roadsides waiting for van... The separate seating space in the buses and female staff at stations made me feel safer." (A college student)

Exploring safety and security inside the metro bus, most of the female commuters expressed complete satisfaction about the metro bus station environment and the separate section for female inside the buses: 94% working women, 82% students, and 96% casual travelers. A few respondents however still expressed concerns regarding safety measures. They had concerns regarding the overcrowded stations where females have to pass through male crowds to reach the bus gate. Some had concerns regarding the lack of proper separation of female compartment inside the buses. While some indicated that the male commuters come to the female designated area due to absence of proper separation and sit on female reserved seats during peak hours. This creates sense of insecurity among female commuters, especially students and lone travelers.

"Due to limited space inside the buses we still face problems... government should take some steps in this regard... Run exclusive buses for female commuters during peak hours would be a great initiative." (A university student)

"The metro bus has given a relief for female commuters especially... before metro we have to travel in small over-crowded dilapidated vans... It was quite a struggle every day to catch a van and then be huddled into it like chickens. Metro bus has brought a measure of dignity to the daily commute especially for female commuters" (A working woman).

Comparing the PMBS ride with other public transport facilities, respondents indicated that inside the public transport van there was no separate space for female passengers, moreover the eve teasing and glaring by male passengers create insecurity and discomfort. While travelling between the two cities female passengers have to change 2-3 vans and while waiting for every next van they have to face eve teasing and comments from people passing through. "Our men don't have respect for women... They don't understand how insecure and discomfort we face due to their ugly remarks... These men are extra conscious about their mother and sisters, but don't respect women traveling on a public transport", said a working woman.

Exploring the behavior of staff at the metro bus station and comparing this with other public transport facilities, a clear majority of participants from all groups confirmed that the presence of female staff at station gives a sense of security, safety and confidence. The female staff at PMBS were mostly respectful and helpful. A majority of the female commuters expressed confidence and satisfaction over the behavior of male staff too.

"The (metro bus) staff is quite respectful. They don't bother us, but are always there to help

#### **Box 4: Safety first**

I am student of (a private college) in Blue Area, Islamabad. Before metro bus my family did not allow me to go to this college alone on public transport. My father or brother used to come with me to drop me, but it was necessary. My family and I believe in safety first. After PMBS, my family now allows me to go alone. I feel safe and secure while travelling on metro bus. I am usually alone, but there are other female travelers, security cameras and security guards everywhere. The separate seating space in the buses and female staff at the stations are good measures. But due to limited space for female passengers inside the buses we (females) still face some problems. *(A college student)*

us. I am thankful to female staff there... they are always there to help every commuter." *(A working woman)*

"Yes, they deal us respectfully. I feel safer and securer when I see them at the station... I know they are there to help if I ever need them." *(A college student)*

On the other hand, most of the responses suggest that the staff – conductor and driver – at the other public transport were the main reason for insecurity and unsafety of female commuters. Some respondents, mostly students and young casual travelers, indicated that the drivers and conductors harass female commuters while travelling. Female passengers feel uncomfortable with the disrespect and foul language used by the van drivers and conductors with fellow male commuters. The overloaded vans with closely fitted seats provide opportunity for drivers and other passengers to do unwanted touching.

"I had no other option since I had to sit on the front seat, next to the driver, because these are the only seats reserved for women in the van... unwanted touching while shifting the gears happens too often and is very uncomfortable... I cannot complaint this to my father due to the fear of fight or he may ask me to discontinue your college." *(A college student)*

"Instead of spending huge funds on the construction of metro track, government should have used the money to provide the same buses on all routes between Rawalpindi and Islamabad... It is unfair that me, along with many other women, are still facing problems while using other public transport on other routes." *(A casual traveler)*

Most of the female commuters had demands regarding further safety measures. They demanded the authority to either provide female only compartments inside buses with an increase in reserved seats for female passengers or run female only buses during peak hours. The overcrowded buses and lack of proper separation of female compartments create sense of unsafety among many female commuters during peak hours.



## 2.14 Ease in Mobility

It is evident from the literature on public transportation that a safe, reliable and affordable public transport facility is necessary for ease in female mobility. A safe and reliable transportation not only improve mobility but may also generate economic and social activity by providing easy access of female to work, education, market place and other social activities. A number of claims were made in the media by the PMBS, including that metro bus offers an opportunity to female passengers who could not travel alone for work, education and market due to absence of a reliable and safe public transport. Along with safety, PMBS also claims offering a comfortable and luxury transportation, due to which people who were using personal vehicles have started using metro buses. This research tests these claims in the context of female mobility, and explores ease in mobility for social and economic activities. The research participants were asked (question 34 and 35) if they have experienced any improvement in economic activity, ease in mobility, freedom from dependence on male member of family, and access to market for shopping and grocery as social activity (see annex 1e).

The safety and privacy of female makes mobility a sensitive activity. Therefore, people prefers a mood of transportation which ensures their safety and privacy (Adeel, Yeh & Zhang, 2014a). A significant proportion of respondents indicated that the metro bus service has helped a lot to improve social activities and market access of female population by providing safe and affordable transportation. Interestingly, respondents from all groups gave different reasons for this. For instance, working women were happier to save money they used to spend on cab, students were more comfortable about their safe and comfortable travel experience, while casual travelers were mainly delighted about coming out of male dependence for social activities such as shopping or visiting a family or friend's place.

"I had to ask my husband a thousand time before he would take me to the market for shopping... Now I take my sister-in-law with me and we do all our shopping without his involvement... He (my husband) is happy too." (A casual traveler)

"God knows how many thousands I have spent on taxi and rickshaw... and above all, that insecurity to travel with an unknown man in taxi... Thank God, I don't have such issues any more... I save a lot now... Nothing is perfect, but traveling on metro bus is a delightful experience." (A working woman)

"I feel safe here (on metro bus)! My brother drops me at the station every morning, and I travel alone to my university in Blue Area, Islamabad." (A university student)

The findings also indicate that some female passengers now travel more freely and frequently on metro bus as compared to their past experience. The findings suggest that female passengers now have improved access to market places such as Centaurus Mall, Rabi Centre Murree Road, Commercial Market and Saddar Rawalpindi. "Although many main markets are close to the metro bus route, we have to take a cab or van to access market places far from the station", said a casual traveler.

Some respondents also highlighted that six large secondary and tertiary government hospitals – CMH & MH Saddar, Benazir Hospital Murree Road, Cardiac Hospital Rawal Road, PIMS Islamabad, and Poly Clinic Islamabad – are just on walking distance from the metro bus route, which provides easy access to general public. "I live in Rawalpindi but I prefer to visit

PIMS hospital (Islamabad) for my pregnancy... The hospital is clean and doctors are good, and metro bus saves both my money and time”, said a casual traveler.

A safe, affordable and reliable mode of public transport helps female population to participate them in education and employment activities (Imran, 2008). Despite a few

### **Box 5: Mobility, freely and frequently**

I am house wife... We (girls in the family) had to plan and seek permission from our elders before any social activity outside house. In most cases, either our request was rejected or a male member of the family used to accompany us to the market... things have changed ever since the metro bus came in. We just let our elders know about our plan and leave. Although I never go out alone, prefer to keep a company with me all the time... Travelling on metro bus is fun. During load-sheddings last summer, we used to take air-conditioned metro bus and enjoy window shopping at the Centaurus Mall. My mother, aunt and cousins also accompany us on our frequent window shopping at Centaurus Mall. (*A casual traveler*)

reservations from a small group of female commuters, a clear majority of the respondents considered that PMBS has brought an ease in female mobility. It has provided a great opportunity for female to engage and participate in economic and social activities. Furthermore, PMBS has given a relief from female dependency on male members to travel on public transport.

“I used to spend hours getting to my office in crowded and smelly vans... By the time I reached my office, my mood was as uneven as my dress. Metro has given a relief from all that situations.” (*A working women*)

“In our society parents and family members tend to take special care in terms of transport facilities for their children, especially girls... I was allowed to get admission in this university just because of metro bus service... My parents do not worry even if I have evening classes... Government should also plan to launch a women’s only transport service. I think it will be a much bigger success than the metro.” (*A university student*)

Male dependence for female mobility outside house is common in our society. While travelling without male, women are sometimes charged with extra fare or sometimes taken to wrong bus stops. They often face harassment, stalking and poor travel environment in public transport and walking on urban roads (Sohail et al, 2006). Knowing this hostile travel conditions, families do not allow women to travel without male especially the young adults. This research explores whether metro bus service has helped females to reduce this dependence. The findings of this research indicate a significant drop in male dependence. Content analysis of the responses suggests that 92% working women, 76% students, and 70% casual travelers were either traveling alone or had the courage to travel alone on metro bus. In contrast to this, around 30% working women, 46% students, and 45% casual travelers indicated that they cannot travel alone on other public transport facility.

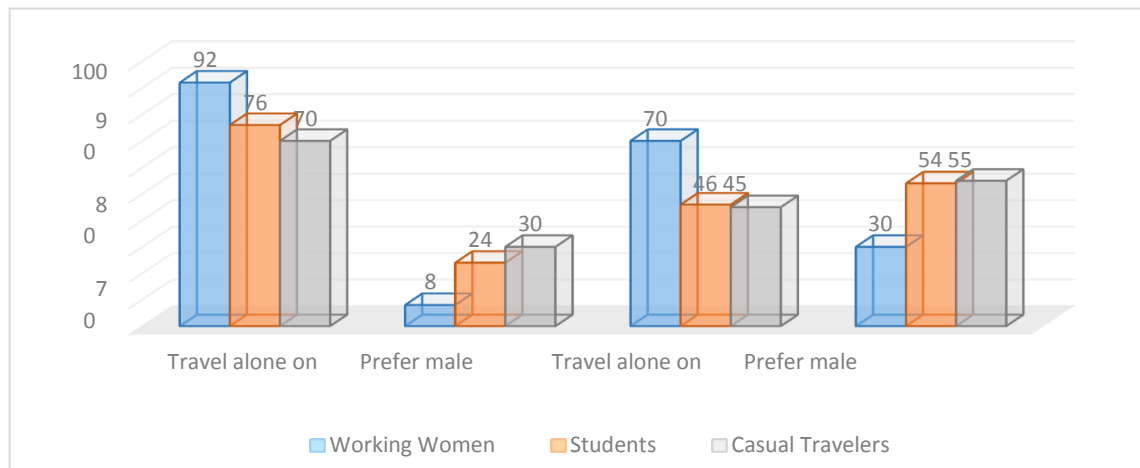
Figure 2.6 presents respondents experience about their dependence on male members of their families while using the metro bus versus other public transport facility. It is clear from the chart that female passengers were more confident to travel alone on metro bus as

compared to ride other public transport service.

However, still there was a sizeable group of respondents who were confident to travel alone on other public transport service. When probed, respondents, mostly working women and students indicated that despite insecurity they have to take other public transport service to reach office or university on time.

"I travel alone on the metro bus as well as on the van, but I feel comfortable and secure in metro bus... I have to take van from Saddar to my house near Ayub Park... If given an option, I would never ride a (public transport) van again." (A working woman)

Figure 2.6 Freedom from dependence on male family member



Respondents confirmed that PMBS has given a relief for most of the female passengers from their dependency on male members of their family. A vast majority of the respondents suggested that they used to need male members while travelling outside house, which was burdensome for them and for their male companions too, especially for students and working women who have to go out on daily basis. Although it was for their own security and comfort, but it was burdensome to have a male member alone with them every day.

"I don't wait for anyone anymore before going to work. I pick my bag and reach the metro bus station by walk. The station is just on 5 minutes' walk, and the neighborhood knows my family well... I don't bother my brothers anymore, and it is a relief for them as well as myself." (A working woman)

"My father has a shop in Saddar Rawalpindi... he comes home late every day... He used to wake up early just for us (me and my sister) to give us a drop to college. Although he never mentioned, but I used to feel bad... Thanks to Shahbaz Sharif (CM Punjab). Now I travel alone on metro bus to my training institute in Islamabad, and my father completes his sleep." (A college student)

In contrast, some female commuters indicated their preference of a male companion along with them while travelling on the metro bus. When probed why, some said they still feel unsafe and insecure due to overcrowded stations and buses, while others said it was not their choice. "I can travel alone on metro bus during the day time, but not allowed to do so", said a college student. Exploring whether metro bus enables the female population to generate economic activity, a few respondents (mostly maids and nurses) indicated that they have started work after the launch of PMBS. "I left my work in G-10 due to expensive travel and harassment during travel (at other public transport system) ... now working again in Islamabad", said a working woman. The findings indicate that despite daily victimization and harassment female face, some of them had to use other public transport to meet household expenses. "I am the sole earners of my family so I have to go out to work every day. Now it is metro bus or van, I need to be at work at any cost", said another working woman. Similarly, praising the metro bus service an old lady (casual traveler) said "I never imagined I would see such a transport facility in my life...

Traveling in old times was difficult, like using a *tanga*. Metro bus is a blessing for female commuters."

## 2.15 Key Findings

In the light of the findings and discussion presented above, following are the key findings underlining the impact of metro bus service in female mobility in Islamabad-Rawalpindi.

### **ACCESSIBILITY AND CONNECTIVITY:**

The PMBS was difficult to access and covers limited areas in Islamabad- Rawalpindi. In contrast, other public transport facilities were easily accessible and more interconnected in terms of coverage of areas than the metro bus service in the twin cities. PMBS stations were accessible to a minority section of female population travelling on this specific metro bus route. Whereas a majority of female population still used other modes of transportation such as van, Suzuki, cab and rickshaw to access PMBS. It was primarily due to the absence of an expanded metro bus network and lack of feeder bus service in Islamabad-Rawalpindi.

### **TANGIBILITY AND AUTOMATED SYSTEM:**

The PMBS scores excellent against all the tangible dimensions and use of technology. PMBS stations and buses were found clean and well maintained, the free Wi-Fi service, air conditions and escalators were working properly. All these were lacking in other public transport services. Regular commuters were aware of the use of these automated facilities, while some casual commuters were getting help from the metro bus staff whenever needed. Overall, the PMBS technology has improved the quality of services in the provision of public transport system.

One of the largest concerns of the female commuters was the limited designated space inside the metro bus. Although all metro buses have separate female seating area and space for standing inside the bus, it was considered not sufficient enough especially during peak morning and evening hours. In addition to congestion problem, lack of proper physical separation of female-male compartments was also highlighted which sometimes creates insecurity among female passengers.

### **AFFORDABILITY, RELIABILITY AND RESPONSIVENESS:**

The PMBS was not just affordable, but safe, reliable and comfortable public transport service. In contrast, although the other public transport services were also affordable, but considered not safe, and not reliable and comfortable. Female commuters of metro bus gave more weightage to the reliability aspect of the PMBS. This includes almost no waiting time, arrival of the buses on schedule, known estimated travel time to desired destination, and sharing of information about bus timings, routes, and stations. In contrast, the other public transport services have an unreliable operation system. It lacks schedule of arrival and known estimated travel time, and information about changing routes, timings and fares. The uncertainty in schedule and travel time delays create sense of insecurity among female commuters, due to which they feel vulnerable to harassment.

The responsiveness of the metro bus management towards its customers was considered good by the female commuters. The role of PMBS staff at the ticket counters and support/security staff in the waiting corridors were mostly appreciated. However, the complaint mechanism was not fully understood. A majority never felt the need to file a complaint, while some felt that the PMBS staff was not always cooperative in registering their complaints. Perhaps it was due to the lack of proper training of staff in dealing with the commuters or there was a lack of mechanism for solving complaints.

### **SAFETY AND ASSURENCE:**

The PMBS has addressed the security and safety needs of female population to a large extent. The security measures at the metro bus stations, presence of female staff at the ticket counters and in the waiting areas, and separate seating space for female commuters offer a sense of safety and security to female passengers, especially to young female commuters. Due to the congestion problem in the designated female area, commuters were also concerned about the safety of their belongings. In contrast, the lack of proper waiting areas and security, and absence of schedule were the factors adding to the vulnerability, harassment and victimization of female commuters using other public transport. Therefore, the metro bus service was considered as a relief from insecurities females faced at other public transport services in the twin cities.

### **EASE IN MOBILITY:**

By proving a safe and reliable mean of public transport, the PMBS has boosted up the confidence and sense of security in the female population of Islamabad- Rawalpindi. The metro bus service not only enables females to save money they used to spend on other public transport means, but also reduces male dependence and offers safe and comfortable travel experience. That is why, it has significantly improved ease in mobility and reduced male dependence for social activities such as market access and visiting a family or friends' place. Before the PMBS, despite several reservations, most of the females either had to use personal vehicle or hire a cab, or take other public transport means. Some female workers, who did not work or left their jobs earlier due to unavailability of safe and affordable public transport system, has started to work after the provision of PMBS.

### **3 CONCLUSION AND RECOMMENDATIONS**

The aim of this study was to investigate the role of public transport system in female mobility in Pakistan. In this context, the objective of this research was to examine the utility of Metro Bus System in female mobility in Islamabad-Rawalpindi. With an overall focus on the impact of the MBS on female mobility in Islamabad-Rawalpindi, this research explored female experience (before and after the provision) of PMBS related to accessibility, tangibility, affordability, safety, reliability, and change in social and economic activity.

This study offers an in-depth understanding of the impact of PMBS on female mobility in Islamabad-Rawalpindi. This study is novel and makes an original contribution to the literature and public policy debate as no other study has so far examined the impact of metro bus specifically on female mobility in the context of Pakistan. This research seeks to inform future policy decisions of the Pakistan government and, more broadly, the private sector in Pakistan by identifying issues and possible ways forward related to the provision of public transportation in urban centers and its role in female mobility.

The overall finding of this research indicates that the metro bus service in Islamabad-Rawalpindi has brought an improvement in the service quality of public transportation for female passengers leading to ease in mobility of the female population which was absent previously. The analysis on all the service quality dimensions, such as reliability, tangibility and affordability, safety and assurance show that the PMBS has effectively addressed the concerns of female population regarding public transportation environment and has significantly improved female mobility in Islamabad and Rawalpindi by providing respectful and hassle-free transportation.

Despite some limitations such as difficulty in accessibility of metro bus stations, limited inter-connectivity, and unavailability of seats during peak hours, and congestion problems due to small space inside the bus, it can be concluded that the MBS has effectively addressed issues such as uncertainty and insecurity of female passengers to a greater extent. Female commuters of all the three groups – working women, students and casual travelers – were mostly satisfied about their safe, reliable and affordable travel experience which other public transport services lack. The findings of this study highlight areas which required renewed attention by the PMBS as well as by the private transporters to make the travel experience more customer friendly, especially for female commuters.

#### **3.1 Policy Recommendations**

In the light of the research findings, this study makes following recommendations to improve the service quality of PMBS for female passengers in Islamabad-Rawalpindi:

1. To improve the accessibility, feeder buses are recommended in Islamabad and Rawalpindi to facilitate the PMBS passengers. It is expected that feeder buses can improve the accessibility of PMBS passengers to a greater extent.
2. To improve the inter-connectivity, it is recommended that PMBS should expand its route network and begin operations on other approved metro bus routes such

as Peshawar-morr to new Islamabad Airport, Bharakahu to Faizabad, Texila to Saddar, and Rawat to Faizabad. It is expected that this will improve the coverage and inter- connectivity.

3. Although the existing PMBS is considered safer and comfortable by a majority of female commuters, congestion problem in the female designated area inside the metro bus was repeatedly highlighted. To overcome this, PMBS should add 'female only' exclusive buses during peak hours. To do so, instead of every three minutes interval, these exclusive buses can run with an interval of every 15 minutes. Meanwhile, PMBS should also provide secured female compartments with an increase in reserved seats for female passengers, separated physically and completely from male compartments in regular metro buses.

## References

- Adeel M., Yeh, A. G. O. & Zhang, F. 2014a. Gender Mobility and Travel Behavior in Pakistan: Analysis of 2007 Time use Survey in 5<sup>th</sup> *International Conference on Women Issues in Transportation: Bridging the Gap*. Ed. A. Dupont kieffer, Paris: Federation Internationale de l'Automobile, P 41-46. Available at [https://mpra.ub.unimuenchen.de/55474/1/MPRA\\_paper\\_55474.pdf](https://mpra.ub.unimuenchen.de/55474/1/MPRA_paper_55474.pdf). (Accessed on 25<sup>th</sup> November, 2016)
- Adeel M., Yeh, A. G. O. & Zhang, F. 2014b. Public Transportation Disadvantages in Rawalpindi and Islamabad: Preliminary Results from Field Survey 2013, *International Conference on Town Planning and Urban Management*, Lahore University of Engineering and Technology, P29-30. Available at [http://adeelmohammad.weebly.com/uploads/1/4/14428004/ictpum14\\_presentation\\_adee\\_et\\_al.pdf](http://adeelmohammad.weebly.com/uploads/1/4/14428004/ictpum14_presentation_adee_et_al.pdf). (Accessed on 1<sup>st</sup> November 2016).
- Asdar A., Kamran. 2012. Women, Work and Public Spaces: Conflict and Coexistence in Karachi's Poor Neighborhoods. *International Journal of Urban and Regional Research*, 36 (3), pp585-605. Available at <https://utexas.influent.utsystem.edu/en/publications/women-work-and-public-spaces-conflict-and-coexistence-in-karachis> (Accessed on 4th October, 2017).
- Atkins, Stephen T. 1989. *Critical Paths: Designing for Secure Travel*. London: Design Council.
- Austin, Thomas L. & Eve S. Buzawa. 1984. Citizen Perceptions on Mass Transit Crime and Its Deterrence: A Case Study. *Transportation Quarterly*, 3 (38), pp103-120. Available at [https://www.researchgate.net/publication/236432557\\_Citizen\\_perceptions\\_on\\_mass\\_transit\\_crime\\_and\\_its\\_deterrence\\_a\\_case\\_study](https://www.researchgate.net/publication/236432557_Citizen_perceptions_on_mass_transit_crime_and_its_deterrence_a_case_study). (Accessed on 5<sup>th</sup> October 2016).
- Badami, M. 2005. The urban transport challenge in India: Considerations, implications and strategies. *International Development Planning Review* 27(2), pp 169-194. Available at [https://www.researchgate.net/publication/250276756\\_The\\_urban\\_transport\\_challenge\\_in\\_India\\_Considerations\\_implications\\_and\\_strategies](https://www.researchgate.net/publication/250276756_The_urban_transport_challenge_in_India_Considerations_implications_and_strategies). (Accessed on 4<sup>th</sup> October, 2017).
- Bryman, A., 2012. *Social research methods*. Oxford: Oxford University Press.
- Carter, Miranda. 2005. Gender Differences in Experience with and Fear of Crime in Relation to Public Transport. *Research on Women's Issues in Transportation*. Washington DC: Transportation Research Board, 35(2), pp. 100. Available at <http://onlinepubs.trb.org/onlinepubs/conf/CP35v2.pdf> (Accessed on 5th October, 2017).
- Flick, U., 2009. *Introduction to qualitative research*. London: Sage publications.



Gilchrist, Elizabeth, Bannister, Ditton and Farrall. 1998. Women and Fear of Crime: Challenging the accepted Stereotypes. *British Journal of Criminology*, 38(3), pp283-299. Available at [https://www.jstor.org/stable/23638718?seq=1#page\\_scan\\_tab\\_contents](https://www.jstor.org/stable/23638718?seq=1#page_scan_tab_contents). (Accessed on 10 November 2016)

Govt. of Pakistan. 2012. Draft of Pakistan transport policy 2012. Ministry of Planning Commission, Islamabad.

Govt. of Pakistan. 2013. Draft of Vision 2025. Ministry of Planning Commission, Islamabad. Available at <http://pc.gov.pk/vision/visiondoc> (Accessed on 11 November 2016)

Govt. of Pakistan. 2009. Constitution of Islamic Republic of Pakistan: 18th Constitutional Amendment. Parliament of Pakistan, Islamabad. Available at [http://www.na.gov.pk/uploads/documents/report\\_constitutional\\_18th\\_amend\\_bill2010\\_020410\\_.pdf](http://www.na.gov.pk/uploads/documents/report_constitutional_18th_amend_bill2010_020410_.pdf) (Accessed on 15 November, 2016).

Govt. of Pakistan. 1991. Prime Minister's public transport scheme. Ministry of Communication, Islamabad.

Govt. of Pakistan. 1996. The people's train: Preliminary evaluation. National Transport Research Centre (NTRC), Islamabad. Available at <http://www.ntrc.gov.pk/LIST>. (Accessed on 8<sup>th</sup> October 2016)

Govt. of Pakistan. 2001. Transport Sector Development Initiative (TSDI) Policy Draft. Ministry of Communication, Islamabad.

Govt. of Pakistan. 1999. National transport strategy draft. Small and Medium Enterprise Development Authority (SMEDA). Ministry of Communication, Islamabad.

Govt. of Pakistan. 2005. Working draft medium term development framework-MTDF (2005-10). Ministry of Planning Commission, Islamabad.

Govt. of Pakistan. 1957. The first five year plan 1955-60. National Planning Board, Islamabad.

Govt. of Pakistan. 1960. The second five year plan 1960-65. Ministry of Planning Commission, Islamabad.

Govt. of Pakistan. 1991. National transport policy draft. National Transport Research Centre, Islamabad. Available at <http://www.ntrc.gov.pk/LIST>. (Accessed on 8<sup>th</sup> October 2016)

Govt. of the Punjab. 1973. Master plan for Greater Lahore. Housing and Physical Planning Department: Master Plan Project Office, Lahore.

Govt. of Punjab. 2016. Terms of reference for Phase II reference design of Lahore Rapid Mass Transit System Priority Green Line. Transport Department, Punjab. Available at

<https://www.adb.org/sites/default/files/project-document/65194/40573-pak-rrp.pdf>.  
(Accessed on 12 November 2016).

Govt. of Punjab. 2014. Security and Safety for Metros Bus System in Rawalpindi and Islamabad (Saddar to PM Secretariat). *Punjab Mass Transit Authority*, pp1-71.

Govt. of UK. 2002. Women and Public Transport: The Checklist. *Department for Transport*, London. Available at <http://webarchive.nationalarchives.gov.uk/20100408115036/http://www.dft.gov.uk/pgr/inclusion/women/public-transport-and-women>. (Accessed on 1<sup>st</sup> December 2017).

HOODBHOY, P. 2013. Women on motorbikes — what's the problem?. *The Express Tribune*, Pakistan. Available at <https://tribune.com.pk/story/511107/women-on-motorbikes-whats-the-problem>. (Accessed on 6<sup>th</sup> October 2017).

Imran, M. 2009. Sustainable Urban Transport in Pakistan: An Institutional Analysis. *International Planning studies*, 2(1), pp120-130. Available at <http://www.tandfonline.com/doi/abs/10.1080/13563475.2010.490668>. (Accessed on 20 November 2016).

International Association of Public Transport (IAPT). 2014. Metro Rail System in India: Glimpses. *UITP*, 1(2), pp1-23. Available at <http://www.india.uitp.org/sites/default/files/documents/News-Metro%20Rail%20System%20in%20India-27-07-2014.pdf>. (Accessed on 15 October 2016).

Imran, M. 2009. Public Transport in Pakistan: A Critical Review. *Journal of Public Transport*, 2(2), pp53-83. Available at <https://www.nctr.usf.edu/jpt/pdf/JPT12-2Imran.pdf>. (Accessed on 20 October 2016).

Imran, M., and N. Low. 2007. Institutional, technical and discursive path dependence in transport planning in Pakistan. *International Development Planning Review* 29(3), pp319-352. Available at [https://www.researchgate.net/publication/250276916\\_Institutional\\_technical\\_and\\_discursive\\_path\\_dependence\\_in\\_transport\\_planning\\_In\\_Pakistan](https://www.researchgate.net/publication/250276916_Institutional_technical_and_discursive_path_dependence_in_transport_planning_In_Pakistan). (Accessed on 4<sup>th</sup> October 2017).

Japan International Cooperation Agency (JICA), National Transport Research Centre (NTRC), Ministry Of Communications, Government Of Pakistan, Pakistan Transport Plan Study in the Islamic Republic of Pakistan, Final Report, 2006.

Junger, Marianne. 1987. Women's Experience of Sexual Harassment. *British Journal of Criminology*, 4 (27), pp358-383. Available at <https://academic.oup.com/bjc/article-abstract/27/4/358/505868/WOMEN-S-EXPERIENCES-OF-SEXUAL-HARASSMENTSOME?redirectedFrom=PDF>. (Accessed on 7<sup>th</sup> November, 2016).

KUGELMAN, M. 2013. Urbanization in Pakistan: causes and consequences. NOREF Expert Analysis: *Norwegian Peace Building Resource Centre*. Oslo. Available at [https://www.files.ethz.ch](https://www.files.ethz.ch/isn/159296/4c5b5fa0ebc5684da2b9f244090593bc.pdf)

[/isn/159296/4c5b5fa0ebc5684da2b9f244090593bc.pdf](https://www.files.ethz.ch/isn/159296/4c5b5fa0ebc5684da2b9f244090593bc.pdf). (Accessed on 14<sup>th</sup> November, 2016).

Lahore Development Authority. 1997. Draft of Integrated master plan of Lahore. NESPAK, Islamabad. Available at <http://uu.urbanunit.gov.pk/Documents/Publications/0/98.pdf>. (Accessed on 20<sup>th</sup> October 2016).

National Institute of population studies. 2013. Demographic and Health Survey 2012. *NIPS*, Islamabad, pp1-34, Available at [http://www.nips.org.pk/abstract\\_files/PDHS%20Final%20Report%20as%20of%20Jan%2022-2014.pdf](http://www.nips.org.pk/abstract_files/PDHS%20Final%20Report%20as%20of%20Jan%2022-2014.pdf). (Accessed on 27<sup>th</sup> October 2016).

National Institute of Population Studies. 2013. Demographic and Health Survey 2012-13. *NIPS Islamabad*, pp1-34. Available at [http://www.nips.org.pk/abstract\\_files/PDHS%20Final%20Report%20as%20of%20Jan%2022-2014.pdf](http://www.nips.org.pk/abstract_files/PDHS%20Final%20Report%20as%20of%20Jan%2022-2014.pdf). (Accessed on 1<sup>st</sup> December 2016).

Reed, B. Thoma. Wallace, Rechar R. & Rodreguize Danial A. 1999. Transit Passenger Perceptions of Transit Related Crime Reduction Measures. *Transportation Research Record* 1731, pp130-141. Available at <http://trrjournalonline.trb.org/doi/abs/10.3141/1731-16>. (Accessed on 1<sup>st</sup> November 2016).

Ritchie, J. & Lewis, J. 2003. *Qualitative research practice: A guide for social science students and researchers*. London: Sage publications.

Sajjad, Fizza., Anjum., Field. & Vyborny. 2017. Gender Equity in transport planning: Improving women access to public transport in Pakistan. *Centre for Economic research in Pakistan*, Lahore. Available at <http://cdpr.org.pk/images/publications/cities/Gender-Equity-Transport-Planning.pdf>. (Accessed on 5<sup>th</sup> October, 2017).

SATHAR, Z. A. & KAZI, S. 1997. Women's autonomy, livelihood and fertility: a study of rural Punjab.

Silva, at el. 1998. Urban Transport Accessibility and Social Inequality in a Developing Country. *Urban Transport Policy*, 15(3), pp709-714.

Smith, Martha J. 2008. Addressing the Security needs of Women Passengers on Public Transport. *Security Journal*, 21(8), pp117-133. Available at <https://www.ncjrs.gov/App/Publications/abstract.aspx?ID=243659>. (Accessed on 5<sup>th</sup> November 2016).

Sohail, M., D. Maunder, and S. Cavill. 2006. Effective regulation for sustainable public transport in developing countries. *Transport Policy* 13(5), pp177-190. Available at [https://www.researchgate.net/publication/223801016\\_Effective\\_regulation\\_for\\_sustainable\\_public\\_transport\\_in\\_developing\\_countries](https://www.researchgate.net/publication/223801016_Effective_regulation_for_sustainable_public_transport_in_developing_countries). (Accessed on 20 November 2016).

Tharasher E. & J. Schnell. 1974. Studies of Public Attitude towards Transit Crime and Vandalism. *Transportation Research Record* 437, pp26-33. Available at <https://trid.trb.org/view.aspx?id=19973>. (Accessed on 10 October 2016).

Turner, J. & Fouracre, P.R. 1995. Women and Transport in Developing Countries. *Transport Reviews*, 15(2), pp77-96. Available at <http://www.tandfonline.com/doi/abs/10.1080/01441649508716902>. (Accessed on 13 November 2016).

Valentine. Gill. 1990. Women's Fear and the Design of Public Space. *Built Environment*, 16 (4), pp288-303. Available at <https://www.jstor.org/stable/23286230>. (Accessed on 26 November, 2016).

Valenti, Jessica. 2007. Is segregation the only answer to sexual harassment? The Guardian, <http://www.guardian.co.uk/lifeandstyle/2007/aug/03healthandwellbeing.gender/> (Accessed on November , 2016).

Wallace et al. 1999. Who Notice? Who Cares? Passengers Reaction to Transit Safety Measures. *Transportation Research Record* 1666, pp133-138. Available at <http://trrjournalonline.trb.org/doi/abs/10.3141/1666-16>. (Accessed on 28<sup>th</sup> November 2016).

Yin, R.K. 2009. *Case Study Research: Design and Methods*. Thousand Oaks: Sage, pp1-445

## CHAPTER 2

# Analysis of Affordability and Accessibility of Public Transport to Women and Disabled Persons in Islamabad

Zain ul Abideen, Dr. Rizwan Ul Haq and Fahd Zulfiqar (2022).

### Abstract

Accessible, inclusive and affordable public transport is essential in urban and rural spaces to allow people to participate in socio-economic activities and access opportunities necessary for their well-being and survival. This research first looks into existing public transport services, infrastructure and Metro Bus Service with a focus to analyse how transport services are being provided to the people of Islamabad living in urban and rural areas and what measures can be taken to improve the transport services to ensure inclusion of women and disabled persons. For this purpose, four locales from rural and urban areas have been selected which includes Bara Kahu, Taramri, G-6 (Aabparah) and G-9 (Karachi Company) respectively, and five Metro Bus Stations were also selected for collecting the data. Qualitative data techniques, with content analysis, observation, semi-structured and unstructured interviews, have been used along with thematic analysis to get the results. Findings show that existing public transport service and infrastructure in Islamabad is creating mobility challenges for women and disabled persons to a greater extent which is leading to social exclusion of both and depriving them of socio-economic opportunities. This research discovers that public transport service and its infrastructure in Islamabad is inaccessible to disabled persons whereas women have to face lot of accessibility issues, harassment, misbehavior etc. while accessing public transport. However, findings, in this research, reveal that Metro Bus Service in Islamabad is accessible to disabled persons to some extent but still improvement and continuous maintenance is required at the stations. Further, women expressed satisfaction with the MBS and suggested to allocate more space for women in the bus. Lastly, MBS should be extended to all of Islamabad to benefit people specially women and disabled persons. At the end, this research makes suggestions and recommendations to help policymakers and government to improve transport services in Islamabad.

### 1 Introduction

Accessible and affordable public transport has become necessary for mobility and active participation in urbanized societies. Urban mobility enables people to access goods and opportunities that ultimately improves their quality of life (Hernández, 2017). Growing urbanization has created mobility and accessibility challenges as distances and travel time are increasing between the activities (Adeel, 2016). Lack of access to public transport deprives people from accessing employment and business opportunities which resultantly

generates poverty, limits economic growth and leads to low quality of life. Besides, it also leads to deprivation, reduced participation and social exclusion to a great extent (Shivonne et.al 2019). Women, children and people with disabilities are marginalized sections of society in Asia and absence of public transport facilities puts them at the risk of exclusion from society (Islam, 2015, ESCAP, 2012 & Shivonne, 2019).

Inclusive transport is among the top priorities of developed countries to meet the transport demand of the people and enhance economic growth. Concept of universal design given by United Nations, has been adopted by developed countries which enables, elderly, women, children and disabled people access to public transport with ease (World Bank, 2013). In addition to this, developed countries are moving forward to shift over to use of electric cars to reduce greenhouse emissions. In Asia, people face excessive mobility issues owing to lack of public transport and infrastructure. People are left out in economic and social activities due to absence of public transport which consequently causes poverty deprivation and social exclusion (Adeel, 2016). Flawed urban and transport planning in Asian countries is causing mobility challenges for all people including disabled persons.

In Pakistan unplanned urbanization is growing at fast pace creating mobility problems for people in accessing education, healthcare facilities and job opportunities. In Pakistan, neither the public transport nor its infrastructure is accessible for disabled, as buses and other modes of transport have no ramps to help them aboard on the bus or rail which resultantly deprives them of availing various opportunities and active participation in socio-economic affairs of life. Government of Pakistan has devised various transport polices but were limited in scope and could not produce effective or desired results (Imran, 2009). Consequently, dilapidated condition of transport sector is negatively affecting economic growth and human development in Pakistan (Haque, 2015). Moreover, it is leading to reduced wellbeing of the people specially women and disabled persons. Owing to safety and security concerns women travel less in public transport or are not allowed to travel alone due to socio-cultural phenomena (Adeel et.al, 2016). Therefore, majority of women do not participate in economic activities by travelling outside their home. Moreover, women face lot of difficulties while accessing public transport such as harassment, limited and uncomfortable seats in local van, rude behaviour of conductors etc.

Islamabad is the Capital city of Pakistan which was planned in 1960s. According to Census of 2017, total population of Islamabad is 2.0 million. Islamabad is adjacent to a historical town, Rawalpindi, and houses most federal ministries, diplomatic missions and major headquarters. The study conducted on Islamabad (CDA, 2012) shows that about 700,000 trips occur every day within the city and up to a further 500,000 daily trips which either travel to or from the city to adjoining urban areas. Currently, Wagon, Coaster, minivan along with Bus Rapid Transit (BRT), remains the main mode of transport in Islamabad. BRT runs from Secretariat covering main commercial area, Blue Area to Saddar Rawalpindi and does not provide service to residential areas. Moreover, public transport services are inadequate and insufficient in Islamabad, therefore, people have to face lot of difficulties and have to rely on their personal vehicle or private taxi's for commuting to offices, schools, universities hospitals etc. According to Pakistan Bureau of Statistics (1998), 3.2 million people in Pakistan are

disabled and around 8500 are living in Islamabad.<sup>1</sup> These numbers are likely to increase in future and these disabled persons require transport service for mobility and accessing opportunities such education job and healthcare facilities. Presently, facilities for disabled persons in public transport is absent in Islamabad which is not only hampering their mobility but is creating lot of challenges for disabled persons and is affecting their quality of life.

Much work has been done globally on improvement of public transport for all including disabled, women and elderly people. Literature and research is sparsely available in Asian and particularly Pakistani context in which problems faced by women and disabled persons have also been highlighted. However, my research is an attempt to analyse the availability of public transport facilities for people with disabilities and women in the urban and rural areas of Islamabad. For the purpose of current research, sub-locales in urban areas of Islamabad include bus-stops at G-6 (Abparah), G-9 (Karachi Company), Khayaban e Johar, Ibn e Sina, PIMS, 7<sup>th</sup> Avenue and Pak Secretariat. In rural areas of Islamabad sub-locales for the current research include, Bara Kahu (Athal Chok) and Tramri. These bus stops and stations are major hubs for passengers commuting within the city. Routes for operating wagons, Suzuki"s and mini buses in Islamabad are approved by Islamabad Transport Authority (ITA) and District Regional Transport Authority Rawalpindi (DRTA). Furthermore, my research has looked into social exclusion caused by inadequate public transport routes and transport services in the above-mentioned sub-locales of Islamabad.

## 1.1 Background

A Greek architect named C. A. Doxiadis was tasked for designing the city. Doxiadis planned Islamabad on a grid-iron pattern having sectors and sub-sectors and one commercial (Markaz) in each sector. Moreover, each of the sector would have low-rise and primarily made up of single-family houses. About 10,000 residents of a sector were to have access to all of the amenities that were generally required in daily living, such as places to shop, worship, schools, parks, or simply hang out for social interaction and pleasure. Residents in a sector would only have to travel further out into the metropolis for employment or special occasions. In addition to this, most of the facilities could be reached on foot, without having to cross any vehicular roads at all (Daechsel, 2015). Therefore, no heed was paid on the transportation system of Islamabad which now has created mobility challenges for the people.

Despite its status as the country's capital, Islamabad was never provided railway access or commercial business district (except Blue Area) or no zoning for the poor. In reality, the regime of the time saw Islamabad's inaccessibility and distance from the main hubs of political and economic life as its *raison d'être*. The capital was not intended to be a city but rather a modern-day analogue of the old colonial hill station, a place where government and the ruled, civil officials and society had as little touch as possible (Daechsel, 2015). Nevertheless, Islamabad has witnessed substantial immigration and urban sprawl due to

---

<sup>1</sup> [https://www.pbs.gov.pk/sites/default/files//disability\\_data\\_1998.pdf](https://www.pbs.gov.pk/sites/default/files//disability_data_1998.pdf)

growth of housing societies and roadways over the wide swaths of land with little regard for urban planning. Urban sprawl and horizontal growth of housing units has increased the travel time, transport cost, pollution and has generated transportation problem as well. However, Doxiadis' plan has been modified and adjusted, but still it suffers from its birth defects (Lubna, et.al. 2020). In order to solve the issues of transportation, master plan of Islamabad also needs to be revisited.

## 1.2 Socio-Demographic Dynamics of Islamabad:

The population of Islamabad has increased manifold due to migration from other parts of Pakistan. In 1950 the population of Islamabad was one hundred and ten thousand and at present, the total population of Islamabad is 2 million out of which 49.39 % live in rural areas. Since the Islamabad is experiencing population growth it is expected to grow more in coming years.

The city of Islamabad is one of the most diverse cities in Pakistan as residents from all over Pakistan have come to settle in capital due to government jobs and to seek jobs in international organizations, embassies and private sector. The city majorly consists of rural to urban migrated populace as well as residents of other cities who have to come seek better prospects for life.

Amongst the general ethnicities of Pakistan, Islamabad is predominantly made up of Punjabis, who make up 65 percent of the population, followed by Urdu Speaking Muhajirs, who make up 14 percent of the population, Pashtuns, who make up 10.5 percent, and Sindhis, Balochis, Kashmiris, and others, who make up the remaining 7% of the population<sup>2</sup>. However, the family characteristics for Islamabad are in consistent with those of Pakistan's other cities. Family structures are traditionally patriarchal, with the eldest being the family's leader and women playing a subordinate role, in keeping with the traditional structure of a typical Pakistani family.

However, given the young populace as well as multiple paradigms shifts amongst the local society as well an increment of individuals transitioning into higher classes in Islamabad, the city is experiencing with a more or less equal gender ratio in the city. Increased exposure to western media as well as international experiences have led to a greater and higher male to female ratio employment in the city. Women often receive equal if not more opportunities in terms of job prospects in the city as well as greater opportunities in terms of family freedom and independence, which reflects in the tendency for women to roam around the city for leisure activities, unaccompanied by a male relative. It is often common these days in the capital for the wife and husband both working in order to support their families, or for single ladies as well as widows to lead in terms of professional prospects.

---

<sup>2</sup> See statistics URL

[https://web.archive.org/web/20060217220529/http://www.statpak.gov.pk/depts/pco/statistics/other\\_tables/pop\\_by\\_mother\\_tongue.pdf](https://web.archive.org/web/20060217220529/http://www.statpak.gov.pk/depts/pco/statistics/other_tables/pop_by_mother_tongue.pdf)



According to Pakistan Bureau of Statistics,<sup>3</sup> Islamabad is one of the cities of Pakistan having highest literacy rates (88%). The major reason behind high literacy rate in Islamabad is that the city has the rich facility of government/private schools, colleges as well as numerous universities. An additional reason might include the city's potential as a service-oriented sector. The unemployment rate of Islamabad is currently 15.7%.<sup>4</sup> The city comprises of people included in the fifteen to sixty-four age bracket, making up for about 59% of the overall population. Over 37% of the population is under the age of fifteen, whereas the older population is comparatively quite small at just around 2.7%.<sup>5</sup> Islam is the dominant religion of the city, with over 95% of the general populace being Muslims and rest 4% follow Christianity, Hinduism and other predominant religions of the sub-continent.<sup>6</sup> In addition to this, Islamabad is home to the biggest number of foreign tourists. Furthermore, the city serves as a rest stop or tourist destination for tourists travelling to the north, particularly to Kashmir, Naran, Kagan, Khunjerab, Gilgit, or Hunza. Tourists would frequently stopover to explore the city and its attractions before continuing on their trip to north.

According to Pakistan Public Administration Research Centre (PPARC), Establishment Division (2018-2019) the actual working strength of civil employees is 581,755 in all Ministries, Divisions, Attached Departments and Subordinate Offices working in the Federal Government, whereas, thousand others work in private service sectors of Islamabad. As stated above, 49.39 % of the population live in rural areas of Islamabad due to lack of housing units and expensive rents in sectors of Islamabad, however, looking at the entire socio-demographic characteristics of Islamabad and horizontal growth of city has increased the travel demand in the city as well and efficient transportation system is required for the movement of people stated above who are involved in different professions and activities on every day basis. Based on this, I have stated study's problem statement in the following text.

### **1.3 Statement of the Problem**

Demand for public transport has been increasing in Islamabad from the past several years. Currently, no bus service, except Metro, is in place in Islamabad and people have to heavily rely on private transport consisting of wagons (local van), coasters, taxis, and more recently on Uber and Careem. Though the Metro Bus Service operates in Islamabad but it does not provide services to rural and other urban areas of Islamabad. Inadequate transport facilities is affecting mobility of urban and rural population of Islamabad. Further it is affecting the mobility of disabled person to a greater extent since no disabled friendly transport or infrastructure is in place in Islamabad. No initiative has been taken so far in installing bus service in Islamabad to improve mobility of masses and unavailability of accessible and affordable public transport is excluding people specially the women and the disabled from active participation in the society. There is a dire need of installing inclusive affordable and accessible transport system with facilities for disabled person and women in the capital in order to ensure communal inclusivity in social and economic affairs of life.

## 1.4 Research Problem

The research problem perused takes up the analysis of affordability and accessibility of public transport to women and disabled persons in Islamabad. For the purpose of this study, I have operationalized the topic of study into the following research objectives and questions for gaining insights and providing an analysis of the topic. In the following are mentioned my study's research questions and objectives:

## 1.5 Research questions

1. What are the major constraints in accessing public transport and Metro Bus Service by women and disabled persons?
2. What facilities are in place for women and disabled persons in public transport and Metro Bus Service?
3. What transport do the women and disabled persons prefer using for traveling in Islamabad?
4. What is the view of women and disabled persons regarding fares charged by public and private transport and Metro Bus Service?

## 1.6 Research objectives

The objectives of the current study are to:

1. Explore issues and constraints faced by women and disabled faced in public transport system that hampers their mobility in rural and urban areas of Islamabad.  
The objective aims to look at the barriers that hampers mobility of women and disabled persons. The research looks into how these people face constraints while accessing public transport in Islamabad and what transport women and disabled use for traveling. Analysis has been done keeping in contexts of their social settings.

2. To study the purpose of travelling by the women and disabled persons for different activities.

The second objective deals with purpose of travelling for different activities. The goal is to document for what purpose women and disabled person travel for their activities and what means of transport do they use.

3. To examine how women and disabled persons commute on daily basis for work, health, education and other services.

This research objective looks into to what extent disabled and women use public transport for employment, education, health and other activities.

4. To explain accessibility and affordability issues faced by women and disabled persons.

This objective looks into problems being faced by women and disabled persons in accessing public transport. The objective is to understand that whether the current public transport is affordable for them or not. Furthermore, the objective is also to explore whether disabled persons are given any concession in public transport. This objective also looks into whether bus stops and vehicles are safe and accessible for

women and disabled persons.

5. To suggest policy measures for improving accessibility and affordability of public transport in Islamabad.

This objective suggests policy measures to government to improve accessibility and affordability of public transport in Islamabad for women and disabled people.

## 1.7 Limitations of the study

Islamabad is divided into five zones and transport operates from different rural and urban areas of Islamabad having hundreds of bus stops. Owing to time constraints, I could not investigate all the bus stops and areas of Islamabad. This study is restricted to Bara Kahu, Taramri, G-6 (Abparah), G-9 (Karachi Company) and five metro bus stations including Pak-Secretariat, 7<sup>th</sup> Avenue, PIMS, Ibn-e-Sina and Khayaban-e-Johar. In this case, this study investigates the problems of accessibility and affordability of public transport to women and disabled persons.

Moreover, I could not approach many women and disabled persons in rural areas of Islamabad to gain more insight about the problems being faced by them. However, difficulties faced by women and disabled persons have been discussed in this thesis.

## 1.8 Significance of the study

The present study has extended the existing knowledge about public transport accessibility and affordability issues faced by women and disabled persons in Islamabad. The research has unearthed problems being faced by women and disabled person in commuting and accessing public transport and the study has also revealed the mode of transport and travelling pattern of disabled persons in Islamabad. The study has also expanded the knowledge about existing ideas of inclusive transport as envisaged in “The National Transport Policy of Pakistan 2018”. Further, this study can prove useful for the Ministry of Communication, NRTC, Ministry of Planning Development and Special Initiatives, Islamabad Transport Authority, policy makers and Capital Development Authority (CDA) in installing bus service and designing/constructing inclusive infrastructure for the betterment of the women and disabled persons. The study can also be helpful for further expansion of research.

## 1.9 Explanation of the Key Concepts

### 1.9.1 Social Exclusion

The Oxford dictionary defines the social exclusion as “exclusion from the prevailing social system and its rights and privileges, typically as a result of poverty or the fact of belonging to a minority social group”. Whereas, the UK government Social Exclusion Unit defines exclusion in terms of a combination of “linked problems such as unemployment, poor skills, low incomes, poor housing, high crime environments, bad health and family breakdown”

(Social Exclusion Unit, 1998). Atiullah, (2018) defines social exclusion as “a process which

causes individuals or groups of society to restrain in taking part in the normal activities in their residential area and has significant spatial demonstration". Duffy (1995) defines social exclusion as "a broader concept than poverty, encompassing not only low material means but the inability to participate effectively in economic, social, political and cultural life and in some characterizations alienation and distance from mainstream society".

These definitions define social exclusion in the case of transport exclusion; hence have been borrowed by me for the current study. I am more inclined towards the definition by Duffy (1995) as it is precise and most relevant to my research questions and objectives regarding transport exclusion, particularly when approached for both women and disabled people.

## 1.9.2 Mobility

Oxford dictionary defines mobility as "the ability to move between different levels in society or employment". Mobility refers to the movement of people or goods. It assumes that "travel" means person-or ton-miles, "trip" means person-or freight-vehicle trip. It assumes that any increase in travel mileage or speed benefits society. Mobility also refers to the movement of people and goods. This recognizes both automobile and transit modes, but still assumes that movement is an end in itself, rather than a means to an end. It tends to give little consideration to non-motorized modes or land-use factors affecting accessibility (Litman, 2011).

These above mentioned definition are well-suited to my research but definition given by Litman, (2011) is the most precise one and can be efficiently used for this research as it explains mobility from motorized and non-motorized perspective which the current study also will take into account.

## 1.9.3 Accessibility

In general, accessibility is labelled as the physical access to goods, services, and destinations. In the context of Urban Economics and Geography, accessibility, which is one of the most important outcomes of the transportation system, is characterized as the facilitation in accessing a specific area or location (Atiullah, 2018).

Accessibility (or just access) refers to the ability to reach desired goods, services, activities and destinations (collectively called opportunities). Access is the ultimate goal of most transportation, except a small portion of travel in which movement is an end in itself (jogging, horseback riding, pleasure drives), with no destination. This perspective assumes that there may be many ways of improving transportation, including improved mobility, improved land-use accessibility (which reduces the distance between destinations), or improved mobility substitutes such as telecommunications or delivery services (Litman, 2011).

I have used composite definitions from two theorists because these are highly useful for my research as my study is based on accessibility of public transport, hence this definition suits well to my research.

## 1.9.4 Universal Design

Universal design is the design of equipment, environments and services to be usable by all people, to the greatest extent possible, without the need for adaption or specialized design regardless of gender, ethnicity, health, size, ability, disability or other factors that may be pertinent. Universal design is the implementation of a process that improves the quality of life and greatly improves independence by enabling and empowering a general, yet diverse, world population to achieve optimal human performance, health and wellness through equal access to all facilities and social participation (A. P. 2020) For the fact that the current definition encapsulates social exclusion and socially excluded groups, hence are relevant to be adopted for the current research.

## 1.9.5 Persons with Disabilities

Centers for Disease Control and Prevention defines disability as “any condition of the body or mind (impairment) that makes it more difficult for the person with the condition to do certain activities (activity limitation) and interact with the world around them (participation restrictions)”. The UN Convention on the Rights of Persons with Disabilities (UNCRPD) recognises that disability is an evolving concept. Persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others. (UNCRPD, 2006). These definitions are specifically suited to my research as they explain disability well.

According to (Disabled World), Paraplegia is defined as an impairment in motor or sensory function of the lower extremities. Paraplegia is usually caused by spinal cord injury or a congenital condition such as spina bifida that affects the neural elements of the spinal canal. People with paraplegia are also referred to as Paraplegics. This form of condition paralysis both the legs of a person and use hands and wheelchair for the movement. I have explained this type of disability because I have interviewed two disabled participants in my research who have this condition.

As defined by (Smith, G. et al) Radial dysplasia (RD) is a wrist deformity, potentially disabling congenital upper limb anomaly, affecting approximately 1 in 8000 births. It is basically a malformation of radial side of the forearm and is characterised by the variable absence of the pre-axial upper limb skeleton (radius and thumb) and soft tissues. Affected children have isolated thumb hypoplasia to complete absence of the thumb and radius, with severe ulnar bowing, elbow stiffness and humeral hypoplasia. I have interviewed a disabled female having this condition.

Limb anomalies is the most common birth defects observed in infants. These malformations can occur as isolated malformations, in combination with hand and/or foot and also involves specific maldevelopments of the radius, fibula, or tibia (Tayel, S M et al). I have also interviewed the person having limb deformity for my research.

## 2 DATA ANALYSIS & DISCUSSION

This section entails all the data gathered through interviews and focused group discussions. Themes have been formulated to present the findings and these themes are framed with the data of forty-six interviews.

### 2.1 Public Transport & Women

#### 2.2 Public Transport Accessibility to Women in Rural Areas

Females are marginalized section of society in Pakistan. Due to social phenomenon most of the females are rarely allowed to travel alone in the public transport. However, in urban areas females travel alone to some extent in the local transport for work, education shopping, healthcare and visiting relatives. Due to lack of accessible and comfortable public transport most of the females face social exclusion and are unable to participate in social and economic affairs of life. Women living in rural areas of Islamabad find it difficult to access public transport as they often have to cover the distance of minimum 20 minutes or more from home to reach on the main van stop. This is because of ineffective town planning where



streets are so congested with no service roads, so the females have to cover the walking distance of more than 20 to 30 minutes to reach the van stop. In addition to this, in order to catch a van females have to wait for up to 15 minutes or more on the bus stop during rush hours because a van carries only 17 passengers and 12 to 14 seats are occupied by male passengers. They have to wait a little extra to find a seat.

Females are accommodated on front and back seat of the van if females are available, otherwise those seats are provided to male passengers. During the rush hours I have observed that there is much crowd on the van stops and number of male passenger in the crowd is always higher than the females. So the males try to embark upon the van either by pushing other passengers or jumping on to the running van leaving no space for females except the front seat. However, during non-rush hour one can catch a van easily within 5 to 10 minutes but then in order to fill the van with passengers drivers make passengers wait inside the van for up to 10 minutes or until the van is full.

Behra Pul, Athal Chok and Bazar Stop of Bara Kahu and Taramri chock are the areas where no proper bus stops, waiting area or shelter are constructed. People including females have to wait under the open sky, even during rain and severe hot weather, for catching a public transport.



### 2.3 Public Transport Accessibility in Urban Areas

Urban areas of Islamabad and sectors such as G-6, G-9 etc. are well planned by Capital Development Authority (CDA), hence public transport is accessible to females within 5 to 10 minutes walking distance. It can be attributed to the fact urban areas are planned well and local transport passes through almost every sector to facilitate commuters. However, females who were living in sectors of Islamabad reported to have accessibility to public transport but were dissatisfied with the service. Interestingly proper bus stops are constructed in the sectors but are so dirty and smelly that females prefer to wait under the open sky rather than inside the bus stop shelter. A female respondent while describing the bus stops condition, said;

*“There are no proper shelters and waiting area, even if there are any, they are so smelly, dirty and broken so I prefer to wait under the sun and not under the shelter”*

Similar response was made by another woman in the following words;

*“You can say some bus stops are developed having shelters in sectors only. But these bus stops are not used by local transport drivers. They would make their own stops away from actual bus stops. So, these shelters are of no use. If there are developed stops drivers won’t use it”.*

Even drivers do not make a stop on properly constructed van stops they would rather stop



upon

sight of a passenger on the road. This has made these bus stops redundant and unusable and later are occupied by street vendors as shown in the picture below.

Despite this, females have better access to public transport in urban areas but still lot of issues are faced by women while traveling in the van.

## 2.4 Public Transport Accessibility in Urban Areas

As drivers and conductors accommodate females on front and seats of the van. Females find those seats quite uncomfortable. Conductors or drivers of the vans accommodate two females on the front seat, next to driver, which women find quite uncomfortable because the space on the front seat is not enough for accommodating two females. There is no such segregation on the front seat and drivers hands touches the women while changing the gear of a van.



Similarly, seats on the back side of driver and the corner seat beside the van door is very uncomfortable and women avoid sitting because passengers embark and get off from the van and conductors open and close the van door frequently and touch women's shoulder (as it can be seen in the picture below) either deliberately or unintentionally. Such actions by the conductors make females feel unsafe. A female respondent said that;

*"When front seats are filled, they accommodate females on the four seats at the back of driver, the corner seat beside door, I myself avoid sitting there and have seen females avoiding that particular seat because conductor opens door frequently and many try to take advantage of that thing, but many get insulted by female passengers. They open and close the door deliberately to touch women and we don't feel secure. However, we don't face any problem on the front window seat but at the back we face lot of problem on door side seat."*

Another female respondent said;

*"I never sit on the corner I always prefer to sit in the mid seat or demand front seat. Because I once sat on the corner seat and it was very difficult because conductor was opening and closing*



*the door again and again. So, I believe other females would also be facing the same issue while sitting on the corner seat because its uncomfortable."*



There are no reserved seats for the females in the van however, drivers and conductors accommodate females according to availability of seats in the van. There is no such segregation in the van for male and female and there cannot be because the van is too small and congested. Drivers and conductors of the vans also accommodate females on the third row seats which has capacity to seat three passengers only. In order to maximize profit conductors overload van with male passengers by making them stand inside the van beside third row seat. I have personally observed that the females feel uncomfortable because male passengers surround them from back, front, and also stand beside them and same fact was confirmed by a female respondent in the following words;

*"I never sit in the third row seat because whenever a man gets in the van than his shoulder touches ours again and again. And that is very awkward situation for being a female. So I never prefer that seat and I believe females should not sit there as well nor they should be offered to sit there. So I try to avoid sitting there."*

Similarly, another female respondent said;

*"We feel too uncomfortable, no matter how well you adjust in the van, they have to fall on us. We get too much angry on this, then they say this passenger will get off on the next stop. This is what they say most of the time."*

*"Mostly females who are outspoken scold them, but women like me remain silent. I never say them anything because they have answers to everything such as "sister we were just opening the door, sister we were just taking the fare from front seat passenger" and they make hundred excuses. So, females who are outspoken get angry on conductors and scold them on the spot."*

Second or third row seats mostly offered to females and male passengers cross those seats while going on the back seats and sometimes their hands or shoulder touch female passengers. Moreover, the conductors also make passengers stand beside second and third row seat making travel uneasy for females. However, females who are outspoken and bold,

argue with the conductors over overloading and touching by passengers or conductors. But after having argument with conductors or passengers, the matter reaches a compromise. Females rarely complain traffic police or transport officials over the overloading of passengers and harassment because females do not receive positive response and many do not know who and where to complain.

## 2.5 Public Transport Accessibility in Urban Areas

Since there are no reserved seats for females, conductors mostly move passengers from seats again and again which angers and irritates them. Similarly, female passengers are moved from their seats to adjust male passengers time and again which results in fight with the conductor. The reason conductors move passengers is because they don't want any seat to go empty and to earn maximum profit. Upon argument by females, conductors simply ask them to travel in another van if she has a problem in changing seat. Since most of the conductors say the same and females are left with no choice but to travel in the same transport. Uber, Careem and taxi service becomes quite expensive for females so they prefer to travel in local transport, due to financial constraints, because it is affordable. Moreover, females also get into argument with conductors over overcharging of fares. Conductors try to charge Rs. 5 to Rs. 10 extra from the passengers which results in arguments with the females. In addition to this, local transport drivers do not observe COVID-19 SoPs. They would overload passengers which also makes travel uncomfortable and risky not only for females but for other passengers as well. However, females are less likely to report this to traffic wardens for action because most of them avoid getting into any trouble since they are females and they might get restrictions on travel from family. A female respondent while sharing her experience said;

*"Since it's a COVID-19 right, when there are four females sitting on the back seat of driver, they will adjust another female in front of me, it gets too uncomfortable, right, when someone is sitting in front of your face and that lady will cough, so, on that point I got so angry with the conductor and I had a fight with him. And, when you want to go directly to your destination they normally charge Rs. 30 but they ask females for Rs 40 instead, over which I had a fight. And most of the time that we have fight with them is on this thing, in order to fill van with passengers, they will first ask you to sit on front seat and then they will ask you to sit at the back seat and then on the third seat and then again they will ask you to come on second seat. I mean I get sick of it and I have argument with them on this thing, now this is a matter of every day and I am used to it."*

## 2.6 Travel Time in Local Transport

Local transport drivers do not observe proper timings and take stops time and again wherever they see a person standing on the road for taking passengers. Even they take long stops at non-designated stops to fill the vacant seats of the van. Since the fares set by the government are less so they cannot afford to leave seats empty. Therefore, a distance that could be covered within half an hour is than covered in one hour owing to drivers' frequent long stops. Female respondents have reported that the total travel of half an hour exceeds to one and half hour. Moreover, females are likely to change two or more vans to reach a

destination which not only becomes costly but time taking as well. Two female respondents said;

*"I have to change 3 vans to reach university and it takes me two hours. I use taxi to reach on bus stop, because bus stop is quite far from my home. From bus stop than I catch a van for Aabparah G-6 and then I catch another van from Aapparah G-6 to reach university gate. And even from university gate we have to get a taxi sometimes so it becomes too difficult."*

*"It takes one and half hour to reach university through public transport but when I come in university bus it takes me half an hour. But it takes one and half hour to reach university through public transport because I have to wait at Aabparah G-6 mostly because they do not have seats for females. I come to university through 120 number route van and they have only 2 seats for females. So, it takes 10 to 15 minutes to find a seat in van."*

Spending too much time in travel not only exhaust passengers but discourage use of public transport also. I personally travelled to various areas of Islamabad where it took me way too much time to reach destination. Moreover, I have observed during travel in public transport that passengers get into arguments with drivers and conductors over longer and unnecessary stops made by drivers and passenger ask them to move van towards destination because in hot weathers its way too difficult to sit in stagnant vehicle for too long and people also get late for their job, tasks etc. So the excessive travel time encourage use of personal transport as it can be used to reach destinations in minimum time.

## **2.7 Affordability of Public Transport**

All female respondents find public transport affordable because fares set by the government are nominal. But when it comes to Uber, Careem and taxi service, females have reported it to be quite expensive. Therefore, private transport is used very rarely by the females. They use these services in case the females are in hurry and want to save their time or going to a place where public transport does not go. Females also use private transport when they have stuff or luggage with them because carrying luggage in local transport is difficult and there is not much space to keep it; a female respondent said.

*"I prefer Uber when I want to go for job interviews because we don't know about the locations and Uber drivers take us to exact location by using Google map and it becomes easy for us. Moreover, I use this service when we are returning home from shopping because we have bags with us and we are also getting late so we prefer using Uber and it also depends on you like if your pocket allows you to travel on private service so you can. And I use Uber once in a month only."*

Another female respondent said;

*"Private transport is expensive, because I am a visiting faculty in International Islamic University. Today I just spent Rs. 1200 on transportation. From Bara Kahu to Islamic University I paid Rs. 500 because no local transport goes to Islamic University and then again from IIUI, I had to come to Quaid e Azam University urgently so I again spent Rs. 500. And then I had to go to Area Study Center and there is no pick and drop service in the university so I again paid Rs.70 rupees for taxi. From there again, I had to come to main huts I again paid Rs. 70. Like this I spent 1200 rupees in*

*just one day and it's really expensive. I am just teaching at Islamic university for my own experience otherwise I don't get enough package from there but I spend more on transportation."*

## **2.8 Harassment in the Local Transport**

However, harassment is common in public transport across Pakistan, whereas in Islamabad females also face this situation. But the female respondents whom I interviewed had never faced harassment incident in the local transport, however, they believed that there is always risk of harassment in the local transport. Verbal talks, body language and gestures of drivers, conductors and the passengers makes females uncomfortable and insecure in the local transport. Many drivers, conductors and even passengers try to make a move on female passengers. A female respondent while describing the situation said;

*"When females are sitting on the back seats of a van conductors would stand beside you and put his arm on the seat for support so it is so weird. Once I was coming with my friend in a van then a conductor put his hand on seat. My friend asked her to remove his hand so he said sister I am just keeping hand for support. So one gets such negative and bad vibes at that time"*

*"Like sometimes van is running at a high speed and driver suddenly puts break so they fall on you. Sometime they keep hand on seat. Sometimes passengers will make gossips and play song etc. Sometime they talk on call and speak their number loudly. They think we don't understand their acts. So these are the few problems that we face by the passengers and conductors."*

*"Like most of the time I faced I realized that most of the people are not giving a very good gestures to females"*

It is not easy for anyone to harass women public transport because a van carries 17 passengers at the same time. Therefore, it is very rare that anyone harasses women in the public transport because of threat of being caught. However, while conducting interviews with drivers and conductors, they confirmed that harassment cases are very rare, it happens twice in a year. It can be attributed to the fact that Islamabad has the highest literacy rate. Even if harassment occurs, the matter is hardly reported to police because females avoid getting into trouble and fear of losing families trust and honor or to face restriction on travel by families. Additionally, if a passenger, driver or conductor is caught harassing a woman then the matter is resolved by passengers by either beating the culprit or by accepting the apology.

## **2.9 Insecurity in Public Transport**

Females feel insecure while traveling in the public transport because of conductors and driver's behavior as they try to take an advantage of female for being alone. Most of the females have reported that the drivers and conductors behave rudely. When females are sitting on front seat they have to take care of lot of things such as taking care of scarf and maintaining distance with the driver and conductors because the front seats are not segregated in the vans. Drivers touch knees of women while shifting gears of a van and conductors sit along on the back four seat while a single woman is sitting there. Some women have reported to have fear of theft while traveling on the local transport. Moreover,

females avoid traveling in the evening and in the night because of insecurity. Following are the responses received from the female respondent over the question whether the public transport is safe and secure;

*"No I don't think so it's safe and secure for females because drivers and conductors mostly behave in a rude manner and sometimes they drop at a place where no other local transport comes or goes. Moreover, when females are sitting on the back seats of a van conductors would stand beside you and put his arm on the seat for support so it is so weird. Sometimes it happens like when you are sitting in a van and there are no females except you so you recite Ayat ul Kursi or pray that some women may sit with us from next stop. So females don't feel safe in local transport"*

*"You always have to take care of lot of things while traveling. If you are sitting with driver on front seat, you will have to take care of distance, then you have to take care of scarf as well. Sometime passengers sitting behind you create lot of hurdles for you. So, it's not easy for every female to freely move, we have to take care of hundreds of things all the time. A few women who are blunt speak on the spot about passenger's behavior and harassment."*

*"Local transport is not safe and secure, there is risk of theft and conductors don't behave nicely"*

*"Look, few days back there was a protest by molvis and roads leading to Quaid e Azam University were blocked. I was with a friend, if she had not been with me, I don't know how I would have faced this situation. So we took a van from Aabparah G-6 and suddenly driver changed our route and took us toward secretariat in the red zone and the driver dropped us there. Now I had no idea about the roads since I don't go out much. I was just worried that how will I go home or university from there. Even network was down and I was not able to call Uber or Careem. So it's not secure for females you don't feel secure. Sometimes there are fights and females get hit by man unintentionally. So such situations are very difficult to face by females"*

However, the private services, such as Uber and Careem are considered much safer than the local transport by females because these companies have set mechanism to ensure safety of passengers as you can share your ride details and live location with your family members and the captains and the cars are registered with the company. Moreover, at the end of the ride there is an option of captain's rating to be given by rider. If any captain misbehaves a rider can lodge an online complaint with the company through mobile Careem or Uber app.

## **2.10 Dependency on Family Members**

Due to lack of public transport facilities females are likely to be dependent on their family members for providing them pick and drop service. Dependency on family members hampers their mobility and discourage them to pursue a career or education because their family members may not be available 24/7 to provide them pick and drop, hence, making it difficult for them to move alone. Moreover, females are dependent on their family members because the transport service is not operating where females are pursuing education or career. They are either left with the option to use private service i.e. Uber or Careem or hire a taxi or ask one of the family members to provide them pick and drop on daily basis. A

female respondent while sharing their experiences told that;

*"Yes, of course. Sometimes it is very troubling to bother my brother when he is stuck somewhere academically and socially and I keep waiting for him at the stop. I am so dependent on my family which demotivates me to pursue higher education or to start professional career."*

*"It happens and local transport passes from my home but there are so many places where local transport does not go or service is unavailable. So, females have to get Careem or have to ask their brothers. Even brothers are not available 24 hours. Careem or Uber is unaffordable. So that's how we face problems."*

*"Yes, we always have to depend on someone because we cannot travel alone"*

*"My parents ask me to take someone from home, for instance, brother in order to be safer and secure."*

*"There are my friends who cannot go out so they have to depend on someone from their home like fathers or brothers. So they give them pick and drop. If someone is not available at home than they are not allowed to go out. My friend missed her practical exams because of this issue."*

It is worth noting that there are parents who have wariness on the public transport, and do not let their daughters travel alone, owing to safety concerns. Secondly, there are few parents who are narrow minded and believe that their women should not go out alone because it would be a disgrace to their honor. Mostly male members discourage female travel in the public transport. Such restrictions suppress female's abilities and potential to do or achieve something in life. In contrast to it, many females reported that they are allowed to travel alone in the public transport because their parents trust them and they know well that their daughters can handle and protect themselves. Such trust empowers women to achieve something and play a positive role in society.

## **2.11 Social Exclusion of Females**

Lack of accessible transport has caused social exclusion of females to a greater extent. There are females who want to participate in social and economic affairs of life but are unable to do so owing to unavailability of public transport or are not allowed by parents to travel in the public transport. Due to these reasons many women have to quit jobs. Females try to find a job where they are provided pick and drop service by the employer or where the public transport operates. Social exclusion not only deprives them from achieving economic independency but also puts them into anxiety and psychological disorder. Following female respondents shared their experience in the following manner;

*"Yes, major issue of Pick and Drop. Right after my graduation I wanted to apply for a job which brought a debate in my home that, who is going to pick her every day and drop. Since my other siblings are also university students and no man of my home was available to facilitate me with this pick and drop service. So I gave up and remained at home."*

*"Yes it happened. Like I am working in HBL so I was being transferred to Red Zone branch but I somehow managed to stop my transfer because of transportation and it was way too difficult to travel from Rawalpindi to Islamabad. So I have quit 2 jobs earlier because of this."*

*"I live at Bari Imam and I was working at I-9 first, then I received a good job offer at DHA but I did not accept it because of unavailability of transport. I even quit my job at I-9 and now I work in travel agency at Melody because I find transport easily from here"*

*"Yes there are so many women whose families who do not allow them to do job if they are not provided pick and drop facility by the employer. So they face lot of difficulties. Parents of my friend did not allow her to do job. They said you can do job where metro bus stop is near to that office, where metro has no access or is not located nearby it you cannot do a job. We will not allow you to travel on local buses or vans. So she did not do job because of this reason."*

Above responses by females show that how much difficulties and resistance they face due to lack of public transport facilities and by family members. Females avoid working at a place where transport facility is not available and also refuse good job offers because of inaccessible public transport. If female participation in economic activities is made sure by providing accessible and affordable transport, it can not only increase the participation of women in economic and social affairs of life but also contribute to our economic growth as well.

## **2.2 Public Transport & Disabled Persons**

### **2.2.1 Accessibility of Public Transport to Disabled Persons**

Local vans, Suzuki's and buses are the main mode of transportation in Islamabad. Majority of population including females use these services to commute on daily basis. However, the ratio of buses and Suzuki's is less in Islamabad than the vans. One of the major problems that disabled persons face is of accessing these local vans, Suzuki's and buses. These transport services are in no way accessible to disabled community especially to those who use wheelchair. Driver respondents said;

*"Our vans are not accessible to disabled persons. How would they travel we don't have seat for them? Even if they travel and someone helps them adjust in seat where would we keep his wheelchair? We have no such place we will have to alter our whole van if they were to adjust in the van"*

*"Wheelchair users never come but persons having different kind of disability do come like blind"*

*"I have mostly seen blind people traveling on the local van, people help them embark upon the van (pakar k bitha ty he). Many times we have helped them cross roads. Even passengers help them and they don't give us opportunity"*



Disabled persons who are on the wheel chair avoid or never use public transport because it is way too difficult and not disabled friendly. They always have to depend on someone to help them embark upon the van or bus. Moreover, these transportation has no specific place or seat for disabled persons where they could easily adjust. However, disabled persons who are handicapped, blind and those who have locomotor disability but can walk or move with difficulty are likely to use public transport but do not prefer it. Vans are quite congested and a disabled person cannot sit comfortably. Front seats of the van have quite enough space for such disabled persons who could spread their legs and sit comfortably but front seat is hardly available for them since it is preferably given to non-disabled females or sometime male community. A disabled female respondent said that;

*"No they don't give us seat on priority, if they have one female and two males they would give priority to males, because get more benefit by adjusting male passengers".*

I have personally observed that drivers of public transport are insensitive towards disabled and old age community. They avoid stopping vans for old age and disabled people because they take time to embark upon the van, since they are competing with other drivers in loading passengers they want every passenger to sit quickly so that he could get another one ahead. Similarly, the disabled persons and aged people take time to disembark from the van so drivers consider it as the waste of time and prefer to take someone who could get in the van quickly. However, I did not see any disabled passenger traveling on the local transport during my field work. This fact was confirmed from the drivers as well who said the disabled passengers travel very less with us and even if they travel they are accompanied by someone.



## 2.2.2 Inaccessible Infrastructure

Another reason that makes transport inaccessible for wheelchair user is infrastructure roads and footpaths which are not constructed well or in a way that makes easy for disabled persons to access the bus stops on wheelchair. Footpaths have huge step and no slopes so wheelchair user require assistance who could drag their wheelchair on the road. A wheelchair user while imploring the situation said.

*"It is very difficult to move on wheelchair on the roads. The roads have patches and pot holes and they are no footpaths than how can we move on wheelchair."*



All the bus stops in the area of Bara Kahu, Taramri, G-6 and G-9 are not disabled friendly as it has huge step which makes impossible for any disabled person to accent. Moreover, the roads are congested and damaged and wheelchair user cannot even move his wheelchair on the road. Inaccessibility of bus stops and public transport compels disabled persons to use alternate means of transport to travel or commute.

## 2.2.3 Private Transport and Affordability

Since there are no facilities for disabled persons in public transport then consequently, those who want to travel prefer private services such as Uber, Careem and taxi for commuting or use their own personal vehicle. Private transport becomes quite expensive for disabled persons if anyone is studying in university or doing job then a disabled person has to pay

more than 20 thousand per month for private taxi service. A disabled respondent said;

*"Yes I used to give home tuition at some place, but that place was not accessible so I had to go on Uber or Careem, but as you know it's too expensive so I had to quit that job because I was unable to meet my expenditures. However, public transport is affordable as compared to Uber and Careem."*

Moreover, disabled persons are not provided with any discount while using private transport service within the Islamabad. Owing to unaffordability and inaccessibility of public and private transport most of the disabled persons prefer to remain at home and get education from home because of high transportation cost. Moreover, disabled persons learn skills and work from home to generate some income.

## **2.2.4 Difficulties in Private Transport**

Morning and evening time in Islamabad is mostly crowded because people are travelling for their jobs, education, etc. making it difficult for disabled persons to find transport during rush hours. In those particular hours transport services such as Uber and Careem are unavailable. Resultantly wheelchair users either travel with peak factor price or wait a little or travel early to avoid inconvenience. Since they are disabled persons they cannot go out to hire a private taxi. One of the wheelchair user respondent said;

*"During rush hours Careem or Uber is unavailable and gets expensive due to peak factor. Companies charge Rs.200 to 300 extra for a trip. Moreover, you have to wait a little extra for like 20 minutes for Uber or Careem to come. So we do face difficulties."*

## **2.2.5 Drivers Behavior towards Disabled Persons**

Disabled persons also face difficulties while using private transport such as Uber Careem and taxi's. Most of the drivers refuse to take ride booked by wheelchair user on the pretext that their car will get damaged by keeping wheelchair in it. A respondent shared her experience as follows

*"Simply Uber and Careem drivers used to refuse on the pretext that their car will get damaged, therefore, they used to ask me to hire another vehicle. There are categories that are cheap, but cheap one, is mini, mehran. Drivers of mini are not literate so they do not accept this thing at all, they say their car will get damaged, so they can't keep the wheelchair in it. If mini charges Rs.200 then business class would charge you Rs. 1000. So I used to hire business class because I could afford it."*

Whereas similar experience was shared by another wheelchair user respondent in following words;

*"But sometimes I used to hire big cars, they used to object and refused to take us because they thought wheelchair would damage their cars. So I had to face this behavior. We also submitted*

*complains but no response was received. It is better to hire a local taxi it is more convenient. Because the drivers used to put wheelchair on the backseat or on the (Jangla).*

A disabled female said;

*“Most of them behave well but some don’t. Sometimes they make issue over pick up and they ask for cancelling the ride since they don’t want to come to the location. Sometime they demand extra fare.”*

Moreover, the disabled persons also face difficulties in adjusting themselves in the car. Since Mehran and 600cc cars have little space so the disabled persons prefer to hire a cars having enough space for them to shift easily. In Pakistan cars are not made keeping in view the disabled persons, its design and structure is same and hence disabled community has to adjust accordingly. Similarly, the disabled persons who are not wheelchair user also face rude behavior by the local transport drivers. They do not treat them nicely. A respondent said that

*“Drivers behave very rudely and they don’t treat us nicely. They just want profit and fares. Every time when I travel via public transport I always fight with the drivers”.*

Even if disabled persons somehow manage to travel in the private vehicle to access education, job etc. then the buildings and infrastructure are not accessible which makes them look for another alternate or compels them to stay idle at home. Inaccessible public transport, buildings and infrastructure excludes them from social and economic participation. Even if some buildings are accessible and have installed ramps and facilities for disabled person, they are of no use for them. They are installed in such a way which makes it difficult for disabled persons to use them. While complaining about the facilities a respondent said that.

## **2.2.6 Dependency on Family Members**

Keeping in view these accessibility issues, wheelchair users have to depend on the family members to travel because many of the wheelchair users have muscular dystrophy and cannot shift into car own their own and require help. Male wheelchair user can ask for help from anyone if he cannot shift in a car but females are dependent on their family members if their shifting techniques are not well. Moreover, wheelchair user cannot travel alone and rely on the family members for travel who would accompany them as well. Their disability becomes a barrier in their movement. Females who are on the wheelchair are also not allowed by their parents to travel alone owing to safety concerns. Since their lower limbs are damaged hence it is difficult for to protect them themselves. The dependency on family members of the wheelchair users is discussed in detail in case study. However, disabled persons who have minor disability do travel alone on the public and private transport but face lots of difficulties while accessing public transport.

*“I think accessibility of public transport depends on how the community is where you live. Do they treat you well and are they aware of the problems that disabled persons face? Now government*

*has provided much relief to disabled person in fare, such as if you travel in Daewoo you get 50 percent discount on ticket and it's not in local transport. Van drivers or conductors do not differentiate between normal and disabled passengers, they don't think that we should be provided some extra care. So they don't do this. They consider us like a normal passenger"*

*"No we can't easily access public transport. For us it's difficult. They don't follow proper timing, they don't maintain proper speed, if we say them anything they would ask passenger to get another van. So I think for disabled persons like wheelchair user or disabled from lower limbs, find it really difficult to travel."*

## **2.2.7 Social Exclusion of Disabled Persons**

Wheelchair users are unable to participate own their own in social, economic and educational activities owing to barriers in their movement caused by absence of affordable and accessible transport, buildings and infrastructure. Consequently, they avoid travelling outside and prefer to stay at home because they consider their disability a burden on their family members. Their frequency of travel outside is comparatively less than other members of family or non- disabled person. A wheelchair user while answering my question on the frequency of travel done by him told me that;

*"I travel very less because lots of places are not accessible for me. I cannot travel outside the city because trains and buses have no facility and no ramps for disabled persons. I have to hire a private taxi which becomes expensive. Islamabad is already very expensive and taxi service charge high price for Lahore and other cities. I made plan to visit Naran, Kagaan but that could not be materialized due to my disability as these places are not accessible for me."*

In addition to this, disabled persons are deprived from enjoying leisure activities and going to cinemas because of lack of accessible infrastructure in cinema halls, hill stations etc. Barrier in movement increases in them the sense of helplessness. Even if the wheelchair users manage to travel on private transport but yet there are places which are inaccessible. Wheelchair users who are poor are completely facing social exclusion because they cannot even afford private transport. A respondent told that;

*"Look there are so many buildings, places and educational institute in Islamabad which are no accessible. Buildings are not accessible, there are no facilities for disabled persons no lifts, no ramps. Moreover, many disabled persons are unable to avail opportunities due to inaccessible public transport. They are left out then and become dependent on family members financially, physically and in every aspect."*

## **2.3 Metro Bus Service & Female**

### **2.3.1 Metro Bus Service**

Metro Bus Service by Punjab Mass Transit Authority began its operation in Islamabad and Rawalpindi from June 2015. It stretches 22 kilometers and operates between Pakistan

Secretariat Islamabad to Saddar Rawalpindi covering 24 stops. More than 100,000 passenger commute every day on Metro Bus Service. Metro Bus starts its service from 6:00 a.m. to 10:00 p.m. with the two employee working shifts, first starts from 6:00 a.m. to 2:00 p.m. and the second from 2:00 p.m. to 10:00 p.m. and after every 3 minutes a bus leaves from Saddar or Pak Secretariat. However, during rush hours additional buses are run with the gap of one minute.



Route Map of Metro Bus Service

### 2.3.2 Accessibility of MBS to Females

Metro Bus Service runs on the specific route and mostly operates through commercial areas of Rawalpindi and Islamabad. Since its stations are located away from the residential areas, females face difficulties in accessing Metro Bus Stations as no shuttle service operates from other routes to Metro Bus Station so most of the females have to depend on their family members to provide them pick and drop or they use taxi service or local transport to access Metro Bus Stations from their homes, educational institutes and job places. Following female respondents remarked about the accessibility of Metro Bus Stations;

*“Actually my brother drops me to the metro bus stop on his motorbike or I take taxi to reach. It's impossible to reach here by walk and there is no facility of public transport from Metro bus stop to my home and it takes 15 to 20 minutes to reach there by motorbike”*

*“My University is in E-9, No, metro does not go there but its two stop away from metro station so I have to travel extra every day. I have hired a shuttle van which provides me pick and drop every day to the Metro Station.”*

*“My home is at 10 minutes' drive from metro bus station so my father comes to pick me up from there.”*

Since there are no shuttle services that could facilitate females to access Metro Stations, it

makes accessibility of MBS difficult for females, hence, they have to depend on family members or local transport to reach the station. However, MBS is accessible to those who live nearby MBS stations. Moreover, the metro does not cover all the routes in Islamabad so females also have to travel extra from MBS stations to access their universities, offices etc.

### **2.3.3 Affordability of MBS to Females**

Metro Bus Service is subsidized by the government in order to make it affordable for common people. All the female respondents have shown satisfaction over the fares charged by the MBS. Fares charged by the MBS are fixed to Rs. 30 and a passenger can travel from Pak Secretariat to Saddar Rawalpindi in just Rs.30. However, the females have to pay extra money to reach to the station or to their desired destination which is somehow extra expenditure. However, if the subsidy is removed and the fares are raised by the government than it might not be affordable for working women, students and labour class. A female while sharing her reservations said that;

*“Metro is affordable till Rs. 30. When it first started operating the fare was Rs. 20, but I have heard that they are going to raise the fare to Rs. 50. If it remains till Rs. 30 it will remain affordable for females and labor force as well. Otherwise people will face difficulties or people will not travel than.”*

### **2.3.4 Women’s Experience in MBS**

Females traveling in the Metro Bus were quite happy with the service, as it provides them affordable, safe and comfortable travel as compared to the local transport. I personally observed that sufficient number of women were traveling in the Metro Bus than local transport because it has enough capacity to carry passenger at same time. The Metro Bus has not only improved female’s mobility but also has saved them from social exclusion to some extent. Since it operates through the commercial areas, it has provided great relief to working women and students as well. Moreover, this service saves lot of their time because it follows proper timings and frequency of buses is good whereas local transport takes double the time than Metro Bus. It has also given females independency where they could travel alone easily. The Metro Bus has reserved seats with separate portion for female where females can sit or stand in the bus therefore, they do not face any kind of issue while traveling in the Metro Bus. A female respondent remarked that;

*“Traveling in metro is a good experience, metro is a good. Despite the fact that seats for females are very limited but at least females are able to stand in the bus with peace. Because male and females have separate portions and it’s up to you whether you want to sit on seat or stand.”*

### **2.3.5 Limited Seats for Females**

Since Metro Bus began its service in Rawalpindi and Islamabad, more and more females have started traveling because it is a great facility for them and provides them access to job

and educational opportunities. Front portion of the Metro Bus is reserved for females where there are twelve seats and enough space for standing. However, females have felt that the number of seats reserved for females is quite less than the seats reserved for males and the seats for females be increased since women are coming out of their home. I have personally observed that seventy-five percent of the bus is occupied by male passengers and 25 percent by females.



A female respondent while depicting the situation said;

*"You see so many girls are seen standing in the bus and female seats are all filled while male seats are empty so it means that girls are coming out for education job and even for shopping. They should not keep 5 to 10 seats only for females because we have seen too much crowd in the female portion."*

*"Well there are very limited seats for females in the bus and those seats are mostly given to the senior citizens. So most of the time I stand and since covid-19 I prefer standing rather than sharing seat with someone because of pandemic."*

Despite limited seats the Metro Bus provides comfortable journey to the females than the local transport because there are no reserved seats for females and they are asked by conductors time and again to move to another seat.

### **2.3.6 Difficulties during Rush Hours**

Morning and evening time are mostly the rush hours when everyone goes for work etc. Normally Metro Bus runs after every 3 minute, but in order to reduce the crowd, additional buses are run during the rush hours with the gap of one minute. During rush hours it is

witnessed that male passengers encroach on the female portion congesting their space. However, it happens only in the specific peak hours when there is too much crowd. However, female find it difficult to travel with limited space in the bus and when the bus is full of passengers, they skip buses and embark on the one which has some space. But the staff employed in the MBS manages the crowd effectively when male passengers encroach in the female portion. Moreover, females also ask MBS drivers to move the male passengers from female portion, he then in turn directs Assistant Platform Inspectors (API) to either disembark passengers and adjust them in another bus or move away passengers from female portion. Following are the responses by females on the rush hour;

*"Due to lack of space, mostly gents come into female portion. Sometimes people also come who look like thieves. But bus drivers disembark them (bahir nikal dete he) and female security also help in this regard."*

*"No, it's happens rarely but normally system is good and it's quite manageable."*

*"Yes I do find, if there is too much crowd I skip buses and wait for the one which has a place."*

*"Well, it is very rare therefore, I haven't faced any trouble. However, if that happens then the security is very active to deal this kind of situation in order to avoid inconvenient situations."*

### **2.3.7 Safety and Security in MBS for Females**

Metro Bus Stations is considered safe and secure by females because CCTV cameras are installed in every Metro Bus Station. Not only this, cameras are also installed in the bus and ample of security staff is employed to assist females and passengers which makes MBS more safe, secure and comfortable. Due to these reasons females find MBS safer than the local transport. In addition to this, majority of the females have reported that they never faced any kind of harassment or misbehave by the staff or passengers because of the fact that PMA has taken enough measures such as installing CCTV cameras and security staff which reduces the chances of harassment to great extent. Female respondents while sharing their opinion about safety and security of the MBS said;

*"No, with the grace of Allah, I have never faced any kind of harassment."*

*"Definitely, definitely, I think it's safer, it's more secure and it's easier for us to travel now even if we are traveling alone."*

*"Definitely, metro bus is (bohat bohat bohat zyada) kind of blessing and I consider it very secure I never faced any difficulty while travelling in metro bus."*

## **2.4 Metro Bus & Disabled persons**

### **2.4.1 Accessibility of MBS to Disabled Persons**

Since the MBS runs on the specific route covering the commercial areas and offices, hence, it is difficult to access by those disabled persons who live far away from Metro Bus Stations.



These disabled persons either have to take a cab or private transport to reach on the metro bus. However, the said service is accessible to those who live nearby the Metro Bus Stations.

A female wheelchair user while commenting on the accessibility of MBS said;

*“Now if your home is 15 kilometers away from metro station then you will have to book a taxi. I mean there should be transport service for disabled (jis ma ek hi dafa struggle karni pary).”*

However, I personally witnessed disabled persons including wheelchair users, blind and people with leg disability traveling on the MBS at different stations, whereas in local transport I did not witness any. Furthermore, upon enquiring from the employees working in the Metro Bus Stations over the average numbers of disabled persons traveling in the bus said;

*“Approximately, five to six disabled persons come every day including wheelchair users.” “8 to 10 disabled persons travel from this station.”*

Further, the disabled persons whom I interviewed displayed satisfaction over the MBS but still they faced issues in the wake of inaccessible infrastructure, malfunctioning of lifts and elevators which are discussed below.

## **2.4.2 Affordability of MBS to Disabled Persons**

Punjab Mass Transit Authority (PMA) does not provide disabled persons with any concession in fares. Conversely, the fares are fixed for every passenger i.e. Rs. 30 and all the disabled persons approved that the fares charged by the MBS are affordable compared to the private services.

## **2.4.3 Reserved Seats for Disabled Persons**

Metro Bus has four reserved seats for disabled persons two for the males and two for the females and there is also enough space for wheelchairs. Passengers cooperate with the disabled persons and provide them seats. However, when no disabled passenger is traveling on bus then normal passengers sit on them but vacate the seat as soon as any disabled embarks on the bus. Besides, there is enough space in the bus for wheelchair where a wheelchair user can travel along with it. During rush hours, employees of the MBS help them embark and disembark the bus, and sometimes they are also assisted by passengers. Interestingly, it was reported by a female, who is handicapped, that non-disabled females do not vacate seats for disabled females whereas males do and she perceives it to be a behavioral issue. She shared her observation in the following manner;

*“In metro bus there are two portions, one for males and one for female and they have also reserved two seats for disabled persons. But these two seats are not provided to disabled persons. It's a behavioral issue, male do give seats to disabled persons but if female is sitting on disabled seat she won't vacate the seat for disabled person. That's the big issue.”*

## 2.4.4 Infrastructure of MBS

Infrastructure designed by PMA is somehow good where lifts and elevators are installed to facilitate disabled and other passengers but still there are flaws in the infrastructure that makes it inaccessible for them. I witnessed that most of the Metro Bus Stations had no slope or ramp on the footpaths leading to Metro Bus Station making it impossible for wheelchair users to access bus station on their own.

Following were responses of wheelchair users on the footpaths leading to Metro Station;

*"Now look at metro bus stations. You can access metro internally but to access metro station is a great difficulty. I have seen on many stations that there are steps now until someone helps you accent the step how can you travel in metro then. Even if someone helps you on accenting steps and you get dropped at your desired station how will you get to home from there which is located far away."*

*"I just visited metro bus once. First barrier is stairs and steps and it's difficult"*

*"I don't know which metro station I visited but I saw that there were two small steps before the lifts so you have to cross those steps to get in the lift. Every wheelchair is of different size now I don't think so everyone would be able to use the lifts."*

Step on the footpath is a great barrier for wheelchair users. It hampers their movement and makes them dependent on someone. Mostly the wheelchair users are accompanied by someone who help them on such stations which have no slope or ramp on the footpath or else are helped by passer-by or metro staff. Upon inquiring from the employee as to why the slopes are not constructed on most of the stations, it was found that the construction of footpaths leading to Metro Bus Station comes under the management of Capital Development Authority (CDA). Nevertheless, people who are handicapped, blind or deaf can access the bus station with assistance. For blinds tactile paving is only installed on the platform to assist them to reach the bus door but this tactile paving is not installed from entry points of the bus stations.

## 2.4.5 Malfunctioning of Lifts and Elevators

Lifts and elevators have been installed on every Metro Bus Station to facilitate disabled persons and passengers but these are mostly out of order owing to technical faults. Resultantly, it becomes difficult for disabled persons to reach the platform since all 24 platforms can only be accessed by stairs because these are either under the ground or at the height. Besides, these lifts and elevators take days to repair by the companies till then the disabled persons face difficulties. While interview with the MBS employees on different stations it was revealed that when lifts and elevators are out of order the employees carry the wheelchair to the platform. They described the situation in the following manner;

*“When lifts are not working we go and help them and lift them up with the help of our staff and accommodate him in the bus. Sometimes we assist wheelchair users and blind people we bring them on the platform from downstairs.”*

*“Security guards and marine operators help them because at every station 2 marine operators and 2 guards are available on each lift. Then operators lift them up from stairs and drop them at platform.”*

## **2.4.6 Behavior of MBS Employees towards Disabled Persons**

Employees of the MBS work in two shifts, first shift starts from 6:00 a.m. to 2:00 p.m. and second starts from 2: 00 p.m. to 10:00 p.m. There are two female and male Assistant Platform Inspectors on every station. All the employees assist and behave well with the passengers and no complaint was reported by the respondents because all the employees manage things effectively. One of the female respondents while sharing her observations said;

*“Metro bus staff is very caring and I have seen them helping disabled persons, even passengers care lot, but security staff helps them. They not only help them but also help aged or ill persons they help them in getting a seat in the bus.”*

Besides this, employees of the MBS respond to the complaints of the passengers promptly and deal with the passengers in a positive manner.

## **2.5. Views of Transport Authority Officials**

### **2.5.1 DRTA & ITA officials about Transport System**

Secretary District Regional Transport Authority Rawalpindi and Secretary Islamabad Transport Authority oversee and implement the rules, regulations and policies issued by the government and regulate the van, taxi Suzuki and bus services. Their task is to issue route permits to the local transport owners, examine the vehicle condition and verify the driver's particulars in accordance with “The Motor Vehicle Rules, 1969”. In addition to this, they suspend route permits, impose fines and seize vehicles for violating rules and policies. According to them there is dire need of mass transit system in the twin cities as females and disabled persons face lot of difficulties in traveling. The infrastructure is not accessible to disabled persons and constructing disabled friendly infrastructure require lot of funding. Moreover, they were of the view that government is trying to extent the metro bus service in twin cities and in future the transport issues are likely to reduce. Moreover, the officials were of the view that they try best to implement rules and regulations framed by the government to facilitate the passengers of twin cities, however, still a lot needs to be done to address overwhelming transport issues of Rawalpindi and Islamabad.

## 2.5.2 Complaints Received by DRTA & ITA

Offices of DRTA and ITA do not receive much complaints by females or disabled persons over harassment or misbehavior by the drivers or conductors. Complaints by females are lodged quite rarely but when it is lodged, the action is taken by the officials by imposing fine, suspending the route permits and seizing the vehicle. Secretary ITA while telling about the nature and number of complaints, said;

*"I have not received such complaints except one or two. A female complained once about overcharging by driver. So we seized the car and shut it for 2 days. But on harassment I have not received such complaint. Yes, there was another complaint by female like drivers play weird and vulgar songs during the night time and we also took action on that."*

The above statement shows that the reporting of complaint by females is very low. It is because of the fact that females are reluctant to lodge complaints to avoid any untoward situation or they are unaware of the proper platform or believe that is useless to complaint since no action will be taken. Female respondents while remarking on the situation said;

*"See we don't have a higher authority when it comes to hiaces and stuff like that, in metro bus for example now this is a proper system so you can have a higher authority on it but there again their drivers and their conductors where is the higher authority who do you call to you cannot what most women can do is to not travel again and that's what they do we don't have a higher authority over there."*

*"I have never complained, because I think people at Aabparah G-6 bus stop has a complete hold. I have seen them fighting there. And I think traffic police has no involvement or say in it. Our fare is Rs.15 but they charge Rs. 20 and this is wrong they should not do that."*

It is a fact that drivers and owners overcharge fares and make violations but mistrust on the authority makes females not to lodge complaints. However, it was revealed that male passengers were more likely to make complaints against the drivers over overcharging, misbehavior and non-completion of routes to concerned authorities and the action is taken promptly by the officials.

## 2.5.3 Seats for Females in Public Transport

There is no as such policy or rule by the government to reserve seats for females in the local transport, however, it is a customary practice to provide front seats to females. Since drivers are not bound to reserve seats for females they sometimes also accommodate male passengers on the front seats to maximize their profit. In order to know the whether they reserve seats for females, a driver told that;

*"We provide women front and second seats remaining are for gents. We are not directed by anyone to reserve seats for females it's us who have reserved seats for females because they can easily get in and get off the van. If we provide them seat at the gent's side it will be a problem"*

## 2.5.4 Accessibility of Public Transport

Officials of the DRTA and ITA conceded that the public transport and its infrastructure is not disabled friendly and accessible to disabled persons at all and females also faced issues while accessing public transport and they showed helplessness since infrastructure and installation of disabled friendly transport is to be done by Metropolitan Corporations and government respectively.

## 2.5.5 Views of NTRC Officials

National Transport Research Centre (NTRC) is functioning as Research and Development wing of the Ministry of Communications which provide ministry with research, strategy and plans needed for transport sector across Pakistan. Number of research and studies have been done by NTRC to provide roadmap to install transport service in Islamabad which are discussed in detail under the policy analysis heading.

## 2.5.6 Reasons for Non-implementation of Transport Policies

NTRC officials are of the view that policies do exist but are not implemented owing to lack of government priority on the transport sector. Government mostly focuses on concrete development such as construction of bridges, roads and underpasses for political scoring, hence, no attention is paid to improve the transport sector. Although inclusive transport is linked with human development as it provides people access to jobs, education, goods etc. But situation in Pakistan is opposite as negligence has further deteriorated condition of public transport. Deputy Chief of NTRC while remarking said;

*"It's all about government priorities, government determines priorities. We mostly focus on concrete development, like constructing roads, bridge. We don't pay attention to human development, so the transport is linked with human development. Have't you heard in old times that travel increases your knowledge. But now we have limited its scope now you are from Shahdadpur and you have come to Islamabad so now you are aware of many things like what the problems of small cities are and what the problem of big cities are, so it has increased your knowledge. So it's all about priorities, we could have introduced Uber 10 years ago, there used to meters on rikshaws and taxi's now they have disappeared. Now the metro was extended by previous government but it's not functional because it's not in the priority of the government. An English man said that if you cannot revamp whole public transport than at least improve the existing one and regularize it properly. Now 50 thousand Qinchigs are operating but you are not allowing it."*

NTRC is only the research wing of Pakistan which provide research related to transport sector. However, lot of studies have been conducted by this wing suggesting practical measures to improve the transport sector. Now it is the work of government to implement transport policies, projects and plans to facilitate people.

## 2.5.7 Government Initiatives for Transport in Islamabad

Number of initiatives were taken by the governments in past but failed to materialize owing

to political reasons. Such as during the regime of Pakistan People's Party from 2008 to 2013, a policy was prepared under the supervision of Prime Minister Yousuf Raza Gillani to provide subsidized loans to private sector to purchase buses and operate it in eleven metropolitan cities of Pakistan including Islamabad but failed to materialize over political disagreement. In addition to this, an Varan Tours Bus Service shut down its operation in February, 2005 owing to political reasons which was not only benefiting the public of twin cities but working females and students as well. Deputy Chief of NRTC said;

*"During the Musharaf regime a company of Uzma Gul, Varan used to run public transport in Islamabad. But wagon mafia stood against them and company also did not meet contractual obligations time to time and did not update stock. It was a successful project. But when General Hameed's Gul relation got bitter with Musharaf and Supreme Court also gave judgment that there had been no bidding before giving contract to Varan Company. So it was closed down. Who would come now? Their 110 buses are rotting in the depot since decade. This is unnecessary intervention and whenever there is unnecessary intervention things get failed unnecessary intervention has far reaching impacts that's why no bus service has come in Islamabad since then."*

Further the officials were of the view that initiative by the government to install Metro Bus Service has greatly benefited the passengers of twin cities and it has been now being extended to New Airport, its infrastructure is already built and we only need to inject buses. But the government is reluctant to make it operational because there are not much passengers on that route and it will hardly meet the operating cost.

## **2.5.8 Views about Transport Sector in Islamabad**

Currently the transport system in Islamabad is not up to the mark, a vacuum created by public transport system is being filled by private vehicle owners. These people have started operating their vehicles on shifts or pick and drop service, carrying children's and females to schools, universities and to offices. The number of these vehicles have increased manifold and the same have not been regularized by the government so far. Moreover, these private vehicles are also not disabled friendly. There is no infrastructure or transport to facilitate disabled persons whereas women also face the issue of accessibility. According to NRTC officials there is need to provide transport facility to general public and then the government can move toward providing facilities to women and disabled persons. However, Metro Bus Service is a good initiative by the government which is facilitating passengers of the twin cities and is also accessible to disabled persons to some extent. In order to improve it further feeder routes or shuttle service is needed to be installed to facilitate passengers of other areas living in Islamabad. According to NRTC official;

*"A person who works in G-9 and lives in Chak Shahzad, it will not be feasible for him to travel every day to his work place while he gets 20 thousand pay only. Now the infrastructure is already built so we should run buses which would connect to metro buses. Now money spent on only metro bus infrastructure could have been spent on running buses in whole of Islamabad. Now buses are also needed toward DHA side. Now there is congestion in van, it damages environment*

*and is not comfortable at all. A single bus replaces 4 wagons, and it does not run on time and creates traffic."*

Buses are more environment friendly and can accommodate huge number of passengers as compared to the vans and single bus replaces four vans. According to the officials, if the buses are run in Islamabad it can solve the transportation problems of the city. However, there is no need to build separate infrastructure for running a bus service since the building this huge infrastructure is way too costly for a country like Pakistan and does not solve the transport issues for all, instead it would be much better if feeder routes or shuttle service is started from rural areas and within Islamabad where MBS does not operate. This approach or policy can benefit great number of people including females and disabled persons as well.

### **3 CASE STUDIES**

This section contains three case studies of disabled persons. In-depth interviews were conducted to gather the data.

#### **3.1 Case Study 1**

Local vans, Suzuki and buses are the main mode of transportation in Islamabad. Majority of population including females use these services to commute on daily basis. However, the ratio of buses and Suzuki is less than the vans in Islamabad. One of the major problems that disabled persons face is of accessing these local vans, Suzuki and buses. In order to assess the problems faced by disabled persons while accessing public transport, especially those who use wheelchair, in-depth interview was conducted from Mr. Adil who is 32-year-old and works in Senate of Pakistan as an Assistant. Adil met a car accident 10 years which caused him Paraplegia. Paraplegia is usually caused by spinal cord injury or a congenital condition such as spina bifida that affects the neural elements of the spinal canal. This form of condition paralysis both the legs of a person hence he uses hands and wheelchair for the movement. Since car accident he has been on the wheelchair. He resides in PWD, Rawalpindi and the distance between his home and office is 20 kilometers and he commutes on daily basis from PWD to Senate of Pakistan. Before coming on to wheelchairs he used to travel on the public transport but now he never uses it due to its inaccessibility. Upon asking as to why he does not use public he told that:

*"It is impossible to use current public transport. Neither you can use bus nor van, neither anything else because you are on wheelchair and you cannot use. Local vans are 100 percent not accessible because vans are at much height and until someone lifts you up and puts you in the van you cannot sit own your own. One can only sit in bus if there are proper bus stops with ramp facility".*

Disabled persons who are on the wheelchair avoid or never use public transport because it is way too difficult for them to embark upon the vans because the public transport and infrastructure are not disabled friendly. They always have to depend on someone to help them embark upon the van or a bus if they ever have to travel in the same. Moreover, these transport vehicles have no specific place or seat for disabled persons specially wheel chair

users where they could easily adjust. The same fact was confirmed from the public transport drivers and conductors that wheelchair users never travel in the vans because of the fact that there is no such space available for them in the van. Further, upon inquiring from Mr. Adil, the reason for not using public transport, his response was;

*“The reason was like you cannot even take a single step on the road. Footpaths and roads are constructed in such a way that one cannot walk on it. I don’t think so you can go on the roads. I live in PWD and I never saw anyone using it nor did I try myself.”*

Even if the disabled persons wanted to access the public transport, the roads and footpaths are in such a bad condition which affect their movement. Therefore, wheelchair users avoid to access or travel in public transport. In addition to this, wheelchair user has to depend upon someone to assist them moving the wheelchair on the road.

### **3.1.1 Dependency on Family Members**

Moreover, lack of transport facilities have also affected the wheelchair user’s mobility. They have to rely upon family members to take them to educational institutes on everyday basis and if they are unable to access the educational institute due to lack of transport facility then they prefer to take education from home. Upon asking how did Mr. Adil completed his education he replied that;

*“I used to take home tuitions at home, but when I had to take a board or university exam after a year, I had to ask someone at home or my brother who would take me for exams.”*

It clearly shows that non-availability of accessible transport increases the dependency of wheelchair users on the family members and makes it difficult for them to access educational institutes own their own. However, launch of transport services such Uber and Careem has greatly benefited the disabled persons specially those who are able to afford it. But these services are way too expensive for those who are poor and financially dependent on their family members. Even for Mr. Adil the services are expensive. Upon asking he was of the view that;

*Few years back services like Uber and Careem started operating so I started using careem and uber. I was lucky enough to be able to afford it so I used this service regularly for commuting to office for about two and half years but they are very expensive, at the onset it was affordable, but now it has become very expensive. There are categories that are cheap, but cheap one, is mini, mehran. Drivers of mini are not literate so they do not accept this*

*thing at all, they say their car will get damaged, so they can’t keep the wheelchair in it. If mini charges Rs.200 then business class would charge you Rs. 1000. So I used to hire business class because I could afford it”*

Commuting on daily basis in the private service is expensive as major chunk of their income is spent on paying transport charges. Moreover, disabled persons also face difficulties while using private transport such as Uber Careem and taxi’s. As stated by Mr. Adil, most of the drivers refuse to take ride, booked by wheelchair user, on the pretext that their car will get



damaged by keeping wheelchair in it. However, business service which were expensive, were more likely to accommodate them in their vehicle.

Further he informed that he can easily shift in a car and does not require assistance by anyone but he has friends who are completely dependent on their family members. He described that;

*“They face lot of difficulties and they do tell me as well. There are female disabled who cannot travel alone and I have observed that they are mostly accompanied by their family member because they have to shift in a vehicle. Now I am a boy, I can shift in a car own my own and sometimes ask for help if I cannot get in the vehicle. I have travelled to Lahore with female friends and it is way too difficult for them. Females face difficulties while shifting in vehicle, sometimes they get late at night and sometimes they don’t find vehicle and sometimes mobile network is down and they cannot hire Careem or other service so it’s way too difficult for them.”*

### **3.1.2 Affordability of Private Transport**

Before working in the Senate of Pakistan Mr. Adil was working in Telenor Company. He was not provided with the transportation service from his office therefore he had to arrange his own transport to commute to office on daily basis. He was being paid Rs. 40,000 per month from his previous job and used to spend most of his income on transport service. Upon inquiring the income spent on transport he informed that;

*“Uber and Careem have become expensive now, at the onset it was affordable, but now it has become very expensive. Almost 90 percent of my income was spent in transportation. Sometimes I had to go to my friends and before that I used to apply for jobs and used to go for interviews. But now I have purchased my own car and drive own my own. I don’t face any issue these days, but if you hire a taxi for travelling outside Islamabad it’s too expensive. They charge 40 thousand or 10 thousand per day so you cannot go outside.”*

Since there are no transport facilities for disabled persons, Mr. Adil was compelled to pay major chunk of his income on transportation alone. However, after getting job in Senate of Pakistan he purchased his own car to commute on daily basis to office. Moreover, disabled persons are not provided with any discount while using private transport service within the Islamabad. Owing to unaffordability and inaccessibility of public and private transport most of the disabled persons prefer to remain at home and get education from home because of high transportation cost. Or else, disabled persons learn skills and work from home to generate some income.

### **3.1.3 Difficulties in Private Transport**

Morning and evening time in Islamabad are mostly crowded because people are travelling for their jobs, education, etc. making it difficult for disabled persons to find transport during rush hours. In those particular peak hours transport services such as Uber and Careem are unavailable as other people also book them. Resultantly wheelchair users either travel with

peak factor price or wait a little extra or travel early to avoid inconvenience. Mr. Adil while explaining difficulties faced by him said that;

*“During rush hours I used to come office quite early, if I had to leave for office at 8 a.m. instead I used to leave at 7 a.m. to avoid peak factor and inconvenience during rush hours. During rush hours, Careem or Uber becomes expensive. I also had to face similar issues after office, so I had to take leave early or wait a little bit. Because Uber or Careem is not available soon after the offices are off as everyone books it. Moreover, my office used to close at 5 or sometime at 6 p.m. or 7 p.m. so I could not find pick and drop easily. Even I faced issues while booking Careem, such as sometimes they used to come late and sometimes network was down so I had to wait for it but somehow I used to manage it.”*

Rush hours puts disabled persons in a very difficult situation as they have to wait little longer for booking a transport service online. A normal person can at least walk till bus a stop or taxi stand to get a transport however, the wheelchairs users are bound to stay at the same place since the roads and footpaths are also not accessible for them. Moreover, protests have become very common in Islamabad in recent years and sometimes mobile and internet services are down for security reasons. In this scenario the wheelchair users also have to face difficulties in terms of booking a vehicle or finding a transport. Due to these issues the disabled persons who are able to afford to purchase a car do so to escape difficulties.

Similarly, Mr. Adil has purchased his own car and now he is able to move freely. Mr. Adil told that;

*“Now I have purchased my own car and imported a device and I drive own my own for coming to office. But this is vehicle is not for disabled, it's a normal car, I have tried my best to import a car but the process is way too difficult. They ask me to get a license first and then a board would approve import of car. When I went to purchase a normal car they did not ask me for any license, they just asked whether you have money or not. I am in need of a car because I am a special person. Even officials at ministry do not know about the process. I tried my best to import a car but could not get approval from government offices as the process is way too difficult. It's not necessary that you have to drive that car and require license, you are a part of a family the family would driver for you. There are many types of disabilities some are blind etc. and they cannot drive a car, so I think procedures should be improved and rules should be relaxed for disabled persons.”*

Lack of transport facilities compels disabled persons, who are able to afford, to purchase a car for personal use. However, the government of Pakistan has provided the provision of importing duty free altered cars to facilitate disabled persons but the procedure is so lengthy and rules are so impractical that the cost of duty free car becomes higher and much cheaper car can be bought by disabled persons in Pakistan.

### 3.1.4 Inaccessible Infrastructure & Social Exclusion of Disabled Persons

Even if disabled persons somehow manage to travel in the private vehicle to access education, job etc. then the buildings and infrastructure are not accessible which compels them to get education from home or look for alternate online source of income or stay idle at home. Inaccessible public transport, buildings and infrastructure excludes them from social and economic participation. Mr. Adil told that;

*There were 99 percent places in which I could not inside because of unavailability of ramps. Even I could not join law chamber because of the same reasons. I had done LLB but could not practice because chambers were not accessible for me. I received offers but could not join because some offices were situated at first floor and some at second which had no lifts or accessibility. So I would become liability for them, instead of providing them service.*

Even if some buildings are accessible and have installed ramps and facilities for disabled person, they are of no use for them. They are installed in such a way which makes it difficult for disabled persons to use them. While complaining about the installed facilities Mr. Adil said that;

*There are facilities but not enough or useful. There are ramps which are of no use for wheelchair users. Take an example of parliament house, there are ramps, such as there is a ramp in media office, I cannot open its door while using ramp, in order to open the door two people have to remove the ramp first and then the door will open. Facilities are there but they very less and not useful. There are no washrooms for disabled person in parliament house I have checked every floor and none of them are accessible for disabled persons. So disabled has to suffer lot while doing job. Mostly disabled persons prefer doing job nearby their home. Wheelchair user needs to use wash rooms and companies avoid hiring such people because they cannot provide them much facilities."*

Public places and buildings should be accessible and barrier-free to disabled people as they find it difficult to access and operate freely without assistance. Major facilities required by disabled people are lacking in many public buildings of Islamabad. As identified by Mr. Adil facilities installed in public buildings are in poor state or of no use and absence of key facilities restricts their movement. Moreover, companies try avoiding such people whom they cannot provide facilities which further reduces their chance of participating in social and economic activities.

Wheelchair users are unable to participate own their own in social, economic and educational activities owing to barriers in their movement caused by absence of affordable and accessible transport, buildings and infrastructure. Consequently, they avoid travelling outside and prefer to stay at home because they consider their disability a burden on their family members. Their frequency of travel outside is comparatively less than other members of family or non- disabled person. Mr. Adil Said that;

*I had to go Lahore but my family went, leaving one person behind at home because of me because I could not go with them. I thought how would they lift me and adjust me in bus and it would be drama, because there are no ramps and no system so avoided it as it's not accessible for me.*

In addition to this, disabled persons are deprived from enjoying leisure activities and going to cinemas because of lack of accessible infrastructure in cinema halls, hill stations etc. Barrier in movement increases in them the sense of helplessness. Even if the wheelchair users manage to travel on private transport but yet there are places which are inaccessible. Wheelchair users who are poor are completely facing social exclusion because they cannot even afford private transport. Mr. Adil said that;

*I avoid going to places which are inaccessible because I don't want to burden any one. Such as my colleagues are planning to visit a water fall and hill stations but they are not going because of me. So I make excuses and do not go. There are so many places that I cannot visit such as cinemas because they have no ramps."*

Due to neglect in providing facilities to disabled persons, their movement is limited greatly which hampers the development of their abilities and restrict them to lead a healthy life like others. However, in Islamabad majority of buildings and places are inaccessible to disabled persons and lot is needed to be done by the government to make all such spaces accessible for disabled persons.

## **3.2 Case Study 2**

Miss. Romaila is 30-year-old woman who has done her masters and works in private organization. She has been on wheelchair since 2005 when she got spinal cord injury in an earthquake and her legs got paralyzed and lost her parents in the same unfortunate incident as well. She has worked in various private organizations and also teaches disabled community self-help and shifting techniques. She is also an activist who works for the empowerment of disabled community.

In order to get insight about how transport in Islamabad has affected female wheelchair user's mobility, in-depth interview was conducted from her. She frequently uses transport and mostly prefers to travels in private and personal transport for social, educational, work and personal reasons. In order to know as to why she prefers private or personal transport she responded that;

*"I have never used vans and hiace because these are not accessible. I have used public transport like Uber and Careem a lot other than my own conveyance. The reason I travelled in Uber or Careem was that we mostly get good drivers and cars and it was affordable. Otherwise I have not travelled in vans because they are not accessible. There are many other disabilities like muscular dystrophy. People have less movements in their hands so they cannot travel in public transport even they cannot shift themselves on front seat. Transportation in Pakistan is not disabled friendly."*

The public transport in Islamabad is not accessible for wheelchair users and the reason she

does not use public transport such as van bus etc. is that these transport and its infrastructure are not accessible to them. Moreover, even if they use it for some reason or the other, especially female wheelchair users have to face lot of difficulties while shifting into these vehicles and have to rely on family members to shift them in a vehicle like these. In order to access educational institute, the wheelchair users cannot use university buses or any other transport as these are not disabled friendly. Upon asking how did she completed her education she replied that;

*"I was pursuing my education in 2009. I could complete my degree at home but I wanted to go regularly so I hired a taxi and after one year my brother purchased a car and he used to provide me pick and drop and that's how I completed my degree. However, after completing my education I started working in a private company which provided us transportation service. The drivers used to keep our wheelchair in the van, but there was no ramp in the shuttle, we had to be dependent on people. So mostly I travelled in taxi or in my own car."*

As stated above, since she could not avail transport facilities provided by university, she had to hire a taxi or travel in personal vehicle to complete her education. It is also pertinent to note that unavailability of accessible transport also increases the cost of education for wheelchair users as they have to use private transport for mobility. Further, it also increases their dependency on family members as they are the one who would provide them pick and drop on every day basis and cannot move own their own. Another problem that wheelchair user face is of shifting in a vehicle. Since they are in wheelchair they either have to depend on someone to shift them in a car or they shift own their own if they know the shifting techniques well.

*"I can transfer on front seat in taxi. It all depends how well you know shifting techniques how independent you are. So for me I can shift on the front seat of any vehicle without anyone's help."*

Since the wheelchair users cannot exercise much they tend to gain weight and it becomes quite difficult for them to shift in a car own their own. Hence, the accessibility of transport becomes difficult for them. However, there should be a training program for such wheelchair users where they must be taught self-skills and shifting techniques which would somehow make them independent. Moreover, they also be taught how to communicate with drivers for help. In addition to this, in Pakistan there is no innovation in cars. There is no change in car infrastructure because they don't make cars keeping disabled persons in mind. So the disabled persons face space and wheelchair accessibility issues.

### **3.2.1 Affordability of Transport**

Since the public transport is inaccessible for disabled persons, consequently, they are left with no other option except personal or private transport such as Uber, Careem or taxi for commuting and mobility. The cost of these transport services is very high for the disabled persons for accessing education or office as they have to spent major chunk of their income on the transportation. Similarly, Miss Romaila also reported that half of her income was spent on the transportation to commute for office. While answering to a question regarding transport expenditure she informed that;

*"I was working with an organization in the past, so I was paying a taxi 18000 rupees a month and my salary was 40000 rupees. Still the driver was not happy with the money and he used to demand more because he used to help me in shifting and keeping wheelchair. So he was blackmailing me on that and was demanding more money."*

Paying high cost for transportation out of income can really be discouraging for people with disabilities especially those using wheelchairs. Moreover, the disabled persons are not provided with any concession neither by local taxis nor by Uber or Careem. This high cost of transportation reduces their participation in society as majority of disabled community may not be able to afford it. However, they are still participating despite many challenges and must be provided ease in mobility. Miss Romaila further said that;

*"We cannot access education and other things on regular basis because taxis are not affordable. Here comes the issue of affordability. If transportation becomes friendly, then people would stop considering disability a taboo. People consider disability a burden, friendly transportation would remove this from people's mind-set. Then parents would send their children to school and jobs. So disabled people can actively participate in society."*

Hence, if the affordable and accessible transport is available for disabled persons, there would be increase in participation of disabled persons as they would be dependent on anyone to travel or move. Moreover, they would be able to pursue their education and career with great ease. However, the current transport and infrastructure in Islamabad is greatly affecting their mobility and they have to rely on costly transportation services for movement.

### **3.2.2 Driver's Behavior**

Though the launch of online taxi service has benefited the people with disabilities as it can be booked via mobile phone and can be used by most of the people. However, it has been witnessed that majority of wheelchair users are not welcomed by the drivers of these services. These transport services have two major disadvantages first is the cost which is discussed above and the second is accessibility of wheelchair in the cars. Most of the drivers of these service refuse the ride owing to wheelchair as they think it could damage the seats. Miss Romaila had also faced the similar situation while booking a taxi service. She said that;

*"It depends on the person and situation as well. It depends which car you are hiring. I mostly used to hire Alto, the drivers of these vehicles used to keep my wheelchair as well. But sometimes I used to hire big cars, they used to object and refused to take me because they thought wheelchair would damage their cars. So I had to face this behavior. We also submitted complains but no response was received. It is better to hire a local taxi it is more convenient. Because the drivers used to put wheelchair on the backseat or on the (Jangla)."*

The major problem is that the cars in Pakistan have not been designed in such a way that can accommodate wheelchair users. However, the refusal to take the ride by drivers disappoint disabled community. These taxi services like Uber and Careem should sensitize their drivers and keep in mind the needs of people with disabilities and must train the drivers

to take care of passengers with disabilities before registering them to operate transport service. There is dire need of spreading awareness regarding disabled persons. Moreover, it is really important to educate and sensitize people and society about the problems faced by disabled persons.

### 3.2.3 Safety of Private Transport

Safety of private transport is very necessary for females to be able to travel safely. Since they are disabled it not only concerns parents but they also have to travel with fear. However, the Careem or Uber are much safer than the local transport as you can share your movement with your close family members and the online taxi service has all the data of a driver. However, the safety is still concern for disabled passenger since they are unable to protect themselves from any danger. Upon asking about safety of safety of Uber and Careem, Miss Romaila was of the view that;

*“Transportation is never safe and secure because you get weird drivers and sometimes you get good drivers so I had to face awkward situation as well. Everything as pros and cons so it depends on the situation. I think Uber and Careem should run specific transport for disabled person which is friendly and has a female or male attendant. They need to educated drivers as well. They should also introduce an app which has cars for disabled persons only. It will build confidence in disabled persons and will also remove security concerns. But now it depends how they take this idea because everyone sees things from business point of view and they see profit only.”*

Keeping in view the specific needs of disabled persons, online taxi service can allow the operation of wheelchair accessible vehicles and drivers of these services can be trained as well. It will allow disabled persons especially females to travel safely. However, it may not be possible for private transport service to allocate attendant as it would become costly for the companies to operate services.

### 3.2.4 Accessibility of MBS

Infrastructure designed by PMA is somehow good where lifts and elevators are installed to facilitate disabled and other passengers but still there are flaws in the infrastructure that makes it inaccessible for disabled persons. I witnessed that most of the Metro Bus Stations had no slope or ramp on the footpaths leading to Metro Bus Station, making it impossible for wheelchair user to access bus station own their own. Therefore, they require someone's help to cross the step. Miss Romaila on the accessibility of Metro Bus Station said that;

*“Now look at metro bus stations. You can access metro internally but to access metro station is a great difficulty. First barrier is stairs and steps and it's difficult. I have seen on many stations that there are steps now until someone lifts your wheelchair and help you accent the step how can you travel in metro then. Even if someone helps you on accenting steps and you get dropped at your desired station how will you get to home from there which is located far away. Now if your home is 15 kilometers away from metro station then you will have to book a taxi. I mean there should be transport service in which disabled person struggles for once only. Now people who are well*

*settled can afford transportation such as Uber or Careem but there are people who are poor whose source of income is very less than how they are supposed to afford.”*

*“I don't know which metro station I visited but I saw that there were two small steps before the lifts so you have to cross those steps in order to get in the lift. Every wheelchair is of different size now I don't think so everyone would be able to use the lifts.”*

Step on the footpath is a great barrier for wheelchair users. It hampers their movement and makes them dependent on someone. Mostly the wheelchair users are accompanied by someone who help them on such stations which have no slope or ramp on the footpath or else are helped by passer-by or metro staff. Upon inquiring from the employee as to why the slopes are not constructed on most of the stations, it was revealed that the construction of footpaths leading to Metro Bus Station comes under the management of Capital Development Authority (CDA). Nevertheless, people who are handicapped, blind or deaf can access the bus station with assistance. For blinds tactile paving is only installed on the platform to assist them to reach the bus door but this tactile paving is not installed from entry points of the bus stations. Moreover, the MBS runs on the specific route and does not cover all the residential areas of Islamabad. Hence, it becomes difficult for the disabled persons to access MBS since they have to get a cab to reach on the nearest MBS station. Hence, MBS is difficult to access by those disabled persons who live far away from Metro Bus Stations. However, the said service is accessible to those who live nearby the Metro Bus Stations.

Further, during the course of field work I observed that the most of lifts and elevators in Metro Bus Stations were out of order and inaccessible that further hampers the mobility of those disabled persons who use MBS. These lifts and elevators remain out of order for weeks and months as spare parts are purchase from Karachi and Lahore which takes plenty of time.

### **3.2.5 Social Exclusion of Disabled Persons**

Availability of inclusive transport is very necessary to avoid social exclusion of people specially disabled persons. Transport available in Islamabad does not cater the needs of people. However, the gap is filled by private transport which becomes difficult for poor to afford. Disabled persons are already marginalized segment of society and face social exclusion in many ways but the situation is further aggravated by the lack of transport facilities for them. Miss Romaila is also an activist and works for the rights of the disabled community, she was of the view that;

*“Exclusion is the biggest problem. I have many friends who face this issue. Now I have friend who lives in Lahore and she is disabled. She has gained lot of weight due to disability and now her parents shift her in a car because she cannot shift own her own. Now she needs a full time attendant. I have another friend whose shifting skills are very poor because her muscles are very weak. She has to ask for help every time. Now the thing is there are people who cannot avail opportunities because of lack of good transportation. Now accessibility is not just about accessing car or transport it's about accessing everything. Suppose if you get a job now the question is, are*



*there any lifts and ramps in the building? Is the building accessible to you or not? Many disabled persons cannot avail opportunity because they can come out of home but how will they then access buildings? Females also avoid using public transport because it's a risk. You don't know whether the driver is good or bad. That's why they are unable to complete their education and consequently job opportunities are reduced for them. That's why I have started teaching shifting techniques to females and disabled persons, and if they are not able to go out they can earn at home by providing online services. Or you earn that much you can hire a taxi or purchase a car."*

There are lot of problems that disabled community face in terms of accessing opportunities due to lack of inclusive transport and infrastructure. Many are left out in the race and further marginalized due to lack of mobility caused by inaccessible transport. Transport is very vital in order to participate in the social affairs of life. Therefore, campaign should be launched by government at huge level highlighting problems being faced by disabled persons to aware the common masses. Campaign should be launched by online taxi service to aware drivers about how to handle a disabled person. Government should also introduce vans and buses accessible for disabled persons with ramp facilities so that disabled persons can get inside easily. Specific seats or space be allotted where disabled person can sit on wheelchair easily. Inclusive transportation should not be introduced in Islamabad but whole of Pakistan so that disabled persons move freely without any barriers.

### **3.3 Case Study 3**

Mr. Irshad is an MPhil Students who hails from Khyber Pakhtunkhwa and studies in Islamabad. He is a disabled person and faces the issue of Limb anomalies since birth. It is the most common birth defects observed in infants. These malformations can occur as isolated malformations, in combination with hand and/or foot and also involves specific main developments of the radius, fibula, or tibia. He frequently uses public and private transport to commute for university and social work and to visit his family at KPK. In order to know about the problems faced by him due to limb deformities while using public transport in depth interview was conducted from him.

However, disabled persons who are handicapped, blind and those who have locomotor disability but can walk or move with difficulty are likely to use public transport but do not prefer it since the vans are quite congested and a disabled person cannot sit and adjust comfortably. Front seats of the van have quite enough space for such disabled persons who could spread their legs and sit comfortably but front seat is hardly available for them since it is preferably given to non-disabled females. In a reply to a question regarding experience of traveling in public transport, Mr. Irshad said that;

*"It is very difficult to catch a local van. I have to wait a lot to get front seat even if they provide me front seat drivers mostly demand double fare. Though government has notified that disabled persons would be charged half fare and would be given front seat on priority but it's not practiced. I prefer front seat because my legs don't bend, they are stiff so I need front seat to sit comfortably because front seat has enough space. But I don't prefer using local vans because they are always in hurry and there is crowd in the van. In vans you have to get in and get off quickly so it's not easy for me. They don't make a long stop and treat us as a normal person. Even drivers of PIDE*

*bus are in hurry. Many times I was about to fall. Even I fell from PIDE bus once but thankfully I did not get injured. That's why I don't prefer public transport".*

I personally observed that drivers of public transport are insensitive towards disabled and old age community. They avoid stopping vans for old age and disabled people because they take time to embark upon the van, since they are competing with other drivers in loading passengers they want every passenger to sit quickly so that he could get another one ahead. Similarly, the disabled persons and aged people take time to disembark from the van so drivers consider it as the waste of time and prefer to take someone who could get in the van quickly. However, I did not see any disabled passenger traveling on the local transport during my field work. This fact was confirmed from the drivers as well who said the disabled passengers travel very less with us and even if they travel they are accompanied by someone.

### **3.3.1 Behavior of Transport Drivers**

Drivers and conductors of local vans always look for passengers who would sit according their wishes. Mostly they avoid taking disabled passengers who require space according to their needs. Since the driver and conductor try to get maximum profits by adjusting extra passengers they try not to take a passenger who would occupy double space. Mr. Irshad while complaining about the behaviors of drivers and conductors said that;

*"Drivers behave very rudely and they don't treat us nicely. They just want profit and fares. Every time when I travel on public transport I always fight with the drivers as they never make a long stop for me. Passengers ask drivers and conductors to stop van for a while because they see I am disabled person."*

Drivers are always in hurry because if they stopped longer at a non-designated stop they are likely to be issued ticket for violation by traffic police. Moreover, the fares set by the government for local transport is quite low so they try to maximize profit by adjusting as many passengers as they can. Contrarily Mr. Irshad finds the behavior of Uber and Careem driver much better and satisfactory because they get rating at the end of the ride so they never behaved rudely with him. Moreover, he has been refused front seat many times by the drivers and conductors and despite making complaints he has not received any positive so far. According to him;

*"I have complained to traffic police but they said they can't do anything until they are directed by Deputy Commissioner. It is because of our complaints the government has issued notification for giving front seat to disabled persons on priority. But it's not implemented and I always end up fighting with them."*

Even when Mr. Irshad travels to KPK he pays double fare for getting a front seat. According to him only those disabled passengers are facilitated by drivers who pay the double fare.

### 3.3.2 Difficulties & Comfort of Local Transport

A local van can accommodate 17 passengers in a single van. The seats inside the van are quite congested even for a common passenger. However, for disabled persons like Mr. Irshad it is difficult to sit and adjust in the van comfortably. Only the front seat has space which is mostly given to female passengers. Mr. Irshad while sharing opinion over the comfort of local van said that;

*“They only provide front seats to females so they don’t give me front seat. So they provide me seat at the back. In Islamabad there is ban on use of CNG cylinder so I spread my feet and sit. But still I face difficulty because passengers have to get off.”*

Moreover, there is always crowd during the peak hours on the van stops so it is difficult for disabled persons to get in the van easily as other passengers push one and other while embarking on the van. Most of the times Mr. Irshad does not find seat in the van and book taxi which consequently becomes expensive for him. Owing to these issues, he travels less on the public transport and his mobility is affected to a greater extent.

### 3.3.3 Facilities and Issues in MBS

Metro Bus Service started operating in Islamabad since 2013. Mr. Irshad sometimes uses MBS for his personal tasks. However, I personally witnessed disabled persons including wheelchair users, blind and people with leg disability traveling on the MBS at different stations, whereas in local transport I did not witness any. Furthermore, upon enquiring about the experience of traveling in the MBS he told that;

*“Yes I travel in metro bus sometime. I had a good experience and easily find seat. Bus service is good but the question is, are the disabled people benefiting or using this service. Because there is too much crowd in metro bus so how would anyone know that the person standing behind me is disable or not. Even if they see that I am disabled person they won’t vacate the seat.”*

Metro Bus has four reserved seats for disabled persons two for the males and two for the females and there is also enough space for wheelchairs. Passengers cooperate with the disabled persons and provide them seats. However, when no disabled passenger is traveling on bus then normal passengers sit on them but vacate the seat as soon as any disabled embarks on the bus. Besides, there is enough space in the bus for wheelchair where a wheelchair user can travel along with it. During rush hours, employees of the MBS also help them embark and disembark the bus, and sometimes they are also assisted by passengers. Further, the disabled persons whom I interviewed displayed satisfaction over the MBS but still they faced issues in the wake of inaccessible infrastructure, malfunctioning of lifts and elevators.

Further Mr. Irshad was of the view that the laws related to providing facilities to the disabled persons should be implement and its true spirit as disabled persons are marginalized segment of society and they have the right to live like other fellows. According to Irshad, a separate transport service should be initiated by every government department and universities which would provide them opportunity to participate equally like other people.

He further stated that;

*"I think government should form a monitoring team in each department whose sole work should be to monitor whether the policies and laws related to disabled persons are being implemented or not. Disabled persons belonging from well off families can enjoy facilities but what about the poor disabled persons. So these monitoring team in transport sector, education sector and other sectors be formed so that they facilitate poor people. A monthly survey should be done and disabled be asked whether they enjoy facilities or not."*

Lastly, disabled persons who can walk or move are likely to use public transport but difficulties in public transport discourage them to use the service. They also confront the odd behavior by the drivers and conductors for not providing them front seats according to their needs where they could adjust comfortably. Moreover, the drivers of these public transport are always in haste and this might cause injury to the disabled persons and further aggravate the problems already faced by the disabled persons.

## **4 CONCLUSION and RECOMMENDATIONS**

Following are the policy recommendations, if taken seriously, can provide great ease to the people especially female and disabled persons and make the capital interconnected.

### **4.1 Revamping Public Transport System in Islamabad**

Islamabad is considered one of the most beautiful capital of the world because of its scenery and developed city planning but, factually, no concrete effort has been made to introduce inclusive public transport system in the city to make it connected. The National Transport Policy of Pakistan 2018 sets targets and visions to be achieved by the government of Pakistan at national level, however, on ground no further policies have been prepared or pursued to set the transport system in right direction in metropolitan cities including Islamabad. Undoubtedly, mass transit system has been implemented in major cities such Multan, Peshawar, Lahore and Islamabad but these have not resolved the transportation issues to the fullest and the issue of traffic and inaccessibility persist, further, people are left with no other option except to use Qingchi's and other modes of transport. Since Pakistan is developing country and is striving hard to achieve economic stability, it should spend money for installing bus service in collaboration with private sector in metropolitan cities, instead of spending huge amount of money on building infrastructure for separate BRT which caters the need for few. Therefore, Pakistan cannot afford to install first class transport service in one go. First a bus system should be introduced in major cities and then the infrastructure be built to cater the needs of people. However, following steps should be taken to improve the public transport system in Islamabad.

### **4.2 Transport Policy for Islamabad**

Since Islamabad was made capital of Pakistan no transport policy has been prepared or implemented. However, many studies have been conducted by National Transport Research Centre (NTRC) in the past, stating the need of mass transit system in the city to reduce traffic

congestion and social exclusion of the people. Though, Metro Bus Service has been implemented in Rawalpindi and Islamabad by the government at exorbitant cost, yet, it has not resolved the transport problems for whole of Islamabad.

Keeping in view, there is dire need of a transport policy for Islamabad, which could revamp the whole public transport system in the city. A transport policy should be prepared by government in consultation with Ministry of Communication, along with NTRC, Ministry of Planning and Development and Special Initiatives, Islamabad Administration, CDA, MCI, and Islamabad Traffic Police. Afterwards, an implementation mechanism should be set and responsibilities should be assigned to concerned ministries/authorities. Funds should be allocated and released by the government to revamp the public transport system in Islamabad. Quarterly policy implementation should be reviewed and evaluated and reformed accordingly.

### **4.3 Collaboration with Private Sector**

Since Pakistan is struggling with its economy, it is not possible for the government to allocate huge chunk of money to install a mass transit system in the city. Instead of building separate infrastructure, stations etc. private sector should be invited to collaborate with the government. Private companies can be financed by the government to purchase buses and replace it with the vans and Suzukis which are the obsolete mode of public transport in the modern world. Such mode of transport is prevalent the capital city of Pakistan and be replaced immediately with the buses as they are more environment friendly and has the capacity to carry the passengers three times more than the van. Private sector/companies can replace these vans with the buses in whole of Islamabad.

Operating buses in Islamabad will not only reduce congestion on the road but will also save travel time, and reduce crowd on the van stops. Moreover, the bus service will be of a great relief for a females traveling every day for accessing job, education health facilities etc. as it would provide them comfortable and safe travel.

### **4.4 Construction of Inclusive Transport Infrastructure**

Metropolitan Corporation Islamabad (MCI) and Capital Development Authority (CDA) should implement inclusive design of bus stops to facilitate disabled persons. Bus stops including footpaths in all of the Islamabad should be constructed in a way that is accessible by all. Waiting area on bus stops for both genders be constructed in whole of Islamabad to facilitate passengers specially women.

### **4.5 Quota for Women & Disabled Persons in Bus**

As findings show that reserved seats for females in vans and MBS are less than the demand, therefore, all the buses should have at least 30-40 percent seats reserved for females. A separate public transport, exclusively for females may not be possible, therefore, by keeping more than 30-40 percent seats would greatly benefit female community in accessing jobs, healthcare facilities leisure activities etc. and would provide them comfortable journey. It would also inculcate in them the sense of safety and security in the bus since women would

have separate space. Risk of harassment in bus would greatly reduce as is the case in MBS. Whereas, in vans, risk of harassment always prevails. Similarly, seats or space should be kept for disabled persons in all the buses which must have ramp facility so that disabled persons access the buses without any trouble.

#### **4.6 Feeder Routes for MBS**

Since the infrastructure is already in place and people living in farther areas find it difficult to access public transport, therefore, feeder routes should be initiated in urban areas to facilitate passengers living in different sectors where MBS does not operate. It will make transport system more connected and will discourage use of personal vehicles and ensure inclusion of different segment of society.

#### **4.7 Bus System in Islamabad**

The only way to resolve the transport system of Islamabad including rural areas is to start bus service in the city. The bus service should be installed to connect rural areas with urban centers, economic hubs, hospitals, educational institutes etc. A good bus service which would observe rules, proper timings and cleanliness can help encourage use of public transport in the city. Affordable bus service would ensure inclusion of neglected segment of society and increase economic output as well.

In addition to this, CCTV cameras on the bus stops and in bus service should be installed to ensure safety and security of females. Resultantly, families will allow their females to travel alone when a good bus service starts in the city where safety and security of females is ensured. It will save females from mental distress and will enable them to utilize their abilities in society. Similarly, bus service will reduce dependency of females and disabled persons on their family members and private transport which is, however, unaffordable and expensive.

#### **4.8 Establishing Complaint Mechanism**

A complain mechanism should be set forth to address the grievances and concerns of passengers. It can either be done by introducing mobile App or by establishing a complaint centers in major bus terminals/stops. Presently, findings show that females hardly report harassment, misbehavior etc. to the authorities to avoid getting into trouble. However, if a good complaint mechanism is in place, would encourage females and disabled persons for reporting of grievances and prompt redressal of complaints would enhance trust of passengers in the government and bus service.

#### **4.9 Training of Drivers and Conductors**

Drivers and conductors of the bus service should be trained and made aware to deal nicely with the passengers including females and disabled passengers. They must ensure that every passenger is travelling comfortably and must adopt cooperative behavior. A rating mechanism of drivers and conductors can be laid down to keep a check on their rules violation such as speeding overloading, misbehavior etc.

## **4.10 Sensitizing Public on the Issue of Disability/Mass Awareness**

Disabled persons are the most deprived segment of society, hence, there is need to provide them comfort, assistance, and priority not only in the bus service but in all affairs of life. Awareness campaigns should be launched by the government to sensitize the public on the problems faced by disabled persons. Non-disabled community needs to change their behavior towards disabled community and should provide them with seats and assist them in embarking and disembarking the bus if required.

## **4.11 Latest Transport Data/Studies**

Latest research studies for transport should be conducted in Islamabad and policies be formed on the basis of collected data. Currently, latest data for Islamabad is unavailable with National Transport Research Centre (NTRC) owing to lack of funding. Funding can be sought from the international organizations or governments for the study projects in Islamabad. However, government can also request universities to conduct research on the transport sector in Islamabad and provide the said thesis/research of students/academia to the government for policy making.

## **4.12 Rural Planning**

Capital Development Authority (CDA) in coordination with Metropolitan Corporation Islamabad should initiate town planning for rural areas as congested streets and spatial growth of population/house is making transport inaccessible for people living in rural areas of Islamabad.

## **4.13 Conclusion**

Inclusive transport system plays significant role in human development and socio-economic growth of a country. Pakistan is a developing country and is struggling for economic stability and social development. Transport sector in Pakistan is facing issues and is in dilapidated condition which requires urgent attention and improvement which is hampering economic growth and human development to a greater extent. Majority of the population of Pakistan lives in rural areas and faces the issue of accessibility of public transport. Likewise, lack of public transport in metropolitan cities such as Islamabad is also creating multiple issues for larger segment of society including women and disabled persons.

Social exclusion of women and disabled persons caused by inaccessible public transport in Islamabad has further aggravated the situation for both and there is dire need of paying attention to the transportation issues. However, The National Transport Policy of Pakistan 2018 envisages principles and policy guidelines for improving the public transport system in the country but no progress has been made so far in achieving inclusive transport for all in major metropolitan cities like Islamabad.

Expansion of roads, underpasses and overhead bridges will not resolve transport problems of the city. Government needs to give priority to transport sector in initiating bus service

with ramp facilities and inclusive bus stop infrastructure in major cities of Pakistan including Islamabad. Later, the government can move ahead with mass transit system keeping in view the funds required for the mass scale projects. Such willingness and steps by the government will not ensure inclusion of women and disabled persons in society but would benefit public at large.



## REFERENCES

- Adeel, M., Yeh, A., & Zhang, F. (2016a). Towards an Inclusive Public Transport System in Pakistan. *Transport and Communications Bulletin for Asia and the Pacific*, 2016, v. 85, p. 33-44
- Adeel, Muhammad, Yeh, Anthony Gar-On and Zhang, Feng (2016) Transportation disadvantage and activity participation in the cities of Rawalpindi and Islamabad, Pakistan. *Transport Policy*, 47. pp. 1-12. ISSN 0967-070X
- Association, A. P. (2020). *Transit Universal Design Guidelines Principles and Best Practices for Implementing Universal Design in Transit*. American Public Transport Association Standards Development Program. APTA SUDS-UD-GL-010-20
- Asian Development Bank. 2015. Policy Brief: A Safe Public Transportation Environment for Women and Girls. © Asian Development Bank. <http://hdl.handle.net/11540/5315>. License: CC BY 3.0 IGO
- Bank, A. D. (2014). PAK: Rapid Assessment of Sexual Harassment in Public Transport and Connected Spaces in Karachi. ADB.
- CDA. (2012). Islamabad Bus Rapid Transit Summary Project Briefing. Islamabad: Capital Development Authority. [Retrieved Online]<https://cdia.asia/wp-content/uploads/2014/09/Islamabad-BRT-Marketing-Brochure.pdf>
- Dr Shivonne Gates, Fiona Gogescu, Dr Chris Grollman, Emily Cooper, Dr Priya Khambhaita. (2019). *Transport and inequality: An evidence review for the Department for Transport*. NatCen Social Research.
- Dimitriou, H. T. and Gakenheimer, R. 2011. *Urban transport in the developing world: a handbook of policy and practice*, Edward Elgar, Cheltenham. 2011. 631 pp.
- ESCAP (2012). *Disability, Livelihood and Poverty in Asia Pacific*. United Nations Economic and Social Commission for Asia and the Pacific.
- Fizzah Sajjad, Ghulam Abbas Anjum, Erica Field, Duk, Kate Vyborny. (2017, March). *Gender Equity in Transport Planning: Improving Women's Access to Public Transport in Pakistan*. International Growth Center.
- Gakenheimer, R. 1999. *Urban mobility in the developing world*. *Transportation Research Part A: Policy and Practice*, vol. 33, issues 7-8, pp. 671-689.
- Hernandez, Diego. (2017). *Public transport, well-being and inequality: Coverage and affordability in the city of Montevideo*. CEPAL review No. 122. pp 151-169.
- Haque, N. U. (2015). "Flawed Urban Development Policies in Pakistan," PIDE-Working Papers 2015:119, Pakistan Institute of Development Economics.
- Haque, ul N., & Rizwan, M. (2020). *PIDE Urban Monograph Series No. 2: Rethinking Mobility (Urban Transport Policy) in Pakistan*. Pakistan Institute of Development Economics (PIDE).

Imran, Muhammad. 2009. Public Transport in Pakistan: A Critical Overview. *Journal of Public Transportation*, 12 (2): 53-83.

Islam, M. R. (2015). Rights of the People with Disabilities and Social Exclusion in Malaysia. *International Journal of Social Science and Humanity*, vol. 5, no. 3, pp. 299-305

Irem Batool, Muhammad Irshad, Muhammad Abid. (2020). A Policy Move towards Sustainable Urban Transport in Pakistan: Measuring the Social, Environmental and Economic Impacts of Lahore BRT System. *The Lahore Journal of Economics*. 25. 27-57. 10.35536/lje.2020.v25.i1.a2.

Lucas, K. (2012). Transport and social exclusion: Where are we now? *Transport Policy*, 20, 105-113.

Litman, Todd. (2003). Measuring transportation: Traffic, mobility and accessibility. *Social Research in Transport (SORT) Clearinghouse*. 73(10).

Masood, M.T., Khan, A., & Naqvi, H. (2011). Transportation Problems in Developing Countries Pakistan: A Case-in-Point. *International Journal of Biometrics*, 6, 256.

Murphy, G.R.F., Logan, M., Smith, G. et al. RADIATE – Radial Dysplasia Assessment, Treatment and Aetiology: protocol for the development of a core outcome set using a Delphi survey. *Trials* 20, 339 (2019). <https://doi.org/10.1186/s13063-019-3459-4>

Noman, S.M., Ahmed, A. & Ali, M.S. Comparative analysis of public transport modes available in Karachi, Pakistan. *SN Appl. Sci.* 2, 967 (2020). <https://doi.org/10.1007/s42452-020-2678-3>

Organization, I. L. (2011). Decent Transport for Working Women. International Labour Organization; ILO Country Office for Pakistan.

Páez, Antonio & Steven Farber, 2012. "Participation and desire: leisure activities among Canadian adults with disabilities," *Transportation*, Springer, vol. 39(6), pages 1055-1078.

Planning Commission, M. o. (2018). National Transport Policy of Pakistan. Government of Pakistan.

Qutub, Syed Ayub and Anjum, Nomana. 2015. Urban open spaces for adolescent girls: An assessment for Islamabad and Rawalpindi, Pakistan. PSSP Working Paper 27. Washington, D.C. and Islamabad, Pakistan: International Food Policy Research Institute (IFPRI).

Rode, P., Heeckt, C., da Cruz, N.F. 2019. National Transport Policy and Cities: Key policy interventions to drive compact and connected urban growth. Coalition for Urban Transitions. London and Washington, DC. <http://newclimateeconomy.net/content/citiesworking-papers>

Sayeed, A., Husain, K., Raza, S. S., & United States Institute of Peace,. (2016). Informality in Karachi's land, manufacturing, and transport sectors: Implications for stability. *Peaceworks* No. 114. First published 2016.

Sánchez-Triana, Ernesto; Afzal, Javaid; Biller, Dan; Malik, Sohail. 2013. Greening Growth in

Pakistan through Transport Sector Reforms : Strategic Environmental, Poverty, and Social Assessment. Directions in Development--Infrastructure;. Washington, DC: World Bank. © World Bank. <https://openknowledge.worldbank.org/handle/10986/15798>

Titheridge, H; Mackett, RL; Christie, N; Oviedo Hernández, D; Ye, R; (2014) Transport and poverty: a review of the evidence. (UCLTI Publications ). UCL Transport Institute, University College London: London, UK.

Tayel, S. M., Fawzia, M. M., Al-Naqeeb, N. A., Gouda, S., Al Awadi, S. A., & Naguib, K. K. (2005). A morpho-etiological description of congenital limb anomalies. *Annals of Saudi medicine*, 25(3), 219–227. <https://doi.org/10.5144/0256-4947.2005.219>

(TUMI), T. U. (2019). : Disability Inclusive Public Transport Practical steps to making public transport disability inclusive . High Volume Transport Applied Research.

United Nations, (2018). Disability and Development Report Realizing the Sustainable Development Goals by, for and with Persons with Disabilities. United Nations Department of Economic and Social Affairs, pp 363 <https://doi.org/10.18356/a0b1b1d1-en>

World Bank. 2013. Improving Accessibility to Transport for People with Limited Mobility : A Practical Guidance Note. Washington, DC. © World Bank. <https://openknowledge.worldbank.org/handle/10986/17592>

World Health Organization & World Bank. (2012) *World Bank Operational Manual System (OMS) - Chapter 10: Procurement of Goods, Works, and Services*. Washington, DC: World Bank. <https://apps.who.int/iris/handle/10665/44575>

Zolnik, E., Malik, A., & Irvin-Erickson, Y. (2018). Who benefits from bus rapid transit? Evidence from the Metro Bus System (MBS) in Lahore. *Journal of Transport Geography*, 71, 139-149

## CHAPTER 3

### **BUS RAPID TRANSIT: MODE SHIFT AND ENVIRONMENTAL IMPACT ANALYSIS. A CASE STUDY OF RAWALPINDI-ISLAMABAD METRO BUS SERVICE.**

**Rehana Ali Naqvi and Dr. Muhammad Irfan (2017)**

#### **Abstract**

Transportation is considered as the fundamental factor for mobility as every individual is highly dependent on transportation so that they have access to jobs, goods and other services. Increasing demand for motorization is causing congestion issues in quickly growing urban communities. Islamabad, capital city of Pakistan, along with its neighboring city Rawalpindi initiated a metro bus service to ease the traffic congestion problem and to reduce the atmospheric pollution. This study aimed to analyze the mode shift behavior of commuters from public transport, own transport and taxi after the implementation of metro bus service. The study used logistic regression because the dependent variable is binary in nature. Secondly, the study was aimed to find out the carbon emissions reduced after the launch of metro bus service in the region. The results of the study indicated that commuters are more willing to shift towards metro bus for job and education purpose. Female travelers are more willing to use metro bus service as compared to males. Income shows no effect on mode shift behavior. The study also found that metro bus has the potential to reduce travel cost of around PKR 1000 per month and travel time of around 23 minutes per month. Lastly it found that metro bus service has the potential to clean the environment by reducing carbon emissions, as it replaced approximately 700 public vehicles from the route, resulting in the reduction of around 8000 metric tons of carbon emissions from the region.

#### **1 Introduction**

Rapid urbanization in developing nations is causing many rural citizens to migrate towards urban areas to explore job opportunities and for better facilities. Along with urbanization, transportation is also increasing instantly due to the fact that it is considered as the fundamental factor in urbanization. Every individual is highly dependent on transportation as it provides mobility to population so that they have access to jobs, goods and services and what they need and want (Deborah and Aligula, 2012). Expanding urban population and motorization are causing adverse effects on urban ecosystem. Increasing demand for motorization is causing congestion issues in quickly growing urban communities (UN-Habitat, 2012). Subsequently, congestion is a noteworthy issue, as lot of time is wasted in traffic. Traffic congestion causes numerous environmental issues too, categorically climate change and air pollution. Increasing rate of greenhouse gas (GHG) emanations, of which carbon dioxide (CO<sub>2</sub>) is most imperative, and assumed to result in more extreme weather

patterns (heavier precipitation and increased drought) among other impacts (UN-Habitat, 2012). The transport sector is responsible for around 25% of global carbon dioxide (CO<sub>2</sub>) emissions (EEA, 2008). China and India are estimated to be responsible for 56% of the global increase in transport-related carbon emissions in the period 2005 to 2030. The share is likely to rise in the future with increasing growth in population and increased affluence in developing countries (Doll & Balaban, 2013). Deep cuts are needed in this sector to reach the emission targets set by the Intergovernmental Panel on Climate Change (IPCC). IPCC states that “a 50% reduction in greenhouse gas (GHG) emissions by 2050 is required to limit global warming to below 2±C” (IPCC, 2014).

Across the globe, urban hubs are troubled with the irregular transportation patterns due to road congestion, noise pollution, and increased use of energy, air pollution and traffic accidents (Jain and Khare, 2010). Mitigating these serious traffic issues is becoming one of the main challenges faced by the all governments of the world. These issues are even more striking for developing cities, where the vehicular growth rate is much greater than the growth rate of transport infrastructure (Santos et al., 2010).

Like many other urban cities in Asia, Islamabad, capital city of Pakistan is also facing a prominent growth due to increased growth rate in population and migration. Islamabad is considered to be nucleus for economic, political and commercial activities, due to which many people attracted towards the city, which increases the demand for passenger transportation. People travel towards Islamabad for job and other economic activities on daily basis from the neighboring cities such as Rawalpindi, Taxila and Hasanabdal, which results in the increased reliance on personal vehicles.

Islamabad, capital city of Pakistan along with its twin city Rawalpindi is considered as the third biggest urban amalgamation in Pakistan having 4.5million population (Pakistan Bureau of Statistics, 2015). Around 525,000 passengers are carried by over 210,000 vehicles on three major corridors of the cities. The main mode of mobility between the cities is only through private transport. (Asian development Bank, 2012).

In order to trap these issues, Government of Pakistan introduced bus rapid transit in Islamabad- Rawalpindi region. By the introduction of an ecologically sustainable urban transport system and switching some of the transport to bus rapid transit system can help to arrest some serious issues. Metro bus service provides multiple benefits i.e. Reduction in traffic congestion, reduction in accidents, time saving to passengers, reduction in air pollution and fuel savings (Murty et al., 2006).

## **Overview of Bus Rapid Transit:**

“Bus Rapid Transit (BRT) is a high-quality bus-based transit system that delivers fast, comfortable, and cost-effective services at metro-level capacities. It does this through the provision of dedicated lanes, with busways and iconic stations typically aligned to the center of the road, off-board fare collection, and fast and frequent operations”.

BRT delivers a higher quality of service (comfortable journey, low fare, time efficient and congestion free ride) than customary urban transport operations in view of decreased

waiting and travel times, expanded administration dependability and an improved user experience (Diaz et al., 2004)

First bus rapid transit built in Curitiba, a city in Brazil in 1974 (Goodman et al., 2005; Lindau et al., 2010). Bogotá's TransMilenio also launched this service in 2000 in Colombia and then, numerous particularly Latin American cities have gone with the same pattern. The worldwide growth of bus rapid transit has been gigantic lately. Today more than 207 urban communities around the world have executed 5468 kilometers of bus rapid transit which carry approximately 34,300,647 daily passenger trips (BRT data, 2016).

### **1.1. Bus Rapid Transit in Pakistan:**

In Pakistan, metro is operating successfully in Lahore and in twin cities, Islamabad and Rawalpindi, having 50 kilometers of total length and carry 305,000 passengers per day (BRT data, 2016).

### **1.2 Bus Rapid Transit in Rawalpindi- Islamabad:**

Islamabad, capital city of Pakistan along with its twin city Rawalpindi is considered as the third biggest urban amalgamation in Pakistan having 4.5 million population. The main mode of mobility between the cities is only through private transport. There was no organized system of transportation in twin cities. Around 525,000 passengers are carried by over 210,000 vehicles on three major corridors of the cities (Asian Development Bank, 2012). During the last couple of years there has been an exceptional increment in vehicular activity which seriously effects urban ecosystem particularly because of increased rate atmospheric pollution and alterations in land use pattern. In order to trap these serious issues in the city, Federal government in collaboration with Punjab metro bus authority launched bus rapid transit system on June 2015 in Rawalpindi-Islamabad region. Metro bus provides several benefits which include reduced motor vehicle accidents, savings in operating costs and travel time and will help make a superior urban condition by reducing congestion and pollution. Environmentally, the bus rapid transit system has a tendency to supplant more than 15 million km wagons, autos and motorcycle travel every year. It will positively affect climate change by decreasing CO<sub>2</sub> discharge by more than 4,000 tons every year (Asian development bank, 2012).

### **1.3 Problem Statement:**

With high level urbanization and rapid economic development, the problems caused by growing vehicle ownership and increasing urban population have resulted in some significant changes in travel behavior and serious traffic congestion in Islamabad. Like all other developing cities, Islamabad has also introduced metro bus service to change travel structure and to reduce traffic congestion. Before the launch of metro bus service, people traveled by public transport, own vehicles and some used taxi. A lot of time was wasted in traffic congestion and traveling expense also increased, but soon after the introduction of metro bus, travelers' mode shift behavior has emerged. They shift from their previous mode of travel towards metro bus. The main reason of traveler's attraction towards metro is that

metro has a separate, congestion free route, so travel time is reduced, low fare is charged and a comfortable and a secure ride is provided to them.

This study tends to analyze the perception of commuters of metro bus service in order to estimate travel cost, travel time reduction due to metro bus service and identifies the priorities of commuters for using metro bus service. In order to assess the perceptions and priorities of commuters for choosing metro mode, an extensive field survey is conducted on various stations of Islamabad-Rawalpindi metro bus service. It further assesses the overall impact of mode split changes due to the deployment of metro bus service. Due to urbanization, transportation is also increasing dramatically and hence air pollution is also rising. From environment point of view, metro bus has replaced around 700 public vehicles from the route, as a result, a significant amount of carbon emission are reduced from the city.

## **1.4 Objectives of the Study:**

By taking into account the above discussion, this study has the following objectives:

- To investigate the mode shift behavior of commuters from public transport, own transport and taxi towards metro bus service.
- To estimate the savings in travel cost and travel time of commuters of metro bus service.
- To evaluate the carbon emissions saved due to launch of metro bus service in the city.

## **1.5 Research Questions:**

- What are the reasons behind the frequent use of metro bus service?
- How much travel cost and travel time is reduced due to launch of metro bus service?
- How much carbon emissions are reduced due to launch of metro bus service in the city?

## **1.6 Significance of the Study:**

Transport activity is considered as the leading part of economic development and human well-being. With an increase in economies, transportation is also rising around the globe. Growing motorization is causing severe impacts such as traffic congestion, air pollution, traffic fatalities and petroleum dependence. These issues are quite acute in developing countries like Pakistan. Metro bus service is launched to capture these serious issues. This study assesses the mode shift behavior of commuters towards metro bus service. On the other hand, this study has contributed to the literature in environment in the context of Pakistan by explaining impact on environment by estimating the amount of carbon emissions which are reduced due to launch of metro bus service in twin cities.

## 2 Results and Discussion

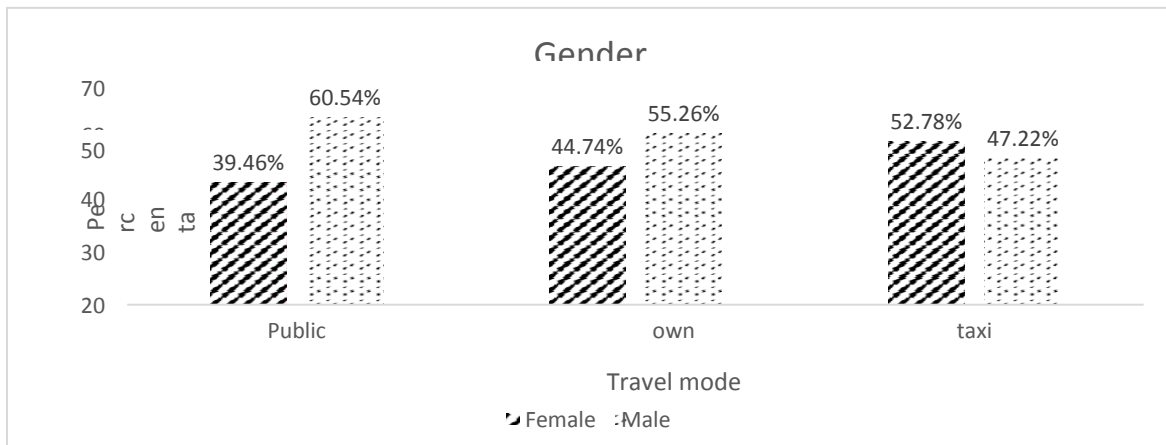
### 2.1 Descriptive Statistics:

This section discusses in detail the demographics of metro bus commuters. The respondents who were using three modes of transport (public transport, own transport and taxi) before metro bus is given in figure 2.1.

- For public transport travelers, out of 223 respondents, male respondents accounted for around 60.54% and female respondents were 39.46%.
- In case of own transport users, among 114 respondents, 55.26% respondents were male and 44.74% respondents were female.
- Out of 108 taxi users, 47.2% were male respondents and 52.78% were female respondents.

It is clear and evident from ground realities, that, males prefer public transport as compared to females, being low in fare whereas, females prefer taxi because of safe and comfortable ride.

**Figure 2.1: Gender Based Travel Mode of Respondents.**



### 2.2 Summary Statistics of Socio-Economic Variables:

Variables	Min	Max	Mean	S.D
Age	15	56	24.957	7.30
Income	5000	300000	58871.922	29393.15
Education	1	8	5.623	1.36
Occupation	1	10	2.623	2.70



Table 2.1.1 shows the descriptive statistics of socio-economic variables. Out of 445 total sample, 249 respondents are males and 196 are females. Age of respondents ranges from 15 years to 56years. Mean age of respondents is 25 years. Average monthly income of respondents is PKR 59485. Monthly income ranges from PKR 5000 to PKR 300,000. Education level of respondents varies from illiterate to 20 years of education. Mean education level is 12 and 14 years of education.40.19% of the respondents have 14 years of education. Both 12 years and 16 years of education constitutes of around 61.6% of total sample size. Most of the travelers are students (62.71%), government employees (6.49%) and private sector employees (9.83%).

## 2.3 Occupation of Respondents:

Listed below are the occupations of respondents who used to travel by public transport, own transport and taxi before the launch of metro bus service in the city. Table 5.1.2 shows the occupation based mode shift behavior of the respondents.

Table 2.1.2: Occupation Information of Survey data (%)				
Alternative mode		Public Transport	Own Transport	Taxi
Occupation	Student	56.50	66.67	75
	Govt. Employee	10.31	7.89	2.78
	Emp.In Private Sector	9.42	20.18	8.33
	Manual Worker	5.83	-	-
	Business/Trade	-	1.75	-
	Household Woman	3.59	-	10.19
	Banker	6.28	-	1.85
	Doctor	3.59	3.51	1.85
	Nurse	1.79	-	-
	Teacher	2.69	-	-
Observations		223	114	108

Table 2.1.2 shows the occupation of respondents who used public transport, own transport and taxi before the introduction of metro bus service in Islamabad- Rawalpindi region. Detail is provided as follows:

- Out of 223 observations of public transport users, 56% students use public transport before metro bus or in other words, 56% students shift their mode from public transport to metro bus, around 66% shifted from their own transport and 75% shifted from taxi towards metro bus service.
- For government employees, 10.31% shifted from public transport, 7.89% from own transport and 2.78% from taxi towards metro bus service.
- Similarly, for respondents who are employees in private sector, around 9.42% shifted their travel mode from public transport to metro, 20.18% shifted from own transport

while 8.33% shifted from taxi towards metro bus service.

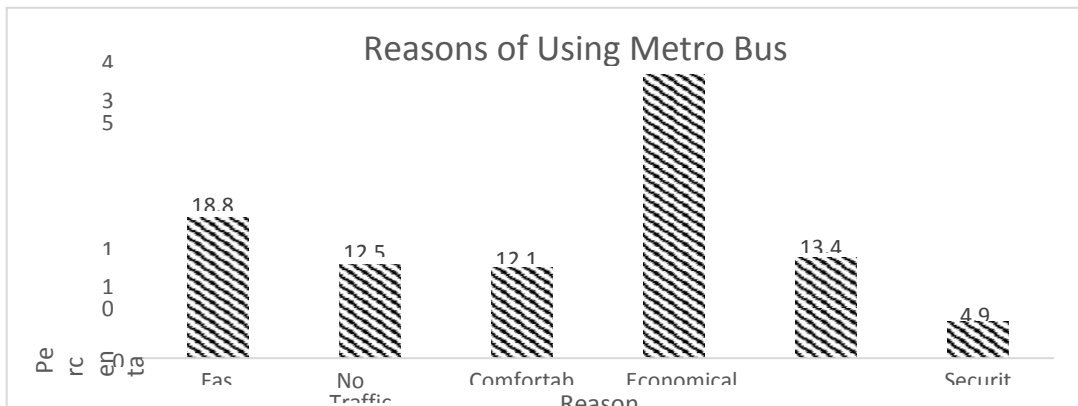
- Around 5.83% manual workers stated that they traveled in public transport before metro bus and now they are using metro bus service.
- Around 1.75% businessmen/traders shifted their travel mode from own transport to metro bus.
- 3.59% and 10.19% household women who shifted from public transport and taxi respectively towards metro bus.
- For bankers, who shifted from public transport to metro bus are 6.28% and 1.85% shifted from taxi to metro bus.
- The percentage of doctors who shifted their travel mode from public transport to metro is 3.59%, 3.51% from own transport and 1.85% from taxi to metro bus.
- The percentage of nurses who shift their travel mode from public transport to metro bus is 1.79%.
- The mode shift of teachers from public transport to metro bus is 2.69%.

## 2.4 Gender Based Trip Purpose of Metro Bus Users:

Gender	Job	Education	Shopping	Hospital	Friend	Social	Total
Female	12.58	11.46	7.64	7.42	1.35	3.60	44.04
Male	12.13	11.69	8.09	3.15	12.58	8.31	55.96
Total	24.72	23.15	15.73	10.56	13.93	11.91	100

Table 2.1.3 summarizes the gender based trip purposes of metro bus users. It shows that 47% trips are for job and education made by both males and females. For shopping purpose, 7.64% females and 8.09% males use metro bus service. Around 3.15% males and 7.42% females reported that they use metro bus service for health related purpose i.e. to visit hospital. The ratio for female is doubled as compared to males for hospital, means that females alone visit hospitals for their own treatment and also for their children. For about 12.58% males and 1.35% females reported that they use metro bus service to visit friends and family while 8.31% males and 3.60% females responded that they use metro bus service for social activities.

**Figure 2.2: Reasons of Using Metro Bus**



Reasons behind the use of metro bus system are shown in figure 2.3. Around 18.88% of the travelers stated that they use metro bus because of its fast speed. Clog free travel accounts for about 12.58% of the reasons presented for using metro bus service. Comfortable travel accounts for 12.13%. Economical/cheap ride accounts for around 37.98% of the reasons referred for using metro bus service. Frequent service and safe ride are also considered as significant features for using metro bus service and accounts for 13.48% and 4.94% respectively. Metro bus riders are pulled into the framework on account of its speed, economical advantage, congestion free travel and comfortable and frequent service.

## 2.5 Frequency of Metro Bus Use:

Frequency	# of response	Percent	Cum.
once in month	84	18.88	18.88
daily	187	42.02	42.02
weekends	134	30.11	91.01
2times a week	25	5.62	96.63
4times a week	15	3.37	100.00
Total	445	100.00	

Table 2.1.4 reflects the frequency of metro bus use. Around 42.02% of the surveyed passengers use metro bus service on daily routine and 30.11% use it only on weekends. The percentage of passengers who ride metro bus once in a month is 18.88%. Passengers who travel 2 times a week and 4 times a week together constitutes for about 8.99%.

## 2.6 Travel Cost and Travel Time of Different Mode Travelers:

Table2.1.5: Travel Cost and Time.				
Alternative mode		Public Transport	Own Transport	Taxi
Travel Cost (PKR)	Mean	1435.47	2753.5	1233.33
	S.D	(1181.3)	(2744.66)	(794.84)
	Min	50	200	300
	Max	5000	10000	4000
Travel Time (Mints.)	Mean	49.8	46.44	57.87
	S.D	(22)	(14.28)	(19.84)
	Min	20	20	25
	Max	120	90	90

Table 2.1.5 exhibits the summary statistics of travelers' trip cost per month and travel time in terms of mean, minimum, maximum and standard deviation (S.D). It reveals that public transport users spent an average of PKR 1435 on travel, where the minimum cost is PKR 50 and maximum cost borne by public transport users is PKR 5000. Similarly, in case of own transport users, a mean of PKR 2753 is spent on their travel and for taxi users, a mean of PKR 1233 is spent on travel per month.

In terms of travel time, around 50 minutes are consumed by public transport users for their travel purpose. An average of 46 minutes are consumed by own transport users and for taxi users, an average of 58 minutes are consumed for travel purpose.

## 2.7 Savings and Benefits from Metro Bus Service:

Table2.1.6: Travel Cost and Time Reduction.				
Alternative mode		Public Transport	Own Transport	Taxi
Travel Cost Reduction (PKR)	Mean	801.21	2268.98	1091.29
	S. D	(773.38)	(2473.06)	(671.70)
	Min	10	100	260
	Max	3800	8800	2960
Travel Time Reduction (Mints.)	Mean	23.78	20.21	25.23
	S. D	(12.04)	(5.65)	(9.72)
	Min	10	10	15
	Max	60	45	50

It is obvious from table 2.6, Metro Bus service has reduced an average of 801 PKR monthly, for those travelers, who use public transport before the launch of metro bus service. Own transport users have saved on average 2269 PKR monthly, by shifting their travel mode towards metro bus. Similarly taxi users also saved 1091PKR on monthly basis by converting travel mode to metro bus.

In terms of travel time reduction, public transport users stated that an average of 24 minutes are saved by using metro bus, whereas for own transport users, an average of 20 minutes are reduced. Similarly, an average of 25 minutes are saved for each trip of taxi users. The reason is metro bus has a separate route, while there is a lot of traffic on other roads, which is the major cause of traffic congestion, due to which a lot of time is consumed on roads.

### 2.1.1 Interpretation of Models:

The following tables discuss in detail the results obtained from the econometric model explained in previous section. As mentioned in the objectives, this study aims to analyze the mode shift behavior of public transport, own transport and taxi users after the implementation of metro bus service. Tables 2.1, 2.2, 2.3, 2.4, 2.5 and 2.6 shows the logistic regression results for job, education, shopping, hospital, friend/family visit and social activities purposes respectively for all transport modes. Explanatory variables of gender, income, distance, travel cost and travel time are also included.

### 2.1.2 Model-1: Logistic Regression Model for Job Purpose:

**Table 2.2.1: Logistic regression Model for Job Purpose**

Variables	Model 1a			Model 1b			Model 1c		
	$\beta$	Odds Ratio	%	$\beta$	Odds Ratio	%	$\beta$	Odds Ratio	%
Gender	0.141 (0.712)	1.152	15.3	-2.427 (0.001)	0.088	-91.2	-0.492 (0.04)	0.611	-38.9
Income	0.000 (0.019)	0.999	0.000	0.000 (0.015)	1.000	0.000	0.000 (0.938)	1	0.000
Distance	0.102 (0.002)	1.108	10.8	0.323 (0.000)	1.382	38.2	0.111 (0.000)	1.118	11.8
Travel Cost	0.001 (0.000)	1.001	0.1	0.001 (0.01)	1.004	0.1	0.005 (0.000)	1.0004	0.1
Travel Time	0.048 (0.002)	1.049	4.9	0.097 (0.019)	0.907	9.3	0.034 (0.003)	1.035	3.6
Constant	-3.358 (0.000)	0.034	.	-3.409 (0.02)	0.033	.	-3.272 (0.000)	0.037	
Observations		223			114			108	
Pseudo R <sup>2</sup>		0.2631			0.4805			0.2444	

Table shows the logistic regression results estimated from equation 5 for model 1 i.e. when the dependent variable is job purpose. This table exhibits the mode shift behavior of public

transport, own transport and taxi users after the introduction of metro bus for job purpose.

**In model 1a** i.e. metro- public transport model, the logistic regression coefficient of gender is 0.141, which shows that males have 15.3% greater odds to shift towards metro bus service. The probability of this shift towards metro is 1.152 units. Income has no impact on mode shift behavior, means when income increases by 1%, then there is no change in mode shift from public transport to metro bus. The regression estimate of distance is 0.102, which implies that as distance increases, likelihood of public transport users to shift towards metro bus increases by 1.108 units. Further it indicates that each additional kilometer increase in distance increases the log odds of shifting towards metro bus by 10.8%. Trip cost also shows significant results for mode shift towards metro bus service. The regression coefficient is positive and significant at 0.01 significance level, indicating that trip cost increases the probability to shift to metro bus service by 1.001 units. As travel cost of public transport increases, the likelihood to travel by metro bus service increases by 0.1%. Lower travel cost of metro attracts the lower and middle income groups to shift their travel mode from public transport to metro bus. Notably, the regression coefficient of travel time is positive and significant, indicating that travel time increases the probability of travelers to shift to metro bus by 1.049 units. Travel time plays a vital role for those who travel for job purpose. As travel time of public transport increases, the likelihood to travel by metro bus service increases by 4.9%.

**Model 1b** i.e. metro- own transport model, shows the mode shift behavior of own transport users after the introduction of metro bus. The logistic regression coefficient of gender is - 2.427, which shows that males are less willing to shift towards metro bus and continue using their own transport. In terms of percentage, males have 91.2% greater odds of using their previous mode of travel as compared to females. Income has no impact on mode shift behavior for job purpose. The regression estimate of distance is 0.323, which implies that as distance increases, likelihood of own transport users to shift towards metro bus increases by 1.382 units. Further it indicates that each additional kilometer increase in distance increases the log odds of shifting towards metro bus by 38.2%. Trip cost also shows significant results for mode shift towards metro bus service. The regression coefficient is positive and significant at 0.01 significance level, indicating that trip cost increases the probability to shift to metro bus service by 1.004 units. As travel cost by own transport increases, the likelihood to travel by metro bus service increases by 0.1%. Lower travel cost of metro attracts the lower and middle income groups to shift their travel mode from public transport to metro bus. The logistic regression coefficient of travel time is positive and significant, indicating that travel time increases the probability of travelers to shift to metro bus by 0.907 units. Travel time plays a vital role for those who travel for job purpose. As travel time increases, the likelihood to travel by metro bus service increases by 9.3%.

**Model 1c** i.e. metro- taxi model also shows logistic regression results. All the explanatory variables are statistically significant except income which is insignificant variable. The logistic estimates for gender is -0.492, which indicates that male travelers are less willing to travel by metro as compared to female travelers. It further exhibits that males have 38.9% greater odds of using taxi as compared to metro bus. Like above two models, income has

no impact on taxi travelers. The logistic regression coefficient of distance is 0.111. It is positive and statistically significant. Odds ratio of distance variable explains that 1 kilometer increase in distance leads to 1.118 units increase in the likelihood to shift to metro bus. The percentage of this shift towards metro is 11.8%. The logistic estimate of travel cost is 0.005. This variable is statistically significant at 0.000 significance level. In terms of percentage, as travel cost of taxi increases, the log odds for mode shift towards metro bus increases by 0.1%. Likewise, travel time is also statistically significant at 0.003 significance level. The logit coefficient of this variable is 0.034. As travel time increases, the likelihood to shift towards metro from taxi mode increases by 3.6%. The pseudo R square for metro-public is 0.2631. It indicates that 26% variation in dependent variable is explained by the explanatory variables whereas, the pseudo R square for metro-own is 0.4805, shows 48% variation in model is explained by the explanatory variables. On the other hand, the pseudo R square for metro-taxi model is 0.2444 shows 24% variation in model is explained by explanatory variables. In terms of significance level, distance, travel time and trip cost are considered to be most influential variables in selection of metro bus service for job purpose.

### 2.1.3 Model-2: Logistic Regression Model Education Purpose:

**Table 2.2.2: Logistic Regression Model for Education Purpose.**

Variables	Model 2a			Model 2b			Model 2c		
	$\beta$	odds Ratio	%	$\beta$	Odds Ratio	%	$\beta$	Odds Ratio	%
Gender	-1.31 (0.001)	0.270	-72.9	-0.197 (0.70)	0.820	-17.9	-0.314 (0.58)	0.729	-27.0
Income	0.000 (0.03)	1.000	0.0	0.000 (0.001)	0.999	0.00	-0.00 (0.52)	0.999	-0.00
Distance	0.174 (0.000)	0.840	15.9	-0.032 (0.40)	0.968	-3.2	-0.045 (0.1)	0.956	-4.4
Travel Cost	0.004 (0.07)	1.001	0.1	0.002 (0.1)	0.98	0.2	0.005 (0.02)	1.0004	0.1
Travel Time	0.076 (0.001)	0.926	7.3	0.038 (0.03)	1.04	3.9	0.025 (0.04)	1.025	2.5
Constant	1.486 (0.03)	0.034	.	1.93 (0.11)	6.941	.	0.116 (0.92)	1.123	
Observations		223		114			108		
Pseudo R <sup>2</sup>		0.2868		0.1947			0.2660		

Table 2.2.2 exhibits the logistic regression results for education purpose.

**In model 2a** i.e. metro- public transport model, the logistic regression coefficient of gender is -1.31, which shows that males have 72.9% greater odds to travel by their existing modes and they are not willing to shift towards metro bus. Income has no impact on mode shift behavior. The logit estimate of distance is 0.174, which implies that as distance increases, likelihood of public transport users to shift towards metro bus increases by 0.840 units. Further it indicates that each additional kilometer increase in distance increases the log odds of shifting towards metro bus by 15.9%. Trip cost also shows significant results for mode shift towards metro bus service for education purpose. The regression coefficient is positive and significant at 0.1 significance level, indicating that trip cost increases the probability to shift to metro bus service by 1.001 units. As travel cost increases, the likelihood to travel by metro bus service increases by 0.1%. Lower travel cost of metro attracts the lower and middle income groups to shift their travel mode from public transport to metro bus. The regression coefficient of travel time is positive and significant, indicating that travel time increases the probability of travelers to shift to metro bus by 0.926 units. As travel time increases, the likelihood to travel by metro bus service increases by 7.3%.

**Model 2b** i.e. metro- own transport model shows the mode shift behavior of own transport users after the introduction of metro bus. The logistic regression coefficient of gender is -0.197, which shows that males are less willing to shift towards metro bus and continue using their own transport. In terms of percentage, males have 17.9% greater odds of using their previous mode of travel as compared to females. Again, Income has no impact on mode shift behavior for education purpose. The regression estimate of distance is -0.032, which implies that as distance increases, likelihood of own transport users to shift towards metro bus decreases by 0.968 units. The coefficient of distance is negative for own transport mode, which means that own transport travelers are not willing to shift to metro mode and continue their existing mode. Further it indicates that each additional kilometer increase in distance decreases the log odds of shifting towards metro bus by 3.2%. Trip cost also shows significant results for mode shift towards metro bus service. The regression coefficient is positive and significant at 0.1 significance level, indicating that trip cost increases the probability to shift to metro bus service by 0.98 units. As travel cost increases, the likelihood to travel by metro bus service increases by 0.2%. Lower travel cost of metro i.e. 20 PKR for a single trip attracts the lower and middle income groups to shift their travel mode from public transport to metro bus. The logistic regression coefficient of travel time is positive and significant, indicating that travel time increases the probability of travelers to shift to metro bus by 1.04 units. Travel time plays a vital role for those who travel for job purpose. As travel time increases, the likelihood to travel by metro bus service increases by 3.9%.

**Model 2c** shows the logistic regression results for metro-taxi mode. All the explanatory variables are statistically significant except gender and income which are insignificant variables. The logistic estimates for gender is -0.314, which indicates that male travelers are less willing to travel by metro as compared to female travelers. It further exhibits that males have 27% greater odds of using taxi as compared to metro bus. Like above two models, income has no impact on taxi travelers. The logistic regression coefficient of distance is -0.045. It is negative and statistically significant. Odds ratio of distance variable explains that



1 kilometer increase in distance leads to 0.956 units decrease in the likelihood to shift to metro bus. It further indicates that the log odds of shifting to metro bus decrease by 4.4%, if distance increases by 1 kilometer. The logistic estimate of travel cost is 0.005. This variable is statistically significant at 0.000 significance level. In terms of percentage, as travel cost increases, the log odds for mode shift towards metro bus increases by 0.1%. Travel time is also statistically significant at 0.04. The logit coefficient of this variable is 0.025. As travel time increases, the likelihood to shift towards metro from taxi mode increases by 2.5%.

The pseudo R square for metro-public is 0.2868, means that 28.6% variation in model is explained by the explanatory variables while the pseudo R square for metro-own transport model is 0.1947, shows 19% variation is explained by explanatory variables in the model. The pseudo R square for metro-taxi model is 0.2660, means that 26.6% variation in the model is explained by explanatory variables.

In terms of significance level, distance, travel time and trip cost are considered to be most influential variables in selection of metro bus service for education purpose.

### 2.1.4 Model-3: Logistic Regression Model for Shopping Purpose:

**Table 2.2.3: Logistic Regression Model for Shopping Purpose.**

Variables	Model 3a			Model 3b			Model 3c		
	$\beta$	odds Ratio	%	$\beta$	Odds Ratio	%	$\beta$	Odds Ratio	%
Gender	-0.136 (0.643)	0.872	-12.8	-0.298 (0.215)	0.742	-25.8	-1.582 (0.030)	0.204	<b>-79.5</b>
Income	-0.000 (0.760)	0.999	0.0	-0.000 (0.301)	0.999	-0.00	-0.000 (0.060)	0.999	<b>-0.00</b>
Distance	0.041 (0.01)	0.959	4.0	0.052 (0.020)	0.949	5.1	0.095 (0.147)	0.909	<b>9.1</b>
Travel Cost	0.003 (0.08)	0.999	0.1	0.005 (0.002)	0.999	0.1	0.002 (0.06)	0.999	<b>0.1</b>
Travel Time	0.01 (0.05)	1.001	0.2	0.010 (0.03)	0.989	1.0	0.030 (0.08)	0.969	<b>3.0</b>
Constant	0.407 (0.41)	1.502	.	1.080 (0.014)	2.94	.	5.175 (0.01)	176.89	
Observations		223				114			<b>108</b>
Pseudo R <sup>2</sup>		0.286				0.152			<b>0.217</b>

Table 2.2.3 exhibits the logistic regression results for three travel modes, when the purpose is shopping as already mentioned in model 3.

**In model 3a**, i.e. metro- public mode for shopping purpose, the logit estimate of gender is -0.136, shows that male travelers are less willing to shift their mode of travel towards metro bus as compared to females. The probability of male travelers to shift to metro decreases by 12.8%. Income has no effect on shift mode, but here it shows inverse association between income and shift towards metro bus when the purpose of travelers is shopping. It means that with an increase in income, the probability to shift to metro bus decreases. The regression coefficient of distance is 0.041, which shows a positive relation between distance and mode shift behavior. Odds ratio of distance explains that one kilometer increase in distance leads to 0.959 units increase in the mode shift behavior of public travelers towards metro bus, whereas in terms of percentage, with additional kilometer increase in distance, increases the log odds to shift towards metro bus increases by 4%. The logit estimate of travel cost in metro-public mode is 0.003 and it is statistically significant at 0.1 significance level. Reduced cost of metro attracts the passengers of other modes by 0.1% for shopping purpose, whereas the odds ratio of this variable indicates that with 1PKR increase in travel cost leads to 0.999 units increase in mode shift behavior towards metro bus service. Correspondingly, travel time has the logit estimate of 0.01 and is significant at 0.05 significance level. Odds ratio of this variable indicates that each additional minute of travel time spent on public transport leads to the increased likelihood to travel by metro by 1.001 units. The mode shift due to travel time towards metro is 0.2%.

**Turning to model 3b**, where metro-own transport model is estimated for shopping purpose. In explaining gender variable, the logit estimate of this variable is -0.298, which indicates that male travelers are less willing to shift their travel mode to metro bus for shopping purpose as compared to female travelers. In terms of percentage, there is 25.8% decline in mode shift behavior of male travelers. In this case, income again has no impact on mode shift behavior, but its coefficient reveals a negative association with mode shift. It means that as income of travelers tends to increase, the probability to shift towards metro bus service decreases and individuals continue to travel by own transport. It is quite obvious from this result that high income individuals are not attracted by the low fare of metro bus service. Distance has the logit coefficient of 0.052, which shows a positive association with mode shift to metro for own transport users. Odds ratio of distance interprets that one kilometer increase in distance leads to 0.949 units increase in the likelihood to shift towards metro bus service. Furthermore, the log odds to shift to metro increases by 5.1%. The logistic regression coefficient of travel cost variable is 0.005 and it is statistically significant at 0.01 significance level. Moreover, it illustrates that low cost of metro attracts the own transport travelers by 0.1% for shopping purpose, whereas the odds ratio of this variable indicates that with 1PKR increase in cost reduction leads to 0.999 units increase in mode shift behavior towards metro bus service. Likewise, travel time has the logit estimate of 0.01 and is significant at 0.05 significance level. Odds ratio of this variable indicates that each additional minute spent on

travel time for own transport leads to the increased likelihood to travel by metro by 0.989 units. The mode shift due to travel time towards metro is 1.0%.

**As for model 3c** i.e. metro-taxi model, the logistic regression results of this model are mentioned here for shopping purpose. Starting from gender variable, the logit estimate of gender is -1.582, shows that male travelers are less willing to change their travel mode from taxi to metro bus as compared to female travelers. The probability of male travelers to shift to metro decreases by 12.8%, while the P-value shows that this variable is significant at 0.05 significance level. Again income has no impact on mode shift behavior, but its coefficient is negative, which interprets that as income tends to rise, travelers use taxi for shopping purpose and not preferring metro bus service. Next, the logit estimate of distance variable is 0.095. It shows a positive association with mode shift to metro bus. Odds ratio interprets that with each additional kilometer increase in distance, increases the mode shift behavior towards metro bus by 0.909 units. It further explains that if distance increases by one kilometer, then the log odds for shifting towards metro mode from taxi mode increases by 9.1%. The logistic estimate of travel cost is 0.002. This variable is statistically significant at 0.1 significance level. In terms of percentage, as travel increases, the log odds for mode shift towards metro bus increases by 0.1%. Travel time is also statistically significant at 0.1 significance level. The logit coefficient of this variable is 0.969. As in travel time increases, the likelihood to shift towards metro from taxi mode increases by 3%.

The pseudo R square for metro-public is 0.2868 and it shows that 28.6% variation in the model is explained by t explanatory variables, while The pseudo R square for metro- own transport model is 0.152, indicates that explanatory variables in the mode explain 15% variation in the model. On the other hand, the pseudo R square for metro-taxi model is 0.2170, shows around 21.7% variation in model due to explanatory variables.

## 2.1.5 Model 4- Logistic Regression Model for Hospital Purpose:

**Table 2.2.4: Logistic Regression Model for Hospital purpose.**

Model 4a				Model 4b			Model 4c		
Variables	$\beta$	odds Ratio	%	$\beta$	Odds Ratio	%	$\beta$	Odds Ratio	%
Gender	-0.522			-0.998			-1.582		
	(0.07)	0.592	40.7	(0.000)	0.368	63.2	(0.030)	0.204	-79.5
Income	0.000			0.000			0.0002		
	(0.66)	1.000	0.0	(0.650)	1.000	0.00	(0.250)	1.0002	0.000
Distance	0.045			0.024			-0.019		
	(0.09)	1.046	4.6	(0.290)	1.025	2.5	(0.842)	0.980	-1.9
Travel Cost	0.0013			-0.0007			-0.004		
	(0.16)	0.998	0.1	(0.000)	0.999	-0.1	(0.163)	0.995	-0.5
Travel Time	0.008			-0.0173			-0.072		
	(0.49)	0.991	0.8	(0.152)	0.982	-1.7	(0.441)	0.930	-7.0
Constant	-0.320			0.478			-8.824		
	(0.51)	0.725	.	(0.295)	1.612	.	(0.293)	0.0001	
Observations	223		114			108			
Pseudo R <sup>2</sup>	0.0214		0.0741			0.3115			

Table 2.2.4 shows the logistic regression results estimated for model 4 i.e. when the dependent variable is visit to hospital purpose. This table exhibits the mode shift behavior of public transport, own transport and taxi users after the introduction of metro bus for health related purpose

**In model 4a** i.e. metro- public transport model, the logistic regression coefficient of gender is -0.522, which shows that the likelihood of male travelers to shift towards metro mode decreases by 0.592 units. The log odds of male travelers to shift towards metro mode for hospital purpose decreases by 40.7% as compared to females. Income has no impact on mode shift behavior. The regression estimate of distance is 0.045, which implies that as distance increases, likelihood of public transport users to shift towards metro bus increases by 1.046 units. Furthermore, it indicates that each additional kilometer increase in distance increases the log odds of shifting towards metro bus by 4.6%. Trip cost also shows significant results for mode shift towards metro bus service. The regression coefficient is positive and significant at 0.1 significance level, indicating that trip cost increases the probability to shift to metro bus service by 0.998 units. As travel cost for own transport increases, the likelihood to travel by metro bus service increases by 0.1%. Lower travel cost of metro bus attracts the lower and middle income groups to shift their travel mode from public transport to metro bus. Notably, the regression coefficient of travel time is also positive, indicating that travel

time increases the probability of travelers to shift to metro bus by 0.991 units. As travel time for public transport increases, the likelihood to travel by metro bus service increases by 0.8%.

**Model 4b** i.e. metro- own transport model, shows the mode shift behavior of own transport users after the introduction of metro bus. The logistic regression coefficient of gender is -0.998, which shows that male travelers are less willing to shift towards metro bus and continue using their own transport. In terms of percentage, males have 63.2% greater odds of using their previous mode of travel as compared to females. Income has no impact on mode shift behavior for health related purpose. The regression estimate of distance is 0.024, which implies that as distance increases, likelihood of own transport users to shift towards metro bus increases by 1.025 units. Further it indicates that each additional kilometer increase in distance increases the log odds of shifting towards metro bus by 2.5%. The regression coefficient of travel cost is -0.0007, indicating that travel cost decreases the probability to shift to metro bus service by 0.999 units. It is obvious that patients have to visit hospitals regardless of the fare charged by any kind of transport. The log odds of not shifting towards metro decreases by 0.1%. Travelers who are sick and not able to come to metro stations, might prefer using own transport. The logit estimate of travel time is -0.017, which explains that, own transport travelers are not willing to shift their travel mode towards metro bus, and continue using their own transport due to health and other issues.

**Model 4c** shows logistic regression results for metro- taxi mode, mentioned in table 5.4. The logistic estimates for gender is -1.582, which indicates that male travelers are less willing to travel by metro as compared to female travelers. It further exhibits that males have 79.5% greater odds of using taxi as female travelers. Like above two models, income has no impact on taxi travelers. The logistic regression coefficient of distance is -0.019. Odds ratio of distance variable explains that 1 kilometer increase in distance leads to 0.980 units decrease in the likelihood to shift to metro bus. It means that taxi travelers prefer to use taxi for health related purpose when the hospital is at far place from their residence. The regression coefficient of travel cost is -0.004, indicating that travel cost decreases the probability to shift to metro bus service by 0.995 units. It is obvious that patients have to visit hospitals regardless of the fare charged by any kind of transport and they continue using taxi for visiting hospital. The logit estimate of travel time is -0.072, which explains that, taxi users are not willing to shift their travel mode towards metro bus, and continue using their own transport due to health and other issues.

The pseudo R square for metro-public is 0.0214 means that 2% variation in the model is explained by explanatory variables, the pseudo R square for metro-own is 0.0741, shows that 7% variation in model is explained by explanatory variables and the pseudo R square for metro-taxi model is 0.3115, means that 31% variation is explained by explanatory variables in the model.

## 2.1.6 Model 5- Logistic Regression Model for Friend/Family Visit Purpose:

**Table 2.2.5: Logistic Regression Model for Friend/Family visit Purpose**

Variables	Model 5a			Model 5b			Model 5c		
	$\beta$	odds Ratio	%	$\beta$	odds Ratio	%	$\beta$	odds Ratio	%
Gender	0.579 (0.346)	1.785	78.5	2.455 (0.000)	11.649	1065.0	2.966 (0.000)	19.416	1841.6
Income	0.000 (0.66)	1.000	0.0	0.000 (0.277)	1.000	0.00	0.000 (0.950)	1	0.000
Distance	0.011 (0.80)	1.012	1.2	0.083 (0.011)	1.086	8.7	0.026 (0.470)	1.027	2.7
Travel Cost	0.002 (0.007)	0.997	0.2	-0.0005 (0.120)	0.999	-0.0	0.0016 (0.002)	0.998	0.2
Travel Time	0.017 (0.08)	1.017	1.87	0.059 (0.000)	1.061	6.1	0.069 (0.000)	1.071	7.2
Constant	-2.343 (0.008)	0.095	.	-6.230 (0.000)	0.001	.	-6.4245 (0.000)	0.001	

	Model 5a	Model 5b	Model 5c
Observations	223	114	108
Pseudo R <sup>2</sup>	0.1336	0.2761	0.4292

Table 2.2.5 shows the logistic regression results estimated from equation 5 for model 5

i.e. when the dependent variable is taken as friends/family visit. This table exhibits the mode shift behavior of public transport, own transport and taxi users after the introduction of metro bus

**Model 5a** i.e. metro- public transport model, explains the logistic regression results for metro-public transport model, when the dependent variable is friends/family visit. The logistic regression estimate of gender variable is 0.579, which shows that male travelers are more willing to shift towards metro bus from public transport as compared to female travelers. It also illustrates that male travelers have 78.5% greater odds to shift towards metro bus service. There is no impact of income on mode shift behavior. The logit estimate of distance is 0.011. Odds ratio of distance variable explains that if distance increases by one kilometer, then the likelihood to shift towards metro increases by 1.012 units. In terms of percentage, the log odds to shift towards metro from public transport increases by 1.2%. The

regression coefficient of travel cost is 0.002 and is also significant. Lower cost for metro attracts the passengers of public transport mode by 0.2%, when the purpose of travelers is to visit friends and family. Whereas the odds ratio of this variable indicates that with 1PKR increase in cost for public transport leads to 0.997 units increase in mode shift behavior towards metro bus service. Correspondingly, travel time has the logit estimate of 0.017 and is significant at 0.1 significance level. Odds ratio of this variable indicates that each additional minute spent on travel time for public transport leads to the increased likelihood to travel by metro by 1.017 units. The mode shift due to travel time reduction towards metro is 1.87%. The main reason behind this shift is metro has a separate route and is time efficient mode of transport as compared to public transport.

**Model 5b** i.e. metro- own transport model, explains the logistic regression results for metro-own transport model, when the dependent variable is friends/family visit. The logistic regression estimate of gender variable is 2.455, which shows that male travelers are more willing to shift towards metro bus as compared to female travelers. It also illustrates that male travelers have 1065.0% greater odds to shift towards metro bus service. There is no impact of income on mode shift behavior. The logit estimate of distance is 0.083. Odds ratio of distance variable explains that if distance increases by one kilometer, then the likelihood to shift towards metro increases by 1.086 units. In terms of percentage, the log odds to shift towards metro from own transport increases by 8.7%. The regression coefficient of travel cost is -0.0005. It means that these travelers are willing to travel by their own transport regardless of high travel cost borne by them while using own transport. Travel time has the logit estimate of 0.059 and is significant at 0.01 significance level. Odds ratio of this variable indicates that each additional minute spent on travel time for own transport leads to the increased likelihood to travel by metro by 1.061 units. The mode shift due to travel time towards metro is 6.1%. The main finding of metro-own transport mode is that travel time is considered as a key factor in shifting the transport mode. Own transport travelers tend to shift towards metro because of time factor and they are giving less importance to travel cost.

**Model 5c**, explains the logistic regression results for metro-taxi model, when the dependent variable is friends/family visit. The logistic regression estimate of gender variable is 0.966, which shows that male travelers are more willing to shift towards metro bus from public transport as compared to female travelers. It also illustrates that male travelers have 1841.6% greater odds to shift towards metro bus service. There is no impact of income on mode shift behavior. The logit estimate of distance is 0.026. Odds ratio of distance variable explains that if distance increases by one kilometer, then the likelihood to shift towards metro increases by 1.027 units. In terms of percentage, the log odds to shift towards metro from public transport increases by 2.7%. The regression coefficient of travel cost is 0.0016 and is also significant. Lower cost for metro attracts the passengers of taxi mode by 0.2%, when the purpose of travelers is to visit friends and family. Whereas the odds ratio of this variable indicates that with 1PKR increase in cost leads to 0.998 units increase in mode shift behavior towards metro bus service. Correspondingly, travel time has the logit estimate of 0.069 and is significant at 0.1 significance level. Odds ratio of this variable indicates that each additional minute spent on travel time for taxi leads to the increased likelihood to travel by metro by 1.071 units. The mode shift due to travel time metro is 7.2%. The main reason

behind this shift is metro has a separate route and is time efficient mode of transport as compared to public transport.

The pseudo R square for metro-public is 0.1336, shows 13% variation in model is explained by explanatory variables, whereas, the pseudo R square for metro-own transport is 0.2761, shows that variation explained by explanatory variables is 27.6% in the model, while, the pseudo R square for metro-taxi model is 0.4292, which also shows that 42.9% variation in the model is explained by explanatory variables.

## 2.1.7 Model 6- Logistic Regression Model for Social Activities:

**Table 2.2.6: Logistic Regression Model for Social Activities Purpose.**

Model 6a	Model 6b			Model 6c					
Variables	$\beta$	odds Ratio	%	$\beta$	Odds Ratio	%	$\beta$	Odds Ratio	%
Gender	1.1941 (0.023)	3.300	230.1	0.826 (0.017)	2.285	128.5	0.120 (0.891)	1.128	12.8
Income	0.000 (0.923)	1.000	0.0	0.000 (0.829)	1.000	0.00	-0.000 (0.315)	0.999	-0.0
Distance	0.011 (0.764)	0.988	1.1	0.021 (0.466)	1.021	2.1	0.243 (0.024)	1.275	27.5
Travel Cost	0.0009 (0.04)	0.999	0.1	0.0003 (0.145)	1.0002	0.0	0.0029 (0.000)	1.002	0.3
Travel Time	-0.008 (0.64)	0.991	-0.9	-0.033 (0.056)	0.966	-3.3	-0.064 (0.429)	0.937	-6.3
Constant	1.869 (0.014)	0.154	.	-2.0703 (0.001)	0.126	.	-5.507 (0.055)	0.004	
Observations	223			114			108		
Pseudo R <sup>2</sup>	0.0840			0.4648			0.0383		

Table 2.2.6 exhibits the logistic regression results for three travel modes, when the purpose is social activities as already mentioned in model 3.

**In model 6a**, i.e. metro- public mode for social activities purpose, the logit estimate of gender



is 1.194, shows that male travelers are more willing to shift their mode of travel towards metro bus as compared to females. The probability of male travelers to shift to metro bus increases by 230.1%. Income has no effect on shift mode. The regression coefficient of distance is 0.011, which shows a positive relation between distance and mode shift behavior. Odds ratio of distance explains that one kilometer increase in distance leads to 0.988 units increase in the mode shift behavior of public travelers towards metro bus, whereas in terms of percentage, with additional kilometer increase in distance, increases the log odds to shift towards metro bus increases by 1.1%. The logit estimate of travel cost in metro-public mode is 0.0009 and it is statistically significant at 0.05 significance level. Lower cost for metro attracts the passengers of other modes by 0.1% for shopping purpose, whereas the odds ratio of this variable indicates that with 1PKR increase in cost for public transport leads to 0.999 units increase in mode shift behavior towards metro bus service. Correspondingly, travel time has the logit estimate of -0.008. Odds ratio of this variable indicates that each additional minute spent on travel time for public transport leads to the decreased likelihood to travel by metro by 0.991 units. This means that public transport users are not affected by long duration of trips. The major factor for their shift is reduced cost of metro bus.

**In model 6b**, where metro-own transport model is estimated for social activities. In explaining gender variable, the logit estimate of this variable is 0.826, which indicates that male travelers are more willing to shift their travel mode to metro bus for social purpose as compared to female travelers. In terms of percentage, there is 128.5% increase in mode shift behavior of male travelers. In this case, income again has no impact on mode shift behavior. Distance has the logit coefficient of 0.021, which shows a positive association with mode shift to metro for own transport users. Odds ratio of distance interprets that one kilometer increase in distance leads to 01.021 units increase in the likelihood to shift towards metro bus service. Furthermore, the log odds to shift to metro increases by 2.1%. The logistic regression coefficient of travel cost variable is 0.0003. Moreover, the odds ratio of this variable indicates that with 1PKR increase in cost of own transport leads to 1.0002 units increase in mode shift behavior towards metro bus service. Likewise, travel time has the logit estimate of -0.033. Odds ratio of this variable indicates that each additional minute spent on travel time for own transport leads to the decreased likelihood to travel by metro by 0.966 units. This means that own transport users are not affected by long duration of trips. The major factor for their shift is reduced cost of metro bus.

**As for model 6c** i.e. metro-taxi model, the logistic regression results of this model are mentioned here for social activities purpose. Starting from gender variable, the logit estimate of gender is 0.120, shows that male travelers are more willing to change their travel mode from taxi to metro bus as compared to female travelers. The probability of male travelers to shift to metro increases by 12.8%. Again income has no impact on mode shift behavior, but its coefficient is negative, which interprets that as income tends to rise, travelers use taxi for social activities and not preferring metro bus service. Next, the logit estimate of distance variable is 0.243. It shows a positive association with mode shift to metro bus. Odds ratio interprets that with each additional kilometer increase in distance, increases the mode shift behavior towards metro bus by 1.275 units. It further explains that if distance increases by one kilometer, then the log odds for shifting towards metro mode from taxi mode increases

by 27.5%. The logistic estimate of travel cost is 0.0029. This variable is statistically significant at 0.011 significance level. In terms of percentage, as travel cost of taxi increases, the log odds for mode shift towards metro bus increases by 0.3%. The logit coefficient of travel cost variable is -0.064. As travel time of taxi increases, the likelihood to shift towards metro from taxi mode decreases by 6.3%. This means that taxi users are not affected by long duration of trips. The major factor for their shift is reduced cost of metro bus.

The pseudo R square for metro-public transport is 0.0840, shows that 8% variation in the model is explained by explanatory variables, while, the pseudo R square for metro- own transport is 0.4648, which also exhibits that 46% variations in the model is explained by explanatory variables, whereas the pseudo R square for metro-taxi model is 0.0383, shows 38% variation in the model is explained by explanatory variables.

### 2.1.8 Carbon Emission Reduction:

According to “Excise and Taxation Department, Islamabad Capital Territory” (2017) a total of 700 public vans are replaced after the implementation of metro bus service in the region. These vans traveled at a distance of 25 kilometers daily on routes 1 and 1c, which were now replaced by metro route. These vans made 5-6 trips daily on these routes. Emissions from three propulsion systems i.e. petrol, diesel and CNG are calculated and then compared by the emissions of metro bus.

According to “Ecoscore” (2017) and “Company Car Tax Calculator” (2017) standard calculations for CO2 emission level from fuel consumption are given below:

- 1 liter of petrol emits 2392 grams of CO2.
- 1 liter of diesel emits 2640 grams of CO2.
- 1 kilogram of CNG emits 2666 grams of CO2.

Older engines might lose a few percent due to unburnt fuel, but otherwise technology can have little effect on this chemistry (“Company Car Tax Calculator”, 2017).

**Table 2.3.1 Fuel Consumption and CO2 Emissions:**

Propulsion System	Consumption /trip/vehicle (Liters)	Consumption /700 vehicles/day (Liters)	CO2 Emissions/liter (Grams)	CO2 Emissions/day (Metric Tons)	CO2 Emissions/day (Metric Tons)
Petrol	3 Liters	25200 Liters	2392 Grams	60.27	18083
Diesel	2.5 Liters	21000 Liters	2640 Grams	55.44	16632
CNG	2 Kg	16800 Kg	2666 Grams	44.78	13437

Table 2.3.1 shows the consumption of fuels by vehicles having different propulsion systems.

If the propulsion system of these vehicles is petrol, then approximately 3 liters of petrol is used for covering a distance of 25 kilometers by a single vehicle. For 12 trips per day by 700 vehicles, the amount of fuel consumption is 25200 liters. If 2392 grams of CO<sub>2</sub> are emitted from 1 liters of petrol, then 60.20 metric tons of carbon is emitted per day and 18083 metric tons of carbon are emitted per year from vehicles using petrol.

If the propulsion system of these vehicles is diesel, then approximately 2.5 liters of diesel is used for covering a distance of 25 kilometer by a single vehicle. For 12 trips per day by 700 vehicles, total fuel consumed is 21000 liters. If 2640 grams of CO<sub>2</sub> are emitted from 1 liters of diesel, then 55.44 metric tons of carbon is emitted per day and 16632 metric tons of carbon are emitted per year from vehicles using diesel. 2 kg of CNG is used for covering a distance of 25 kilometer by a single vehicle. For 12 trips per day by 700 vehicles, total CNG consumed is 16800 kg. If 2666 grams of CO<sub>2</sub> are emitted from 1 kg of CNG, then 44.78 metric tons of carbon is emitted per day and 13437 metric tons of carbon are emitted per year from vehicles using CNG.

### Fuel Consumption of Metro Bus:

On the other hand, a total of 60 buses travel across this route, covering a distance of 16906km and daily consumption of diesel is 9798liters.

1 liter diesel = 2640grams of CO<sub>2</sub>

9798 liters = 25,866,720 grams of CO<sub>2</sub>/day

300\*25,866,720 = 7,760,016,000 grams of CO<sub>2</sub>/anum.

7760 metric tons of CO<sub>2</sub> emitted from metro buses per year.

## 2.1.9 Reduction in CO<sub>2</sub> Emissions:

### 2.1.2: Reduction in CO<sub>2</sub> Emissions.

Propulsion System	CO <sub>2</sub> reduction	(metric tons/anum)
Petrol		10323.5
Diesel		8872
CNG		5677

It is obvious from table 5.3.2, that metro bus service has reduced the significant amount of carbon emissions by replacing public vehicles from the route, subsequently cleaner air quality is achieved. It is evident from the table that if the replaced vehicles used petrol, then around 10323.5 metric tons of carbon emissions are reduced. Similarly, if the replaced vehicles used diesel, then 8872 metric tons of carbon emissions are reduced, whereas for CNG vehicles, 5677 metric tons of carbon emissions are reduced annually. It is concluded that metro bus service has contributed in cleaner air quality of the region.

## 3 Conclusion and Recommendations

### 3.1 Conclusion

This study used logistic regression method to analyze the survey data associated with the metro bus service in Islamabad- Rawalpindi, twin cities in Pakistan and examine mode shift behavior for shift to metro service for public transport, own transport and taxi users. Factors that are statistically significant in affecting model shifts to metro bus service include trip distance, travel cost and travel time of commuters. From the survey data of metro bus service, it is found that 18% of metro passengers were former public transport users and own transport and taxi users together comprised 17% metro travelers. In the prior studies, the modal shift was 50% from bus and train users and 27% from car users (Knowles, 1996). The new metro in Athens has attracted 53% of bus passengers and 16% of former car travelers (Golias, 2002). In the Madrid subway project, 50% of passengers were former bus users, and 26% of passengers used to travel by car (Monzon, 2000). Finally, 69% of Tramlink passengers were bus users and 19% of passengers were former auto travelers in Croydon (Copley et al. 2002). The comparisons among Pakistan metro bus and other cities indicate that mode shifts to newly introduced metro from public transport closely resemble one another. Another interesting finding can be seen from gender factor that a negative signs of gender variable in the overall models indicate that women travelers are more likely than men to use metro. This conclusion is inconsistent with prior research findings (Patterson et al. 2005; Enam and Choudhury, 2011; Rahul, 2011), presenting that female travelers are reluctant to include public transport modes in their choice sets. Income showed no impact on mode shift behavior.

Secondly, this study intended to found the reduction in travel cost and travel time due to implementation of metro bus system. According to the results almost PKR 801 to PKR 1091 and travel time of around 23 minutes are reduced respectively for metro bus commuters. This conclusion is consistent with prior research findings (Domencich et al. 1968; O'Sullivan, 2000; Golias, 2002; Levinson et al. 2013; Wang et al. 2013).

Lastly the study found that metro bus service has replaced around 700 public vehicles from the route of metro bus. It is estimated that approximately 800 metric tons of carbon emissions are reduced from the city so far. In the previous studies, nearly 1 million of carbon is reduced per year in Bogota (Turner et al. 2012), around 167 tons of carbon emissions are reduced daily in Istanbul (Alpkokin and Ergun, 2012). Levinson et al. (2013) have found out that with the launch of metro bus, around 80,000 vehicles reduced from the road and hence 623 tons of CO<sub>2</sub> is reduced on daily basis.

## 3.2 Policy Recommendations

Some important recommendations are as under:

- 3.2.1 Future expansion of metro route needs to be implemented to formulate an integrated network within the city.
- 3.2.2 More travel time could be saved by extending metro route in congested areas.
- 3.2.3 Metro route should be extended in such a way that students and employees can easily reach their respective institutions.
- 3.2.4 Ring Road as constructed in Lahore, should also be constructed in Rawalpindi-Islamabad so that it covers a larger area and more stations of metro bus service can be built on that route.
- 3.2.5 More buses are required in the existing fleet, to reduce the congestion within buses.
- 3.2.6 Moreover, some policies such as implementation of park and ride facilities may be effective in attracting more passengers from own transport mode towards metro bus service.
- 3.2.7 The impacts on easing traffic congestions by a single metro corridor are not significant, and some parallel policies need to be adopted for the support of metro services such as construction of overhead bridges and underpasses.

## References:

- Abou-Zeid, M., Witter, R., Bierlaire, M., Kaufmann, V., & Ben-Akiva, M. (2012). Happiness and travel mode switching: Findings from a Swiss public transportation experiment. *Transport Policy*, 19(1), 93–104.
- Ahern, A. A., & Tapley, N. (2008). The use of stated preference techniques to model modal choices on interurban trips in Ireland. *Transportation Research Part A: Policy and Practice*, 42(1), 15-27.
- Ahern, A., and Tapley, N. (2008). "The use of stated preference techniques to model modal choices on interurban trips in Ireland." *Transp. Res. Part A*, 42(1), 15–27.
- Alpkokin, P., & Ergun, M. (2012). Istanbul Metrobüs: first intercontinental bus rapid transit. *Journal of Transport Geography*, 24, 58-66.
- Asian Development Bank Annual Report 2012. (2013, April). Retrieved from <https://www.adb.org/documents/adb-annual-report-2012>.
- Ben-Akiva, M., and Lerman, S. R. (1985). *Discrete choice analysis: Theory and application to travel demand*, MIT Press, Cambridge, MA.
- Berkson, J. (1953). "A statistically precise and relatively simple method of estimating the bio-assay with quantal response based on the logistic function." *J. Am. Stat. Assoc.*, 48(263), 565–599.
- Berritella, M., Certa, A., Enea, M., & Zito, P. (2008). Transport policy and climate change: How to decide when experts disagree. *Environmental Science &*
- Bhat, C. R., & Sardesai, R. (2006). The impact of stop-making and travel time reliability on commute mode choice. *Transportation Research Part B*, 40,
- Boile, M. P., Spasovic, L. N., and Bladikas, A. K. (1994). "Modeling intermodal auto- rail commuter networks." *Transportation Research Record* 1516, Transportation Research Board, Washington, DC, 38–47.
- Bowman, J. L., and Ben-Akiva, M. (1997). "Activity-based travel forecasting." *Activity-Based Travel Forecasting Conf. Proc.*, New Orleans, Louisiana.
- City of Xi'an. (2009). *Residents travel survey report 2008*, Xi'an City Metro Construction Headquarters Office, Xi'an, China.
- Cantwell, M., Caulfield, B., & O'Mahony, M. (2009). Examining the factors that impact public transport commuting satisfaction. *Journal of Public*
- Car Company Tax Calculator. (2017). *Vehicle CO2 Emissions Footprint Calculator*. United Kingdom. Retrieved from <http://comcar.co.uk/emissions/footprint/>.
- Chandra, S., Bari, M. E., Devarasetty, P. C., & Vadali, S. (2013). Accessibility evaluations of feeder transit services. *Transportation Research Part A*, 52, 47–63.
- Copley, G., Thomas, M., and Georgeson, N. (2002). "Croydon Tramlink impact study."

European Transport Research Conf., Association for European Transport, London, UK.

De Guzman, M. P., Diaz, C. E., & Baguio City, P. D. (2005). Analysis of mode choice behavior of students in exclusive schools in Metro Manila: the case of Ateneo De Manila University and Miriam College. Paper presented at the Proceedings of the Eastern Asia Society for Transportation Studies.

Doll, C. N., & Balaban, O. (2013). A methodology for evaluating environmental co-benefits in the transport sector: application to the Delhi metro. *Journal of Cleaner Production*, 58, 61-73.

Domencich, T., and McFadden, D. L. (1975). *Urban travel demand: A behavioral analysis*, North-Holland, Amsterdam, Netherlands.

Du, J., and Wang, Q. (2011). "Exploring reciprocal influence between individual shopping travel and urban form: Agent-based modeling approach." *J. Urban Plann. Dev.*, 137(4), 390-401.

Eboli, L., & Mazzulla, G. (2007). Service quality attributes affecting Customer Satisfaction for Bus Transit. *Journal of Public Transport*, 10(3), 21-34.

Ecoscore. (2017). Retrieved from <http://ecoscore.be/en/info/ecoscore/co2>.

Enam, A., & Choudhury, C. (2011). Methodological issues in developing mode choice models for dhaka, bangladesh. *Transportation Research Record: Journal of the Transportation Research Board* (2239), 84-92.

Energy and Environment Report 2008. (2008, November 20). Retrieved from [https://www.eea.europa.eu/publications/eea\\_report\\_2008\\_6](https://www.eea.europa.eu/publications/eea_report_2008_6).

Excise and Taxation Department, Islamabad Capital Territory. (2017). Retrieved from <http://islamabadexcise.gov.pk/>.

Global BRT Data. (2016). Retrieved from <https://www.brtdata.org>.

Golias, J. C. (2002). Analysis of traffic corridor impacts from the introduction of the new Athens Metro system. *Journal of Transport Geography*, 10(2), 91-97.

Guzzo, R., and Mazzulla, G. (2004). "Modal choice models estimation using mixed revealed and stated preferences data." *Urban transport X. Urban transport and the environment in the 21st century*, WIT Press, Southampton, England, 245-254.

Hensher, D. A. (1994). Stated preference analysis of travel choices: the state of practice. *Transportation*, 21(2), 107-133.

Hess, D. B. (2001). "The effects of free parking on commuter mode choice: Evidence from travel diary data." *Transportation Research Record* 1753, Transportation Research Board, Washington, DC, 35-42.

Jane et al. (2012). Annual Report 2012: United Nations Human Settlement Programme. Retrieved from UN Habitat website: <https://unhabitat.org/un-habitat-annual-report-2012/>

- Johnson, M. A. (1978). "Attribute importance in multiattribute transportation decisions." *Transportation Research Record* 673, Transportation Research Board, Washington, DC, 15-21.
- Knowles, R. (1996). "Transport impacts of Greater Manchester's Metrolink light rail system." *J. Transp. Geogr.*, 4(1), 1-14.
- Krizek, K., & El-Geneidy, A. (2006). *Better Understanding the Potential Market of Metro Transit's Ridership and Service.*
- Lawton, T. K. (1997). "Activity and time use data for activity-based forecasting." *Activity-Based Travel Forecasting Conf. Proc.*, New Orleans.
- Le-Klähn, D.-T., Gerike, R., & Hall, C. M. (2014). Visitor users vs. non-users of public transport: The case of Munich, Germany. *Journal of Destination Marketing & Management*, 3(3), 152-161.
- Levinson, H. S., Ilcali, M., Camkesen, N., & Kamga, C. (2013). A Bus Rapid Transit Line Case Study: Istanbul's Metrobüs System. *Journal of Public Transportation*, 16(1).
- Louviere, J. J., Hensher, D. A., & Swait, J. D. (2000). *Stated choice methods: analysis and applications*: Cambridge University Press.
- Louviere, J. J., Hensher, D. A., and Swait, J. D. (2000). *Stated choice methods analysis and applications*, Cambridge University Press, Cambridge, UK.
- Maddala, G. S. (1983). *Limited-dependent and qualitative variables in econometrics*, Cambridge University Press, Cambridge, UK.
- Mark, D. G., and Crispin, E. D. (2005). "Analysis of mode choice behavior of students in exclusive schools in metro Manila: The case of Ateneo de Manila University & Miriam College." *Proc., Eastern Asia Society for Transportation Studies*, Vol. 5, 1116- 1131.
- McFadden, D. (1973). *Conditional logit analysis of qualitative choice behavior: Frontiers in econometrics*, Academic, New York.
- McFadden, D. (1978). *Modeling the choice of residential location. Spatial interaction theory and planning models*, North-Holland, Amsterdam, Netherlands.
- Monzon, A. (2000). "Travel demand impacts of a new privately operated suburban rail in the Madrid N-III corridor." *European Transport Research Conf., European Transport Conference*, Cambridge, UK.
- Murty, M. N., Dhavala, K. K., Ghosh, M., & Singh, R. (2006). Social cost-benefit analysis of Delhi Metro. *Institute of Economic Growth, Delhi. of Cleaner Production*, 58, 61-73. *Policy*, 11, 307-314.
- Pakistan Bureau of Statistics. (2015). *Pakistan Statistical Year Book*. Pakistan: National Book Foundation.
- PCC, 2014: *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and*



III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (Eds.)]. IPCC, Geneva, Switzerland, 151 pp.

Rahman, M. S.-U., & Nahrin, K. (2012). Bus services in Dhaka City-users' experiences and opinions. *Journal of Bangladesh Institute of Planners* ISSN, 2075, 9363.

Theil, H. (1970). On the estimation of relationships involving qualitative variables. *American Journal of Sociology*, 76(1), 103-154. *Transportation*, 12(2), 1-21.

UNFCCC. (2007). *IMPACTS, VULNERABILITIES AND ADAPTATION IN DEVELOPING COUNTRIES*. UNFCCC Secretariat. Bonn, Germany. Retrieved from <https://unfccc.int/resource/docs/publications/impacts.pdf>.

Vedagiri, P., & Arasan, V. T. (2009). Estimating modal shift of car travelers to bus on introduction of bus priority system. *Journal of transportation systems engineering and information technology*, 9(6), 120-129.

Wang, Y., Li, L., Wang, Z., Lv, T., & Wang, L. (2013). Mode shift behavior impacts from the introduction of metro service: Case study of Xi'an, China. *Journal of Urban Planning and Development*, 139(3), 216-225.

Yazici, M. A., Levinson, H. S., Ilicali, M., Camkesen, N., & Kamga, C. (2013). A Bus Rapid Transit Line Case Study: Istanbul's Metrobüs System. *Journal of Public Transportation*, 16(1), 8.

Yedla, S., & Shrestha, R. M. (2003). Multi criteria approach for selection of alternative options for environmentally sustainable transport system in Delhi. *Transportation Research Part A*, 37, 717-729.

## CHAPTER 4

### Quantifying the Environmental Impact of Mass Transit System Using Remote Sensing and Survey Based Approach: Before Implementation and After Implementation

Muhammad Hamza Saeed, Dr Junaid Ahmed and Dr Fahad Amjad (2022)

#### Abstract

A sustainable transportation system is a key to a sustainable city. The majority of sustainability indices show that existing urban travel habits are unsustainable. As a result, before our cities can be made sustainable, their transportation networks must be changed and adapted. For this purpose, Mass Transit System (MTS) is a highly innovative and cutting-edge mode of transportation. Due to Pakistan's fast urbanization and rising levels of air pollution, MTS development was deemed a top priority technology for balancing demand. The main goal of this study is to see if the Murree Road, Rawalpindi MTS has a positive or negative environmental impact before and after it is implemented, to analyze the environmental impact using a GIS- based remote sensing approach, and to see how this policy affects Pakistan's transportation system, as well as how the environmental impact can be minimized. Environmental quality is an indication of regional quality of life, supporting public health and well-being as well as the natural and regional environment's sustainability. The images of Murree Road were obtained using QGIS quarterly from 2015 to 2019 for environmental impact measurement. The findings showed that temperature dynamics have improved significantly after MTS was deployed, as have environmental conditions in the study area. The vegetation indices dropped during construction, but they stabilized afterward, suggesting that there was no substantial infrastructural development along the path. In addition to this, a survey is being conducted to find out what people think of the Murree Road MTS if they are comfortable with it, what has to be worked on in their opinion, and how much pollution has been decreased so far. A total of 200 hundred respondents were interviewed face to face along MTS routes, including users, residents, and non-residents. Male users were mostly discovered since there were more seats available for them on the bus, resulting in a gender imbalance. The results showed that MTS has had a beneficial impact on many people's lives, such as creating jobs, as expected by respondents. Respondents expressed a strong desire to utilize MTS instead of traditional public transportation and expressed satisfaction with its effects.

#### 1 Introduction

The world's population numbered nearly 7.7 billion as of mid-2019, implying that the world has added approximately 1.6 billion people over the last 19 years indicating 26.2 percent

increase in total population (UNDESA 2019). The growing population has put a lot of strain on urbanization. Out of a total population of 7.7 billion, 3.4 billion live in rural regions as compared to 3.2 billion people in the year 2000 indicating 6.25 percent increase and 4.3 billion in cities, compared to 2.8 billion in cities in the year 2000 indicating 53 percent increase in urban population. Due to this, metropolitan areas are responsible for a large number of environmental impacts: they overexploit natural resources, create excessive waste with no closed-loop mechanism, and contribute to climate change to some level. All of these facts contradict sustainability ideals. One of the most important policy hurdles facing governments in developing nations like Pakistan is recognizing and resolving transportation issues (Tahir Masood et al., 2011). In emerging nations, transportation accounts for 6 to 12 percent of GDP. According to prior research, an effective Mass Transit system (MTS) has a major impact on economic growth and provides better living and working possibilities in a given location. ((Weisbrod et al., 2014) Yu et al., 2020; Filippova & Sheng, 2020; Pasha et al., 2020). This has grown increasingly significant in recent years as the global population, transportation demand, and greenhouse gas emissions (GHGs) have all increased. Concerns about excessive traffic congestion, air pollution, and energy concerns prompted policymakers to place a greater emphasis on (MTS) to alleviate environmental and traffic challenges (Deng & Nelson, 2013). Particularly since the inception of CPEC in Pakistan, the transportation sector has grown in importance since all trade between Pakistan and China is dependent on transportation, which demands the development of efficient transportation infrastructure. China's investment in the Lahore MTS is important, and the country also plans to build an MTS in Quetta and revive Karachi's MTS. Twenty growing cities have installed MTS in the previous two decades, and many others are actively planning to do so (Fouracre & Gardner, 1993).

Developing countries are faced with the dual problem of providing an effective MTS for their citizens while also ensuring that this development has the least possible environmental impact to fulfill sustainable development goals (SDG's). Transportation infrastructure, which includes roads, railways, airports, and seaports, has historically been known as a key driver of productivity and economic growth. Improvements to public transportation, it has been suggested, can provide significant external advantages by facilitating agglomeration economies, which leads to greater productivity (Deng, 2013). According to the State Bank of Pakistan, the GDP generated by the transportation sector in Pakistan averaged 7.47 USD billion from 2006 to 2019, with a high of 9.44 USD billion in 2019 and a low of 5.51 USD billion in 2006, and is expected to reach 9.30 USD billion by the end of 2020. Until 2020, the United States will have 548 USD billion, Singapore will have 3.65 USD billion, Hong Kong will have 3.31 USD billion, and China will have 2.90 USD billion. (All figures converted in current exchange rates)

Finding out the environmental effect, the availability of data such as carbon emissions, aerosols, and other environmental concerns, is one of the most pressing challenges confronting emerging countries as they construct mass transportation systems. Developing countries, like developed countries, lack reliable data to investigate the environmental effect. International authorities have examined this problem for planning and monitoring purposes.

The governments of developing nations needed to do extensive study in this sector to formulate policy, and this is the major reason why they are unable to construct a sustainable MTS. This means that decision-makers should examine and change their thought processes, engage stakeholder's preferences and experts, and consider environmental and human well-being problems. To continue systematically, it is necessary to create clearly defined criteria and their relative significance following stakeholders' preferences.

Another issue that rising countries face in the transportation sector is sustainability. Because modern transportation technologies are expected to play a significant role in an environmentally sustainable transportation system, sustainability must be addressed. Regrettably, there is no precedent for the development authority to bridge this gap. As a result, the focus of this research is on assessing the environmental impact assessment for Murree Road, Rawalpindi MTS service utilizing a geographic information system (GIS). The majority of the challenges have a direct or indirect relationship with their geographical significance. In this regard, GIS is a valuable tool for bringing together, prioritizing, and evaluating the geospatially related components of sustainable development. These integrated utilities are required for a sustainable transportation system, effective urban design, and implementation in the future. In addition, a questionnaire- based study was undertaken to determine how people perceive SGD's and MTS, as well as their perspectives on the development of MTS and their environmental effect.

The chapter is split into two sections. To begin, principles for sustainable transportation will be utilized to analyze the policy transportation set up in the examined urban region, describing how bad the problem is and why such a scenario occurs. Second, the findings of the methodology that simulates how to measure the environmental impact of the Murree Road MTS service and what people think about this project will be presented to analyze the potential reduction of environmental impacts in the transportation sector will be presented.

## **1.1 Murree Road MTS Overview**

Cities' ground coverage is growing at a faster rate than population increase throughout the world. Between 1990 and 2000, the population increased by 17%, compared to a 28% increase in metropolitan areas. In 2030, urban growth is predicted to be three times that of population growth, which is expected to be double that of current statistics in emerging nations. This unrestrained urbanization poses a threat to many areas of life, including environment, which has changed dramatically in the previous two decades. Urban spread is promoting some facets of economic and social build-up while it is causing natural environment to die Urban spread is also creating bigger issues like decline in energy resources, down sloping of life quality, and scarcity of basic human necessities for generations to come (F. Li et al., 2009). This is why, in developed economies, the notion of sustainability is being taken seriously, but in developing countries, the impact of the facts is still being assimilated. Pakistan is the world's fifth most populated country, and hence stood at fourth in Asia Pakistan's urban population grew at an average yearly rate of 0.81 percent from 25.1 percent in 1971 to 37.2 percent in 2020.

Rawalpindi's population reached at 2,196,000 in 2019 as compared to 2,156,000 in 2018, a 1.86% increase from 2018. Rawalpindi had a population of 233,207 people in 1950. Rawalpindi's population has increased by 43,828 during 2015, indicating 1.96 percent yearly increase and it is predicted to rise even more to 2.49 percent by 2030. These figures indicate Rawalpindi's urban agglomeration, which generally includes the city's population as well as nearby suburban regions. Therefore, because of its shorter length and simple access, Murree Road has become one of the most popular links between Rawalpindi and Islamabad as a result of growing urbanization and rising pollution levels in both cities. There has been a tremendous increase in vehicle rush hour traffic in the city in recent years, notably along Murree Road, resulting in significant gridlock on this route. For day-to-day travelers, this barrier produces unreasonable congestion, environmental concerns, and financial challenges. Prior to the introduction of MTS between Rawalpindi and Islamabad, private vehicles such as Toyota Hiace, taxis, Suzuki vans, and Mazda were the primary modes of transportation between the two cities, with numerous routes being used inside and between the two cities. In these two cities, there was no organized metropolitan transportation administration. The quality of service provided by the minibuses falls well short of any acceptable standard.

In 2012, the provincial and federal governments used the Asian Development Bank's (ADB) "Pre-feasibility study on Bus Rapid Transit Project in Islamabad" to fund the achievability study "Transport Modeling of Mass Transit System in Rawalpindi and Islamabad 2014" conducted by CDA and Punjab Metro Bus Authority, as well as the Infrastructure Project Development Facility (IPDF). The project was sponsored in a 50:50 cost-sharing ratio by both the government and the private sector. At the time, the Prime Minister determined that the Punjab government would begin this project with the aid of the Rawalpindi Development Authority (RDA), which would serve as the single administrative entity for both the Rawalpindi and Islamabad portions of the endeavor. For the Islamabad portion of the project, it would collaborate closely with the Capital Development Authority (CDA). After the job is completed, the Punjab Metro Bus Authority (PMA) will oversee the activities and maintenance.

## **1.2 Motivation of the Study**

People's mobility has been driven by economic development and population growth in the last two decades, and demand for an efficient transportation system has grown by the day. Given the growing population in all of Pakistan's cities, a more advanced and long-term MTS infrastructure is necessary. In Pakistan, there are five operating MTS: Lahore, Rawalpindi/Islamabad, Peshawar, and Multan; one project is under development, namely the Karachi MTS; and one is proposed, namely the Faisalabad MTS. According to the available literature, little study has been done so far on the environmental impact assessment of Pakistan's public transportation system, which has become increasingly important in recent years. We began this research intending to evaluate indigenous environmentally sustainable transportation planning. The previous research was centered on primary data, and no one focused on analyzing the environmental effect using secondary data, which is the biggest gap in the literature that we discovered. Most nations are now focused on secondary data-

based research, but estimating the environmental effect of public transportation systems has never been done in Pakistan.

Secondly, between Rawalpindi and Islamabad, the Murree Road is the primary route. Daily, a substantial portion of Rawalpindi's inhabitants go to Islamabad for employment, school, or business. There are few transit choices, thus people are stressed for time. Women, in particular, who must travel to Islamabad, endure considerable hardship. The metro bus fixes the problem since it has a separate track and charges the inhabitants of twin cities a reasonable fare. Furthermore, this initiative was created to reduce the environmental effect. But what occurred when it was finished? Have we met the objectives for which this project was created? Have we constructed a sustainable transportation system in Murree road, Rawalpindi? These are the questions that drove me to work in this field, analyzing the policy implications of Murree Road MTS and determining how close we are to meeting our objectives.

### 1.3 Research Objective

We are focusing on the Rawalpindi region, which is Pakistan's top five polluted cities. According to the latest US embassy Air Quality Index (AQI), Rawalpindi has a 168 real-time AQI, which is unhealthy, with 87.6 g/m<sup>3</sup> of PM<sub>2.5</sub> in Rawalpindi, which is above the WHO guidelines of 25 g/m<sup>3</sup>, posing a serious health risk. The main goal of this research is to determine whether the Murree Road, Rawalpindi MTS has a positive or negative environmental impact after it is implemented, to analyze the environmental impact using a GIS-based remote sensing based approach, and to determine how this policy affects Pakistan's transportation system, how the environmental impact can be minimized, and what policy options are available. In addition, a survey is being performed to learn what people think about the Murree Road MTS and, if they are comfortable, what has to be focused on in their perspective, and how much pollution has been reduced so far in their opinion.

### 1.4 Research Questions

- 1- Is mass transit system a viable option for long-term sustainability?
- 2- How may the environmental impact of transportation in Rawalpindi be reduced, and how might remote sensing assist us in this regard?
- 3- What policy options do we have in Pakistan to enhance our transportation sector

## 2 Results and Discussion

In a sustainable city, the transportation system should meet certain requirements that are in line with sustainable ideals. Sustainability refers to fulfilling current demands without jeopardizing future generations' capacity to meet their own. With this in mind, four principles govern sustainable growth. The first principle is that substances taken from the ground should not be allowed to accumulate in the environment systematically. The second states

that society- produced substances must not be allowed to accumulate in the environment systematically. The third principle states that the physical state for development and variety within the ecosystem must not progressively decline, while the fourth principle states that resource utilization must be efficient and just in satisfying human needs. These four sustainability principles are a little hazy, which is why they may be somewhat restated to identify what a transportation system should strive for to be sustainable.

As a result, the findings given in this chapter are important factors to consider when assessing the long-term viability of Pakistan's transportation strategy. First, using a QGIS-based remote sensing method, we calculated the vegetation indices and surface temperature of Murree Road MTS. The 2015 to 2019 NDVI and LST images are analyzed to get a better understanding of the NDVI and LST trends. Because most of the research done in Pakistan is based on primary data methodologies, this method is relatively new in Pakistan. However, most developed nations are currently focused on secondary analysis because this approach is more accurate and trustworthy in terms of policy analysis. However, data accessibility is a major issue in Pakistan, particularly when it comes to air quality data. So extracting data and then measuring NDVI and surface temperature for Murree road MTS took a long time.

The NDVI and surface temperature for Murree Road, Rawalpindi are shown in figures 5 to 9. The data displays the results of NDVI and surface temperature quarterly from 2015 to 2019. The outcomes of these two approaches are shown in the table below.

**Table 2.1: NDVI and Land Surface Temperature results**

Results				
Date	NDVI	Average NDVI	Surface Temperature	Average surface Temperature
13-05-2015	0 - 0.390702	0.405952	0 - 33.88632	36.50516
04-09-2015	0 - 0.421202		0 - 39.12399	
27-02-2016	-0.01194 - 0.358226	-0.01194	0 - 20.71304	27.46416
17-05-2016	-0.01194 - 0.358226	-	0 - 44.13742	
06-09-2016	-0.01194 - 0.358226	0.358226	0 - 27.60248	
11-12-2016	-0.01194 - 0.358226		0 - 17.40369	
13-02-2017	-0.01194 - 0.358226	-0.01194	0 - 17.43616	25.64227
04-05-2017	-0.01194 - 0.358226	-	0 - 33.94888	
09-09-2017	-0.01194 - 0.358226	0.358226	0 - 27.59824	
27-10-2017	-0.01194 - 0.358226		0 - 23.58582	
15-01-2018	-0.01194 - 0.358226	-0.01194	0 - 12.56708	19.54895
21-04-2018	-0.01194 - 0.358226	-	0 - 23.61401	
30-10-2018	-0.01194 - 0.358226	0.358226	0 - 22.46576	
03-02-2019	-0.01194 - 0.358226	0.01194	0 - 14.586	23.28982
26-05-2019	-0.01194 - 0.358226	-	0 - 34.01584	
18-11-2019	-0.01194 - 0.358226	0.358226	0 - 21.26761	

The NDVI has long been used to investigate the link between spectral variability and variations in vegetation growth rate. It's also beneficial for determining green vegetation development and detecting changes in vegetation. As a consequence, the findings in table 2 represent the different characteristics retrieved for the Murree Road from QGIS. The average values of the NDVI and surface temperature from 2015 to 2019 are shown in the findings. When discussing the vegetation indices or NDVI data for Murree Road MTS, the NDVI peaks occurs in vegetated regions, which are depicted as green in the images, whereas less vegetated areas are indicated in red, we can see that there is more vegetation before the commencement of MTS at Murree Road than after the deployment of MTS. According to the data, the average NDVI value in 2015 was 0.405952, which decreased to 0.358226 after the MTS was installed at Murree Road, and remained the same until 2019. This indicates that there will be no major infrastructure improvements at Murree Road following the implementation of MTS.

Additionally, LST maps for Murree Road are created for the years 2015 to 2019. Because the original LST was computed in Kelvin, a Kelvin to °C conversion was used, and the results were shown in °C. High-temperature zones are represented in red and belong to barren surfaces, buildings, and highways, whereas low-temperature areas are represented in blue and belong to water bodies and vegetation. According to the findings of this study, land surface temperature has fallen considerably between 2015 and 2018. Then, as seen in table 5.1, there is a small rise in LST. Before the commencement of MTS at Murree Road, the average LST in this region was 36.50516, but it began to decline from 2016 to 2018, with the average LST temperature falling to 27.46416, 25.64227, and 19.54895. This demonstrates that LST at Murree Road has reduced by 16.95621, or almost 17 °C, following the deployment of MTS, which is a significant shift in temperature dynamics. However, in 2019, the LST temperature increased from 19.54895 to 23.28982, possibly due to an increase in the number of cars in the investigated area, or reduction in rainfall during that year.

Rapidly increasing car numbers, excessive fuel usage, smoke cloud cover, and pollution are wreaking havoc on the natural beauty and environment of cities, as well as posing major health risks. According to the WHO, around 92 percent of the world's population lives in places where WHO environmental requirements are not satisfied. MTS has helped to cut greenhouse gas emissions all around the world. Simply put, the QGIS findings revealed a considerable shift in the environment, and we can conclude that MTS is an environment friendly transportation policy that is good for Pakistan's environment and transportation system. Furthermore, such initiatives are not only dependable but also cost-effective. Such projects for sustainable transportation must be started in underdeveloped nations like Pakistan. Overall, Rawalpindi MTS has a positive impact on environment and such kind of projects should be implemented in other cities of Pakistan because of their environment friendliness and cheap rates for the commuters.

This study also used a survey-based technique to estimate the environmental effect of MTS. SPSS was used to analyze this method. The frequency and proportion of questions asked of Murree Road MTS respondents were shown in the descriptive analysis. Because females were unwilling to answer the questions, the majority of the data was obtained from males. In Pakistan, the majority of women, particularly housewives, do not travel regularly.



Furthermore, the government adopted a regulation that stated that males had more seat availability than females, resulting in gender disparity. It might be one of the causes for the low female participation rate. MTS has been used more frequently by middle-aged people (26-32). The elderly was in small numbers since accessing entry and departure points, both below and above ground, was difficult for them. People with a high school degree or more were more likely to use MTS daily since it met their needs and received positive feedback. Low-income individuals liked to travel by MTS because it was cost-effective and provided a smooth ride.

MTS was rated well by respondents. MTS, according to more than half of those interviewed, contributes to the reduction of unemployment in Pakistan. The majority of people believe that MTS has improved environmental conditions more than any other project. People who have a good job and a decent income package, on the other hand, are still eager to utilize their car during this survey. Before MTS, the majority of individuals traveled inside the city on their motorbikes. Because of the bad service and discomfort, they did not rely on regular buses. Furthermore, they are unable to pay the rising costs of local transportation. Those who were willing to utilize MTS were low-income individuals who were either non-users or dissatisfied long-term users of traditional public transit. In terms of economics, the majority of individuals believe that MTS is advantageous to them because of the affordable fares. MTS has a good impact on employment since it reduces commute time and improves workplace accessibility, according to the majority of respondents. Because these are along the MTS route, access to other facilities such as businesses, schools, colleges, universities, and shopping malls is also increased. MTS has a significant effect on the value of properties along its path.

**Table 2.2: Social, Economic and Environmental impact of MTS**

Descriptive Statistics					
Statements	N	Minimum	Maximum	Mean	Std. Deviation
Social Aspect of MTS					
Manmade disasters (major oil spills or industrial accidents, etc.)	200	1.00	8.00	4.1950	2.46523
Agricultural pollution (use of pesticides, fertilizers, etc.)	200	1.00	8.00	4.3700	2.34319
Consequences of current transport modes (increased use of individual cars, motorways, increased air traffic, etc.)	200	1.00	8.00	3.7550	2.20665
Noise and Air pollution	200	1.00	8.00	4.1600	2.28484
Water pollution (seas, rivers, lakes and underground sources)	200	1.00	8.00	4.1850	2.30812
Urban problems (traffic jams, pollution, lack of green spaces, etc.)	200	1.00	8.00	4.2900	2.25418

The impact on our health of chemicals used in everyday products	200	1.00	8.00	4.5600	2.41153
Growing waste	200	1.00	8.00	4.5700	2.52527
Mass transit system (e.g.: subway and tramway system)	200	1.00	7.00	2.8500	1.97662
Transport management and telematics (e.g.: intelligent ticket system, one ticket for all public transport, light-signal system, parking ordinance)	200	1.00	7.00	3.4850	1.84847
Reduce fares for public transport users (e.g.: off-peak reduced fares, reduce fare for students, free travel in a special zone)	200	1.00	7.00	3.5450	1.97674
Financial subsidy for public transport companies	200	1.00	7.00	3.8100	1.87924
Humanistic service (e.g.: free Wi-Fi on buses and trains)	200	1.00	7.00	4.2400	2.03052
New bus lanes	200	1.00	7.00	4.0500	2.12605
Priority (e.g.: maximum priority for public transport at traffic lights)	200	1.00	7.00	4.3200	2.15425
Satisfy your traffic demand	200	1.00	8.00	4.6200	2.47106
Create lively streets	200	1.00	8.00	4.9900	2.51626
Reduce numbers of traffic accident	200	1.00	8.00	3.9750	2.25606
Make transport system sustainable	200	1.00	8.00	3.4000	2.19867
Change the travel behavior to healthier and more sustainable way	200	1.00	8.00	4.2800	2.27982
Reduce fossil fuel use	200	1.00	8.00	3.7750	2.15117
Financial concern (e.g. Reduce cost per use)	200	1.00	8.00	4.3850	2.22972
Reduce greenhouse gas emission	200	1.00	8.00	4.1650	2.45723
Economic Aspect of MTS					
Current mode of transportation to travel within the city	200	1.00	11.00	2.7000	1.66247
Travel purpose	200	1.00	17.00	4.2500	4.44141
Is there any project that would strengthen the transport network instead of the Mass Transit System (MTS)	200	1.00	3.00	1.8400	0.38095
I prefer Bus Rapid Transit (BRT) over my own vehicle	200	1.00	4.00	1.9200	0.96865
I am satisfied with BRT	200	1.00	5.00	1.9750	0.87073
Metro bus saves my time	200	1.00	5.00	1.9500	0.86093
I prefer BRT due to its Affordability	200	1.00	4.00	1.9450	0.83394
BRT helps me to avoid traffic as it has separate track	200	1.00	5.00	1.7250	0.72249
I prefer BRT due to Safe travelling	200	1.00	4.00	1.8300	0.84538
I prefer BRT as it provides me parking facility.	200	1.00	5.00	2.7200	1.11707
BRT gives me comfortable ride	200	1.00	4.00	1.9400	0.81222

BRT helps me in saving money	200	1.00	5.00	1.8100	0.78548
I observe that rental of property near BRT stations appreciated	200	1.00	5.00	2.4100	1.00346
BRT generates employment opportunities	200	1.00	5.00	2.3650	1.01337
Environmental Aspect of MTS					
In general, how informed do you feel about environmental issues	200	1.00	5.00	1.9050	0.73394
Which is your main source of information about the environment	200	1	7	2.61	1.371
In my view, Bus Rapid Transit (BRT) is environment friendly project	200	1.00	3.00	1.1350	0.44471
I feel that BRT contributes to reduce air pollution	200	1.00	3.00	1.4500	0.69275
After the initiation BRT, there is decrease in road accidents.	200	1.00	3.00	1.5800	0.76585
I think current BRT is a good option of Sustainable environment	200	1.00	3.00	1.1750	0.46417
I like to use BRT	200	1.00	3.00	1.1700	0.47139
I feel that BRT helps to reduce traffic problems	200	1.00	3.00	1.1900	0.50515
I observe that BRT provide a secure way of transportation	200	1.00	3.00	1.0950	0.34141
I think after the implementation of BRT in Rawalpindi, environmental conditions have improved.	200	1.00	3.00	1.3350	0.65184
I believe that education is an effective way to reduce environmental impact of transportation.	200	1.00	5.00	1.5650	0.73380
According to my understanding, Policies to reduce individual car use have a direct impact on reducing environmental pollution.	200	1.00	5.00	1.7850	0.72207
Policies such as walking, bicycling and BRT use are an effective way to decrease the environmental impact.	200	1.00	4.00	1.7100	0.68428
I observe that imposing more taxes (i.e. pollution) will lead to minimum impact of transportation on environment.	200	1.00	5.00	1.7700	0.80019
Sustainable urban design is a productive method of reducing environmental impact of transportation as per my knowledge.	200	1.00	4.00	1.7100	0.69159
When it comes to environmental issues, who do you trust the most from the list?	200	1.00	14.00	5.4150	3.99155

The Rawalpindi - Islamabad MTS runs from Murree Road in Pindi to Jinnah Avenue in Islamabad, connecting the twin towns. Since its inception in 2015, the MTS has been Pakistanis' preferred mode of public transportation, carrying 125,000 commuters daily between Islamabad and Rawalpindi. Prior to the Rawalpindi - Islamabad MTS, public

discontent with current public transportation was high, with over 90% of people dissatisfied. Women, the elderly, and the underprivileged group all mentioned service dependability, seat availability, and being handled with respect by drivers and conductors as major flaws. Buses serve commuters from all walks of life with a cheap, comfortable, and respectable commuting choice, much to the satisfaction of commuters. Passengers may travel to their destination in half the time they would have taken without the MTS by paying a small cost of Rs.20 per ride anywhere in the transit route. The Rawalpindi-Islamabad MTS has a modern design, is air-conditioned, and has comfortable seats for ladies in the front. Ticketing booths, concourse level passenger transfers, platform screen doors, and other facilities for passenger safety and convenience are also available at its stations. The Metro Bus Project has had a favorable influence on pro-poor and collaborative development, urban government, and the environment, according to the findings.

The above table 5.2 contains the whole questionnaire that was sent to the respondents, as well as the average response. The minimum, maximum, mean, and standard deviation are all included in the table. The responders were asked a total of 16 questions. Because the number of questions in each set varies, the lowest value for all sets of questions is the same, but the maximum value for all sets of questions is different. For example, in the first set of questions, we asked the responders eight questions, in the second set, seven questions, in the third set, eight questions, and so on. In the social aspect of MTS, we asked three questions. The biggest environmental concern, according to 4.195 percent of respondents, is a man-made disaster. Agriculture pollution, according to 4.37 percent of individuals, is a greater concern. 3.755 percent believe current transportation modes have negative consequences, 4.16 percent believe noise and air pollution are a bigger problem, 4.185 percent believe water pollution is a bigger problem, 4.29 percent believe urban problems are a bigger problem, 4.56 percent believe chemicals have negative health effects, and 4.57 percent believe growing waste is a bigger problem.

The response to proposals to improve public transportation is that 2.85 percent of people believe MTS will improve public transportation. 3.485 percent are enthusiastic about transportation management and telematics, 3.545 percent are optimistic about lower fares for public transportation users, 3.81 percent are passionate about financial subsidies, 4.24 percent are enthusiastic about humanistic service, 4.05 percent are excited about new bus lanes, and 4.32 percent believe that giving public transportation top priority can help the transportation system.

The social aspect of MTS also depicts the response to a component that is a key element of a successful transportation plan. 4.62 percent of respondents ranked satisfying traffic demand first, followed by 4.99 percent for creating lively streets, 3.975 percent for reducing traffic accidents, 3.4 percent for making transportation sustainable, 4.28 percent for changing travel behavior, 3.775 percent for reducing fossil fuel usage, 4.385 percent for financial concerns, and 4.165 percent for believing that reducing greenhouse gas emission are the factor that are core feature of effective transportation strategy.

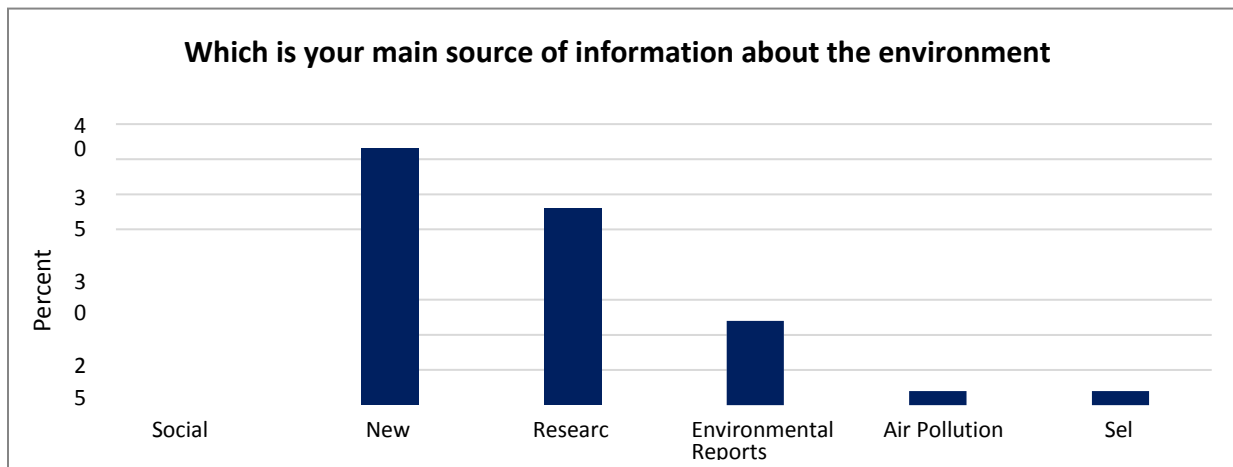
In addition, 23.2 percent of people utilize motorcycles to get around the city. Traveling is done by 28.4 percent by personal car, 54.6 percent by public transportation or MTS, and 3.6 percent by foot. People go to work daily in 47.9% of cases, 25.3 percent for business, 36.1

percent for education, and 20.1 percent for shopping.

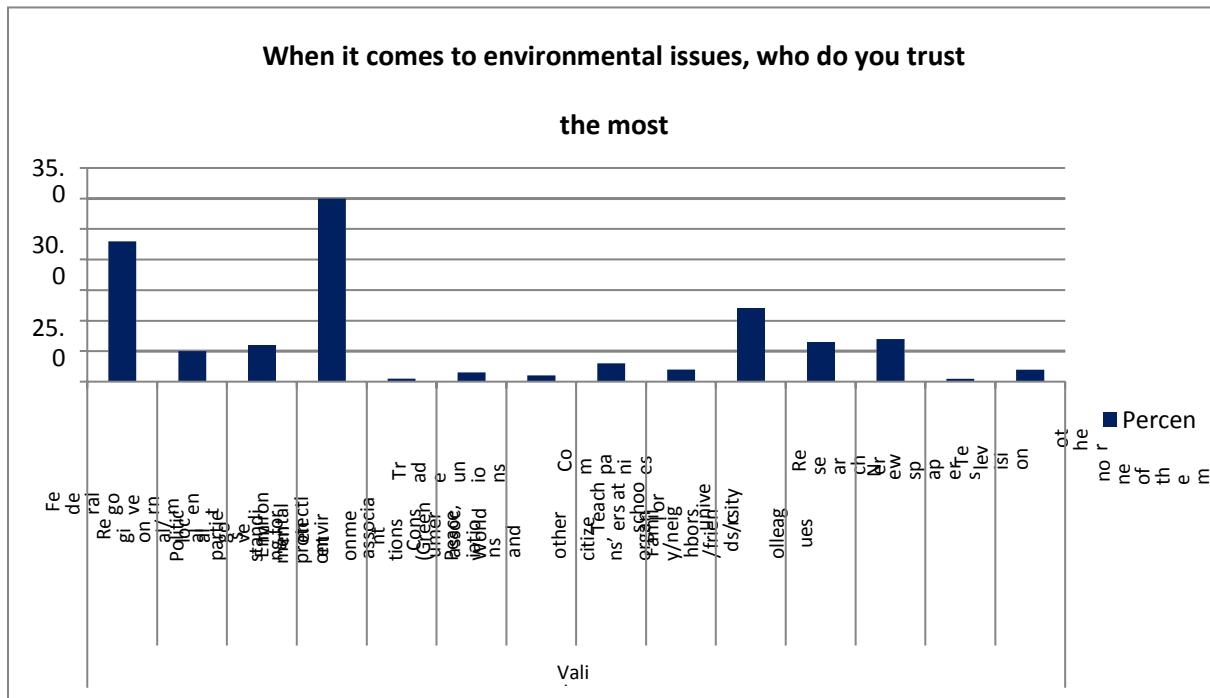
Aside from their views on the social and economic aspects of MTS, respondents agreed that it had decreased air and noise pollution while also improving their health. When asked how well educated they are on environmental issues, 2.84 percent said they are very well informed, 55.7 percent said they are pretty well knowledgeable, 13.9 percent said they are fairly badly informed, and 3% said they are very poorly educated and don't know. Figure 5.1 depicts the respondents' primary source of environmental knowledge. News is the primary source for 36.5 percent of people, while 28 percent rely on research, 19.5 percent on social media, 12 percent on environmental seminars, 2 percent on self, and 2 percent on air pollution reports. Furthermore, the respondents were offered two sets of argument-related questions, to which they responded with varied answers towards own experience.

Finally, when it comes to environmental concerns, people are asked who they trust the most. Figure 5.2 is the graphical representation of this question. 23 percent said the federal government, 5 percent regional governments, 6 percent environmental political parties, 30 percent environmental protection organizations (Green Peace, World Wildlife Fund, etc), 0.5 percent trade unions, and 1.5 percent consumer organizations., Companies account for 1 percent, teachers account for 3 percent family/neighbors/friends/colleagues account for 2 percent, and researchers account for 12 percent. Newspapers account for 6.5 percent, television for 7 percent, others for 0.5 percent, and none at all for 2 percent.

**Figure 2.1: Main source of information about environment**



**Figure 2.2: When it comes to environmental issues, who do you trust the most**



We can readily determine the environmental effect of Murree road MTS using remote sensing and a survey-based technique. The NDVI and LST have been shown to be effective in reducing environmental impact. However, when we look at the results of the survey, we see that individuals in our society lack knowledge about the environment, which is a limiting factor that must be addressed. Every member of society must have a thorough understanding of the environment in order to improve it. Respondents claimed to have a strong understanding of environmental issues, but when I interviewed them, I discovered that the majority of them did not. This is the area where the government should focus its efforts in order to create a more educated society. The conclusion of this study will be offered in the next section, followed by recommendations for good transportation policy and a discussion of the loopholes discovered in this research so that future MTS initiatives will be useful and effective.

### 3 Conclusion & Recommendations

In today's world, the manifestation of sustainability is an unavoidable fact. It is deserving of attention at all levels of government because it has the potential to make urban growth a resource-provider rather than a resource-depleting entity. MTS are essential components of sustainable transportation systems, and their design should take into account the costs of the user, the operator, and the environment. This thesis work is an endeavor to put forward a set of strategies and methodologies that allows reaching out to stakeholders and their participation in assessing the policy of sustainable MTS at Murree Road, Rawalpindi, as a result of the same. This research uses remote sensing and a survey-based technique to assess the benefits of the Murree Road MTS. MTS has a substantial influence on decreasing

environmental emissions, according to the research. The environmental conditions have improved since the start of MTS at Murree Road, according to the NDVI and LST techniques employed in this study. MTS was a brand-new project in Pakistan that completely transformed the transportation industry. Overall, it was a pleasant experience for Rawalpindi residents to move about the city. It benefited those from the lower classes, who had lower income and worse living conditions. Because its quality and pricing were superior to those of traditional bus systems, most people preferred to ride it. MTS has benefited a large number of individuals by providing a safe mode of transportation. By creating a distinct track for MTS, it enhanced the safety of travel. It also enhanced the environment along Murree Road by lowering pollutants and changing temperature dynamics. It was both time and money-efficient. It also increased employment opportunities and property value. Going further, after gathering feedback and analyzing it, we discovered that people prefer MTS to other means of transportation and are happy with its impact in this era of rapid urbanization. It paved the way for the construction of many updated transportation projects not only in Rawalpindi but throughout Pakistan. This research will aid in the analysis of transportation policies for other Pakistani sustainable transportation initiatives. After further refining, the concept and thinking process used here can be used in normal planning and decision-making at government organizations.

### 3.1 Recommendations

We assessed the environmental effect of Murree Road MTS after a thorough analysis of the literature and the study's conclusions. However, certain suggestions must be made.

1. To begin with, transportation initiatives must be founded on a welfare goal rather than political gains. Many of the respondents to this study's poll believed that MTS was designed to get political benefit rather than benefit society. This is a poor idea that should be severely evaluated. It is also the citizen's responsibility to use such initiatives solely for their gain, not for political purposes.
2. The expansion of public transportation should be prioritized. To incorporate transportation, health, and environmental objectives into urban and spatial planning strategies, the supply and usage of high-quality and attractive public transportation services should be an integrated component of wider planning for recovery, resilience, and sustainable urban mobility.
3. In Pakistan, data availability is a major concern. There is no AQI data for Pakistan in any database. Only the US Embassy in Pakistan provides AQI data, which is limited to Lahore, Karachi, and Islamabad. Pakistan is a large nation, and the growing number of cars in the country is contributing to increased pollution. Suparco has started collecting a lot of space data, but these data sets are unfortunately out of reach for policymakers. The government should establish environmental organizations in each district of Pakistan to calculate AQI statistics regularly, making data more accessible.
4. When I was interviewing respondents, I saw that while individuals pretend to know everything about the environment, but they don't. Knowledge sharing should be raised by the government through campaigns, conferences, awareness programs, school and university-level teaching, and environmental legislation that encourages

people to learn more about the environment. In short, environmental education must be done on grass- root level.

5. MTS is an important aspect of a sustainable transportation system; hence their design must take into account user, operator, and environmental costs.
6. The study also recommends a full assessment of present transportation policies, emphasizing the importance of assessing environmental and economic impacts to make our transportation system more sustainable.
7. To achieve optimal accessibility, unplanned geographical dispersion and population growth should be avoided, and effective commuting planning should be in place for various developmental projects.
8. More environmentally friendly initiatives, such as solar automobiles and electric or wind- powered public transportation are also recommended.
9. Ensuring that geographical and urban planning standards and policies prioritize the availability needs of the entire community, particularly vulnerable users such as children and teens, as well as the elderly and others with limited mobility.
10. The government should begin future transportation investments in multidimensional infrastructure for sustainability, with a focus on underprivileged areas and locations with zero MTS availability.
11. To ensure greater implementation of sustainable transportation initiatives, the Pakistani government should adopt legislation and policies regarding sustainable transportation practices.



## References:

- Adom, D., & Hussain, Emad.Kamil. and Joe, A. . A. (2018). THEORETICAL AND CONCEPTUAL FRAMEWORK : MANDATORY INGREDIENTS THEORETICAL AND CONCEPTUAL FRAMEWORK : MANDATORY INGREDIENTS Engineering  
Dickson Adom \* Emad Kamil Hussein. *International Journal of Scientific Research*, 7(1), 93–98. <https://www.researchgate.net/publication/322204158%0ATHEORETICAL>
- Awais, M., Samin, T., Gulzar, M. A., & Hwang, J. (2019). The sustainable development of the China Pakistan Economic Corridor: Synergy among economic, social, and environmental sustainability. *Sustainability (Switzerland)*, 11(24). <https://doi.org/10.3390/su11247044>
- Baghini, M. S., Ismail, A., Hafezi, M. H., Seifabad, O. K., & Almansob, R. A. (2014). Bus Rapid Transit (BRT) system impacts to environmental quality. *Research Journal of Applied Sciences, Engineering and Technology*, 7(7), 1158–1164. <https://doi.org/10.19026/rjaset.7.400>
- Bel, G., & Holst, M. (2018). Evaluation of the impact of Bus Rapid Transit on air pollution in Mexico City. *Transport Policy*, 63(March 2017), 209–220. <https://doi.org/10.1016/j.tranpol.2018.01.001>
- Bhandari, A. K., Kumar, A., & Singh, G. K. (2012). Feature Extraction using Normalized Difference Vegetation Index (NDVI): A Case Study of Jabalpur City. *Procedia Technology*, 6, 612–621. <https://doi.org/10.1016/j.protcy.2012.10.074>
- Bhatta, B. (2010). Causes and consequences of urban growth and sprawl. In *Analysis of urban growth and sprawl from remote sensing data* (pp. 17–36). Springer.
- Carteni, A. (2014). Urban sustainable mobility. Part 1: Rationality in transport planning. *Transport Problems*, 9(4), 39–48.
- Chetiwal, S. (2017). Sustainable Public Transportation in Jaipur City. *International Journal on Emerging Technologies*, 8(1), 674–679. [www.researchtrend.net](http://www.researchtrend.net)
- Demirel, H., Sertel, E., Kaya, S., & Zafer Seker, D. (2008). Exploring impacts of road transportation on environment: a spatial approach. *Desalination*, 226(1–3), 279–288. <https://doi.org/10.1016/j.desal.2007.02.111>
- Deng, T. (2013). Impacts of Transport Infrastructure on Productivity and Economic Growth: Recent Advances and Research Challenges. *Transport Reviews*, 33(6), 686–699. <https://doi.org/10.1080/01441647.2013.851745>
- Deng, T., & Nelson, J. D. (2013). Bus Rapid Transit implementation in Beijing: An evaluation of performance and impacts. *Research in Transportation Economics*, 39(1), 108–113.
- Filippova, O., & Sheng, M. (2020). Impact of bus rapid transit on residential property prices in Auckland, New Zealand. *Journal of Transport Geography*, 86(June), 102780. <https://doi.org/10.1016/j.jtrangeo.2020.102780>

- Fisk, C. S. (1986). Conceptual Framework for Optimal Transportation Systems Planning With Integrated Supply and Demand Models. *Transportation Science*, 20(1), 37–47. <https://doi.org/10.1287/trsc.20.1.37>
- Fouracre, P. R., & Gardner, G. (1993). Mass transit in developing cities. *Journal of Advanced Transportation*, 27(3), 251–260. <https://doi.org/10.1002/atr.5670270304>
- Gandhi, G. M., Parthiban, S., Thummalu, N., & Christy, A. (2015). Ndvi: Vegetation Change Detection Using Remote Sensing and Gis - A Case Study of Vellore District. *Procedia Computer Science*, 57(August), 1199–1210. <https://doi.org/10.1016/j.procs.2015.07.415>
- Gascon, M., Cirach, M., Martínez, D., Dadvand, P., Valentín, A., Plasència, A., & Nieuwenhuijsen, M. J. (2016). Normalized difference vegetation index (NDVI) as a marker of surrounding greenness in epidemiological studies: The case of Barcelona city. *Urban Forestry and Urban Greening*, 19, 88–94. <https://doi.org/10.1016/j.ufug.2016.07.001>
- Gupta, P., Christopher, S. A., Wang, J., Gehrig, R., Lee, Y. C., & Kumar, N. (2006). Satellite remote sensing of particulate matter and air quality assessment over global cities. *Atmospheric Environment*, 40(30), 5880–5892.
- Hameed, R., & Anjum, G. A. (2013). Improving the Environmental Performance of Bus-based Public Transport System in Lahore-Pakistan. *J. Engg. & Appl. Sci*, 12, 111–126.
- Ilyas, S. (2010). A Review of Transport and Urban Air Pollution in Pakistan. *Journal of Applied Sciences and Environmental Management*, 11(2). <https://doi.org/10.4314/jasem.v11i2.55004>
- Imam, R., & Jamrah, A. (2012). Energy consumption and environmental impacts of Bus Rapid Transit (BRT) systems. *Jordan Journal of Civil Engineering*, 159(699), 1–12.
- João, E., & Fonseca, A. (1996). The role of gis in improving environmental assessment effectiveness: Theory vs. practice. *Impact Assessment*, 14(4), 371–387. <https://doi.org/10.1080/07349165.1996.9725913>
- Johnson, M. P. (2001). Environmental impacts of urban sprawl: a survey of the literature and proposed research agenda. *Environment and Planning A*, 33(4), 717–735.
- kassahun daniel. (2005). Environmental Consciousness Survey of University Students. *AKADEMIK PLATFORM*.
- Kepaptsoglou, K., Milioti, C., Spyropoulou, D., Haider, F., & Karlaftis, A. G. (2020). Comparing traveler preferences for BRT and LRT systems in developing countries: Evidence from Multan, Pakistan. *Journal of Traffic and Transportation Engineering (English Edition)*, 7(3), 384–393. <https://doi.org/10.1016/j.jtte.2018.10.013>
- Khanna, P., Jain, S., Sharma, P., & Mishra, S. (2011). Impact of increasing mass transit share on energy use and emissions from transport sector for National Capital Territory of Delhi.

*Transportation Research Part D: Transport and Environment*, 16(1), 65–72.  
<https://doi.org/10.1016/j.trd.2010.08.005>

Li, F., Liu, X., Hu, D., Wang, R., Yang, W., Li, D., & Zhao, D. (2009). Measurement indicators and an evaluation approach for assessing urban sustainable development: A case study for China's Jining City. *Landscape and Urban Planning*, 90(3–4), 134–142.  
<https://doi.org/10.1016/j.landurbplan.2008.10.022>

Li, H., Deng, Q., Zhang, J., Olanipekun, A. O., & Lyu, S. (2019). Environmental impact assessment of transportation infrastructure in the life cycle: Case study of a fast track transportation project in China. *Energies*, 12(6), 1–15. <https://doi.org/10.3390/en12061015>

Mansoor, A., Zahid, I., & Shahzad, L. (2016). Evaluation of social and environmental aspects of lahore metro bus transit through public opinion. *Journal of Environmental Science and Management*, 19(2), 27–37.

Martin, R. V. (2008). Satellite remote sensing of surface air quality. *Atmospheric Environment*, 42(34), 7823–7843.

Miller, P., de Barros, A. G., Kattan, L., & Wirasinghe, S. C. (2016). Public transportation and sustainability: A review. *KSCE Journal of Civil Engineering*, 20(3), 1076–1083.  
<https://doi.org/10.1007/s12205-016-0705-0>

Miller, R. B., & Small, C. (2003). Cities from space: potential applications of remote sensing in urban environmental research and policy. *Environmental Science & Policy*, 6(2), 129–137.

Mujabar, S., & Rao, V. (2018). Estimation and analysis of land surface temperature of Jubail Industrial City, Saudi Arabia, by using remote sensing and GIS technologies. *Arabian Journal of Geosciences*, 11(23). <https://doi.org/10.1007/s12517-018-4109-y>

Pasha, O., Wyczalkowski, C., Sohrabian, D., & Lendel, I. (2020). Transit effects on poverty, employment, and rent in Cuyahoga County, Ohio. *Transport Policy*, 88(January), 33–41.  
<https://doi.org/10.1016/j.tranpol.2020.01.013>

*Pilot Project - Raising Awareness of Alternatives to Private Car*. (n.d.). 1–8. <https://www.ecn-eu.com/news/28/08/2017/1997>

Pternea, M., Kepaptsoglou, K., & Karlaftis, M. G. (2015). Sustainable urban transit network design. *Transportation Research Part A: Policy and Practice*, 77, 276–291.

Qadir, N. F. (1996). *Air Quality in Urban areas in Pakistan Vs Transport Planning: Issues and Management Tools By*.

Slovic, A. D., & Ribeiro, H. (2018). Policy instruments surrounding urban air quality: The cases of São Paulo, New York City and Paris. *Environmental Science and Policy*, 81(March 2017), 1–9.  
<https://doi.org/10.1016/j.envsci.2017.12.001>

- Solanky, V., Singh, S., & Katiyar, S. K. (2018). *Land Surface Temperature Estimation Using Remote Sensing Data. January*, 343–351. [https://doi.org/10.1007/978-981-10-5801-1\\_24](https://doi.org/10.1007/978-981-10-5801-1_24)
- Tahir Masood, M., Khan, A., & A. Naqvi, H. (2011). Transportation Problems in Developing Countries Pakistan: A Case-in-Point. *International Journal of Business and Management*, 6(11). <https://doi.org/10.5539/ijbm.v6n11p256>
- Tánczos, K., & Török, Á. (2008). Impact of transportation on environment. *Periodica Polytechnica Transportation Engineering*, 36(1–2), 105–110. <https://doi.org/10.3311/pp.tr.2008-1-2.19>
- Topalovic, P., Carter, J., Topalovic, M., & Krantzberg, G. (2012). Light rail transit in Hamilton: Health, environmental and economic impact analysis. *Social Indicators Research*, 108(2), 329–350.
- Vincent, B. (2013). Energy and Environmental Impacts of BRT in APEC Economies. *Breakthrough Technologies Institute*.
- Wang, L., Xue, X., Zhao, Z., & Wang, Z. (2018). The impacts of transportation infrastructure on sustainable development: Emerging trends and challenges. *International Journal of Environmental Research and Public Health*, 15(6). <https://doi.org/10.3390/ijerph15061172>
- Weisbrod, G., Cutler, D., & Chandler, D. (2014). Economic impact of public transportation investment: 2014 update. *American Public Transportation Association*, 1–54.
- Xiuwan, C. (2002). Using remote sensing and GIS to analyse land cover change and its impacts on regional sustainable development. *International Journal of Remote Sensing*, 23(1), 107–124. <https://doi.org/10.1080/01431160010007051>
- Yu, M., Yu, R., Tang, Y., & Liu, Z. (2020). Empirical study on the impact of China's metro services on urban transportation energy consumption. *Research in Transportation Economics*, 80(January), 100821. <https://doi.org/10.1016/j.retrec.2020.100821>

## CHAPTER 5

# UNDERSTANDING PUBLIC MOBILITY TO DESIGN A GREEN TRANSPORT SYSTEM FOR ISLAMABAD

Farzana Rubab and Dr. Junaid Alam Memon (2023)

### Abstract

The transportation industry in Pakistan is growing rapidly which in turn has raised the cost of energy imports, usage of petroleum products, air pollution, and traffic congestion. It is perturbing that the world is too much dependent on fossil fuels to meet its energy requirements. In order to address energy, economic and environmental problems of any nation, electrification of road transportation appears to be a game-changer. The aim of this study is to help implement a green transportation system in Islamabad and Rawalpindi. This study compares the financial and environmental costs of using electric, diesel, and solar buses. It also assesses the viability of using suitable electric vehicles (EVs) for Islamabad and Rawalpindi's public transit systems and considers several technological choices.

Electric vehicles (EVs) provide a solution to these problems. Hence, switching from fossil fuel vehicles (FFVs) to EVs is a necessary step in decarbonizing the country's transportation sector and reversing its dire socioeconomic situation.

In this study, the applied quantitative and qualitative analysis forms the foundation of the primary research design as we examine the energy usage and consumption in Plug-In Electric Vehicles (PEVs) for the current private services in Islamabad and Rawalpindi. In this paper, socio-environmental and financial comparison among FFVs, EVs and Solar buses have been evaluated.

The study's findings indicate that solar buses use only 18% energy as compared to electric buses which use 30% while diesel buses use 52% for same seating capacity and same distance covered. However, batteries powered buses are currently more expensive than diesel buses. Although it costs more than diesel buses, using electric and solar buses is beneficial for both human and the environment.

### 1 Introduction

Traffic congestion can be determined by looking at the pattern of developing and underdeveloped nations. According to studies, a society's economy and special activities are hampered by traffic congestion. The lack of an active non-motorized transportation system is another element that these emerging nations have in common. Yet, the number of private vehicles is growing over time. Because poor transportation systems simultaneously cause noise pollution and air pollution, they pose a danger to environmental quality (Jain, Sharma et al. 2012).

The transport sector contributes greatly to an economy's expansion by linking numerous economic sectors. Along with playing a positive role, it also significantly contributes to the global pollution caused by use of fossil fuels. As indicated by (Staff 2012), transportation discharges include 25% of world fossil fuel byproducts, which is 71% more than that of outflows in 1990s. Additionally, oil accounts for 93 % of all transportation energy use (Raturi 2019).

Pakistan's pollution statistics present a grim picture. Due to the extensive growth of the country's transportation networks, an estimated 47.2 percent of petroleum products are in demand. As a result, the average vehicle in Pakistan emits 25 times the amount of carbon dioxide as the average vehicle in the United States (Channa).

As a result of the transportation sector's excessive reliance on petroleum derivatives, which also contributes to environmental change and the unfavorable rise in global temperatures, managing green transportation is arguably one of the most difficult challenges faced by the modern society (Balsalobre-Lorente, Driha et al. 2021). Street transportation is considered as the main supporter of out flows among the various vehicle modes. The aviation area is the main backer of transportation after mass transit. Yet, because they alter the climate at great altitudes and degrade the quality of nature at the surface, aviation sector outflows are even more hazardous to the environment.

Transport plays an important role in urban development by providing masses the accessibility to workplaces, education, recreational sites. Specifically, for the developing countries to provide affordable transport system (Ali, Socci et al. 2018). Societies with better transportation infrastructure merge all economic activity into one. More integrated economic activity result from a better organized transportation infrastructure. A common characteristic of nations with good development indices is a developed transportation infrastructure (O'Neill, Coney et al. 2020)

While most of the emissions. In addition are released near to the surface, the remaining half are carried over a height of 6,000 feet (Uherek, Halenka et al. 2010). That is why the world needs a better sustainable transportation system which can contribute to the environment and society.

## **1.1 Transport Sector in Pakistan**

The primary source of financial growth and development is thought to be the transportation sector. 10% of the GDP and 6% of the country's new business prospects are attributable to Pakistan. This area connects numerous economic sectors through the growth of agglomerations, the expansion of crossline and public trade, and the facilitation of spatial transformation. Due to the inefficiencies of the present vehicle and strategy framework, the Pakistani economy loses 4-6 percent of GDP each year, which is crucial for the health of the economy as a whole (Sánchez-Triana, Afzal et al. 2013). Pakistan also ranks the global rankings for being open to environmental issues. Climate change is anticipated to have unfavorable impact on Pakistan. This is peculiar for a nation, which ranks 135th in the world in terms of global greenhouse gases (GHG) emissions per capita but ranks 16th in terms of vulnerability to climate change (Khan, Khan et al. 2016). A green transportation

framework is urgently needed since it contributes significantly to environmental quality.

Due to various factors, Pakistan's transportation industry is growing at a double-digit rate. With 64% of the total population under 30 years of age, the country has the highest proportion of youth in the world. The population of the entire country is growing at a 2.1% annual rate. Pakistan is also undergoing fastest urbanization among South Asian nations; by 2025, the country's metropolitan population is anticipated to reach 60% (Ullah 2019).

Many issues with Pakistan's transportation system have various impacts on the country's energy and environmental issues. For instance, rail route transit rated as the main means of transportation throughout Pakistan's entire history. Prior to declining to 4% in 2011, it handled 73% of cargo transit during its peak between 1955 and 1960. Between 1991 and 2011, it reduced the length of its track by 11%, or from 8875 to 7791 km. Moreover, from 84.9 to 58.9 million passengers were transported overall during the same period, a 31% decrease (O'Neill, Coney et al. 2020). In 2019–2020, there were 39.4 million fewer travelers.

Another test for Pakistan's automotive industry is the use of high-sulfur fuels in the automobiles. The bulk of Pakistan's power plants have Sulphur levels between 5000 and 10,000 parts per million. The Euro III and Euro IV outflow guidelines are considerably exceeded by this sum. These Euro III or IV standards have been accepted by some South Asian nations. The appropriation interaction is typically delayed in Pakistan for a variety of reasons.

Transportation is believed to be Pakistan's second-largest energy user. As much as 97 percent of energy is derived from petroleum, and up to 28 percent of its energy mix is biased towards conventional sources. Pakistan's energy-related CO<sub>2</sub> emissions grew due to the amount of energy needed for transportation-related activities from 68,242 (kt) in 1991 to 166,298 (kt) in 2014 (Majeed and Tauqir 2020). The transportation industry globally emits 22% of greenhouse gases, a number that is expected to increase by 1.75 times by the year 2035 (Channa). Pakistan's ineffective and costly public transportation infrastructure has led to a development in the private transportation industry. Also, as its working class expands, private automobile demand has been steadily rising (Rasool, Zaidi et al. 2019).

Yet, employing environmentally friendly transportation strategies can aid in resolving the issues with the current transportation system. Implementing green transportation systems is one of the best methods to reduce oppression and meet the mobility needs of the steadily growing urban population, even though developing routes is not an option. Green transportation is an essential part of the sustainable development goals, which have been created over time by different experts. It can be summed up as "any form of transportation that takes into account people and offers a variety of safe, affordable routes of transportation."

Green transportation also has a negligible influence on the environment because it only uses energy that is either renewable or recycled, as opposed to fossil fuels-based vehicles like electric Bicycle, Auto Electric Sky Trains and Electric Motorcycles. The main contributors to the green energy transportation are vehicles with multiple occupants (which decreases the demand for more vehicles) and hybrid vehicles, among others (Pamuła and Pamuła 2020).

## 1.2 Introducing Green Transportation in Pakistan

Green transportation promotes a healthy and ideal way of living in addition to being an environment friendly or low-carbon method of transportation. Green transportation system development is advantageous for the efficient use of route resources for ease of over trafficking, the reduction of energy consumption, the reduction of over emissions, and finally it will minimize GHGS emissions.

Pakistan is one of the country's most vulnerable to climate change because it is primarily fueled by pollution. Due to significant Green House Gas (GHG) emissions, it is ranked as the third worst country in the world in the Global Air Quality Index Report 2022.

The recent data from the Pakistan Bureau of Statistics (PBS) show that recorded oil imports for the July to October period of 2020–21 were \$3.15 billion, demonstrating that the usage of fossil fuels is harmful to both the environment and the economy.

China and Japan are excellent examples of green travel, where high timeliness and performance flexibility are essential building blocks. It serves as a crucial component of integrated urban transportation and is the ideal mode of transportation for short-distance travel and transfer. In summary, developing green transportation significantly affects energy conservation, reducing carbon sequestration and PM2.5 emissions and enhancing the environment (Hua-pu 2009).

Climate challenges can be resolved by introducing EVs. EVs don't use fuel; instead, they run on electricity. EVs don't emit harmful contaminants in this way. Hence, replacing FFVs with EVs can significantly reduce the release of toxins which can aid to enhance the environment for decomposition. Suburban EV drivers will pay a hefty sticker price for each unit of power purchased from the government. The public authority can coordinate the amount for limit installments and generate a sizable money in this approach. Knowledge of EVs is certain to bring several other economic advantages. By drastically reducing gasoline imports, EVs will mitigate the growing import/export imbalance. The integration of EVs into the transportation system may create a completely new industry in Pakistan, opening a variety of economic opportunities and strengthening the nation's economy (Todoruț, Cordoș et al. 2020).

For the transportation sector, the energy input from fossil fuels is essential. Total transportation energy increased from 23% in 1971 to 29% in 2017. Moreover, oil accounts for 93% of all transport energy. Because the transportation industry is so dependent on fossil fuels and contributes to climate change and the difficulties related to global warming, dealing with green transportation is one of the most urgent issues facing the modern world (Sánchez-Triana, Afzal et al. 2013)

Road transportation is cited as the primary source of emissions among other modes of transportation. Following that, the aviation industry is the primary source of emissions (Bahadır 2022). Transport and industry make up the two major energy-using sectors in Pakistan. The energy mix is strongly biased in favor of traditional techniques since roughly 28 percent of the energy, which is derived from fossil fuels, is used for transportation (Sánchez-Triana, Afzal et al. 2013).



## 1.3 Problem Statement

For places like Islamabad and Rawalpindi, where urban expansion and development have led to increased population and land use, the risk of environmental degradation and climate change is a question of time given the high speed of technological innovation, industrial development and urban growth. These cities are growing rapidly and as they do, so do their needs for decent housing, decent educational facilities and decent transportation.

This study examines the lack of a transportation system in Islamabad and Rawalpindi, which are cities with at least minimal green and sustainable transportation policies in place. The Pakistani government has implemented Bus Rapid Transit (BRT) systems like Metro Bus Service to meet the country's rising demand for public transportation but did not properly calculate the environmental cost. These BRT initiatives didn't even account for long-term green goals to move from fossil fuel to electric vehicles. The goal of this project is to develop a replacement system for running the current transportation services in Islamabad and Rawalpindi that is based on an environmentally friendly and sustainable transportation system.

As a result, this study will gather information and compare the cost of an electric vehicle for the same project to an FFV that is now in use in Islamabad/Rawalpindi. The study will present the financial, social, and environmental costs of both FFV and EV. The alternative (EV) should also be able to provide all the specific operational and functional needs, such as charging stations, mileage, storage, and consumption.

## 1.4 Objectives of the Study

- 1) To analyse the mobility trends in Rawalpindi and Islamabad and propose mass transit routes for the twin cities.
- 2) To estimate the investment that would be required to establish an EV base mass transit system for the twin cities and compare it with the financial, economic and environmental cost of same system when operated on fossil fuels.

## 1.5 Significance of the Study

Many less developed nations are experiencing network issues and growing costs of living because of rising temperatures. An increase in Greenhouse Gases (GHG) is undeniably connected to an increase in temperature because of several anthropogenic and non-anthropogenic activities. There has been a considerable change in temperature during industrialization. GHG emissions have increased due to industrialization, surpassing all prior records from the previous 100 years and going beyond the point of no return. After industrialization, there has also been an increase in demand for transportation of goods from the point of manufacture to commercial hubs and to the doorsteps of customers all over the world. Yet, transportation is also essential for many economic and non-economic activities, which also produce significant amounts of CO<sub>2</sub>.

Bangladesh, a relatively underdeveloped country to Pakistan, has started taking moves to electrify its nation's roads. To promote EV growth, Bangladesh's Ministry of Industry has created the Automobile Industry Development Policy 2021. By 2030, the subject policy aims to transition the majority of goods used in public transportation to electric vehicles.

The 10-year tax vacation, financial incentives, buying subsidies, road tax waiver, duty cuts incentives for setting up battery recycling industries, and networks of charging stations have all been suggested by Bangladesh's ministry of industry. In addition, this policy recommends creating an "Energy-Efficient Vehicle Manufacturing Fund" into which fines and taxes on automobiles that pollute the environment will be put.

In Pakistan's transportation sector, a few solutions have been identified to reduce emissions by switching to alternative fuels because of their potential to reduce greenhouse gas emissions, benefits from economic growth and affordability. The vehicle offices include passenger cars, cabs, vans and trucks. CNG, diesel, gasoline and solar energy will replace current fuel sources.

On Prime Minister's directives, Ministry of Climate Change developed Pakistan's first National Electric Vehicle Policy (2019). The Policy suggests a strengthened and tiered approach for achieving the infiltration goals for electric vehicles in three stages, including market improvement and public awareness, the substitution of fuel import charges, neighborhood reception, and fare. Across the globe, EVs are dominating the automotive sector. In Pakistan, the transportation sector has experienced two- digit growth.

Almost all facets of transportation rely on petroleum-derived products, and the nation spends close to USD 13 billion on oil imports each year. The price of importing oil is anticipated to climb in the following years if the market for vehicles keeps expanding at the current two-digit rate. The country would likely face serious challenges in the next years because of the triple blow of rising fuel tax installments, unavoidable corruption, and limit tax installments. It is widely acknowledged that introducing EVs into the nation, with the appropriate strategic system, will not only improve the aforementioned concerns but will also lead to job creation and economic growth in the nation (Ullah 2019).

Although the National Electric Vehicle Policy is something to be grateful for, especially for the environment, work on this plan has not yet begun. This configuration is for all types of vehicles, including trucks, cars, and buses, but in Pakistan, only initial work on electric vehicles has been done. As we are aware, electric vehicles are more expensive than conventional vehicles, and only a small percentage of people can afford them. Therefore, on the off chance that we offer EVs as open vehicles and operate electric transports for public vehicles, it will be beneficial for both our nation and sustainability.

## **2 Results and Discussion:**

### **2.1 Brief about Calculations**

We have to calculate the forces for the individual buses. Equation No 1:  $\sum F = F_{\text{rail}} + F_{\text{grade}} + F_{\text{air}} + F_{\text{ace}}$ . The  $F_{\text{roll}}$  essentially represents the rolling resistance force. The force interface between the

tyres and the ground is called F grade, and the force is grade related. If the vehicle is moving downward, this could be detrimental because gravity will be assisting in propulsion in this situation. F air is the vehicle's resistance to the air, and F ace is the acceleration force acting on the vehicle. This formula has been used to determine the total of these forces separately for each type of bus

**Table 2.1: Forces for all categories**

Forces (N)	For Electric Buses	For Diesel Buses	For Solar Buses
F rail	360	320	63.5
F grade	97,200	86,400	17145
F air	105332.4	105332.4	105332.4
F ace	127.47	125.6	94.08
$\Sigma F$	<b>203019.8</b>	<b>192177.6</b>	<b>122634.9</b>

In Table 2.2 we have calculated the  $\Sigma F$  that is Total Forces acting on or moving the vehicle like acceleration and air resistance by using the formula for Electric buses, Diesel buses and Solar buses. The total force required to run electric buses is 203019.8 N for diesel buses 192177.6 N and for solar buses 122634.9 N

**Table 2.2: Preexisting Bus Routes of Islamabad and Rawalpindi**

Route No.	Distance (km)	Duration (hours)	Routes
1	44.513	0.884	Bhara Kahu to Morga
2	130.716	2.82	G-6 through RWP to I-8
3	24.324	0.5	I-8 to PWD Housing Society
4	44.451	1.063	Islamabad Sectors
5	83.08	1.541	PIEAS to Rawat
6	89.444	1.911	PIEAS to Rawat to Afzal Town
7	17.056	0.332	Pir Sohawa to F-7 Markaz
8	67.885	1.545	QAU to Saddar
9	20.918	0.564	Rawalpindi Medical Line
10	97.661	2.309	Satellite Town to Blue Area

In Table 2.2 we have taken the preexisting routes for Islamabad and Rawalpindi. In column three time is taken in hours but in the coming tables this time is converted into seconds through formula. The data is collected from the following factors.

- Road Length and Travel Distance
- Timetable on Bus Usage (Preexisting)
- Bus Stops (Number of stations in a single Bus Route)

Time, Power, and Energy consumption through given below formulas.

$$(1) \quad \text{Time } (t) \quad (t^{+}=\Delta t)-E(t) * \alpha * \beta$$

$$D(t+\Delta t)-D(t)$$

In this formula E represent the elevation over the time span (t, Δt) while D signify the distance (length of the route) a bus travels in the single time step Δt (One second is used in this study for Δt), α shows the traffic response and increase or decrease in traffic and β represent Go and Stop status of the vehicle (traffic stops).

For the assessment of the socio-environmental comparison between FFV and EV, the author wants to adapt an econometrics model of environmental impact of both the types of vehicles.

$$(2) \quad P = v \times \sum F$$

Where, V is the Velocity of the Bus and ∑F represent the total Forces acting on or moving the vehicle like acceleration and air resistance.

In formula two power is equal to velocity (V) multiply F characterize the total Forces acting on or moving the vehicle like acceleration and air resistance (∑F). Velocity for electric and solar bus is

## 2.2 but for diesel bus, is 4.7.

Velocity for diesel bus is higher because when a diesel bus running on fuel, 70 percent of its fuel is used, and the remaining 30 percent is going to waste. For fuel efficiency of modern vehicles, they are trying to convert them into half hybrid vehicles so that they can run on 30 percent electricity and energy loss will be 10 percent. All vehicles that are currently running in Pakistan, 70 percent of their fuel is being used and the remaining 30 percent is being wasted.

$$(3) \quad E \text{ Total} = t \times P$$

In this formula P shows the Power and T shows time between two set points.

In table 4.3 Time is the same for all buses. While power (P) and total Energy (E) are different for Deasil bus, Electric bus, and Solar bus.

**Table 2.3: Energy Consumption of Diesel Bus**

No. of Routes	Distance Km	Time (T) minutes	Power (P) watt (w)	Energy (E) kilowatt hour
1	44.513	0.884	903234.72	1092914.0
2	130.716	2.82	903234.72	370.3
3	24.324	0.5	903234.72	1806.4
4	44.451	1.063	903234.72	1083.8
5	83.08	1.541	903234.72	5871.0
6	89.444	1.911	903234.72	541.9
7	17.056	0.332	903234.72	2769.7
8	67.885	1.545	903234.72	6322.6
9	20.918	0.564	903234.72	1806.4
10	97.661	2.309	903234.72	451.6

As mentioned in the beginning, distance and time are the same for all kinds of buses but power and energy are different. So, using the formula which is given in the methodology section, we have found out the power and energy for all types of buses.

### 2.3 For Electric Buses

Table 2.4: Energy Consumption of Electric Bus

No of Route	Distance km	Time (T) minute	Power (P) watt (w)	Energy (E) kilowatt hour
1	44.513	0.884	507549.5	614134.8
2	130.716	2.82	507549.5	208.0
3	24.324	0.5	507549.5	1050.0
4	44.451	1.063	507549.5	609.0
5	83.08	1.541	507549.5	32990.7
6	89.444	1.911	507549.5	304.0
7	17.056	0.332	507549.5	1522.6
8	67.885	1.545	507549.5	3552.8
9	20.918	0.564	507549.5	1015.0
10	97.661	2.309	507549.5	279.1

### 2.4 For Solar Buses

Table 2.5: Energy Consumption of Solar Bus

No of Route	Distance km	Time (T) minutes	Power (P) watt (w)	Energy (E) kilowatt hour
1	44.513	0.884	306587.2	370970.5
2	130.716	2.82	306587.2	125.7
3	24.324	0.5	306587.2	613.1
4	44.451	1.063	306587.2	369.9

In the above tables 2.3, 2.4 and 2.5 total ten routes are taken for Islamabad and Rawalpindi. Time

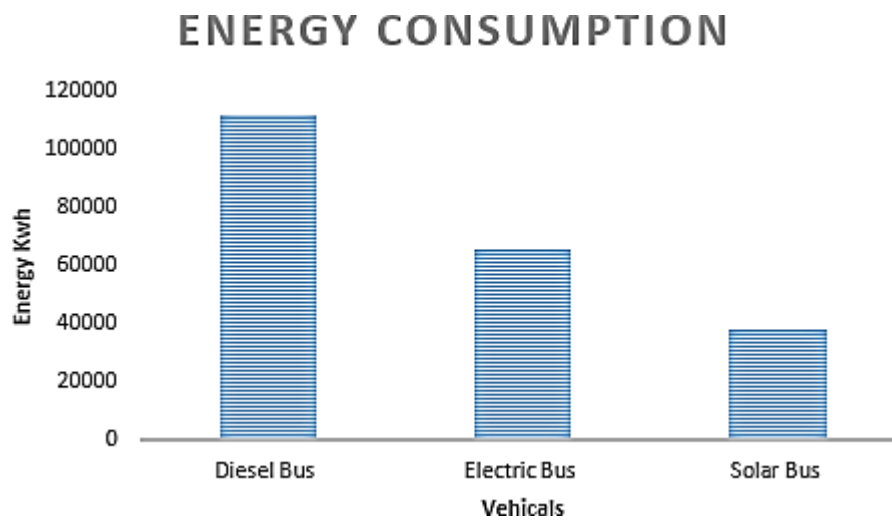
(T) and distance is same because we are doing comparisons among Electric buses, Diesel buses and Solar buses so, distance and time is same for all buses. Power and energy are different for Electric buses, Diesel buses and Solar buses.

## 2.5 Analysis

**Table 2.6: Total Energy Consumption of the Buses**

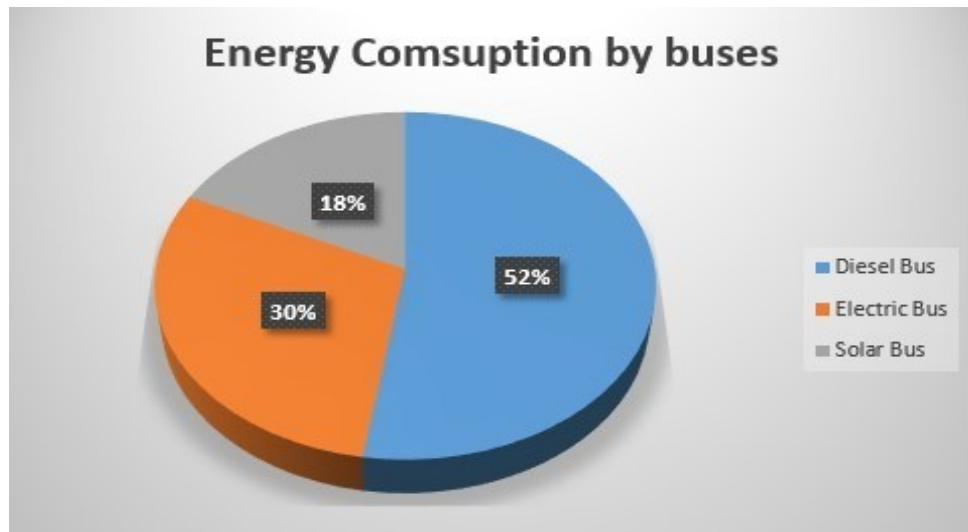
Buses Category	Duration (hours)	Average of the bus Energy (E) kilowatt hour
Diesel Bus	13.4	111393.37
Electric Bus	13.4	65566.6
Solar Bus	13.4	37810.34

In this research we are assuming total ten routes and combining these routes the total distance becomes 13.4 hours.



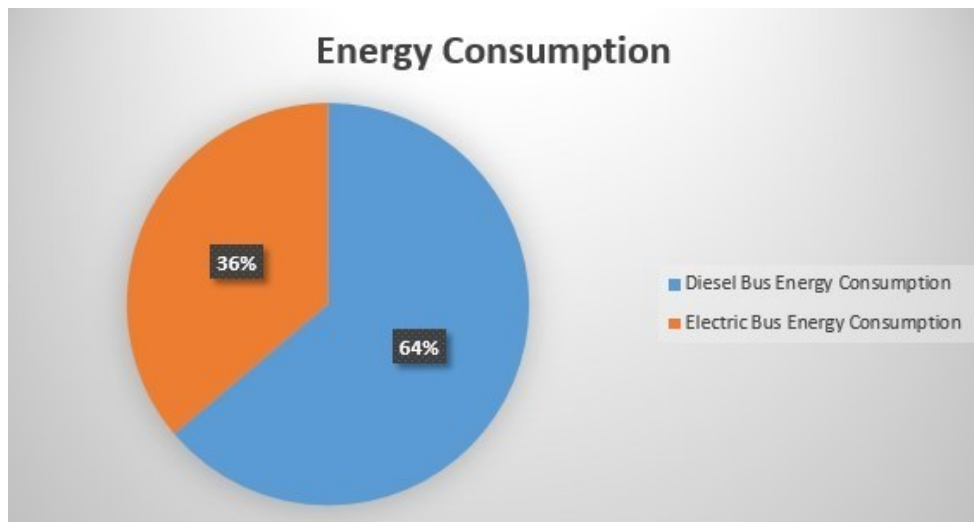
**Figure 2.1: Energy Consumption Comparison of all Buses**

The above diagram shows that diesel buses consume more energy than electric buses and solar buses.



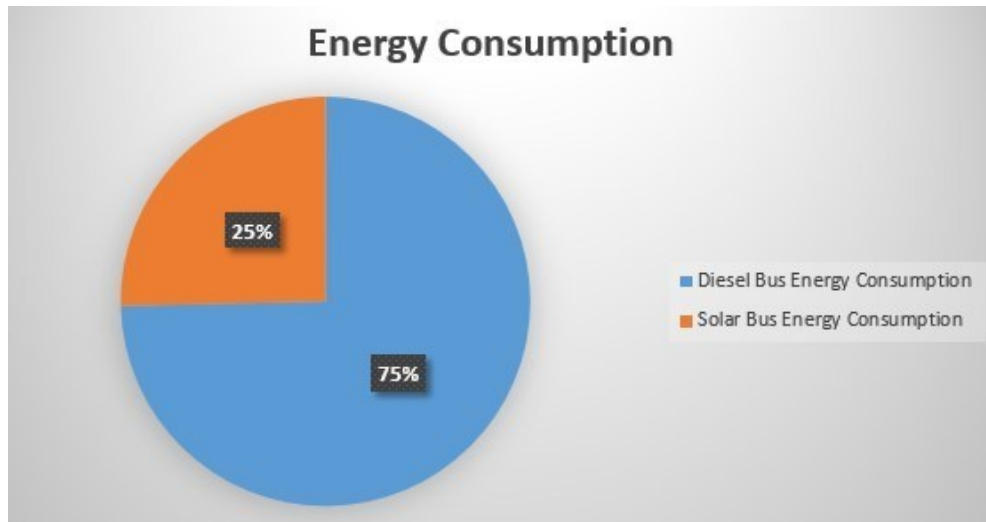
**Figure 2.2: Energy Consumption Comparison of all Buses (Pie Chart)**

The above diagram shows that diesel bus consumes total 52% energy, electric bus consumes 30% while solar bus consumes only 18% energy. So, we can say that the electric bus and solar bus are quite better than diesel bus.



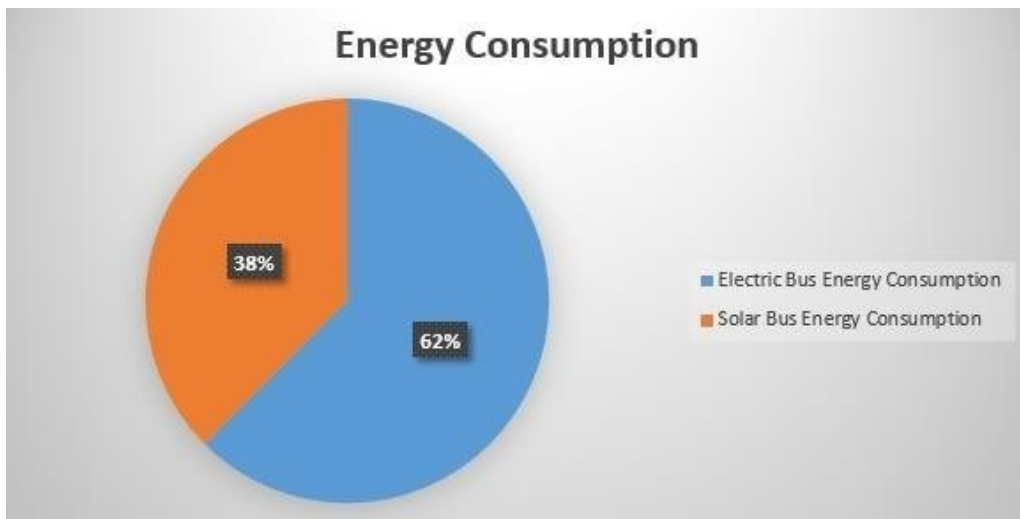
**Figure 2.3: Energy Consumption Comparison of diesel and electric buses (Pie Chart)**

If we do the comparison between diesel bus and solar bus than the diesel bus consumes 64% energy and electric bus consumes 36% of the total energy.



**Figure 2.4: Energy Consumption Comparison of all Buses (Pie Chart)**

Above diagram shows that diesel bus consumes 75% energy and solar bus consume only 25% energy.



**Figure 2.5: Energy Consumption Comparison of all Buses (Pie Chart)**

Above diagram shows the comparison between electric bus and solar bus. So solar bus consumes 38% energy and electric bus consume 62% energy.

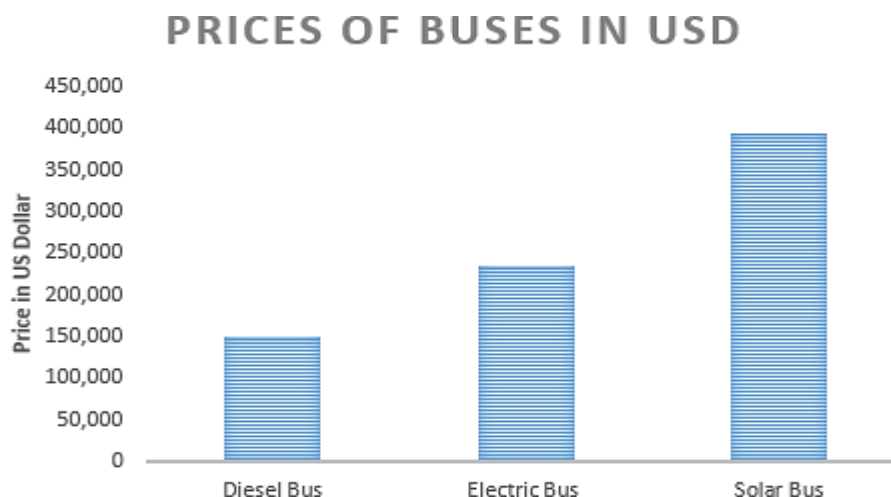


Pakistan's annual import of oil and gas accounts for about 80%. "If all 240,000 buses in Pakistan were changed into electric ones, it would save a lot of fuel, and the dependence on imports will be largely reduced. 40-50% of traffic emissions pollution can be lessened," said Liu Xueliang, General Manager of Asia Pacific Auto Sales Division, BYD.

**Figure 2.6: Energy Comparison of diesel and electric bus**

A	B	C
Diesel Bus		
	Quantity	Units
Energy in one Liter of Diesel	10	Kwh
Diesel Bus Consumption per 100 Km	40	Liters
Energy in 40 Liter of Diesel	400	Kwh
Evs		
Energy Consumption Per Km	1.3	Kwh
Energy Consumption in 100 Km	130	Kwh
Total Energy saved	270	Kwh

## 2.6 Financial Analysis



**Figure 2.7: Financial Comparison of all buses**

For the introducing of any new project its financial cost matters. The recent price of diesel bus is 150,000US\$, electric bus is 235,000 US\$ and for the solar bus is 395,000US\$. In a comparison among electric buses, diesel buses and solar buses the result shows that electric buses are still more expensive that fossil fueled buses, electric buses can provide cost saving over the long run. Prices for diesel, electric and solar buses have been acquired from M/s Hino Motors Global, M/s Zhengzhou Yutong China and M/s.

## 2.7 Discussion

**Table 2.7: Total Distance in miles for all routes under consideration**

Route No.	Distance (km)	Duration (hours)	Routes	Total Distance Both sides (km)	Distance (Miles)	Charging Station Required
1	44.513	0.884	Bhara Kahu to Morga	89.026	55	2
2	130.716	2.82	G-6 through RWP to I-8	261.432	162	5
3	24.324	0.5	I-8 to PWD Housing Society	48.648	30	1
4	44.451	1.063	Islamabad Sectors	88.902	55	2
5	83.08	1.541	PIEAS to Rawat	166.16	103	3
6	89.444	1.911	PIEAS to Rawat to Afzal	178.888	111	3
7	17.056	0.332	Pir Sohawa to F-7 Markaz	34.112	21	1
8	67.885	1.545	QAU to Saddar	135.77	84	3
9	20.918	0.564	Rawalpindi Medical Line	41.836	26	1
10	97.661	2.309	Satellite Town to Blue Area	195.322	121	4
	<b>620.048</b>	<b>13.469</b>		<b>1240.096</b>	<b>768</b>	<b>25</b>

In this research author takes total ten routes of Islamabad city for all buses as mentioned in below table. It is quite evident from the estimations that bus will cover **768 miles** (round trips) as a whole for all these ten routes in **13.5 hours**. Total number of charging station required for all routes are **25** as a whole. As rule of thumb one charging station is required for after each 40 miles, because batteries powered vehicles can cover 40 miles with initial full charge.

**Table 2.8 Cost of Charging Station**

Station	Cost of Charging
Charger	\$20,000
Installation	\$1,000
New Connection	\$2,500
Misc. @ 10%	\$2,350
Total Cost (USD) / Charging Station	\$25,850
Total Cost (PKR) / Charging station	723800
No. Charging Station Required	25
Total Cost of all charging stations (billion PKR)	0.18

The installation cost included the labor cost, material cost, and other such parameters; the new connection cost was the cost of the regulator, and in the case of the transformer, there

was a minimum cost both for the regulator and transformer. The operational and maintenance cost was taken as the 10% annual cost. The electricity and taxes costs were obtained from the provider, while we had to consider the rupee devaluation for investment and some miscellaneous charges, as this is the new technology, and there will inevitably be some unknown annual charges.

Cost and benefit analysis for all three buses (diesel, electric and solar) has been mentioned in the following table.

Following equations were used in the analysis:

1. Average Cost (Rs) = Average energy consumption (kWh) \* Cost of Generation (Rs/kWh)
2. Depreciation cost per route= Duration of all routes \* Average Cost
3. Adjusted Cost (PKR) = Average Cost + Depreciation cost per route
4. Net Saving (Billion PKR) = HSD Import bill reduction + Adjustment of Charging Station

For the estimation of savings of EVs and solar buses, adjusted cost has been determined by including depreciation cost, price of single unit of energy and amount of total energy consumed by each vehicle. During the analysis, considerable savings have been recorded from both electric and solar bus as 41% and 65% respectively. Use of electric bus and solar bus can save up to 220.62 and 353 billion PKRs of Total HSD Import bill. Moreover, Net savings by adding charging station adjustment has been recorded as 220.81 and 353.18 billion PKR for electric and solar bus respectively.

**Table 2.9: Net saving overview of Electric and Solar Bus in comparison with diesel bus**

Sr. #	Description	Diesel Bus	Electric Bus	Solar Bus
1	Duration (Hrs.)	13.4	13.4	13.4
2	Prices (USD)	150,000	235,000	395,000
3	Prices (PKR) (1 USD = 280 PKR)	42,000,000	65,800,000	110,600,000
4	Average Life of Bus (Km)	250,000	250,000	250,000
5	Depreciation	168	263.2	442.4
6	Average Bus Energy Consumption (kWh)	111393.37	65566.6	37810.34
7	Cost of Generation (Rs/ kWh) *	6.2654	6.2654	6.2654
8	Average Cost (PKR)	697924.02	410800.98	236896.90
9	Depreciation per route	2251.2	3526.88	5928.16
10	Adjusted Cost (PKR)	700175.22	414327.86	242825.06
11	Net Saving	-	40.8%	65.3%
12	Import Bill of Diesel (Billion PKR)**	540.42	319.80	187.42
13	Saving of Import Bill (Billion PKR)	-	220.63	353.00
14	Adjustment for charging station	-	0.18	0.18
15	Net Saving (Billion PKR)	-	220.81	353.18

Total import bill for all petroleum products for the year 2022 is \$ 4,6405,690,00, while 42% of this amount (\$1,930,087,598) is being consumed for HSD only. Which needs to address on priority basis. Introduction of EVs and solar buses can definitely reduce import bills as reflected in aforementioned analysis. Electric and solar buses requires less fossil fuel power energy as compare to diesel buses, while having same passengers' capacity. Which reflects benefits of these batteries powered vehicles over diesel buses.

**Table 2.10: Pakistan Energy Yearbook 2021**

<b>Fuel Mix 2020-21</b>		
Aviation Fuel	185,872	1%
Motor Spirit	8,889,188	49%
HOBC	172,865	1%
Kerosene	0	0%
HSD	7,481,533	42%
LDO	0	0%
Furnace OIL	175	0%
Electricity	0	0%
Natural Gas	1,258,447	7%
<b>Total Tons of Oil Equivalent</b>	<b>17,988,080</b>	

## 2.8 Environmental Impact of Different Transport Vehicles

The 200,000 km assumed for vehicle and battery lifespan is in line with the average lifetime estimates given by the automobile industry. Consumption phase is primarily responsible for the GWP impact, either directly through fuel combustion or indirectly through the production of electricity.

Using the base case assumption of a 200,000 km vehicle lifetime, EVs are found to lower GWP by 20% to 24% compared to gasoline FFVs and by 10% to 14% relative to diesel FFVs when fueled by typical European electricity.

We predict that LiNCM EVs offer a reduction in GHG emissions of 12% when compared to gasoline FFVs and achieve break-even with diesel FFVs when fueled by electricity generated from natural gas. Compared to diesel and gasoline FFVs, coal electricity-powered EVs are predicted to result in a 17%– 27% increase in global warming potential (GWP).

In comparison to FFVs, the production of an EV accounts for roughly half of its life cycle GWP. We calculate that the GWP from the manufacture of EVs will be between 87 and 95 grams of carbon dioxide equivalent per kilometer (g CO<sub>2</sub>-eq/km), or about twice as much as the 43 g CO<sub>2</sub>-eq/km attributed to the production of FFVs.

The GWP of the EV production phase is mostly made up of the manufacturing of batteries, which accounts for 35% to 41% of the total. 16% to 18% of the embedded GWP of EVs comes from other powertrain parts, particularly inverters and the passive battery cooling system with its high aluminum content.

Due to the higher energy density of their batteries, LiNCM EVs have a marginally lower GWP impact than LiFePO<sub>4</sub> EVs when life expectancies are held constant. The LiNCM and LiFePO<sub>4</sub>

cars have life cycle GWP intensities of 197 and 206 g CO<sub>2</sub>-eq/km, respectively, with the European electricity mix.

Assuming a vehicle lifetime of 200,000 km exaggerates the GWP benefits of EVs to 27% to 29% relative to gasoline vehicles or 17% to 20% relative to diesel vehicles because production-related impacts are distributed over the longer lifetime. This is because production impacts are more significant for EVs than conventional vehicles. The benefit of EVs compared to gasoline vehicles is reduced to 9% to 14% under the assumption of 100,000 km, and the environmental effects are same to those of a diesel vehicle.

The impact of both the vehicle and the electricity generating process, as well as important elements like energy consumption, battery lives, and vehicle lifetimes, all play a significant role in how environmentally friendly electric vehicles operate. The GWP impact of the diesel FFV would be smaller, for instance, if the calculation was done with a lifetime of 200,000 km for the FFV and a battery replacement assumption during the lifetime of the EV.

EVs are a significant technological advance with significant potential environmental benefits, but they cannot be used everywhere or under all circumstances. Our findings unequivocally show that encouraging EV use in regions where electricity is largely generated by the burning of lignite, coal, or even heavy oil is ineffective. Such electrical mixtures may, at best, result in local emission reductions.

Hence, EVs move emissions off of the road rather than lowering them globally. By using power generated from natural gas, EVs only accomplish a small number of benefits. Increased fuel economy or switching from gasoline to diesel FFVs without considerable issue-shifting could potentially result in a more significant reduction in GWP in the absence of foreseen improvements to power blends (with the exception of smog).

In comparison, the use of EVs in conjunction with clean energy sources could enable significant reductions in the environmental effects of numerous modes of transportation, particularly with regard to climate change, air quality, and the preservation of fossil fuels. So, the numerous benefits of EVs should be a driving force for improving regional electricity mixes, but their promotion should not come before a commitment to grid upgrading.

The benefits across time should be taken into account while considering alternative vehicle technology. While EVs might only provide marginal advantages or even disadvantages under a first-generation grid, their growth and market penetration should be assessed along with plausible long-term scenarios for grid expansion.

EVs appear to have a larger potential to harm humans, freshwater ecosystems, eutrophicate freshwater, and deplete metals. Nonetheless, there is a significant role for uncertainty and risk assessment in this trade-off.

As was previously mentioned, there are considerable uncertainty around both release inventories and characterization parameters in relation to these impacts. In order to effectively promote EVs through policy instruments, it may be necessary to achieve obvious reductions in emissions with known impact potentials, such as GWP and FDP, at the expense of uncertain increases in emissions that may have unknown effects, such as FETP.

A boost of EVs should be combined with stronger life cycle management and life cycle

auditing in light of this trade-off. Effective recycling systems and extended EV lives would be a reasonable first reaction, given that the possible problem shifts are mostly caused by the material requirements of EV manufacture.

It is necessary to develop a comprehensive material flow strategy that takes into account component recyclability, alternative materials, and secondary sources.

For policymakers and stakeholders, the change in emissions that EVs are expected to bring about—the elimination of tailpipe emissions at the expense of rising emissions throughout the production chains of cars and electricity—brings new opportunities and concerns.

On the one hand, EVs would consolidate emissions at a few point sources (such as mines, power stations, etc.) as opposed to millions of mobility sources, making it conceptually simpler to monitor and improve societies' transportation networks (McKinsey & Company, 2009).

On the other hand, we face difficulties as a community due to the indirect nature of these emissions, which are embedded in internationally traded commodities like copper, nickel, and energy. It asks if we take life cycle thinking seriously and how much control and monitoring, we, as consumers and policymakers, think should be exercised over production chains.

## 2.9 Environmental Impact of Diesel Buses

Diesel is a fossil fuel, which is extracted from crude oil in the refinery. Diesel is one of the primary sources for energy in Pakistan. Many sectors like power, oil and gas, cement, fertilizers, and manufacturing depend upon this fuel. Diesel's flash point is considerably low as 50° C as compared to its competitor furnace oil (Yusof, Abas et al. 2021). That's why diesel is used mostly in internal combustion engines (IC engines used in transport industry widely). When we look upon environmental impacts of fossil fuel-based engines, following consideration will come in the mind.

Diesel is a hydrocarbon-based fuel. Hydrocarbons means hydrogen and carbon molecules are available in this fuel. Combustion of hydrocarbons contributes mainly towards air pollution due to production of primary and secondary pollutants during combustion (Lloyd and Cackette 2001).

List of primary pollutants are mentioned below.

- Carbon monoxide (CO)
- Oxides of Sulfur (SOX)
- Oxides of nitrogen (NOX)
- Particles (Soot or Ash)

Interaction of primary pollutants with air or water leads towards formation of secondary pollutants List of secondary pollutants are as mentioned below.

- Acid Rain
- Smog

Short briefs about all these pollutants are as following.

Carbon Monoxide (CO) is generated from incomplete combustion of fuel. Hazard of air pollution due to carbon monoxide mainly comes from automobiles and transportation vehicles. Headache, nausea, unconsciousness, or death during extreme conditions are possible consequences during working in an area with highly concentrated carbon monoxide or having long exposure in a carbon monoxide rich environment (Gabriel, Martin et al. 2021).

Sulfur is also present in fossil fuels and during combustion this sulfur can encounter oxygen. Sulfur dioxide (SO<sub>2</sub>) and sulfur trioxide (SO<sub>3</sub>) are the main products of this interaction.

Sulfur trioxide (SO<sub>3</sub>) can cause problems in the respiratory tract. As per study, one volume concentration of (SO<sub>3</sub>) in a million volumes of air can lead towards coughing and choking. Sulfur trioxide (SO<sub>3</sub>) in combination with water makes sulfuric acid (H<sub>2</sub>SO<sub>4</sub>), which is harmful for metal objects due to its corroding nature.

Nitrogen oxides (NO<sub>x</sub>) mainly come from nitrogen present in fuel and air and already available oxygen in the air. Nitric oxide (NO) is one of the possible outcomes. Some nitric oxide (NO) is produced during interaction of nitrogen atom and fuel during oxidation of fuel and remaining nitric oxide (NO) is produced during high temperature combustion processes (Jurkovič, Kalina et al. 2020). Further interaction of nitric oxide with oxygen results in formation of nitrogen dioxide (NO<sub>2</sub>), which is highly noxious gas for lungs.

Particulate matter emissions (soot and fly ash) mainly disturb lungs, eyes and skin. Constant penetration and exposure of these fine particles into the lungs of humans can decrease the air capacity of the lungs, which will cause breathing and respiratory problems. Chronic asthma and emphysema are also severe outcomes of these PMs Emissions.

Acid rains originate from combination of (SO<sub>x</sub>) or (NO<sub>x</sub>) with water. Main products from these relationships are sulfuric acid and nitric acid. Oxides of Sulfur (SO<sub>x</sub>) are main contributors of acid rain. Acid rain can cause water pollution, which is harmful for aquatic living beings. Apart from this, acid rains can decrease pH of the soil which can harm the crops and forests (Potkány, Hlatká et al. 2018).

Smog is one of the major problems in our big cities of Pakistan like Lahore and Karachi. Such environmental degradations can lead towards respiratory problems, skin, and eye irritation. A major problem while mitigation plans is that these particles are too much fine and smaller in size. Normal protective masks are not sufficient and adequate against these particles.

## **2.10 Environmental Impact of Electric Buses**

### **2.10.1 No Emissions**

Electric vehicles do not produce zero any “tailpipe emissions”. Tailpipe emissions are basically the emissions that came out from exhaust of vehicles during combustion of fuel. Carbon dioxide (*CO<sub>2</sub>*), nitrogen oxides (*NO<sub>x</sub>*), hydrocarbons (HC), sulfur oxides (*SO<sub>x</sub>*), Particulate matter (*PM<sub>10</sub>*) are the major examples of tailpipe emissions.

Electric vehicles do not have any internal combustion engine likewise in diesel bus. Electric vehicles do not use any fossil fuel. So, hazard of tailpipe emission is being neglected completely by electric vehicles.

### **2.10.2 Reduction in Air and Noise Pollution**

Electric vehicles do not contribute to air pollution of eco-system. Air quality is also being improved due to use of EVs instead of diesel vehicles. Replacing the traditional diesel buses with EVs will also reduce noise pollution in the environment as well.

Improved quality of air due to reduced noise and emissions level can improve human’s behavior as well. Nickel is obtained after horizontal surface mining, which leads towards extensive environmental degradations like deforestation and scrapping out the top layer of soil. Such degradation of natural resources should remain under consideration during electrification of transport system.

Extraction of lithium is also a lengthy and difficult process. Lithium extraction can take up to 12 to 18 months. During this process, huge amount of water like 500,000 gallons will be required for one ton of lithium. So, this process also can lead towards water and soil contamination.

Moreover, other elements (cobalt and copper) used in batteries also do have similar types of issues. Batteries can also impact environment in case of poor disposal. Poor disposal techniques can contaminate the water and soil.

### **2.10.3 Fossil fuel-based production of electric cars:**

EVs don’t use fossil fuels during running on the roads but their production and supply chain is dependent upon such fuels. Manufacturing of EVs is still not powered or energized from green energy sources like biogas, solar or wind. So, assembling of these vehicles do have carbon and greenhouse gas traces on the environment.

### **2.10.4 Fossil fuel-based sources for charging of EVs:**

EVs are not directly depended upon fossil fuels as they don’t have any internal combustion engine. But EVs still depends upon these types of fuels when it comes to the charging of the EVs. Batteries need charging during day-to-day trips. Charging of these batteries is being done through normal AC supply obtained from national grid.

The electricity needed for charging is not usually come from renewable energy sources. We don’t know the exact source of the electricity from where EV is going to be charged. Because



source of electricity could be thermal, hydro or any other renewable energy source like solar or wind. If we look upon electricity generation mix of Pakistan, 58% of generation is depended upon thermal for the FY (2020-21) as per NTDC Power System Statistics 47th Edition December 2022. This data depicts that charging of these vehicles will mainly contribute form fossil fuels.

EVs usually used lithium-ion batteries. These batteries do have serviceability over 10 to 15 years. These batteries can be recycled. As per new technologies available now a day, we can recover up to 90% of battery components. During recycling process, delicate care should be taken during handling of battery cell electrolyte. This electrolyte can be exposed to human and surroundings which can contaminate the water and soil. So, during recycling, hazard of environmental degradation is always there.

Electric vehicles are being supported by governments and automakers all over the world as a significant technology to reduce oil consumption and combat climate change. While most experts concur, that plug-in cars are a more environmentally friendly option than conventional cars, their construction and charging methods can still have an impact on the environment.

### **2.10.5 Production of Batteries:**

Main or primary source of energy in case of EVs is batteries. Lithium-ion batteries are used mostly in EVs. These batteries have a low self-discharge rate, more charge cycles, high energy density, low maintenance requirements, and are lightweight and small (Yusof, Abas et al. 2021) According to an estimate, calculation for CO<sub>2</sub> emissions was made as mentioned below.

Amount of CO<sub>2</sub> released for 1 kilowatt-hour (kWh) = 150 kg

Battery capacity required for decent range (Yusof, Abas et al. 2021) (like 300 miles)

between charges = 60 kWh Total amount of CO<sub>2</sub> released for 60 kilowatt-hour  
(kWh) = 9000 kg

### **2.10.6 Charging issues:**

Electric motors are almost always far greener than conventional cars if you assume they get their energy from the typical American grid, which often consists of a mix of fossil fuel and renewable energy plants. Because of their batteries, electric cars produce more emissions during production, but their electric motors are still greener than traditional internal combustion engines, which burn fossil fuels. However, that is just an average.

### **2.10.7 Battery manufacturing:**

The lithium-ion cells that power most electric motors rely, like many other batteries, on raw minerals like cobalt, lithium, and rare earth elements that have been linked to serious environmental and human rights concerns. Problems with cobalt have been particularly

severe. Cobalt mining produces hazardous tailings and slags that could leak into the environment, and studies have shown that nearby communities are very susceptible to cobalt and other metals, especially among children. Smelting, a process used to separate the metals from their ores, is also required. Smelting has the potential to release Sulphur oxide and other hazardous substances that are extremely detrimental to the environment.

### **2.10.8 Easy Recycling:**

According to experts, old batteries contain valuable metals and other materials that can be salvaged and used again. Battery recycling can use a lot of water or discharge toxins into the air, depending on the procedure utilized. Lithium battery recycling rates are now quite low, but they will undoubtedly rise with time and innovation. Finding new uses for used electric vehicle batteries in storage and other areas is one of the encouraging strategies that have been suggested. Lowering the range of mileage by shortening the battery's life.

### **2.10.9 Quicker Payback:**

Based on an average yearly driving distance of roughly 7,800 km for cars in the UK, an electric car will produce 30% less carbon than a conventional car over the course of its roughly 12-year lifespan. It implies that your payback would come quicker the more you drive.

In my perspective, driving a petrol or diesel car can never offset the emissions that were started during the manufacture process.

### **2.10.10 EVs have no direct tailpipe emissions:**

During operation, traditional cars burn fossil fuels, which generates CO<sub>2</sub> along with other pollutants including nitrogen oxides that cause a variety of health issues. In comparison, an electric car causes zero direct tailpipe emissions.

### **2.10.11 EVs will keep getting greener with the electricity grid:**

In more than 90% of the world's population, recharging an EV produces fewer carbon emissions than running it on gasoline or diesel. EVs are significantly greener in nations where a big portion of the electricity grid is powered by low-carbon and renewable energy sources. For instance, they produce 70% less carbon during their lifetime than a standard car in France and Sweden.

### **2.10.12 EV batteries have an environmental impact but are getting greener:**

Batteries used in EVs usually made up of metals like nickel, lithium, cobalt, and copper. Extraction of these metal is a big environmental challenge. Battery producers are currently renovating batteries that have need of fewer resources, but there is no disagreeing that they do incorporate an ethical cost just like other goods such as electronics and clothing.

### **2.10.13 Almost all EV can be recycled including the battery:**

When a battery loses 70% of its capacity, many battery manufacturers advise replacing it. Because they still have a reasonable amount of life in them, manufacturers may convert them into household batteries for storing solar-generated electricity. EV manufacturers taking charge of recycling or reusing batteries from their own models. Nissan, for instance, already powers automated vehicles in their industrial unit using their own approach.

### **2.10.14 Environmental Impacts of Solar Buses:**

Solar buses are eco-friendlier as compared to diesel or electric vehicles. Because primary source of solar powered bus is not depended upon any type of fossil fuel. Solar buses and electric buses both have advantage of zero emission over diesel bus during running or operation (Shahina, Ebenezer et al. 2021).

Solar buses and electric vehicles do have many similarities like both runs with the batteries. Solar buses and electric buses share some environmental impacts in common due to these similarities. Common environmental impacts will be as following.

- CO2 Emission during manufacturing of batteries.
- Degradation of natural resources during mining and extraction of rare metals for batteries.
- Use of hydrocarbon or fossil fuel during production of the bus.
- Use of non-renewable energy sources for charging of batteries.
- Handling of hazardous components of batteries during recycling process.

Impacts are due to batteries. Solar buses do have other environmental impacts mainly due to solar panels. Which are listed as mentioned below.

### **2.10.15 Solar panels manufacturing:**

Solar panel is made up of semiconductor material. Semiconductors such as silicon, germanium, and gallium arsenide are used in formation of solar cells (Collins, Powell et al. 2015). Huge amount of energy is being consumed in the process of mining of raw material, manufacturing, and transportation to obtain useable solar module.

During the formation of solar cell, quartz or crystals of raw materials must go through extensive processing and cleaning (Xu, Li et al. 2018). During manufacturing stages, high power consuming heaters are used for heating of quartz. In short, all these processes do need a lot of energy (kWh) which mostly comes from non-renewable energy sources. Use of these non-renewable energy sources will surely impact environment.

### **2.10.16 Chemicals:**

Transformation from raw semiconductor material to a useable solar panel requires an extensive process as mentioned earlier.

During this process, hazardous materials like hydrochloric acid, sulfuric acid, nitric acid,

hydrogen fluoride and acetone are used for cleaning of semiconductor surface. Moreover, toxic chemicals like hydrofluoric acid and sodium hydroxides are also used in the processing stages.

Exposure of these chemicals to humans, water or soil can be harmful and may leads towards degradation of natural resources. Proper disposal techniques should be adopted for management of toxic waste materials hydrofluoric acid and sodium hydroxides are also used in the processing stages.

### **2.10.17 Solar Waste:**

Solar cell technology is quite new in this world, so recycling of solar panel is not being explored very well. Major concern during recycling of solar cells is presence of cadmium and lead in solar cells. Mostly old solar cells are disposed in large landfills (Xu, Li et al. 2018). These toxic elements present in the waste can contaminate soil and water severely.

## **3 Conclusion**

Developed nations like the USA, Europe, and others are constantly concentrating on adopting environmentally friendly practices which generate fewer CO<sub>2</sub> emissions. One sustainable move is the recent development of electric automobiles. These environmentally conscious regimes should be implemented in South Asian developing countries like Pakistan, Bangladesh, and India. Although the introduction of EVs alone is not the only or entirely solution to attaining a clean and green environment in the nation, taking these actions will help us move closer to an environment with less emissions.

Solar and electric buses are superior to diesel bus while considering overall environmental footprint and impacts. As both solar and electric buses have almost zero emission technology during operation. At present moment or initially, cost-feasibility is positive for diesel bus due to low prices of vehicle in comparison with solar or electric bus and cost-feasibility is negative for electric and solar bus due huge capital expenditure (CAPEX) requirement in the beginning.

In a long run, social feasibility will be positive for electric and solar bus. As human being's attitudes towards environment friendly appliances, equipment and machines are quite optimistic. Behaviors of humans towards energy efficient and environmentally friendly solutions are increasing day by day as shown in upcoming few examples such as, preferring wind or solar energy sources over thermal, replacing old conventional lights with LED. These positive behaviors depict that people will move or prefer electric or solar bus over the diesel bus. Therefore, in the future, social feasibility of diesel bus will be negative.

The detailed analysis and study of both fossil fuel and electric vehicles differentiate the use of both vehicles. The electric vehicles are expensive but their prices are coming down. With new Chinese automotive brands, the prices have become equal to or less than fossil fuel vehicles. Electric vehicles also have less maintenance cost, low fuel cost depends on the source of electricity production, and completely environment friendly, and also have a more

safety factor.

Although fossil fuel vehicles are cheap but have a high maintenance cost, more fuel cost and running of fuel leaves behind the dangerous carbon, Sulfur, and fine particulate matter which are destroying the environment, endangers the human lives, and economy of Pakistan.

It is concluded from this paper that using the electric car in Pakistan can be very useful, cost-saving, environment saving, fuel-saving, and life-saving as well. The increasing population and increasing number of cars on roads are creating serious problems for the nation. As the world is moving towards renewable sources of energy so, it is the responsibility of our government to invest in using the new technology resources to save the lives and environment of Pakistan. In the light of the current automotive market, new electric car manufacturing is encouraged and a tax-free import of electric vehicles is allowed.

### 3.1 Recommendations

- Driving the EVs from renewable energy sources will significantly enrich system efficiency the in general.
- Pakistan must implement a successful and environmentally sustainable fuel substitution strategy during economic downturns. Environmentally friendly manufacturing, transportation, and supply production methods should be used to encourage increased growth and sustainable mobility.
- Rethinking physical infrastructure is required, as is the development of green transportation, as well as public education about the usage of and financial investment in green transportation options through tax breaks, subsidies, and incentives.

Develop local innovation and capacity-building initiatives that will enable local investors to gain from the inflow of capital and cutting-edge technology. The expansion of local markets will be facilitated by this in.

## REFERENCES:

- Abousleiman, R. and O. Rawashdeh (2015). Energy consumption model of an electric vehicle. 2015 IEEE transportation electrification conference and expo (ITEC), IEEE.
- Ali, Y., et al. (2018). "Economic and environmental impact of transport sector on Europe economy." Asia- Pacific Journal of Regional Science **2**: 361-397.
- Allahmoradi, E., et al. (2022). "Policy Instruments for the Improvement of Customers' Willingness to Purchase Electric Vehicles: A Case Study in Iran." Energies **15**(12): 4269.
- Allan, A. (2012). The transport policy and planning implications of electric cars for Australian cities. Australasian Transport Research Forum (ATRF), 35th, 2012, Perth, Western Australia, Australia.
- Anwar, S., et al. (2022). "Consumers' switching intentions from conventional to green vehicles in the context of smog risk in Pakistan." Case Studies on Transport Policy **10**(3): 1695-1705.
- Asghar, R., et al. (2021). "Electric vehicles and key adaptation challenges and prospects in Pakistan: A comprehensive review." Journal of Cleaner Production **278**: 123375.
- Asim, M., et al. (2022). "Estimating the long-term effects of national and international sustainable transport policies on energy consumption and emissions of road transport sector of Pakistan." Sustainability **14**(9): 5732.
- Bahadır, S. (2022). "Analyzing the environmental Kuznets Curve hypothesis in terms of airplane transport: empirical examination for Baltic States." International Journal of Energy Economics and Policy **12**(5): 252-259.
- Balsalobre-Lorente, D., et al. (2021). "The asymmetric impact of air transport on economic growth in Spain: fresh evidence from the tourism-led growth hypothesis." Current issues in tourism **24**(4): 503- 519.
- Barber, N. (2008). "World in Focus-Focus on Pakistan." World Almanac Library, Stamford, Ct.
- Berckmans, G., et al. (2017). "Cost projection of state of the art lithium-ion batteries for electric vehicles up to 2030." Energies **10**(9): 1314.
- Bilal, M., et al. (2021). "Air pollution scenario over Pakistan: Characterization and ranking of extremely polluted cities using long-term concentrations of aerosols and trace gases." Remote Sensing of Environment **264**: 112617.
- Channa, A. K. "FACTORS INFLUENCING HYBRID CAR OWNERSHIP IN ISLAMABAD: DOES ENVIRONMENTAL IMPACT PLAY A ROLE IN THE PURCHASE OF A HYBRID CAR?".
- Collins, K., et al. (2015). Life cycle assessment of silicon solar panels manufacturing in the United States. 2015 IEEE 42nd Photovoltaic Specialist Conference (PVSC), IEEE.

Correa Perelmuter, G., et al. (2017). "Performance comparison of conventional, hybrid, hydrogen and electric urban buses using well to wheel analysis."

Costa, C. M., et al. (2021). "Electric vehicles: To what extent are environmentally friendly and cost effective? –Comparative study by european countries." Renewable and Sustainable Energy Reviews **151**: 111548.

Crabtree, G., et al. (2017). "Where is transportation going?" Europhysics News **48**(3): 21-25.

Cusenza, M. A., et al. (2019). "Reuse of electric vehicle batteries in buildings: An integrated load match analysis and life cycle assessment approach." Energy and buildings **186**: 339-354.

de Mello Bandeira, R. A., et al. (2019). "Electric vehicles in the last mile of urban freight transportation: A sustainability assessment of postal deliveries in Rio de Janeiro-Brazil." Transportation Research Part D: Transport and Environment **67**: 491-502.

Delprat, S., et al. (2004). "Control of a parallel hybrid powertrain: optimal control." IEEE transactions on Vehicular Technology **53**(3): 872-881.

Ebrie, A. S. and Y. J. Kim (2022). "Investigating Market Diffusion of Electric Vehicles with Experimental Design of Agent-Based Modeling Simulation." Systems **10**(2): 28.

Enang, W. and C. Bannister (2017). "Modelling and control of hybrid electric vehicles (A comprehensive review)." Renewable and Sustainable Energy Reviews **74**: 1210-1239.

Few, S., et al. (2018). "Prospective improvements in cost and cycle life of off-grid lithium-ion battery packs: An analysis informed by expert elicitations." Energy Policy **114**: 578-590.

Gabriel, N. R., et al. (2021). "A comparative life cycle assessment of electric, compressed natural gas, and diesel buses in Thailand." Journal of Cleaner Production **314**: 128013.

Gabsalikhova, L., et al. (2018). "Activities to convert the public transport fleet to electric buses." Transportation research procedia **36**: 669-675.

Galati, A., et al. (2022). "Consumers' willingness to pay for agri-food products delivered with electric vehicles in the short supply chains." FIIB Business Review: 23197145221112743.

Gambhir, A., et al. (2015). "Reducing China's road transport sector CO2 emissions to 2050: Technologies, costs and decomposition analysis." Applied energy **157**: 905-917.

Gomez Vilchez, J. J., et al. (2019). "Electric car purchase price as a factor determining consumers' choice and their views on incentives in Europe." Sustainability **11**(22): 6357.

Guo, Y., et al. (2022). "Variability in total cost of vehicle ownership across vehicle and user profiles." Communications in Transportation Research **2**: 100071.

Hawkins, T. R., et al. (2013). "Comparative environmental life cycle assessment of conventional and electric vehicles." Journal of industrial ecology **17**(1): 53-64.

Hoekstra, A. (2019). "The underestimated potential of battery electric vehicles to reduce emissions." Joule **3**(6): 1412-1414.

- Hua-pu, L. (2009). "Approaches towards realization of urban green transportation." Urban Transport of China **7**(6): 23-27.
- Hyard, A. (2012). "Cost-benefit analysis according to Sen: An application in the evaluation of transport infrastructures in France." Transportation Research Part A: Policy and Practice **46**(4): 707-719.
- Jacobson, M. Z. (2009). "Review of solutions to global warming, air pollution, and energy security." Energy & Environmental Science **2**(2): 148-173.
- Jaffery, S. H. I., et al. (2014). "The potential of solar powered transportation and the case for solar powered railway in Pakistan." Renewable and Sustainable Energy Reviews **39**: 270-276.
- Jain, V., et al. (2012). Road traffic congestion in the developing world. Proceedings of the 2nd ACM Symposium on Computing for Development.
- Jiang, Y., et al. (2017). "Recognition of battery aging variations for LiFePO<sub>4</sub> batteries in 2nd use applications combining incremental capacity analysis and statistical approaches." Journal of Power Sources **360**: 180-188.
- Jurkovič, M., et al. (2020). "Environmental impacts of introducing LNG as alternative fuel for urban buses—case study in Slovakia." Promet-Traffic&Transportation **32**(6): 837-847.
- Khan, F., et al. (2022). "An Evaluation of Cost Optimization Strategies for BRT Projects in Pakistan." Engineering, Technology & Applied Science Research **12**(4): 8825-8830.
- Khan, F., et al. (2020). "Sustainable hybrid electric vehicle selection in the context of a developing country." Air Quality, Atmosphere & Health **13**: 489-499.
- Khan, M. A., et al. (2016). "The challenge of climate change and policy response in Pakistan." Environmental Earth Sciences **75**: 1-16.
- Khwaja, M. A. (2005). "Air pollution: key environmental issues in Pakistan."
- Kitthamkesorn, S. and A. Chen (2017). "Alternate weibit-based model for assessing green transport systems with combined mode and route travel choices." Transportation Research Part B: Methodological **103**: 291-310.
- Kühne, R. (2010). "Electric buses—An energy efficient urban transportation means." Energy **35**(12): 4510- 4513.
- Lajunen, A. (2014). "Energy consumption and cost-benefit analysis of hybrid and electric city buses." Transportation Research Part C: Emerging Technologies **38**: 1-15.
- Lajunen, A. and T. Lipman (2016). "Lifecycle cost assessment and carbon dioxide emissions of diesel, natural gas, hybrid electric, fuel cell hybrid and electric transit buses." Energy **106**: 329-342.
- Li, Z., et al. (2019). "A comprehensive review of the key technologies for pure electric vehicles." Energy **182**: 824-839.



- Lin, C., et al. (2013). "Life-cycle private costs of hybrid electric vehicles in the current Chinese market." Energy Policy **55**: 501-510.
- Lloyd, A. C. and T. A. Cackette (2001). "Diesel engines: environmental impact and control." Journal of the Air & Waste Management Association **51**(6): 809-847.
- Luo, L., et al. (2018). "Optimal planning of electric vehicle charging stations comprising multi-types of charging facilities." Applied energy **226**: 1087-1099.
- Mahmoud, M., et al. (2016). "Electric buses: A review of alternative powertrains." Renewable and Sustainable Energy Reviews **62**: 673-684.
- Majeed, M. T. and A. Tauqir (2020). "Effects of urbanization, industrialization, economic growth, energy consumption, financial development on carbon emissions: an extended STIRPAT model for heterogeneous income groups." Pakistan Journal of Commerce and Social Sciences (PJCSS) **14**(3): 652- 681.
- McKenzie, E. C. and P. L. Durango-Cohen (2012). "Environmental life-cycle assessment of transit buses with alternative fuel technology." Transportation Research Part D: Transport and Environment **17**(1): 39- 47.
- Miao, Y., et al. (2019). "Current Li-ion battery technologies in electric vehicles and opportunities for advancements." Energies **12**(6): 1074.
- Napoli, G., et al. (2021). "Freight distribution with electric vehicles: A case study in Sicily. Delivery van development." Transportation Engineering **3**: 100048.
- Neubauer, J. and A. Pesaran (2011). "The ability of battery second use strategies to impact plug-in electric vehicle prices and serve utility energy storage applications." Journal of Power Sources **196**(23): 10351-10358.
- Newman, D., et al. (2014). "Urban, sub-urban or rural: where is the best place for electric vehicles?" International Journal of Automotive Technology and Management **14**(3-4): 306-323.
- Nikolić, Z. and Z. Živanović (2012). The Contribution and Prospects of the Technical Development on Implementation of Electric and Hybrid Vehicles. New Generation of Electric Vehicles, IntechOpen London: 27-66.
- Nurhadi, L., et al. (2014). "Advancing from efficiency to sustainability in Swedish medium-sized cities: an approach for recommending powertrains and energy carriers for public bus transport systems." Procedia-Social and Behavioral Sciences **111**: 1218-1225.
- O'Neill, B., et al. (2020). Effectiveness of electric vehicle policies and implications for Pakistan, National Renewable Energy Lab.(NREL), Golden, CO (United States).
- OECD, I. (2016). "Energy and air pollution: world energy outlook special report 2016."
- Pagliaro, M. and F. Meneguzzo Lithium battery reusing and recycling: a circular economy insight. Heliyon. 5, e01866 (2019).

- Pamuła, T. and W. Pamuła (2020). "Estimation of the energy consumption of battery electric buses for public transport networks using real-world data and deep learning." Energies **13**(9): 2340.
- Panchal, S., et al. (2020). "High reynold's number turbulent model for micro-channel cold plate using reverse engineering approach for water-cooled battery in electric vehicles." Energies **13**(7): 1638.
- Peiseler, L. and A. C. Serrenho (2022). "How can current German and EU policies be improved to enhance the reduction of CO2 emissions of road transport? Revising policies on electric vehicles informed by stakeholder and technical assessments." Energy Policy **168**: 113124.
- Petrauskiene, K., et al. (2020). "Situation analysis of policies for electric mobility development: Experience from five european regions." Sustainability **12**(7): 2935.
- Pipitone, E., et al. (2021). "A life cycle environmental impact comparison between traditional, hybrid, and electric vehicles in the European context." Sustainability **13**(19): 10992.
- Potkány, M., et al. (2018). "Comparison of the lifecycle cost structure of electric and diesel buses." NAŠE MORE: znanstveni časopis za more i pomorstvo **65**(4 Special issue): 270-275.
- Rasool, Y., et al. (2019). "Determinants of carbon emissions in Pakistan's transport sector." Environmental Science and Pollution Research **26**: 22907-22921.
- Raturi, A. K. (2019). "Renewables 2019 global status report."
- Ribau, J., et al. (2014). "A new offline optimization approach for designing a fuel cell hybrid bus." Transportation Research Part C: Emerging Technologies **42**: 14-27.
- Richa, K., et al. (2017). "Eco-efficiency analysis of a lithium-ion battery waste hierarchy inspired by circular economy." Journal of industrial ecology **21**(3): 715-730.
- Rosenberger, K., et al. (2022). "Estimating the potential of electric mobility in commercial transport considering the availability of charging infrastructure–A behavioural model analysis for the city of Hamburg." Research in Transportation Business & Management **43**: 100772.
- Sánchez-Triana, E., et al. (2013). Greening growth in Pakistan through transport sector reforms: a strategic environmental, poverty, and social assessment, World Bank Publications.
- Sandmo, A. (2011). Economics evolving: A history of economic thought, Princeton University Press.
- Shahid, M., et al. (2022). "Economic and environmental analysis of green transport penetration in Pakistan." Energy Policy **166**: 113040.

- Shahina, T., et al. (2021). Investigation of Large-scale Solar Integration on a Standard Bus. 2021 International Conference on Communication, Control and Information Sciences (ICCISc), IEEE.
- Siragusa, C., et al. (2022). "Electric vehicles performing last-mile delivery in B2C e-commerce: An economic and environmental assessment." International Journal of Sustainable Transportation **16**(1): 22-33.
- Sommer, S. and C. Vance (2021). "Do more chargers mean more electric cars?" Environmental Research Letters **16**(6): 064092.
- Staff, I. E. A. (2012). CO2 emissions from fuel combustion, Organization for Economic.
- Sun, X.-H., et al. (2016). "Fast-charging station choice behavior among battery electric vehicle users." Transportation Research Part D: Transport and Environment **46**: 26-39.
- Thiel, C., et al. (2020). "Will electric vehicles be killed (again) or are they the next mobility killer app?" Energies **13**(7): 1828.
- Tie, S. F. and C. W. Tan (2013). "A review of energy sources and energy management system in electric vehicles." Renewable and Sustainable Energy Reviews **20**: 82-102.
- Todoruț, A., et al. (2020). "Replacing Diesel Buses with Electric Buses for Sustainable Public Transportation and Reduction of CO 2 Emissions." Polish Journal of Environmental Studies **29**(5).
- Tsakalidis, A., et al. (2019). "The role of infrastructure for electric passenger car uptake in Europe." Energies **12**(22): 4348.
- Uherek, E., et al. (2010). "Transport impacts on atmosphere and climate: Land transport." Atmospheric environment **44**(37): 4772-4816.
- Uk, G. (2020). "The ten point plan for a green industrial revolution." Building Back Better, Supporting Green Jobs, and Accelerating Our Path to Net Zero: 14e16.
- Ullah, K., et al. (2023). "The symmetric and asymmetric impacts of green energy, eco-innovation, and urbanization in explaining low-carbon economy for Pakistan." Environmental Science and Pollution Research **30**(12): 33375-33395.
- Ullah, N. (2019). "Electric vehicles in Pakistan: Policy recommendations volume I cars." Energy Inst., Lahore Univ. Manage. Sci., Lahore, Pakistan, Tech. Rep.
- White, L. V., et al. (2022). "Why are charging stations associated with electric vehicle adoption? Untangling effects in three United States metropolitan areas." Energy Research & Social Science **89**: 102663.
- Xu, Y., et al. (2018). "Global status of recycling waste solar panels: A review." Waste management **75**: 450-458.

Yao, E., et al. (2020). "Optimization of electric vehicle scheduling with multiple vehicle types in public transport." Sustainable Cities and Society **52**: 101862.

Yusof, N. K., et al. (2021). "Techno-economic analysis and environmental impact of electric buses." World Electric Vehicle Journal **12**(1): 31.

Żelazna, A., et al. (2020). "Corporate Social Responsibility towards the Environment in Lublin Region, Poland: A comparative study of 2009 and 2019." Sustainability **12**(11): 4463.

## CHAPTER 6

# SUSTAINABLE URBAN PLANNING TRANSPORTATION POLICY FOR ISLAMABAD AND RAWALPINDI

Saadia Khizar and Dr. Junaid Alam Memon (2021)

### Abstract

Under the sustainable development goals 2030 agenda, the 12<sup>th</sup> goal of responsible consumption and production states that nations should ensure sustainable consumption and production patterns to reduce effects on environment and human behavior. The consumption of any recourse is considered sustainable if their negative by products does not transfer to future generations or the need of present generation compromises the needs of future generations. Prioritizing efficient usage of recourses and minimalizing the wastage is the desired goal. The consumption patterns of transportation in Islamabad and Rawalpindi are mostly depended on the Private automobile sector and lacks efficient Public Transportation System to address increase demand and consumption of Cars, Taxi Services, or different Private Ventures. Bus Rapid Transit (BRT) like Metrobus are a good initiative but not enough of the increase urban expansion and urban demand. Hence, this study has appointed 200+ buses at present partially operational under different public and semi-public institutes to create a fully functioning conventional Public Bus System based of applied quantitative research for Islamabad and Rawalpindi. The research also analyzed the mobility trend and patterns of the two cities through various sources of Data specific from Google Traffic Live, Public authorities like RTA, ITP, and Private ventures Careem and Uber. The study determine common mobility needs and accurate Public Bus Routes for both inter and intra-city transportation of Islamabad-Rawalpindi.

**Keywords:** *Urban Transportation, Mobility Metrix, Mobility trend, Public Bus System, Transportation Routes.*

## 1 Introduction

### 1.1 Background of the Study:

Transportation is critical to the functioning of society whether economic or social. People and goods move according to socio-economic, geospatial, cultural and legal constraints (Wang, Zhang, Hu, Yang, & Lee, 2017). Transportation is one of the essential tools of an urbanized society where your economical choices dominate your personal preferences. An average worker looks for sustainable, affordable, safe and time effective transportation system as his daily income depends on his ability to move where his work takes him. In this highly competitive society, where everything is measured according to the profit it yields, hence, public transportation is an alternative for the working class (Agency, 2005).

In transport sector, increased spatial dispersion with evidential urban expansion and exposure has created both positive and negative impacts/externalities (The Global Economy, 2019). Firstly, it has created mobility challenges for the majority population living under poverty line. Secondly, the negative impacts of a car-based transportation system have grown to the point where they create incremental reduction in mobility and accessibility. Especially issues like congestion, air and noise pollution, traffic accidents, and consumption of finite resources are examples of what has been termed the unsustainability of transportation.

According to a research conducted by Ghaffar (2015), Low road quality, higher road consumption, rapid population and unchecked urbanization has created spatial dispersion in land use and transportation among the Asian countries which further results in creating mobility challenges for the majority population living under poverty line earning on day to day basis (Muhammad Adeel, 2014).

The ground reality states that the average distance between economic activities are increasing but the accessibility and mobility are reducing with unchecked growth of private sector transportation (Litman, 2007). In this time, the lack of inclusive public transport, poor transportation infrastructure, poor road quality, rising road consumption, rising levels of private automobile ownerships and lack of private sector regulation authority or traffic regulation are creating further issues towards already crumbling mobility options.

A world where businesses, trades, cultural, economic, and physical practices triumphed, a place where goods, products and services were bartered from a place of surplus to a place in need of that good. For example, Labor moving according to their work placement, or as simple as travel to acquire commodities. Hence, the concept of movement was always present in the world where it was a motion to movement for collection of water at domestic level or the travel associate with migration in search of sustainable living in early parts of our civilization.

The movement or travel today's urbanized world are completely different as today's people still are in need to travel to acquire their means of living, to socialize and interact within their communities, to establish links and bonds with their surroundings, to meet substantial requirements of living a good life etc.

Moreover, the travel patterns have evolved quit significantly over hundred thousand years of civilization's effort towards creating an industrially revolutionized world. Travel patterns, now, has been clearly divided into two categories of inter and intra city travel; where inter-city travel means travel between two cities and intra-city means travel within the same city. This study will focus on creating an inter-city and intra-city Transportation plan for Islamabad-Rawalpindi, Pakistan.

Transportation is generally classified into three broader categories namely land, water, and air transportation as for the modes of transportation we will only focus on land transportation. The most common mode of transport are Railways, Roadways, Waterways, Airways and Pipelines. The land transportation or the roadways are further classified as off road and on road transportation where railway is generally associated with on road transportation (Nijkamp, 1994). For this story, we will focus on off road transportation that

deliver services from door-to-door basis, we will specifically focus on passenger vehicles like buses, taxis, Wagon etc.

Islamabad and Rawalpindi are at the center of urban development and are experiencing capital dispersion throughout with new developmental zone and scheme. But sadly, the transportation options of the twin cities are limited to BRT (Metro bus Service), Government regulated Private transport and Private transport.

The existing policy action taken up by Pakistani government has been of mediation or regulation rather than working as provider of any public service. The Regional Transportation Authority (RTA) and Transportation Department, Government of Punjab act as regulators for different Private companies like Daewoo Express or individual entities like Wagons and Taxi owners. The Transportation Department of Punjab and RTA provide services like route permits, registration, licensing, and Road info.

For Public transport projects, the Punjab Mass transit Authority (PMA) working under the guidance of Transportation Department, Government of Punjab has initiated few Public transportation projects like Metro Bus Services (MBS) in Lahore, Islamabad-Rawalpindi, and Multan as well as Orange Line Metro Train in Lahore and Karachi both ongoing projects. The Lahore Metro Bus System was first initiated in 2013, while Islamabad-Rawalpindi, Multan in 2015 and 2017, respectively. Above all types of transport works on partial mobility mechanism limiting their use as compared to private sector. The LMBS (Lahore Metro Bus Service) also has a Feeder Bus Service which will increase the mobility range as more people be able to use it. Currently, more than 70% travel in Pakistan is supported by Private sector or individual entities.

On the other hand, Private sector consists of Individual Ventures, Private Cars and Semi-Private Vehicles. Urban Transport demand is met with positive response on purchase and import of vehicles by the governmental regulate bodies (Nijkamp, 1994). Hence, resulting in increased number of purchases of personal transport as well as increased number of vehicles on the road directly linked to road accumulation and traffic problems.

The following presents some statistics regarding the increase in the number of privately owned vehicles.

**Table 1: The Number of Privately Owned Vehicles over the Years**

Year	M. Cycle/ Scooter	Motor Car	M. Cab/ Taxi	Motor Rickshaw	D. Van	Pick up	Station Wagon	Buses/ Minibus	Truck	Total
2015-16	6,669.3	6,131.7	186.5	118.5	191.4	166.3	192.0	150.6	263.8	15,568.8
2016-17	11,975.3	6,954.0	197.4	122.0	204.2	176.4	201.9	156.3	276.2	21,858.6
2017-18	14,060.9	7,183.5	197.7	128.1	210.1	187.2	206.6	159.2	280.0	24,268.0
2018-19	14,623.3	7,470.8	205.6	133.2	218.5	194.7	214.9	165.6	291.2	25,238.7

Increased private consumption is also contributing factor of spatial dispersion and extended land cover. Urban area in Pakistan, like Islamabad and Rawalpindi, spread over thousands of kilometers requiring people to travel from one end to another. Hence, the private mode of transport is considered accurate and necessary in the absence of any public transportation alternative which might be more feasible and accessible. The types of transportation currently available is both formal and informal transport like Bus rapid transit (BRT), Wagon, Suzuki, and Qing qi which are used for Public transportation purposes.

There is a gradual increase in the number of the vehicles used in all genres at the rate of ten thousand per one unit according to National Transport Research Centre (NTRC) but for those who cannot have a personal vehicle turn to privately owned Taxi, Wagons etc. Accordingly, to Wang et al. (2017), around 80,000 workers and students travel in between the two cities over a distance of 30 kilometers on average to both ends of Islamabad and Rawalpindi (Ramli & Monterola, 2015).

With this description state, the study will explore alternative and efficient transportation policies while utilizing the preexisting recourse the cities of Islamabad-Rawalpindi have to offer (Taylor, 2015). Rawalpindi and Islamabad metropolitan area (RIMA) is the third largest metropolitan district combine in Pakistan with different transport authorities.<sup>3</sup>

Statistically, around 200+ buses or minibuses 30–40-seater are currently operating in Islamabad and Rawalpindi under the indirect authority of varies government or semi government universities but are not operating at full utility as they cater to student or university demand only

(Jamil, Rashid, & Yar, 2017). This study will collect current data on the number of buses operational in Islamabad-Rawalpindi to establish the Bus system.

The economic activity of a worker depends on the ability to move from one place to another at the cheapest possible option, sadly, Pakistani citizen's mobility is directed by a large private sector with profit maximizing approach where either the rate of travel is expensive, or the routes are not presenting optimal connectivity causing time wastage. In Pakistan, 80% of the transportation sector is private, hence, causing inequality and limited access to spatial distribution.

In Pakistan, sadly, there is a unique lack of public transportation system. Pakistan has created a market for private consumption when it comes to transportation and the public sector is dominated by privately owned taxi/Wagon system or private contractors (Asif Bajwa, 2015). The inefficiencies of this system have led to safety hazards like road accidents, unsafe driving, neglect towards traffic regulation, and increase in bikes and overcrowding in parking spaces. The inefficient structure of transportation also creates undesirable issues like gender

---

<sup>3</sup> Rawalpindi and Islamabad metropolitan area (RIMA) is the third largest metropolitan district combine in Pakistan with different transport authorities namely District Regional Transport Authority (Rawalpindi – RTA) and Islamabad transport Authority (Islamabad – ITA) respectively. It is based on the economic, labor and industrial growth of both the cities as well as the growing urban migration rate towards the twin cities, cumulative rise in the population.



inequality and financial exclusion etc. Time management and ease of service has also created inefficiencies in current transportation sector of Pakistan (Camargo Pérez, Carrillo, & Montoya-Torres, 2014).

## **1.2 Summary:**

Increased urbanization, spatial distancing and an increased need to mobility has led the author to write about the importance of conventional Public Transportation System. This study plans to create efficient and effective use of already available recourse, Public and Semi-Public Institute's owned Buses used for individual transport (operational university buses), to empower the population of two cities by increasing their mobility. This alternative use of the buses will help create a more financially affordable, environmentally sustainable and more socially acceptable Public transportation plan (Sciara, 2017). This study will illustrate (through QGIS) optimal connectivity routes both inter and intra city from these buses and the number of buses needed to eliminate demand constraints and spatial constraints (overcrowding by private automobile ownership) for Islamabad and Rawalpindi.

## **1.3 Problem Statement:**

The rapid increase in urban expansion and spatial dispersion has create a huge gap in the demand of affordable and sustainable transportation modes. Governmental response to mobility and transportation issue has boasted the Private Sector consumption like Motor Vehicle Sales reaching all time high of 26,550 units in 2018 and the entry of luxury modes of transport like Uber, Careem, but failed to increase the quality of roads with only 0.1% difference in year 2018-2019 (National Transport Research Centre (NTRC), 2019).

Islamabad-Rawalpindi are primary example of urban areas having low road quality, high traffic congestion, high spatial constraints and high urban expansion with higher commuting cost and low alternative modes of travel. Currently, in Islamabad-Rawalpindi 260 buses are present and operational at partially utility under different Public and Semi-Public institutions, so, the problem is not the availability of resources but of effective implementation of these resources to get the maximum benefit for the citizens of Islamabad-Rawalpindi. Hence, under 12<sup>th</sup> SDG of responsible consumption, this study will use the above mentioned 260 buses to create a conventional Public Bus System.

There is a need to create an optimal public transportation plan to increase the general mobility and accessibility of the people of Islamabad-Rawalpindi. Bus system to equip people with better mobility, affordability, and accessibility than those of private consumption. The purpose of this study is to use all the resources (land, buses, labor) Islamabad-Rawalpindi have to create a Public Bus Service to fit all the transportation needs of public in this area. Hence, therefore, I would like to propose a sustainable and efficient public transportation policy combining both efficiency and utilization of existing resource plus ensure accessibility and mobility of all.

## 1.4 Objectives:

The following are the objectives of this study.

- To create a sustainable Public Transportation plan by allocating already existing resources to maximize efficiency and accuracy in transport need.
- To increase accessibility and mobility of individuals by identifying common flow of mass commute or demand patterns in residential and commercial areas of Islamabad-Rawalpindi.
- To use GIS (Geographic information system, QGIS info, QGIS catalog and QGIS Map) for mapping and to illustrate the working routes of proposed public transportation plan.

## 1.5 Research Questions:

After analysis the modes of transportation and the need for an alternative of mass demand of mobility, this study has determined the need for the following research questions for mobility re- equipment's of Islamabad - Rawalpindi.

- How to create a sustainable and efficient Public Transportation plan for Islamabad – Rawalpindi?
- What are the commute patterns of the general population in Islamabad – Rawalpindi?
- What are the optimal routes for the proposed Public Transportation plan to increase mobility and accessibility for all?

## 1.6 Significance of the Study:

The significance or importance of the study is based on the analysis of efficient and accurate usage of transport means in Islamabad-Rawalpindi. The study aims to find a sustainable transportation plan for Islamabad-Rawalpindi by determining the mobility and accessibility of public of the twin cities. Also, this study under 12<sup>th</sup> SDGs will increase the utilization of preexisting resources of Islamabad-Rawalpindi to benefit more people of the twin cities. Creating a Public Bus System (Bus Sharing) to eliminate the need for private consumption of transport.

The second importance of this study is the data collection technique employed, where the author will have used real time data collection and, hence, develop a database of common mobility patterns of the citizens of Islamabad-Rawalpindi. This database will be beneficial for future research regarding mobility trends and need of urban areas.

## 2 Findings and Discussion

### 2.1 Data Analysis and Findings:

The aim of the study is to apply the 175 bus (chapter no 4 number of university buses) to create optimal accessibility for a public transport system. For the various data collected, it now time to analysis that in an organized and accurate method. Initially, the author divided the obtained data into direct mobility and derived mobility classification to later be converted

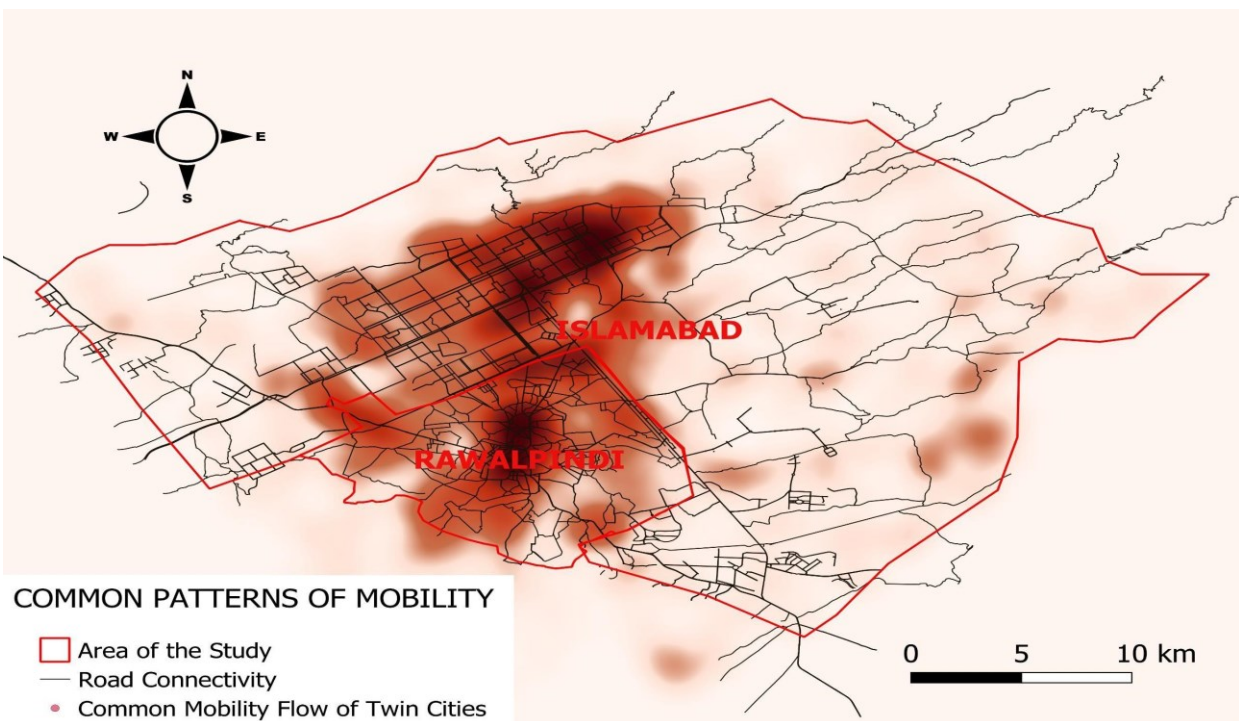
into point data based on their movement nodes (start and end). For direct mobility, the starting of a trip and end of a trip provide the specific movement nodes but, for derived mobility, it is important to understand the geographical area and using temporal dependencies to draw some common nodes for the majority of transport.

As discussed in chapter no 3, the author will generate a graduation map for the union councils of Islamabad and Rawalpindi to highlight each UC's need for travel and, hence, develop the flow of routes of the final transport plan from them.

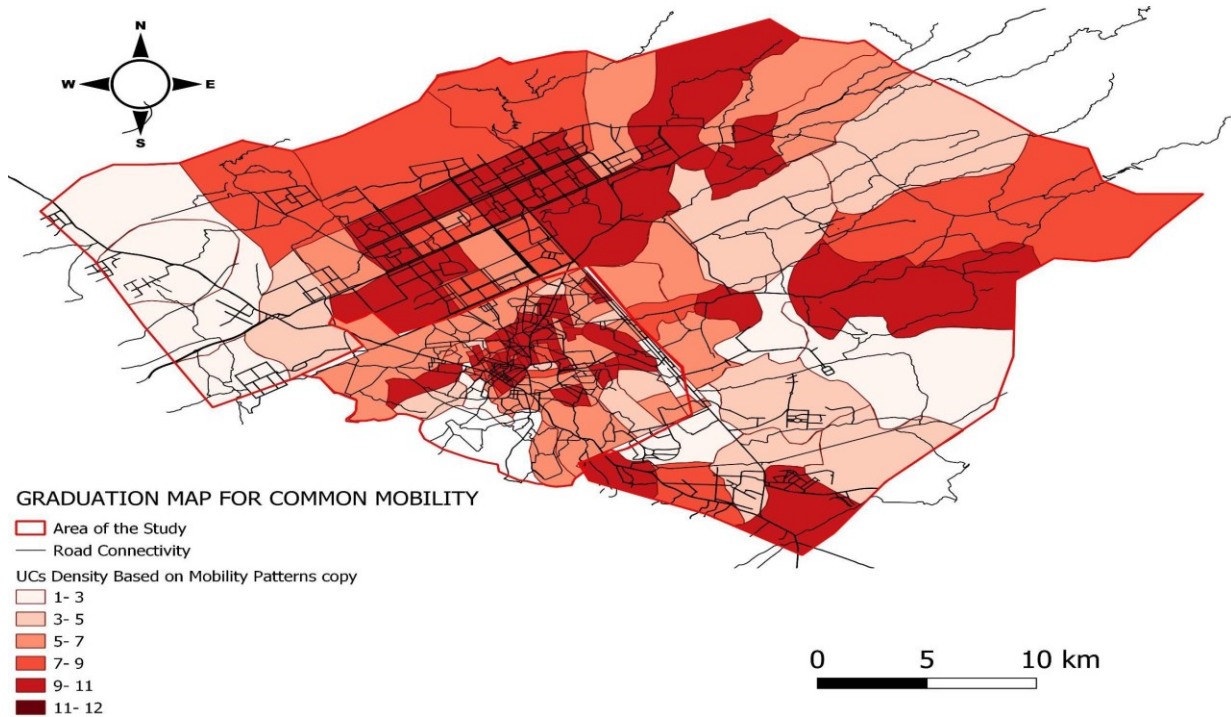
For the visual representation of the collected data, the author has created two maps as follows which provide a rough idea of the common mobility patterns or high traffic flow areas according to all the sources of data. The best visual map is a heat map for both Islamabad and Rawalpindi and for further understanding, a graduation map showing the difference of travel in between different union councils of Islamabad-Rawalpindi.

The following two maps are the initial stage for the analysis of determining the optimal routes of connectivity and accessibility.

**Map 1: Heat Map for the Common Patterns of Mobility In Islamabad-Rawalpindi**



**Map 2: Mobility Density Based On Union Council Division for Islamabad-**



The following concept is used to rationalize the different spatial data (polygon, polyline, and point) obtained.

## 2.2 Link Connectivity:

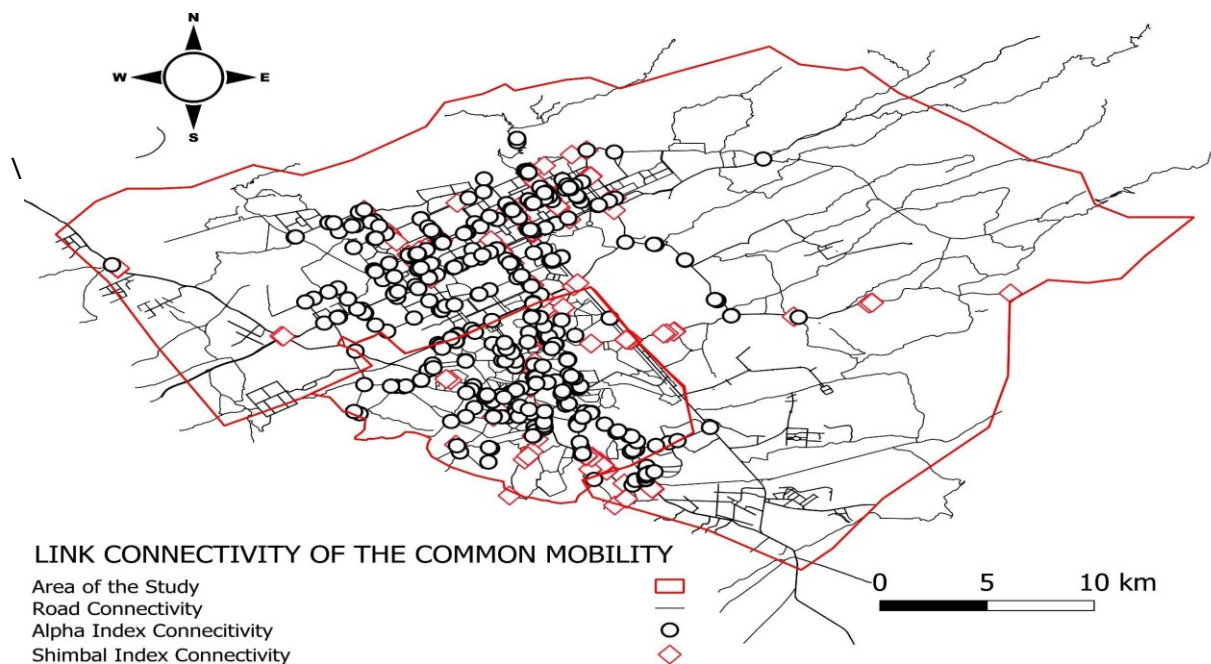
The concept of link connectivity is very commonly used in transportation planning, ranging from Mass Transit to Railway construction (Kevin S., 2019). The basic road connectivity consists of nodes (points of interaction between two or more roads) that are placed as indicators to highlight the connectivity of the roads. The nodes on the road connectivity represent the commonality of two different roads, hence, the word connect is used as these nodes are used to connect two or more lines. The link connectivity creates a circuit between multiple layers of data. If you observe a road structure closely, you will see lots of turns and points joining two or more lines, those points are known as link (node) connectivity (Xjini, 2018).

There are many types of link connectivity that are used in different types of areas from science to construction. There is alpha index (link connectivity) which represents all the common nodes in a connect. The alpha index simply includes all the common connectivity nodes and lines. For example, in a traffic stop intersection there are four alpha connectivity nodes as each share the same common point of interaction. There is beta index which represents a tree type connectivity where larger links are connected to smaller through beta index. For example, Murree Road is interconnected to 6<sup>th</sup> road forming a tree like shape (Urban Lab, 2014).

There is also shimbel index of connectivity which represents the shortest distance between

two nodes. This index determines the closeness of each node, it is also called closeness centrality or distance centrality. There is also gamma index ( $\gamma$ ) which is a ratio between the observed number of links and nodes of a given transportation network to get a clear picture of the scale of the transportation network.

**Map 3: Link Connectivity for Mobility Dense Areas of Islamabad-Rawalpindi**



There are many other link connectives (detour, Pi index) which the author will use to determine the connectivity of the different types of data obtained. The aim is to create point shape file for the data obtained and create an output of common nodes based on that.

For this study, these nodes will be accumulated for each source of data obtained and combined to create a connectivity network for highlighting the opaquest nodded areas of Islamabad-Rawalpindi.

### 2.3 Major and Minor Trip Generator:

To acquire the final routes of the public transport plan in this study, the author will employ trip generation techniques. The purpose of trip generation is to estimate the number of trips per route necessary to provide optimal accessibility to the citizens of Islamabad-Rawalpindi. The author will calculate the total travel time on each routes using ORS tools with real time API for traffic delay, hence, estimating the minimum number of buses used by each route.

The land use of any urban development is divided into two board categories, residential and non-residential areas, here most of the travel demand originates from and to depending on the usage. Hence, the trips are represented as residential trip production acquired from households and non-residential as trip attractions from different forms of land use. The trip

generation is followed by destination choice, mode choice and route choice according to conventional transportation design process which determine the travel demands.

It predicts the number of trips originating in or destined for a particular traffic analysis zone. Every trip has two ends, and we need to know where both are. The first part is determining how many trips originate in a zone and the second part is how many trips are destined for a zone. Because land use can be divided into two broad categories (residential and non-residential) we have models that are household based and non-household based (e.g., a function of number of jobs or retail activity).

For the residential side of things, trip generation is thought of as a function of the social and economic attributes of households (households and housing units are very similar measures, but sometimes housing units have no households, and sometimes they contain multiple households, clearly housing units are easier to measure, and those are often used instead for models, it is important to be clear which assumption you are using).

At the level of the traffic analysis zone, the language is that of land uses "producing" or attracting trips, whereby assumption trips are "produced" by households and "attracted" to non-households. Production and attractions differ from origins and destinations. Trips are produced by households even when they are returning home (that is, when the household is a destination). Again, it is important to be clear what assumptions you are using.

## 2.4 Stop Density for Each Route:

The study will determine the trip generator of each route proposed based on high or low travel density of that area. The final routes will be divided into major trip generators and minor trip generators depending to the length of the route and their potential stops.

Also, the author will determine the ratio of stops or stop density for each route based on accessibility factor. Here, the ideal distance from and to a potential stop is taken as 1.2 kilometers or 15 minutes walking approx. as referred by Clarence Perry's 15 minutes' city in 1900s.

The formula to estimate the stop density of each route is as follows.

## 2.5 Equation

$$\text{Duration } t \text{ from A to B} = \text{Duration } c \frac{\sum N}{\sum N} + \alpha + \beta + \pi \quad (5.1)$$

**Whereas,**

Duration  $t$  from A to B = Duration of travel between two consecutive bus stations. Duration

$c \sum N$  = Total duration of travel on one complete Bus Route.

$N$  = Total number of stations 1.5 km apart on that

Route  $\alpha$  = Traffic constant.

$\beta$  = Traffic signal constant.

$\pi$  = Occupancy of Passengers (loading and unloading).

Also, the formula to calculate the number of buses used per route is as follows.

### Equation

$$N_b = \frac{\text{Duration } c \sum N}{\text{Duration } t \text{ from A to B}} \quad (5.2)$$

So, the number of buses on one route is equal to total time used to travel on one route (in minutes) divided by the duration of travel between two consecutive bus stations.

**Table 2: The Number of Buses Used And Their Usage According To The Time Travel:**

Name of the Routes	Number of Stops	Distance Between Two Stops in Minutes	Bus Interval between Two Stops Approx. (After $a$ , $b$ , $\pi$ )	Total Distance of Route by QGIS	Total Travel Time of Route by ORS	Number of Buses on Each Route 10 minutes apart
Bhara Kahu to Morga	10	5.5 min	10 min	20 km	30 min	3
G-6 through RWP to I-8	15	7 min	10 min	37 km	2-hours 12 min	13
I-8 to PWD Housing Society	8	6 min	10 min	16.7 km	45 min	4
Islamabad Sectors	11	6 min	10 min	22 km	1-hour 10 min	7
PIEAS to Rawat to Afzal Town	12	5 min	10 min	26 km	79 min	8
PIEAS to Rawat	6	4 min	10 min	12 km	25 min	2
Pir Sohawa to F-7 Markaz	5	8 min	10 min	10 km	40 min	4
QAU to Saddar	15	6 min	10 min	30 km	2-hours	12
Raja Bazar to DHA House Scheme	9	5 min	10 min	15 km	60 min	6
Rawalpindi Medical Line	9	6 min	10 min	20 km	55 min	6
Satellite Town to Blue Area	16	6 min	10 min	24 km	2-hours 30 min	15
Tarnol to Westridge	7	4 min	10 min	18 km	20 min	2
Waris Khan to Murree	4	7 min	10 min	7 km	20 min	2
Total buses used to create Bus Transport System						84

**Table 3: The Names of the Stops per Route in the Proposed Bus System:**

Name of the Routes	Number of Stops	Name of the Stops
Bhara Kahu to Morga	10	Kashmiri Mohalla Dohk Jillani, Lake View Park, Shakarparian National, Chaklala Scheme, Morga.
G-6 through RWP to I-8	15	F-8, F-9, F-10, I-9, I-8, G-8, G-6
I-8 to PWD Housing Society	8	I-8, Pirwandi, Holy Family Hospital, Chaklala Scheme
Islamabad Sectors	11	F-9, F-8, F-6, F-10, Blue Area, Faisal Avenue
PIEAS to Rawat to Afzal Town	12	PIEAS, Chashzda, COMSATS, Rawat, Lake view
PIEAS to Rawat	6	Kashmiri Mohalla Dohk Jillani, Lake View Park, Shakarparian National, Chaklala Scheme, Morga.
Pir Sohawa to F-7 Markaz	5	F-8, F-9, F-10, I-9, I-8, G-8, G-6
QAU to Saddar	15	I-8, Pirwandi, Holy Family Hospital, Chaklala Scheme
Raja Bazar to DHA House Scheme	9	F-9, F-8, F-6, F-10, Blue Area, Faisal Avenue
Rawalpindi Medical Line	9	PIEAS, Chashzda, COMSATS, Rawat, Lake view
Satellite Town to Blue Area	16	Kashmiri Mohalla Dohk Jillani, Lake View Park, Shakarparian National, Chaklala Scheme, Morga.
Tarnol to Westridge	7	Tarnol, Goral road, westridge no1, Westridge 2
Waris Khan to Murree	4	Murree, Waris Khan, Bahira enclaves

### 3 Results and Final Product

#### 3.1 Results of the Study:

Under 12th SDG goal 2030 responsible consumption is a way out of environmental and spatial degradation for the world as well as a nation's obligation towards a sustainable future, here responsible consumption is referring to the optimal utilization of resources at hand and refrain from overcrowding of a single resource. But sadly, the transportation planning for Islamabad- Rawalpindi is moving in opposite direction of overlaying or vertical infrastructure (over accumulation of land) and budgetary subsidies in vehicle purchase and manufacture.

With growing spatial dispersion and an increase urbanized zoning, truly there is an increased demand of transportation, but answer does not lie in congestion of roads or parking lots, infrastructure with huge sank cost and partial mobility limiting its usage in a set geographical constraint. it lies with optimal utilization of resource.

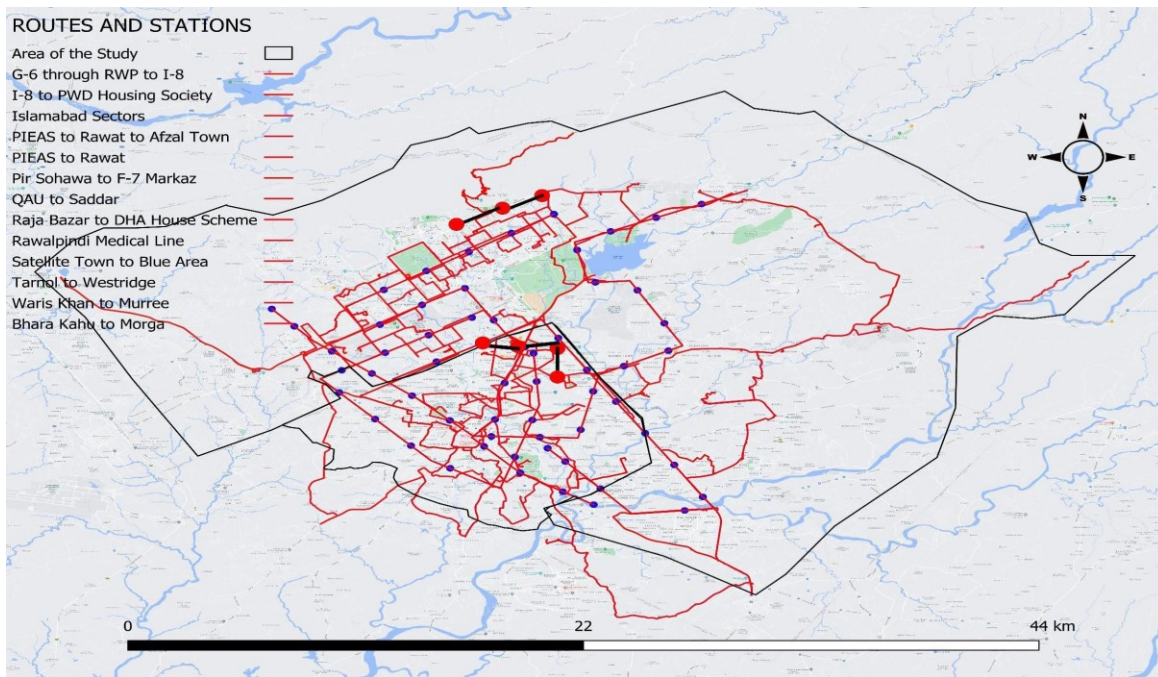
Whereas several private ventures dove into the concept of shared mobility with, nevertheless, corrupted inhibitions of profit maximization.



### 3.2 Feasibility Analysis between University Transport and Conventional Bus System:

So, the idea is to propose a sustainable alternative transportation plan which addresses increased demand and put forwards a solution for limited resources and Environmental degradation. The following map presents the proposed new routes for the conventional Bus Transport of Islamabad and Rawalpindi

**MAP 4: The Proposed New Transport System with Routes and Stops for Islamabad and Rawalpindi**



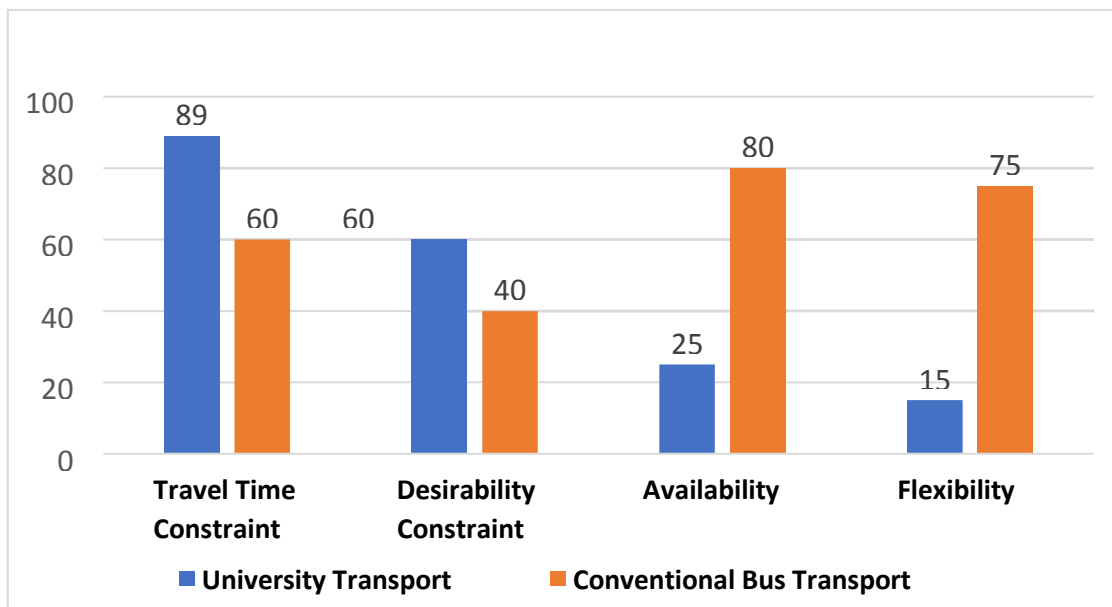
A conventional Bus transportation system, now being adopted by developed countries like China, is age old example of shared mobility for a specific population (4.1 million). Islamabad and Rawalpindi are hosts of 23 public universities of which almost 20 universities are equipped with their own transportation system big or small containing 175 buses empowering only 3.7% of Islamabad-Rawalpindi’s population. Now, removing these buses from university administration and using them to create a conventional bus transport system caters to a large portion of this population. Also, a sustainable solution to transportation demand in conscious of environment.

### 3.3 Social Feasibility:

Islamabad and Rawalpindi are hosts of 23 public universities of which almost 20 universities are equipped with their own transportation system big or small containing 175 buses empowering only 3.7% (148,000) of Islamabad-Rawalpindi’s population (6,500 students per university). The university Bus transport caters to 200 students per one bus, whereas the

conventional bus system provides more flexibility and availability. The following graph represent the social feasibility of both among the people of Islamabad and Rawalpindi.

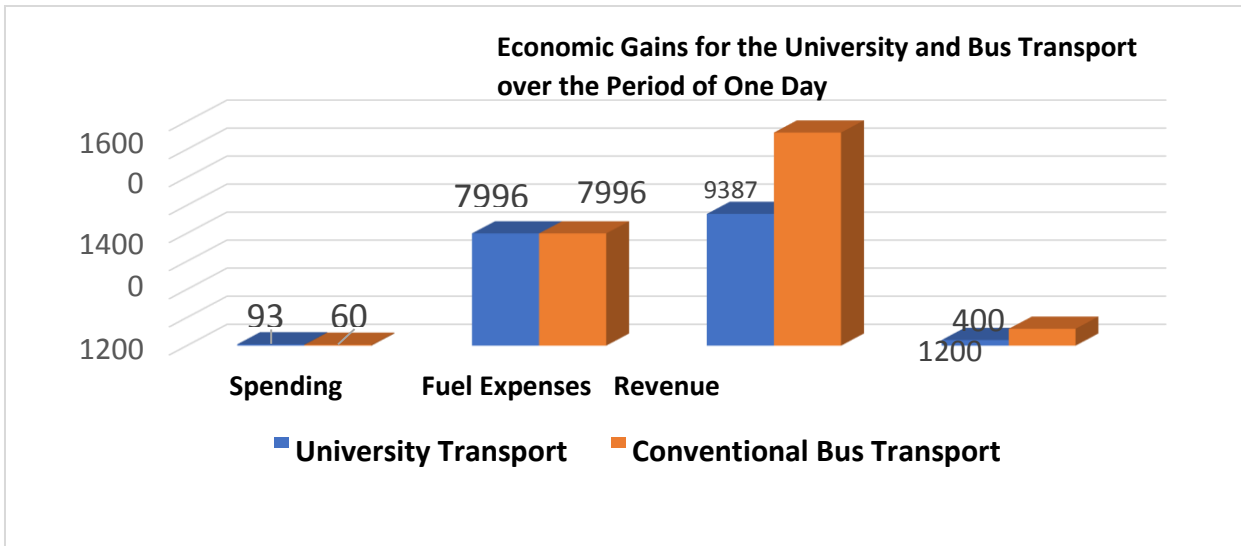
**Travel Time, Desirable, Available and Flexible Transport**



**FIGURE 1: SOCIAL FEASIBILITY: TIME TRAVEL, AVAILABILITY AND FLEXIBILITY**

### 3.4 Economic Feasibility:

Building and implementing Sustainable system is yielding both monetary and sustainable results. Constructing investment side economic activities by providing affordable necessities is much beneficial as compared to consumption-based economy. Integrated and interconnection networking of resources is very important. The following figure presents the economic gains between the two system: university transport and conventional bus system. The chart above presents the daily expenditure and revenue of both university and conventional bus system with one yielding significant difference in revenue generation and if calculated on a time period of an year results in 3 million total collection on one bus.

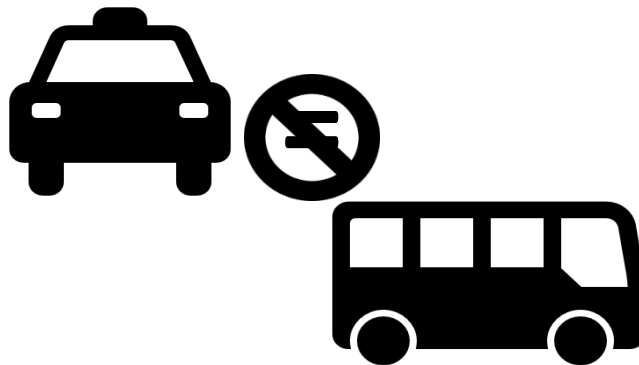


**Figure 2: Economic Gains for The University and Conventional Bus System**

### 3.5 Environmental Feasibility:

A university Transport only serves limited people and for limited time pushing for a passenger vehicle use instead.

A passenger car emission 120 grams per km of CO<sub>2</sub> with an occupancy of 1.6. Hence incurring 60 grams of emissions. Whereas an average emission from a bus is 820 grams per km with a occupancy of 36-55 people. Hence only 30 grams' emission is incurred by an single person reducing his or her carbon footprint. So, the university buses are utilized to serve only 3.7% (148,000) of population from 4.1 million, unfortunately, resulting in the use of private vehicles by the remaining population contributing to greater environmental degradation.



**Figure 7: Comparison of Emission Between Car and Bus**

Enabling transport is one of the great motivators when it comes to Economic growth of a country. Providing cheap and accessible transport can boast the current economic status of Pakistan, not to mention provide bases for future investments from foreign countries given the future increase in ease of business from a good transport sector.

### 3.6 Conclusion

Pakistan being a developing nation lacks the potential investments to establish a well-integrated and systematic transportation plan for its cities but sadly, Pakistan has also neglected creating a reasonable and sustainable solution for its transport problems. In the past, government of Pakistan based their policies on foreign aids project regarding infrastructure development but failed to properly accumulate its own population with an efficient public transportation system (Bajwa, 2017).

Pakistan's answer to complex mobility and accessibility issues includes building BRT projects with huge sunk cost on separate infrastructure and focus on private consumption of transport allowing exports from foreign countries, encourage local manufacturers of vehicle with subsidies on cost of production increasing road congestion with cars and bikes etc.

The concept of responsible consumption in transport is unconvinced and evident from the governmental policies mentioned in the last paragraph. Attitude in transport sector of Pakistan is of high consumption, if you can afford it, then it is okay. There is no regard for the consequence our frequent consumption brings on the future generations or the environment as long as the present needs are met (Smith, 2019).

Developing infrastructure is an important part of economic growth but it is also important to understand demand, supply, utilization and need of any resource. The wastage of any resource or service is unreasonable and unjust as this study highlights the wastage of available resource like university buses. Creating public bus system from university buses is based on optimal utility of preexisting resource and responsible consumption. 10 people sharing one bus on a single route is economically, socially, and environmentally better than 10 people using 10 cars to travel on the same distance.

Understanding the mobility needs of different people helps generate common patterns of travel. This study has invested in the idea of responsible consumption and mobility trends to create a transportation system for the twin cities of Islamabad-Rawalpindi. The study proves that there is no shortage of resources to create public bus system and create bus sharing network for the twin cities to provide opportunities to all.

The 175 buses used in this study were in surplus usage as they were not fully used and were limited to a particular type of use. The routes of this study were determined based on common patterns and travel density of each union council of twin cities. The study included designs based on both inter and intracity transportation system where minor trip generator was mostly intercity and major trip generator were intracity.

The new use of these buses is sustainable, catering to larger masses, ensures complete utilization and generates revenue unlike its previous use as a university transport. The revenue earned from the implementation of this bus transport system can be used for enhancing and updating the transport sector in the future. One of the future benefits of this plan is decrease in the traffic congestions and improved road condition, not to mention, the decrease in parking issues.

The future benefit of this plan in the long-term aspect can be the adaptation of a healthier lifestyle by the general public involving walking and exercise. Also, the prospect of increased

economic movement is one of the advantages of this plan where people might explore more distanced working opportunity regardless of the fear of cost of commuting. The factor of travel will not affect the decision making of people when considering employment at far-out places.

Enabling transport is one of the great motivators when it comes to economic growth of a country. Providing cheap and accessible transport can boost the current economic status of Pakistan, not to mention provide bases for future investments from foreign countries given the further increase in ease of business from a good transport sector.

Ensuring the proper implementation of this study and further research or evidence building can improve the quality of the output of each single route. Also, further additions like new routes can be added to this plan to achieve success. To address issues like over congestion in a bus passenger, new bus can be added to the same route.

Cost of operation of this plan can also be covered with the charge of travel instead of creating subsidies or budget allocations of huge amount of money. This plan can be self-sustaining if implemented correctly with proper analysis the affordability of the people. The affordability of this plan can be determined from further research and evaluation.

Hence, this study provides an outline to what and how a sustainable transportation plan can achieve if implemented correctly and with evidence-based policy.

### **3.7 Recommendations**

Apart from the implementation of this study, the author has several recommendations on salvation and improvement of the transportation sector of Pakistan. So, the government and people can make more efficient decisions about the choice of consumption when it comes to the usage of private and public transport.

- Investment in understanding the need for and data collection on mobility patterns for any mass transit project should be made mandatory by the government for increased efficacy.
- The presence of alternatives in transportation is beneficial in the long run growth of any country to adopt as it would help reduce over accumulation of any single mode. Policies regarding infrastructure development should encompass sustainable planning for all modes of transportation; Private, Public and Semi Public etc.
- Creation of a regulatory body at local level (for Islamabad-Rawalpindi) in transport sector for the integration and interconnection of public and private consumption is an idea worth investing in. For example, creating a sharing mobility bus by public/private collaboration.
- Integration of two or more public transportation plan should be considered for larger demand areas. For example, integrating Metrobus service with this proposed bus transportation policy or regulating private sector to support BRT project like creating taxi zones.
- Introduction of more sustainable policies like solar vehicles and electric or wind powered public transportation system are also advised.

- The research also proposes a thorough investigation on the current transport mechanism like analysis of road capacity against volume of traffic flow and developing separate lane concept for bus, track, bikes and cars.
- Teaching the value of public transport to the masses is also the responsibility of the government. Importance of public transport as necessity, not a hassle needs to be implemented to change all over consumption patterns.
- Unplanned spatial dispersion and urban expansion should be avoided, and proper planning on commuting should be in place for different developmental projects to ensure optimal accessibility.

## References

- Aamir, M., Masroor, S., Ali, Z. A., & Ting, B. T. (2019). Sustainable Framework for Smart Transportation System: A Case Study of Karachi. *Wireless Personal Communications*, 106(1), 27-40. doi:10.1007/s11277-019-06259-4
- Adeel, M., Yeh, A. G.-O., & Zhang, F. (2016). Transportation disadvantage and activity participation in the cities of Rawalpindi and Islamabad, Pakistan. *Transport Policy*, 47, 1- 12.
- Agency, T. R. B. F. H. A. U. S. E. P. (2005). Integrating Sustainability into the Transportation Planning Process. *Committee for the Conference on Introducing Sustainability into Surface Transportation Planning Baltimore, Maryland* 37.
- Aggarwal, P., & Jain, S. (2016). Energy demand and CO2 emissions from urban on-road transport in Delhi: current and future projections under various policy measures. *Journal of Cleaner Production*, 128, 48-61. doi:10.1016/j.jclepro.2014.12.012
- Aifadopoulou, G., Ziliaskopoulos, A., & Chrisohoou, E. (2007). Multiobjective Optimum Path Algorithm for Passenger Pretrip Planning in Multimodal Transportation Networks. *Transportation Research Record: Journal of the Transportation Research Board*, 2032(1), 26-34. doi:10.3141/2032-04
- Amiri Khorheh, M., Moisiadis, F., & Davarzani, H. (2015). Socio-environmental performance of transportation systems. *Management of Environmental Quality: An International Journal*, 26(6), 826-851. doi:doi:10.1108/MEQ-09-2014-0140
- Awan, J. H., Memon, S., Shah, A. A., & Pathan, K. T. (2020). Proposed framework of smart transportation in Pakistan: issues, challenges, vulnerabilities, and solutions. *International Journal of Cyber Warfare and Terrorism (IJCWT)*, 10(4), 48-63.
- Asif Bajwa, C. S. (2015 ). COMPENDIUM ON ENVIRONMENT STATISTICS OF PAKISTAN *Statistics House*(21).
- Baloch, M. A. (2018). Dynamic linkages between road transport energy consumption, economic growth, and environmental quality: evidence from Pakistan. *Environmental Science and Pollution Research*, 25(8), 7541-7552.
- Bast, H., Delling, D., Goldberg, A., Müller-Hannemann, M., Pajor, T., Sanders, P., . . . Werneck, R. F. (2016). Route planning in transportation networks. In *Algorithm engineering* (pp. 19- 80): Springer.
- Batool, I., & Goldmann, K. (2020). The role of public and private transport infrastructure capital in economic growth. Evidence from Pakistan. *Research in Transportation Economics*, 100886.
- Batur, İ., & Koç, M. (2017). Travel Demand Management (TDM) case study for social behavioral change towards sustainable urban transportation in Istanbul. *Cities*, 69, 20-35.
- Camargo Pérez, J., Carrillo, M. H., & Montoya-Torres, J. R. (2014). Multi-criteria approaches for urban passenger transport systems: a literature review. *Annals of Operations Research*, 226(1), 69-87. doi:10.1007/s10479-014-1681-8

- Cao, R. (2016). Systems and methods for on-demand transportation. In: Google Patents.
- Chen, T. D., Kockelman, K., & Zhao, Y. (2015). *What Matters Most in Transportation Demand Model Specifications: A Comparison of Outputs in a Mid-size Network*. Paper presented at the Journal of the Transportation Research Forum.
- COHEN, S. L. (2016). Effect of Bus Turnouts on Traffic Congestion and Fuel Consumption *Transportation Research Record* 901
- Cortés, C. E., Burgos, V., & Fernández, R. (2010). Modelling passengers, buses and stops in traffic microsimulation: review and extensions. *Journal of Advanced Transportation*, 44(2), 72-88. doi:10.1002/atr.110
- Ditta, A., Figueroa, O., Galindo, G., & Yie-Pinedo, R. (2018). A review on research in transportation of hazardous materials. *Socio-Economic Planning Sciences*.
- Donaldson, D. (2018). Railroads of the Raj: Estimating the impact of transportation infrastructure. *American Economic Review*, 108(4-5), 899-934.
- Ghaffar, M. N.-u.-m. B. a. A. (2015). Use of Geospatial Techniques in Monitoring Urban Expansion and Land Use Change Analysis: A Case of Lahore, Pakistan *Journal of Basic & Applied Sciences*, 11, 265-273
- Gomina Mama, F., Yang, Z. Z., & Xia, D. D. (2014). Strategies for Sustainable Urban Transport: A Case Study of Cotonou, Benin. *International Journal of Engineering Research in Africa*, 13, 9-20. doi:10.4028/www.scientific.net/JERA.13.9
- Greene, D. L., & Wegener, M. (1997). Sustainable transport. *Journal of transport geography*, 5(3), 177-190.
- Hanif, S., Mu, D., Baig, S., & Alam, K. M. (2020). A Correlative Analysis of Modern Logistics Industry to Developing Economy Using the VAR Model: A Case of Pakistan. *Journal of Advanced Transportation*, 2020.
- Hassan, Z., Shabbir, R., Ahmad, S. S., Malik, A. H., Aziz, N., Butt, A., & Erum, S. (2016). Dynamics of land use and land cover change (LULCC) using geospatial techniques: a case study of Islamabad Pakistan. *Springerplus*, 5(1), 812. doi:10.1186/s40064-016-2414-z
- Lee, J., & Miller, H. J. (2018). Measuring the impacts of new public transit services on space-time accessibility: An analysis of transit system redesign and new bus rapid transit in Columbus, Ohio, USA. *Applied Geography*, 93, 47-63. doi:10.1016/j.apgeog.2018.02.012
- Lester, A. B., Winters, P. L., & Pham, M. (2019). Segment: Applicability of an Existing Segmentation Technique to Transportation Demand Management Campaigns in the United States. *Transportation Research Record*, 0361198119844248.
- Li, D., Chi Man Hui, E., Xu, X., & Li, Q. (2012). Methodology for Assessing the Sustainability of Metro Systems Based on Emergy Analysis. *Journal of Management in Engineering*, 28(1), 59-



69. doi:10.1061/(asce)me.1943-5479.0000092

Litman, T. (2007). Developing indicators for comprehensive and sustainable transport planning.

*Transportation Research Record*, 2017(1), 10-15.

Litman, T. (2017). *Smart transportation emission reduction strategies*: Victoria Transport Policy Institute.

Lo, H. K., Watling, D. P., & Cantarellac, G. (2016). Day-to-day dynamics in transportation networks. *Transportation Research Part B: Methodological*, 92(Part A), 1-2.

Mahmoudi, M., Song, Y., Miller, H. J., & Zhou, X. (2019). Accessibility with time and resource constraints: Computing hyper-prisms for sustainable transportation planning. *Computers, Environment and Urban Systems*, 73, 171-183.

Majid, H., Alam, K., Madl, P., & Hofmann, W. (2013). Exposure assessment and associated lung deposition calculations for vehicular exhaust in four metropolitan cities of Pakistan. *Environ Monit Assess*, 185(6), 5265-5276. doi:10.1007/s10661-012-2942-0

Merlin, L. A., Levine, J., & Grengs, J. (2018). Accessibility analysis for transportation projects and plans. *Transport Policy*, 69(C), 35-48.

Mohmand, Y. T., Wang, A., & Saeed, A. (2017). The impact of transportation infrastructure on economic growth: empirical evidence from Pakistan. *Transportation Letters*, 9(2), 63-69.

Mohmand, Y. T., Mehmood, F., Mughal, K. S., & Aslam, F. (2020). Investigating the causal relationship between transport infrastructure, economic growth and transport emissions in Pakistan. *Research in Transportation Economics*, 100972.

Muhammad Adeel, A. G. O. Y. a. Z. F. (2014). TOWARDS AN INCLUSIVE PUBLIC TRANSPORT SYSTEM IN PAKISTAN. *Oxford University* 10.

Nijkamp, P. (1994). Roads toward environmentally sustainable transport. *Transportation Research part A: Policy and Practice*, 28(4), 261-271.

Ramli, M. A., & Monterola, C. P. (2015). The Resilience of the Encounter Network of Commuters for a Metropolitan Public Bus System. *Procedia Computer Science*, 51, 2117-2126. doi:10.1016/j.procs.2015.05.482

Ramudhin, A., & Lalwani, C. S. (2018). A COLLABORATIVE FRAMEWORK FOR MODELLING TRANSPORTATION INFRASTRUCTURE FOR MULTI-MODAL PLANNING. *on Logistics (ISL 2018) Big Data Enabled Supply Chain Innovations*.

Routray, R. K. M. a. J. K. (2001). Identification and accessibility analysis of rural service centers in Kendrapara District, Orissa, India: a GIS-based application. *Regional and Rural Development Planning, School of Environment, Resources and Development, Asian Institute of Technology (AIT) Bangkok, Volume 3 (Issue 1)*.

- Sciara, G.-C. (2017). Metropolitan transportation planning: Lessons from the past, institutions for the future. *Journal of the American Planning Association*, 83(3), 262-276.
- Shabbir, R., & Ahmad, S. S. (2010). Monitoring urban transport air pollution and energy demand in Rawalpindi and Islamabad using leap model. *Energy*, 35(5), 2323-2332.
- Shahbaz, M., Chaudhary, A., & Ozturk, I. (2017a). Does urbanization cause increasing energy demand in Pakistan? Empirical evidence from STIRPAT model. *Energy*, 122, 83-93.
- Shahbaz, M., Chaudhary, A. R., & Ozturk, I. (2017b). Does urbanization cause increasing energy demand in Pakistan? Empirical evidence from STIRPAT model. *Energy*, 122, 83-93. doi:10.1016/j.energy.2017.01.080
- Sobhani, M. G., Imtiyaz, M. N., Azam, M. S., & Hossain, M. (2019). A framework for analyzing the competitiveness of unconventional modes of transportation in developing cities. *Transportation Research Part A: Policy and Practice*. doi:10.1016/j.tra.2019.02.001
- Tareen, W. U. K., Anjum, Z., Yasin, N., Siddiqui, L., Farhat, I., Malik, S. A., ... & Chek, L. W. (2018). The prospective non-conventional alternate and renewable energy sources in Pakistan—A focus on biomass energy for power generation, transportation, and industrial fuel. *Energies*, 11(9), 2431.
- Taylor, G. R. (2015). *The transportation revolution, 1815-60*: Routledge.
- Wang, Y., Zhang, D., Hu, L., Yang, Y., & Lee, L. H. (2017). A Data-Driven and Optimal Bus Scheduling Model With Time-Dependent Traffic and Demand. *IEEE Transactions on Intelligent Transportation Systems*, 18(9), 2443-2452. doi:10.1109/tits.2016.2644725
- Weiner, E. (2016). *Urban transportation planning in the United States: history, policy, and practice*: Springer.
- Yaqoob, H., Teoh, Y. H., Goraya, T. S., Sher, F., Jamil, M. A., Rashid, T., & Yar, K. A. (2021). Energy evaluation and environmental impact assessment of transportation fuels in Pakistan. *Case Studies in Chemical and Environmental Engineering*, 3, 100081.
- Zuberi, M. J. S., Torkmahalleh, M. A., & Ali, S. H. (2015). A comparative study of biomass resources utilization for power generation and transportation in Pakistan. *international journal of hydrogen energy*, 40(34), 11154-11160.

## CHAPTER 7

### PRIVATE SCHOOL VAN SERVICE IN ISLAMABAD: IMPLICATIONS FOR URBAN TRANSPORT REGULATIONS

Alishba Naeem Ansari and Faheem Jehangir Khan (2022)

#### Abstract

School transport issues are important concerns for public policy from transport as well as educational perspective. This exploratory study investigates how children are traveling to school in the city of Islamabad and gauges the quality and safety of existing service through school children's experience and views about private school van service. The research employed qualitative methods of data collection and thematic analysis approach. For this purpose, focus groups discussions were conducted with children at ten private and eight government schools. To gauge perspective of all relevant stakeholders, parents, service providers, school management, Capital Development Authority, Transport Authority, Private Education Institutes Regulatory Authority and Traffic Police were interviewed using an interview guide. The results of the study indicate that private school van is the second most used mode of transport among both government and private schools. The parental work schedule and location, home-school distance, attitude towards van service and household factors are influential in school travel decisions, inter alia. As for perception about travel, with respect to school van social aspect is viewed positively by parents and children. However, comfort and safety levels are viewed negatively. The study revealed that overloading is a major concern for van users and regulators alike. The issues of vehicle fitness and service registration are also analyzed. The study identified that gap in enforcement is mainly due to legislative, and resource constrains. Additionally, the study also discusses issues limitations on active modes of transport for school travel. The outcomes of this study can be used by transport regulators and policymakers to formulate regulations for the service and other school transport issues.

#### 1 Introduction

The population growth and urban expansion of a city lead to an increase in demand of efficient transport facilities for all purposes of mobility. This demand for transport is met by both private and public service providers. However, the deregulation of public transport in Pakistan, consistent with evidence of dearth of regulation in other developing countries led to proliferation of private operators in urban transport services (Adeel et al., 2016; Sohail et al., 2006). The development pattern of sprawl along with prioritization of road expansion, made private motorized transport the default mode of mobility in cities. Therefore, the gap in provision of public transport was filled by small van operators while government's role was limited to regulation of routes and fares. (Imran, 2009) Given the prevailing car

dependency at one hand and absence of efficient means of urban transport the problems of traffic congestion and environmental pollution are exacerbating.

Islamabad has annual population growth rate of 4.9% (Pakistan Bureau of Statistics, 2017) and over time has witnessed uneven development and urban sprawl (Liu et al., 2021). The change in population density and distribution, along with change in functional structure of city, is found to increase distance to school from residence, making motorized transport more feasible than active transport (Burgmanis, 2012). Given these demographic factors of the city, this study explored factors involved in school travel behavior of children in Islamabad. Also it is found that the travel time of commuters is observed to increase a lot in peak hours along the routes where schools are established in Islamabad due to traffic congestion and commuter's driving behavior. It is found that as private schools are constructed in residential spaces, along major roads, travel time increases and needs to be optimized using traffic management and control systems (Syed et al., 2014, 2017).

## **1.1. School Transport System in Other Countries**

A study on traffic congestion in Beijing revealed that school trips are the major contributor to traffic congestion in peak hours (Lu et al., 2017) Similar pattern has been observed with respect to school trips in India and Sri Lanka (Dias et al., 2022; Singh & Vasudevan, 2018). Therefore, it is pertinent to study school transport issues, particular modes and travel behavior. In terms of mode choice, while being unregulated and privately operated school vans were found to be the most opted for mode choice for school trips in Kandy, Sri Lanka (Dias et al., 2022). Likewise, in Islamabad, school vans were found to be privately operated and unregulated, second most used mode of transport among private school children (Zafar et al., 2015). Although school vans fill the gap in provision of school transport, the issues of quality and safety along with problems of multiplicity of operators pose governance challenges and negative externalities. A summary of available school transport services in different countries is presented below in Table 1.1.

**Table 1.1: School Transport System in Different Countries**

School transport models in different countries						
Country	Transport provision type	Type of school eligible	Eligibility criteria	Provided by	Fee	Private van usage
Malta (Malta Government, n.d.)	Purchased Buses	Govt and Pvt	Living 1km or away	Private operators/ Companies but paid by Government	Free	No
Sri Lanka (Kumarage et al., 2022)	Existing public transport and Dedicated buses	Govt and Pvt	-	Public and private contractor but paid by government.	Concessio nary rate	Yes
China (Zhang et al., 2017)	Outsourced	-	-	Private Schools	Complete fare	Yes
India (Save Life Foundation, 2021)	Private school owned or contracted Buses	-	-	Private School Government School	Complete fare Concessio nary fare	Yes
UK (Thorntwaite, 2016)	Selected grant aided schools	Existin g public transp ort and dedica ted busses	Compulso ry school age living in 2-8 miles range	Local Authorities at District level (concessionary schemes on existing transport and private contractor paid by government)	Free under Education Act 1944	

## 1.2. School Transport Studies

Exploring school transport McMillan, (2005) provided a framework to understand factors that influence school travel decision. She argues that apart from urban form and distance, safety, attitude towards a particular mode, sociodemographic factors and social norms influence parental decision. The literature on transport conventionally investigates user perception and attitude on service quality of a transport facility, to identify different attributes of service that influence travel decision (Hensher et al., 2003; Litman, 2007). Additionally, Van Acker et al., (2016) observes that travel behavior is multidimensional and can be understood in terms of observable behavior, attitude and preference in the broader socioeconomic context and lifestyle.

## 1.3 Private Van Service for Schools

Unlike paratransit, privately operated school vans are not regulated by any laws related to transport. Though, similar to paratransit it is a commercial service. There is high

fragmentation in service providers, as operators or drivers operate independently. While paratransit is regularly inspected for vehicle safety the enforcement of safety standards on school vans is limited. Given these realities of the operating mechanism and service provision we can say that the service is being informally operated in light of the definition provided by Ehebrect et al., (2018)

*"The term "informality" in most scientific papers on transport refers to services for which no, or only a weak, formal regulatory framework exists and/or where existing state regulations are not (fully) enforced. This takes the form of, among other manifestations, weak government control, missing service standards, uncertified operators, non-compliance with traffic regulations, road safety issues and other externalities."* Ehebrect et al., 2018

The reason why informal transport fills the space is not only because of lack of provision of service by government but is also aided by confusion about mandate and responsibility of different government departments (UITP, 2021). In Pakistan, governance and regulatory responsibilities of road transport are not under central authority (Hisam, 2006). The role of government was discussed by Docherty et al., (2018) with reference to market failure and public policy as the central actor. Hence, as stakeholders and agents of government, the role of transport regulatory authority, city administration and traffic police were of particular importance in understanding the scope of governance of such mode of transport.

Additionally, in studying privately operated school vans this research investigated parents and children's views and behavior of this mode of transport in view of the literature as users and major stakeholders. Also as school's transport and traffic policy effects surrounding built environment, management and availability of transport around the school (Ikeda et al., 2020) this research engaged school management as one of the stakeholders and incorporated their views as well.

This research has found limited public policy debate and literature on the subject; exploring privately operated school transportation. A study by Zafar et al., 2015 did cover the discussion on the topic, however the scope is limited to investigating environmental impact only. The study does not include the views of service providers. It's been suggested by Cervero & Golub, (2007) that irrespective of lack of regulatory oversight, restricting operation of such services is likely to incur social costs and hence the perspective service provider is essential. Therefore, this research will contribute to the existing understanding about the topic by incorporating the perspective of school management, parents, school children, relevant authorities and drivers of private school vans or service providers to inform the demand and supply related issues and other aspects influencing the choices.

## **1.4. Statement of the Problem**

Although, government schools in Islamabad provide transport facility to a number of students, there's no such service provided either by government or by schools in case of private education institutes. In Islamabad there are 411 public sector schools, out of which 143 fall in urban areas (Pakistan Education Statistics 2017-2018, 2021). At the national level, 44% of children enrolled in schools are enrolled in private education institutes and the proportion for Islamabad is slightly higher. (AEPAM, 2021). The total number of registered

private schools in Islamabad is close to 1285, whereas 261 private registered schools are in Urban Educational Zone (UEZ) of Islamabad. <sup>4</sup> As per statistics acquired from Private Education Institutes Regulatory Authority (PEIRA), the total number of students enrolled in private schools in Islamabad is 321,542 and for UEZ enrollment is around 80,954. In private schools, demand for school transport is being met by privately operated school van service and private motorized trips. As school vans are high occupancy vehicles, they are better than private motorized trips in reducing congestion and environmental pollution. However, the parking of vans can be a critical issue as observed in Si Lanka (Dias et al., 2022).

In 2010, Islamabad Transport Authority, proposed a program for provision of 60 buses to cater the demand of private school transport however the project was not taken up by the Federal Government (Zafar et al., 2015). Hence, despite safety, overcrowding and comfort concerns, many children in both government and private schools rely on these private vehicles for commute. One of the safety concerns being use of CNG cylinders. Punjab government banned use of CNG cylinders after an incident in Muzafargarh in 2018, whereas in 2019 OGRA also banned its use in public transport (Kiani, 2019). The only precedent of school van specific regulatory policy action among provinces is some of the actions that were notified in the province of Sindh. The specifications instructed under this 2015 notification required yellow paint over the vans, ban use of LPG or CNG, installing fire extinguisher and availability of an attendant. (Mansoor, 2019) Due to non-compliance, and relaxation by revised order from court, traffic police led campaign was launched in 2019, however the All Karachi School and College Transport Welfare Association protested against this drive. (Hasan, 2019)

A study analysed the reasons for accidents in natural gas vehicles in Pakistan, found that Pakistan CNG safety rules 1992 do not cover all the required safety measures to prevent CNG vehicle accidents. It also found that one of the major reason of CNG accidents is lack of awareness about rules and regulation and driver negligence (M. I. Khan et al., 2016).

The above discussion reveals that there is considerable demand for school transport and a fragmented school transport system has emerged in a low transport governance environment. Keeping this in view, this research seeks to investigate the existing school transportation arrangement from the perspective of all stakeholders including parents, children, van drivers, school management, Islamabad transport authority, private education institutes regulatory authority, traffic police and capital development authority.

## 1.5. Research Problem

Due to the absence of transport service for private school students, limited provision for government school and lack of supplementary public transport facilities in Islamabad, school children depend on private school vans and personal transport for school travel. As private school vans are the only alternate school transport arrangement available, there is a need to study the experience of children and parents using the mode, the operations of school van service and the challenges it poses towards transport regulation.

---

<sup>4</sup> The figure for total registered private educational institutes was sought from Private Educational Institutes Regulatory Authority's Policy and Coordination department on June 10, 2022

## 1.6. Research Objectives

- 1 To analyse the perception and experience of school travel among parents and children.
- 2 To explore the privately operated school van system from the perspective of all stakeholders and the associated transport governance issues.

## 1.7. Research Questions

1. What are the factors that influence school travel behavior of children and mode choice?
2. What is the perception and experience of children and parents about private school van service?
3. How and to what extent existing rules, plans and practices of transport safety and regulations govern private school transport?

## 1.8 Significance of the study

The experts in transport studies and anthropologists have raised concerns that young people's mobility needs are largely neglected in transport planning except in the context of road safety (Porter & Turner, 2019). In low- and middle-income countries this is more concerning as over half of the population is under 18 years of age, while their cities are rapidly urbanizing and motorizing. A review of grey and published literature from Asia and Africa on the issue of young people's mobility needs, identifies several gaps in research in this area across different disciplines. This review indicates that the subject is still unexplored and requires in-depth research, particularly in Asia and instead of the prevailing quantitative survey approach it's been emphasized that more mixed method inter-disciplinary research approach is adopted (Porter & Turner, 2019).

In light of these findings and requirements of this study, qualitative method of research was adopted by combining different instruments of qualitative data collection.

Apart from global concerns about young people's mobility needs, the lack of research on the subject researched makes it important in Pakistan's context as well. In urban areas children are even less likely to walk or cycle to school in Pakistan, that increases their dependence on available transport options. The gendered implications of this dependence is more apparent in how likely girls are to walk to school as compared to boys. A study on Active School Commuting among 27 Asia Pacific countries found that boys are three times more likely to use active mode of travel for going to school than girls (Uddin et al., 2019).

A legislative assessment report by National Transport Research Centre (NTRC) has found that Pakistan lacks in regulations for vehicle safety standards (NTRC, 2020). In such a case, this study shall provide essential evidence on aspects that can be regulated in view of perspective and experiences of users being investigated in this study.

Taking Islamabad Capital Territory (ICT) as a case in this research, the study explores user experience of school van service and the issues associated with its operations and



regulation. This would be a novel contribution in the existing literature and understanding of the subject that will inform the policymakers, practitioners, local administration bodies and stakeholders involved in the provision of service. This would also help the relevant authorities to design and implement rules and/or regulations ensuring the safety of school going children.

## **2. Findings and Discussion**

### **2.1 School Travel Behavior of Children in Selected Public and Private Schools**

This section presents the findings and discussion, for reasons underlying decisions, of school travel among private and government school children. This was explored by deploying Focus Group Discussions (FGDs) with children and Topic Guide interviews with parents and school management. It was noted during the fieldwork that the use of private school vans in the high fee category private schools is negligible. Hence, only low/middle fee category private school category schools were selected for this study.

In the first section a brief summary of aggregate mode share estimates from each school are presented.

### **2.2 Summary of Mode share in Travel to School**

In this section, share of different modes of transport used by students are discussed on the basis of estimates provided by the school management. These estimates are not exact measures however, their validity is based upon school management's knowledge and information about the subject. In case of government schools, exact estimates for share of bus users were available as bus card data is maintained by schools, while estimate for the rest of the modes, is based broadly based upon observations of the school management.

The school management provided modes share estimate for each mode of transport in percentage figures. For the purpose of this analysis, average percentage share of each mode of transport were calculated for all private schools and for all government schools. These averages were then plotted to visually depict what is the average mode share of modes of travel to school for private and government schools. The averages for each mode are compared using clustered bar chart presented in figure 2.1.

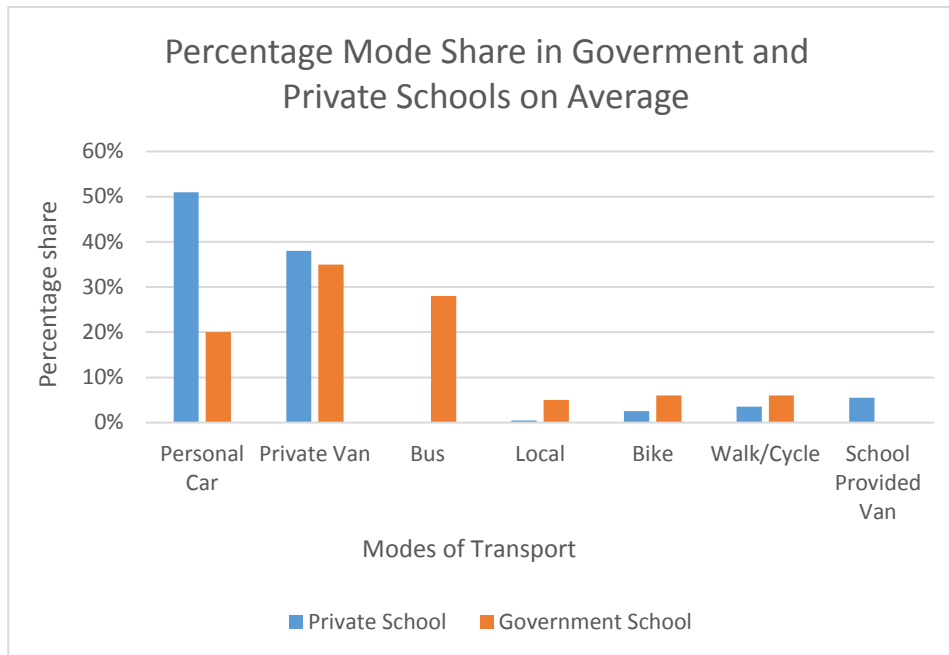


Figure 2.1: Mode of transport share among private and government schools

Although mode of transport share varies for each school depending on location and neighborhood characteristics among other factors, the average figures illustrate how each mode usage differs between government and private schools. This comparison is discussed in detail in the following section.

### 2.3 Private Schools

The share of personal car among different modes in private schools is higher, whereas, private van service is the second most common mode of transport. Among studies on mode choice in private schools, it's observed in India (Tetali et al., 2016), Sri Lanka (Dias et al., 2022), and United Kingdom (Gristy & Johnson, 2018) that compared to public schools, students of private schools are more likely be driven by parents, instead of walking or using a bus service.

The prevalence of personal mode of transport over a privately operated service shows that, if possible, majority of parents opt for driving their kids to school. Another way to look upon high share of personal car is the amount of traffic generated by school trips and its future implications in terms of sustainability. In absence of school transport facilities, higher share of personal car trips has higher environmental cost.

The use of local public transport among private schools is negligible given that most families opting for private school can afford private pick and drop service if driving kids to school is not possible. Also compared to local public transport, van service is safer and a dedicated school transport service. Overall compared to government schools, where mode share is more diverse, two modes of transport (personal car and private van) are more common because of difference in household level factors among government and private school children. Also within government school, children come from diverse socio-economic

background and localities. Similar to government school, minor boys are using motor bikes for school travel without license, but the share of this mode is less in private schools and only two schools reported bike usage.

While government schools provide bus service, among private schools only two schools selected under this study are providing school transport. However, the transport service is only managed by school and provided by private contractors.

### 2.3.1 Transport Provided by Private Schools

Two private schools, one low fee category and another middle fee category, provide transport by outsourcing it to private operators on contractual terms. As transport is provided at only a limited level its share among modes is not very high and the rest of students either travel by private vans or personal cars. The characteristics of school transport provision mechanism by these schools is provided in Table 4.1. Although school is managing this transport, much of the characteristics of the service are similar to private van service, as vehicles being used are same, also the service is being operated by private contractor and is not owned by school.

**Table 2.1. Private School Provided Transport**

Characteristics	Low Fee Category School	Middle fee category school
Transport provision mechanism	Contractual/ Outsourced	Contractual/ Outsourced
Transport owned by	Drivers	Drivers
Vehicle type	5 Suzuki Bolan	3 Suzuki Bolan, 1 Toyota Hiace
Starting fee (Per child per month)	1300	2000
Name of school written on vehicle	Yes	No
Usage by students	High	Medium
Mode Share	30%	25%
Role of school	Route Management, Student and fee management	Route management, student and fee management
Transport manager of School	Yes	No
Transport Maintenance	Checked by School but responsibility of driver	Sole responsibility of driver

### 2.3.2 Difference in mode of transport among private schools

As for school centric factors among private schools, the number of children traveling by private van decreases as school fee increases, or where school is located in high density areas. As middle fee category schools are mostly attended by students from relatively affluent families, availability of more than one vehicle, parental and children attitude towards other modes of transport encourage personal car usage. The findings of this study concur with the preceding argument as lesser number of students travelled on van in relatively

higher fee category schools of the selected sample. The variability of mode choice depending on socioeconomic factors can also be studied based on neighborhood socioeconomic status (Fusco et al., 2013) or difference among private and semi-private schools (Tetali et al., 2016).

Another factor by which modes of travel varies among private school is school location and urban form of the neighborhood where school is located. In high density sectors, such as G-8/4 and small housing unit sector such as G-6/2, it was observed that children also walk to school. Students from a school in G-8/4 who walked to school or previously walked to school, were asked if they had any safety concern while walking. To this a girl responded

*“Not really, as distance is short and I just have to walk past a few flats on my way and I know a lot of people in the neighborhood.”*

Although the selected schools in these sectors are not high fee category, the share of students driven by parents is still high compared to van users. The reason may be that it is more convenient for parents to drive their kids when distance to school is less. This impact of neighborhood characteristics and distance is discussed in detail later in this chapter.

## 2.4 Government Schools

The mode share in government schools is more diverse as compared to private schools as represented in Fig. 4.1. Reason being Public schools cater to students from different socioeconomic backgrounds as mentioned earlier. Therefore, students utilize whatever mode is accessible to them. For example, a lot of children, mainly boys also travel on local public transport i.e. wagon and walk to school from the nearest stop. Many of these children travel from Zone IV towards Urban Sector schools, in pursuit of better quality education.

The share of personal car is low among government school students compared to private schools. Availability of bus service under supervision of schools, is one of the reasons that less parents are chauffeuring kids to school. However, the extent of bus usage in mode share is identical to the capacity of bus service provided by schools. For those schools where only two or three buses are available the share of bus users is very less. In such cases, private van service fills the gap and has higher mode share. The percentage of mode share for private pick and drop service is higher compared to personal car in government school, hence bus service provision alone cannot explain this pattern. Compared to private schools, government schools have a negligible fee structure, this makes arranging private van service affordable for households of middle-income group.

### 2.4.1 School Bus Service of Government Schools

Under a scheme launched for Federal Government schools and colleges, 200 buses were provided by the federal government to be run and managed by schools (Naqvi, 2019). All school principals informed that demand of school bus transport is high among parents and that buses are being run above the capacity i.e. more students ride the bus than vehicle's seating space. Although initially the project was started on shared funding basis and subsidy from government, the lack of funding is putting the bus service under stress. One of the Government School's Principal stated:

*“Initially the idea was shared funding, i.e. some amount would be paid by students whereas the rest would be paid by the government. But it’s being discussed between Federal Directorate of Education and Ministry of Finance that schools are allowed to charge students entire amount for transport service. Right now funding is available for some buses from Federal Government and not all the buses. So we have to manage the rest of amount by charging students a certain amount.”*

Due to unavailability of funds, some schools are not able to run the entire bus fleet, because some buses requiring maintenance are stationed in school and non-functional. Therefore, the bus fleet of government schools cannot entirely cater to the large number of students enrolled.

To resolve the matter of bus scheme expenditure, School Management Committees are being established for each public school under the under the Federal Directorate of Education (Abbasi, 2021). As per the “Right to Free and Compulsory Education and School and College Management Committee Rules, 2021” these committees shall be responsible for generating funds, maintenance of transport and monitoring of financial resources of the school bus services. Given these committees are responsible for overseeing transport related matters, they can be engaged in school van registration process as well, or at least to maintain data of van drivers providing service to their school’s children.

While school bus service has highest mode share, the private van service stands as second in mode share. Therefore, a large number of students’ transport needs are being catered by private van service. As buses have defined routes, students from other residential areas opt for private van service.

Under Prime Minister scheme, the objective behind providing school transport was increasing accessibility to school, indirectly decreasing drop-out rate and increasing enrollment of girl child. Therefore, more buses were provided to government girls school compared to boys’ schools. This difference effects mode shares as well. In a boys’ school with 1074 children in morning shift and only two functional buses available, a boy mentioned

*“I am traveling on van because the school is not issuing bus cards anymore. There are a lot of children who request for bus cards but there is no space on bus.”*

Therefore, it becomes pertinent to compare mode share among government schools for boys and girls.

#### **2.4.2 Mode share comparison for government girls and boys school**

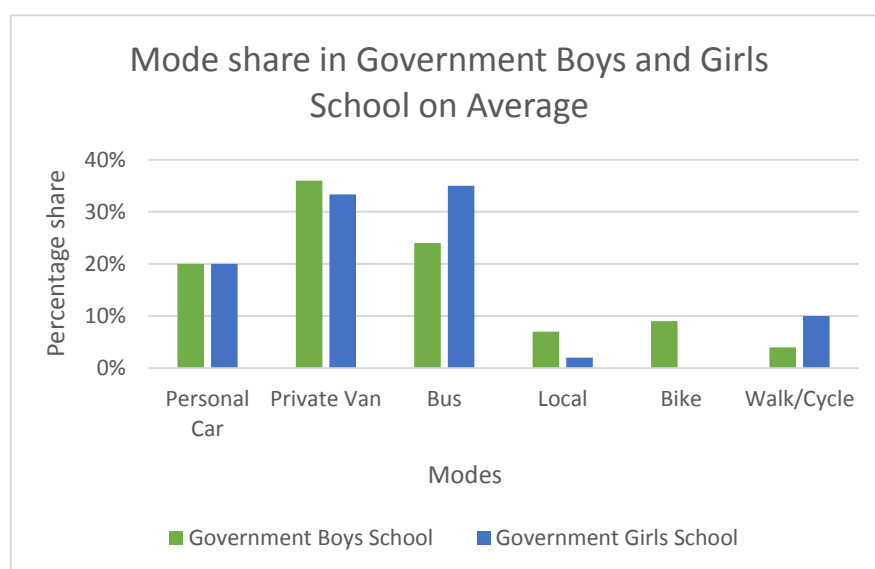
Among government schools the share for personal car is about the same among boys and girls. In case of private van service, the average share difference is very less. The difference of students travelling on school bus is more prominent as school bus share for boys on average is 24% while for girl’s school it was 35%. (See figure 2.2) The reason being less share of buses allocated to boy’s school. In case of usage of local public transport wagon boys are more likely to use it than girls, as boys do not have to be escorted for this mode but if a girl is traveling on local her parents would want to escort her to school for safety. Similar to independent mobility pattern observed in case of local transport, many boys even minors,

are using motorbikes for travel to school. This pattern is worrisome as boys as young as 7th or 8th grade students are using this mode of transport.

It was also observed by author during field visits, that girl students are less likely to be seen standing outside the school at off time than boys. This spectacle at gate is an exemplar for seeing how safety and cultural concerns are prioritized in case of girl child. The share for walking is high for girls in the selected schools for two reasons. First, because one of the schools selected for the study is next to a low-income housing (Katchi Abaadi) and a lot of girls walk from there to school. A girl who lives nearby to her school reported

*“In morning my father walks me to the school, and it takes around 10 minutes to reach. So, I do not need to use bus.”*

Secondly, while girl’s walk to school boys have access to motorbikes due to cultural perception among parents.



**Figure2.2: Mode share in government boys and girls school**

Parents of girl child are also concerned about who will escort her to a bus stop. It is one of the reasons why children opt for van instead of a bus. A student

*“I used to travel in bus first. My brother used to accompany me till the bus stop and pick me from there as well. But since he joined university, no one else is there to walk me to and from the stop. Hence, my parents preferred that I go on a van instead.”*

As parents prefer private van service safer and culturally more viable for girls over local transport, where parents cannot escort their daughter to school or bus stop, it’s more likely for her to travel by a van than school bus. Despite a van costing more than double the school bus charges, parents are willing to send their children on a van due to such cultural and safety concerns. Given the importance children and parents attribute to safety concerns, this issue is discussed in detail later in this chapter.

The next section of this chapter discusses the factors that explain school travel behavior for students of private and public schools in urban sectors of Islamabad. The analysis provided

under this section is based upon thematic analysis of FGDs with children and semi-structured interview deployment of Topic Guide of with parents. Some themes, sub-themes, concepts and categories were identified through a rigorous review of literature, that helped framing and designing of interview guides for face-to-face interviews and FGDs.

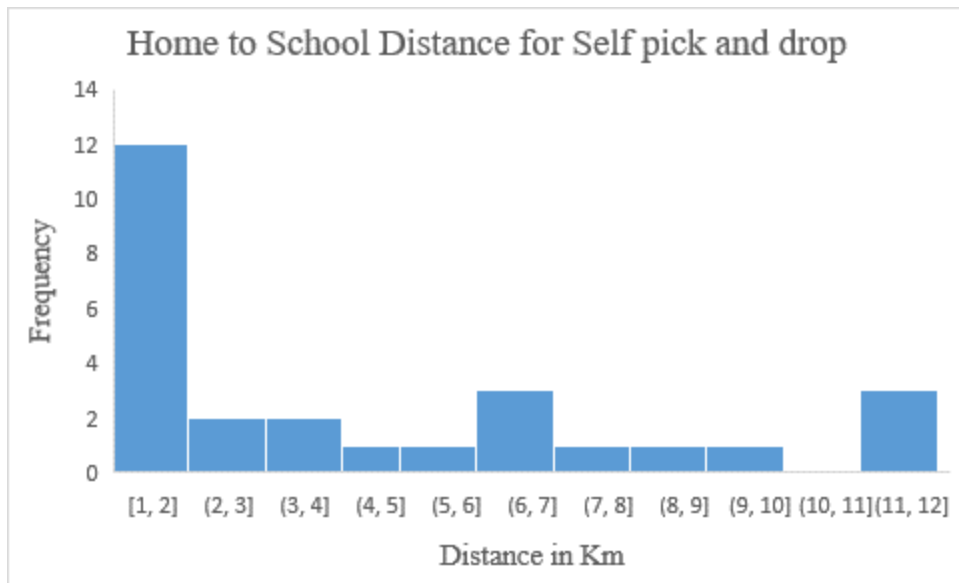
## **2.5 School Travel Behavior**

### **2.5.1 Distance and Land use**

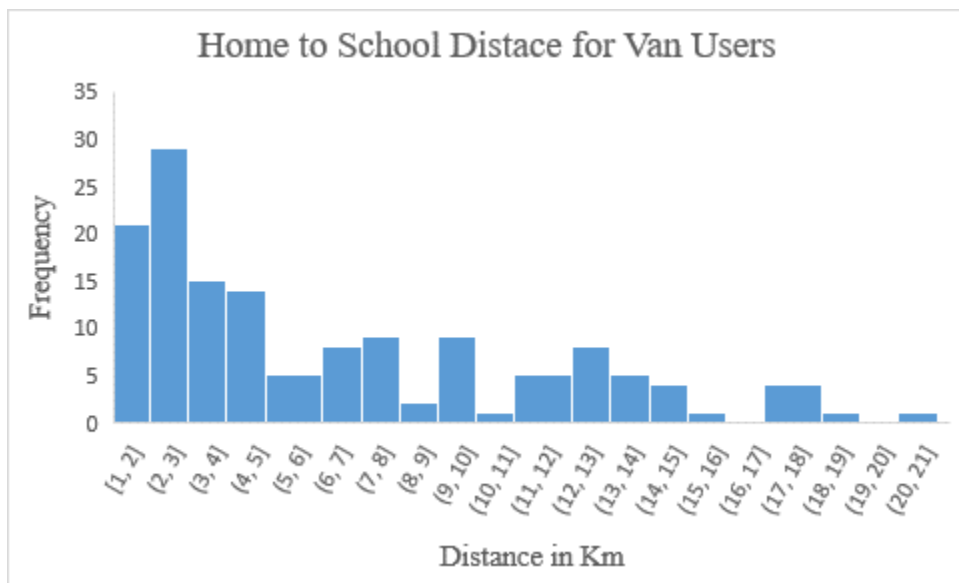
Home to school distance for the majority of students and children of parents who participated in this study was under 5km for both van users and driven to school children (See. Fig. 2.3 and 2.4). Number of children traveling more than 8 km distance is higher for van users as compared to non-van users. Also, private van commuters are travelling as far as 18km-20km and the number of students residing in more than 12 km radius of school is also higher for van users. Among those children who were driven to school, 63% resided within 1-5 km distance from school. Hence, when work schedule is convenient for parents, they can manage pick and drop in a minimal radius. As for van users, 54% reside in 1-5 km distance from school. However, the distance being traveled by children depends on school choice of parents, as educational quality is priority for parents especially for children above the age of primary school education. A mother of three who manages to pick and drop her children by herself mentioned "We live in F-11 but most good schools in Islamabad are in H-8. Hence, we preferred to send our children to a school there."

The preference for better quality education is not restricted to private school students. A government girls school student who travels on a bus from Barakahu to F-6 stated "It's a better school, plus we have more private schools near our home and my parents wanted me to go to a government school."

Hence, distance alone cannot explain why some children would travel on van as compared to personal car. For instance, in a private middle school included in this study from I-10, most children resided in 2-3 km radius from school but travelled on van, reason being parent's work schedule and van driver's trustworthiness. The same cannot be said for distance above 8 km whereby only 27% van users reside in 8km above radius compared to 18% car driven children. For a clearer understanding the issue was also analyzed from the perspective of school type.



**Figure 2.3: Home to School Distance (Self Pick and Drop)**



**Figure 2.4: Home to School Distance (Private Van users)**

### 2.5.2 Home-School distance for Private and Government Schools

The most prominent difference between government and private school students is the share of children who travel from more than 12km distance. In case of government school students this pattern is more consistent for children travelling from areas in Barakahu, Lehtrar road or towns along the Islamabad Expressway. There are two reasons stated for this, one being school bus capacity and another school choice. Government school buses on these routes are already overloaded as informed by school management, whereby private vans act as an alternative for students coming from these areas. As not many government schools are built in suburban localities of Islamabad and those built are not as



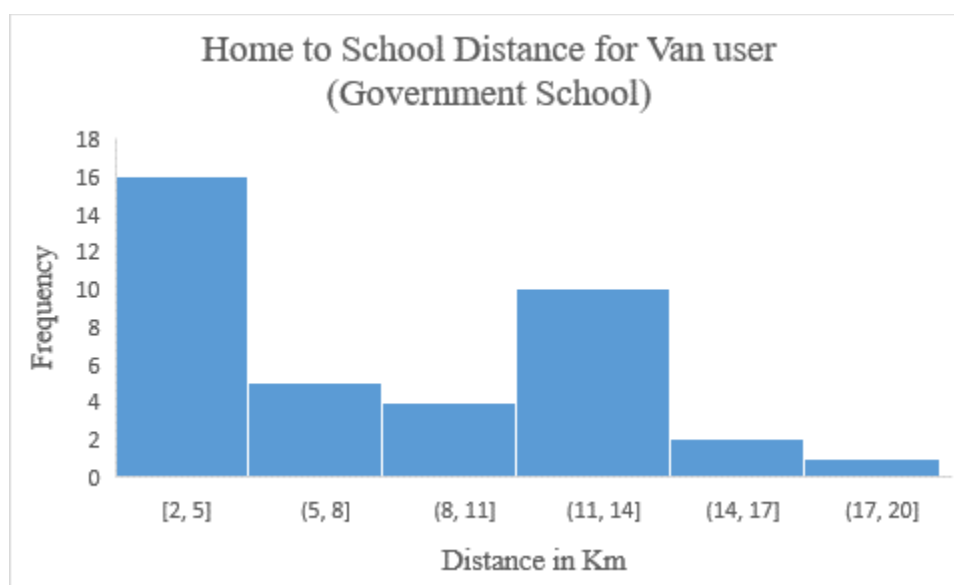
good in quality, students travel from farther areas to attend to these schools. Availability of transport alternatives, therefore, allows children from new and developing sectors with less amenities to access better quality education which might not be available near their residence.

Among van users, only 10% of private school students in the sample reside in more than 10km radius, whereas about 22% government school students reside in more than 10km radius. Unlike less number of government schools in rural demarcated areas of ICT relative to private schools, there are about 1024 registered private schools in Rural Educational Zone as per PEIRA. Principal of a government school elaborated this issue as

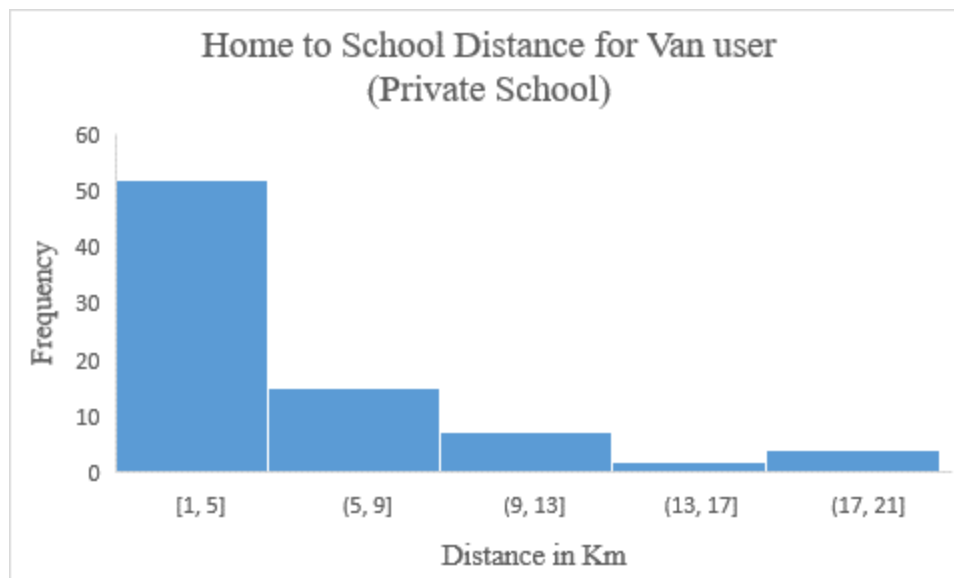
*“Islamabad has expanded a lot. But amenities are in old sectors. Government schools are in old sectors. Now it's difficult for people in new sectors to find quality education in their sectors. Those who can afford therefore send their kids through private vehicles. That's what promotes the business of private van service as well. I suggest all private and government institutes have their own transport.”*

However, private school students also travel further, although not in as large numbers. One of the reasons can be that many families move from urban to sub-urban localities with time but are not likely to change educational institutes of children. In such a case, private vans facilitate commuters from sectors such as B-17, D-18 and housing societies in Zone IV and V. These qualitative factors about why children are traveling such far distances should be further explored qualitatively as recommended by Easton & Ferrari, 2015.

Also, it should be kept in mind that household level socioeconomic factors vary among private and government school children and have significant impact on transport decisions. The role of these factors is discussed in detail later in the chapter.



**Figure 2.5: Home to School Distance for Van User (Government School)**



**Figure 2.6: Home to School Distance for Van User (Private School)**

### 2.5.3 Implications for active modes of school travel

In terms of walkable distance, 44% students driven to school by parents reside in 2km radius from school, whereas only 15% children residing in 2km radius opt for van. This ratio has implications both for active modes of mobility and motorized trips.

Studies on active mode of school travel and independent children mobility show that home-school distance of less than 3km is feasible for active modes of school travel when complemented by built environment and neighborhood characteristics (D’Haese et al., 2011; Fyhri & Hjorthol, 2009; McDonald, 2008; Tetali et al., 2016). In terms of active modes, we see that where distance is 2km, parents are still chauffeuring their kids to school instead of children using active modes of transport. However, distance alone cannot explain mode choice for active modes of school transport, as neighborhood density has strong effect on mode choice through home-school distance (McDonald, 2008).

Even if home- school distance is under 2km or less, walkability/cycling towards school depends upon whether collector roads or major arterial roads come in the way. Given Islamabad’s grid like sectoral development, traveling to school often involves traveling from one sub-sector to another and collector roads or major roads separate them. The same has been observed from the data of children living in 2km or less distance in this study. Also, PIDE’s urban monograph series (2019-2020) suggests that Pakistani cities are not walkable cities (Haq & Rizwan, 2020). Also schools private or government in CDA sectors are built adjacent to collector roads (as per building bylaws) which makes actives modes unfeasible in terms of road and traffic safety for children. Maria & Imran, 2006 lamenting over the urban form of Zone I, objects that the intersectioning of 600 and 300 feet wide roads built according to the Master Plan, make walking and cycling inconvenient as mode of transportation. In case of schools selected in high urban density areas and mixed housing of low and middle income groups, field observation, show of hand survey and school provided data showed that

children residing in such neighborhoods often walk to the school. One of the students who walks to school a private school in G-6 describes her experience as *"I feel cheerful as the weather is nice in morning. Seeing greenery, plants and trees makes me feel fresh. While walking I'm only concerned with traffic because I have to cross the road and there's usually a busy traffic as school is in front of Markaz."*

#### 2.5.4 Perception of distance

While studies in planning behavior generalize distance related findings and focus on relationship between distance and mode choice, this study found that perception of home to school distance is also very important in school travel decisions. This implies that how far a school is might be considered differently by different people depending upon their socio-economic status and attitude towards different modes of travel. When asked about how home-school distance effects decision for driving children to school, a mother from upper middle-income household who travels 12km to chauffer her four children to school states *"No, the school is not very far away from my home. It's the traffic congestion that causes problem. Also, I believe vans drop kids very late and it gets tiring for children. So, it is better to manage on one's own."*

On the other hand, mother from lower middle-income household whose children travel on a van for the same distance remarked that *"one of the reasons for opting for van service is the distance of school and office location. Their father takes the car so there is no other option."*

It shows that perception of distance, is mediated by household level factors and attitudes of parents towards different modes. For the first parent distance didn't matter as much because they owned more than one car and don't find vans as an attractive mode of transport. The second parent is more concerned about distance because they don't have another vehicle.

#### 2.5.5 Work Schedule and Work Location of Parents

This is one of the recurrent themes that came up in discussion with children and parents about the reasons for their mode choice. For most children who travel to school on a van, the reason for choosing this mode, is primarily due to clash with school and parent's work timing. Adding to this, location of the school, parents' work place and home also found to be an important factor due to which parents opt for private school van service. A student whose school is 15 km from home states *"My father's office is around 20km away from home. It is just not feasible for him to pick and drop me every day."*

On the other hand, a child who lives around 3k away from his school, also shared that his parents work commitments are the main reason why he is travelling in a van, *"My father leaves for office early, while van comes late and drops early as I live nearby."* He & Giuliano, 2015 describe this factor as a scheduling and spatial constrain in parent's decision of driving or walking their children to school. The fact that school travel decision is made by parents makes their employment related concerns an important determining factor. *"We both work and it's hard to manage under a tight schedule as I am lawyer as well as my husband. So we chose*

*to send our child on a van. As we live in joint family there's no issue of him coming back home before us."* Says mother of a six-year-old boy.

Among parents of non-van users, the spatial and temporal constraints of chauffeuring children was reported as source of disruption in work. One of the mothers reported "my husband has his own business so it's manageable for him but he has to leave work for an hour or two to cater our children needs." Still other scholars, have analyzed this as a household level decision where group dynamics unfold decision making (Ermagun & Levinson, 2016).

## 2.5.6 Safety

Although distance and parental employment constraints are very important in school travel decisions, safety and perception of safety among children and parents often becomes more important (Mehdizadeh et al., 2018; Ross, 2007; Zwerts et al., 2010). Among parents of non-van users road and vehicle safety concerns such as driving behavior and vehicle maintenance were expressed as negative aspects of van. Another important safety concern that's more common among respondents is regarding social safety of child. When asked whether you are willing to send children on a bus or van service with better quality one of the mothers states

*"Van is not safe at all. It can be safe, but the chances are 50-50. I do not want the odds in case of my own child. I have seen once or twice the drivers inappropriately touching kids. Can't take the risk. I can never ever send my daughter with any stranger. We used to go on government buses. They were so uncomfortable. three people used to share two-seater seat, while some had to stand throughout their journey as well.*

While these concerns of safety seem to be legitimate, it was observed that such impressions have developed from personal their own experiences or the experiences of their loved ones/close relatives and friends. In such cases, attitude towards mode safety is passed on from parents to children as cited elsewhere by other researchers (Baslington, 2008).

Among girl child it was reported by some students that they switched from van to personal car due to safety and harassment concerns. An 8th grade student from a private school raised these concerns as *I do not understand the problem with drivers staring at us? My father started to pick and drop me (to school) himself just because of this reason. I felt very uncomfortable by such behavior."*

## 2.6 School policy

Only two private schools in the selected sample provide transport whereas, transport provision by government schools was also limited.

### 2.6.1 Government Schools

A government school principal expressed concerns regarding limited provision of bus service as *"I think we still do not provide for enough students, since the demand by additional students for bus service is equivalent to the ones already being provided bus service. But fuel*

*costs have been rising over the years causing a lot of financial constraints.”*

School bus service was started for public schools in Islamabad with an objective to increase accessibility of education and ultimately increasing enrollment of children. Despite having a school choice policy of catering to neighborhood children, government schools enroll children from other areas as well. Hence, school choice policy is not fully enforced rather open to parents to choose as per quality due to false address given by parents and obligation of school management to give admission to government officer children. This makes harder to manage transport for every child, as seen elsewhere with school bus transport system operating in open school choice policy (Easton & Ferrari, 2015).

## 2.6.2 Private Schools

Although in many other countries such as India, private schools provide their own buses (Save Life Foundation, 2021), schools in Pakistan rarely provide any service. In Islamabad where private schools provide a van service, most students avail it, as discussed earlier. As there is no school choice restriction for private schools, to devise a mechanism for transport provision is really hard for school management (Gristy & Johnson, 2018). The change in school choice policy in UK and increasing market oriented schooling policies has created routing problems for school transport (Gristy & Johnson, 2018). The same was observed by Principal of a private school in G-11 regarding route management: *Government schools grant admission to students only from a nearby area. But in case of private institutes children come from varying areas because of difference of education quality. Some children come from I-11 some as far as Ghouri Town. Therefore, unlike government schools which can manage routes, private schools cannot manage so many different routes. You must've known that even the bigger private education franchises do not provide their own transport.”*

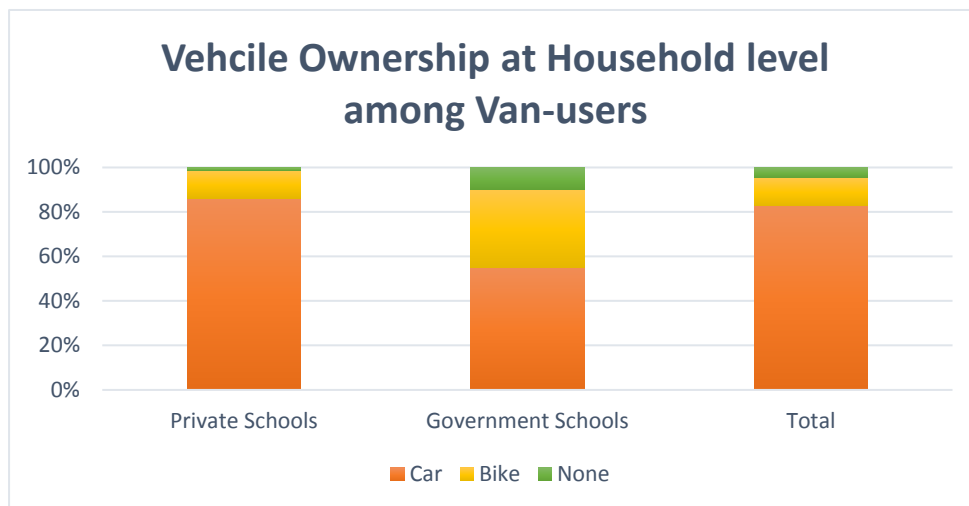
School management of other schools also described financial constraints, additional responsibility on administrative staff and additional responsibility of children's safety as reasons for not providing transport. *“School doesn't want to take an additional responsibility. Such a service provision would require additional resources and school staff to work beyond school hours and most managers and admin people are not willing to work that long.”*

## 2.7 Household Factors

Household income and vehicle ownership are both inter-related and important determinants of transport options accessible to people. In Pakistan, average household income per month is low, which means owning a car is less affordable for many people (Adeel et al., 2014). According to recent statistics, average monthly household income in Pakistan is 41,545 (Pakistan Bureau of Statistics, 2021). which also implies low car ownership. Among household related factors, car ownership is considered important in school travel behavior as well (Dias et al., 2022; Lin & Yu, 2011; Singh & Vasudevan, 2018). The findings of this study also revealed that among van-users some children did not have a car at home, instead a bike or no vehicle. While number of cars per household could provide detailed understanding of children's travel behavior and attitude towards different modes, the validity of such information in accounts of children is very low. Therefore, only the

ownership of car or bike was considered as an indicator for access to a personal family vehicle. About 24% of van users among private and public schools reported that they did not have a car at home. The ownership of car is even lesser among government school children (see figure 2.7.). Those children in government schools who do not have access to bus service neither a car at home are more likely to use van service. This should explain the higher share of private van usage among government schools (see figure 2.1) compared to personal car despite having a dedicated bus service.

**Figure 2.7: Vehicle ownership at Household level among Van-Users**



Regardless of how many cars are owned per household, the fact that many van users who have a family car are traveling on van is due to several reasons. Primarily, the distance between work and home location as discussed earlier and parental work commitment and timing clash are the reasons. The parents who own one car are more likely to send children on van, especially if parent’s office and child’s school are spatially distant. A mother stated *“She has to go on van because my husband takes the car and his office is quite far. Otherwise, I would pick her up from school.”*

The impact of car ownership on travel choices for school, is explained in children geography as an outcome of the spatially dispersed lifestyle activities, that having a car enables (Barker, 2003). As car ownership allows more options to choose workplace, school for children or residence, the people with higher income and more than one car are able to manage the transport of their children. This pattern was observed in parents of non-van users where often mothers chauffeur their children for school run.

## 2.8 Travel Time

Travel time is an estimate of time taken for a student to reach from home to school. The estimates were measured by asking students when they leave home and when they reached school. The purpose of collecting this information is to understand how travel time by van service compares to time taken for same distance of travel by a child driven to school by

parents. The table 2.2. represents aggregate results for these estimates taking average time for those distances most traveled by school children.

**Table 2.2. Travel time comparison between van-users and non-van users**

Home to school Distance (Km)	Average Travel time to reach school Van user *	Average Travel Time to reach school Self Pick and Drop	Difference in travel time *
2-3	15-20 min	5-10 min	2-3 times
7-8	40-60 min	20 min	2-3 times
12-13	60-80 min	30 min	2-2.6 times

\* Range is given because some kids are dropped first while others are dropped at the end

From this analysis it was found that on average travel time for students traveling on a van is 2-3 times more than travel time for students traveling on personal car depending upon when the student's stop arrives. A boy who studies at a school in G-10 states *"School off time is 2pm, but I reach home by 3:30 or 3:40, as I am picked in second shift and dropped in last. I get really tired by the time I reach home."*

Among parents of non van users this was shared as one of the reasons for not opting for van service. This perception among parents and children is described in social geography in terms of "cultural meaning of time" whereby the daily work schedule and school schedules culture people into adopting ways of live that are described as time saving (Baslington, 2008; Kostelnik et al., 1988). A mother of four school going children who drives her kids to and from school herself mentioned *"School vans drop off children very late. Even I get stuck in traffic when I have to pick up my children from school. It takes more than one and half hour for us to reach home without any stop. Whereas, the school van would make multiple stops to drop off other children. Also, two of my children are way too young to be sent off under a stranger's supervision."* Apart from influence on school travel decision, travel time impacts experience and comfort levels for children who travel on van service.

## 2.9 Attitude towards different modes of school transport

The attitude held by people towards public transport, personal car or active modes of transport are also important determinants in travel behavior. (Beirão & Cabral, 2007; Fishman et al., 2012; Larsen, 2014; Ye & Titheridge, 2017) In case of school travel decisions, parental attitudes towards different modes of transport are considered more relevant compared to children's attitude as they are the decision makers. (Crawford et al., 2017; T. E. McMillan, 2005; Mehdizadeh et al., 2018; Nikitas et al., 2019; Van Ristell et al., 2013). The children were asked who decides at home how children travel to school and whether they discuss things about their school journey with their parents. It was concluded that only a few students discussed travel with parents and the decision of school travel rests with mother or father. Hence, we focus this analysis on parental attitude towards available means of transport for school transport.

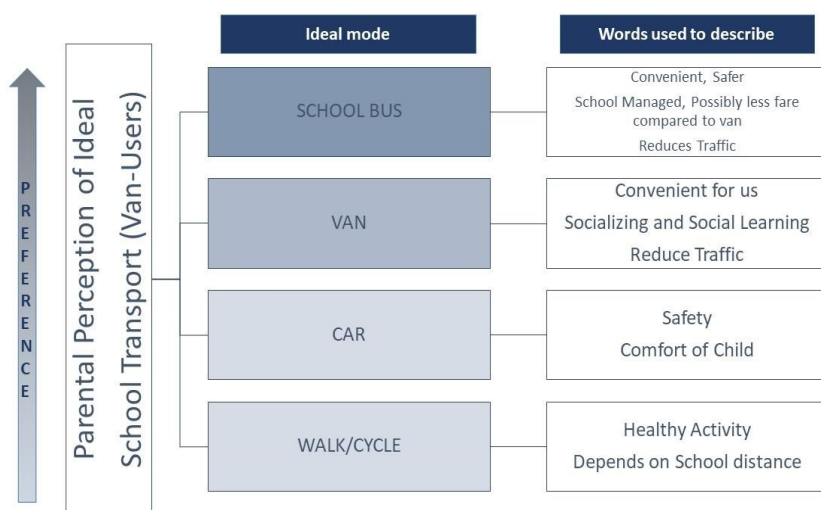
To gauge parental perception of school transport modes, they were asked to consider how should children ideally travel, perception about that mode and others. The perception and

preference of different modes of transport varies between parents of van users and non-users. In Figure. 2.6 and 2.7 parental attitude is visualized in a hierarchical chart showing preference level for each mode among parents and the attributes parents associate with these modes.

## 2.10 Parental Attitude towards School Transport (Van-Users)

Among parents whose children travel on van, the preference for a transport service in the form of school bus or van is higher than personal car. The common attribute or reason parents describe for both these modes is convenience for parents. In this context, convenience implies ability to manage responsibilities towards family and workplace. *“It is convenient for us to send our child on van due to office timing. If I were to pick my child from school, I will have to leave work.”*

This viewpoint coupled with household level car ownership and income, shows that household level factors may be related with how a parent views a transport mode. As for how they evaluate the transport service itself, parents talked more of the journey’s social aspects. Some parents described how children get to make friends and socialize in van. A mother who’s also a lawyer herself, mentioned that she believes traveling in van, would help her child learn social skills and adapt to social realities of life. The experience of sharing space with fellow children, is considered a positive interaction with the surroundings and children.



**Figure2.8: Parental Attitude towards School Transport (Van-Users)**

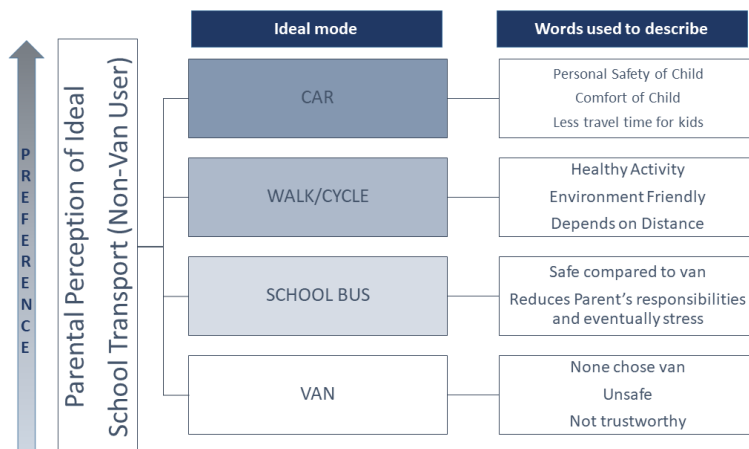


This sentiment of socializing in van and talking with friends, was also shared by children in FGDs. These views are in line with findings of Zwerts et al., 2010. Similarly, a comparative study on impact of school travel modes on cognitive performance and travel satisfaction, found that compared to car users, children who walk or ride bus with other children share more positive feelings and satisfaction with travel (Westman et al., 2017). As for feelings about travel experience, bus users were more satisfied with the experience compared to van users, as where crowding was an issue in van ridership. Comparatively parents of non-users evaluate transport service differently, as observed in studies of travel attitude among users and non-users elsewhere (Beirão & Cabral, 2007).

A very few parents opted for walking or cycling and even those who mentioned were concerned of distance from school. Parents who opted for this mode described it as a healthy activity implying awareness about health impact. However, the home to school distance is an impediment. A mother stated “You know we only have a bike. If her school was nearer I would definitely walk her to school.”

## 2.11 Parental Attitude towards School Transport (Non-Van Users)

The preference of car among non-users over other modes was quite prominent. Although parents who drive their children to school are from relatively higher income group and some own more than one car, the reason for preference of car is also the perception of safety and comfort. As mentioned earlier, parents of non-users do not evaluate transport service in same way as users i.e. in terms of social aspect, rather concerns of safety and comfort frame their view. Parents described car as safer and more comfortable option for children. These findings are consistent with other studies that have shown that higher income household families are likely to prioritize comfort and opt for car in school travel decisions (Mehdizadeh et al., 2018). The perception of safety is also associated with more care use (Mehdizadeh et al., 2018; Nikitas et al., 2019).



**Figure 2.9. Parental Attitude towards School Transport (Non-Van Users)**

None of the parents opted for van service while only one opted for school bus service showing that underlying perception of safety and trust are very low for transport service among non-users. Hence, while household factors may be important the attitude and perception parents hold for such collective ridership also impact decision making may be as mediating variables (Mehdizadeh et al., 2018) or as moderating variables. (T. E. McMillan, 2005). Similar negative perception about safety and comfort of van service were identified among non-user children.

In line with perception about health benefits of walking or cycling among van users, the parents who drive their children to school also held positive views about walking. However, the distance and unsuitable urban infrastructure for walking and cycling are observed as hindrance in opting for this mode.

## 2.12 School Travel Experience of Private

The purpose of analyzing travel experience is to identify positive and negative aspects of the van service, as described by children and parents in their accounts of the journey to school and the attributes of it (Table 4.3). Approaching the perception of children about how they travel, as an experience instead of focus on perception of travel characteristics alone allows understanding the things that matter to children themselves and why they do. Additionally, experience of those who travel with their parents are also analysed in positive and negative aspects. (Table 4.4)

**Table 2.3: Positive and negative aspects of van journey (Van-Users)**

<i>Positive Aspects</i>	<i>Negative Aspects</i>
<p><b>Door to door service unlike school bus</b> (Emphasized more by students of public schools for girls)</p> <p><b>Do not have to stand during journey compared to bus</b> (Students of some government schools where buses are run over the capacity)</p> <p><b>Punctual and reliable</b> (Mentioned by most children)</p> <p><b>Travel with friends</b> (Described as fun and joyful by most children)</p> <p><b>Ease for parents</b> (Generally for all parents, specifically for single parents, parent who can't drive due to medical condition, parents with one or no car ownership, and parents with work commitments)</p> <p><b>Trustworthy drivers</b> (As parents often know them if resident of neighborhood. Most children rated drivers good in terms of trust.)</p>	<p><b>Crowded</b> (Concern for majority but not all children)</p> <p><b>Seating related comfort issues</b> (Concern for majority but not all children)</p> <p><b>Bags hung outside at back</b> (Concern for majority but not all children)</p> <p><b>Uncomfortable in summer</b> (Mentioned by all children)</p> <p><b>Lack of window at back seat</b> (Some kids reported their vans have a window; the main concern is the impact of hot weather conditions)</p> <p><b>Fast driving</b> (Not a concern for majority of children, but some expressed their worries)</p> <p><b>Long travel time</b> (Not a big issue for all children as children from the neighborhood and same school are also on board)</p> <p><b>Issues with the door</b> (Not reported by all children, some say that door gets stuck because of how children use the van)</p> <p><b>Possible van breakdown issues: Puncture or car heating up</b> (Only a few reported such incidents)</p>

The parents above stated issues are based on perceptions of both parents and children. While parents do show concern over these matters, they maintain contact with the driver. *"I make sure that I call the driver in the morning in case he's late, so that my child isn't late to school. Also, if my child is late than usual on way back home, I call the driver. He always picks up the phone."*

Also, drivers often live in the same neighborhood or have been providing service in the same neighborhood for a long time. This builds trust among parents.

The negative aspects of travel experience, such as seating, driving speed and vehicle maintenance shed light on possible areas that need to be explored more from regulatory side. Hence, these issues are discussed in detail. Additionally, one of the parents expressed their worry about children commuting on van, in times of sudden political events in the city.

**Table 2.4: Positive and negative aspects of car journey (Non-Van users)**

<p><i>Positive Aspects</i></p> <p><b>Safer and secure</b> (Mentioned by all of parents and children)</p> <p><b>Children feel parents their parents are concerned about them</b> (Both children and parents mentioned this)</p> <p><b>Saves time for children and they reach home early</b> (Both children and parents reported)</p> <p><b>Spend more time with children/parents</b> (Both children and parents reported)</p> <p><b>Child's comfort</b> (Both children and parents reported. Children expressed how traveling alone and with AC was more comfortable for them)</p> <p><b>Interact with parents of other students and school staff</b> (Mentioned by some parents)</p>	<p><i>Negative Aspects</i></p> <p><b>Fatigue/ Hectic Routine</b> (Mentioned by all parents)</p> <p><b>Traffic congestion around school</b> (Majority of parents expressed this concern and finding it hard to park the car)</p> <p><b>Work loss</b> (Some parents have to leave work)</p> <p><b>Children may get late on some days</b> (Children reported it often happens because as parents and children's schedule for work and school differ)</p>
--	---

### 3 Conclusion

In this section, school travel behavior of students is analyzed to understand how different factors effect travel behavior of students. As the study includes both public and private schools the purpose is not to generalize the findings of this study rather the subject is to explore how parents and children view their school travel behavior themselves and what factors underlie these behaviors and perceptions. For this purpose, reasons behind travel behavior were explored both as stated reasons as well as inference from perception about different factor and attitudes towards other modes. Although, all factors contribute collectively to travel decision but among stated reasons, parental work schedule and location and perception safety are the most important deciding factors for mode choice as well as attitude towards other modes of transport.

As for mode share, the study found van to be the second most used mode of school

transport, whereas as traveling by personal car is found to be the most used mode in private schools. Among private schools the share of van usage is less in higher fee category school students, and schools located in high density areas. Share of personal car-based traveling is less among government school children primarily due to availability of bus service and secondly due to household level factors. The less number of good quality government schools in non-CDA sectors drives people from other localities to send their children to government schools in CDA sectors for better quality education. Due to this reason a lot of children use van in government schools. The study found that students residing in more than 12km radius from school in both private and government schools are more likely to use vans than cars. The underlying reason is that, in Pakistan there is no school choice policy restricting enrollment according to home-residence distance for private schools and in case of government schools could not be enforced. As for school transport policy the study found that the reason only two of the selected private schools are providing transport on contractual terms. School principals cited that route management is one of the problems due to which transport provision is unfeasible for schools. However, the findings of the study suggest that majority of the students in this study reside in 5km radius of school. For this distance provision of transport is manageable. Another important finding related to distance in this study is that 44% of children who travel with their parents in this study reside in walkable distance from school. The implications of this finding for future studies is to explore why this group of children do not use active modes of transport instead and what policies can help encourage walkability and behavioral change. As for attitude towards van service and personal car, a prominent difference with respect to how users and non-users evaluate the van service is identified. It is observed that while non-users evaluate the van service on the basis of perception safety and comfort, van users evaluate the service on the basis of utility as an alternative from own transport and social aspects.

In this chapter the perceptions and experience of students and parents helped identify areas of regulatory concern as well which are explored in the next section in view of discussion with officials from government entities and private van drivers.

### **3.1 Regulatory oversight on Private School Vans**

This section addresses these concerns, first by exploring school transport regulations in other countries. Second, existing regulatory framework for urban transport regulation in Pakistan is reviewed in the context of privately operated van service. How these regulations attend to the issues identified by parents and children and how do the drivers reflect upon these issues is the focus of analysis. The perspective of each stakeholder in local authorities over service provision and concerns informed on the limitations in existing system and gaps in enforcement.

The rules and regulations consulted include Motor Vehicle Ordinance 1965 and Motor Vehicle Rules 1969 and the Model Road Safety Act 2020. Some recent government reports conducted with international consultation and private institutes with in country were also reviewed (Communication, 2019; NTRC, 2020).

## 3.2 School Transport Regulation in other Countries According to Modes of School Transport Services

Provision of school transport in other countries was discussed in section 1 (see Table 1.1). The difference in role of government in transport provision is prominent between developed and developing countries. Although in some Asian countries like Sri Lanka, provision of transport for schools goes long way back, the privatization of urban transport in 1980s like the rest of the world led to proliferation of private operators in the market. Similarly, school transport provision at government level in India is also low and private operators are engaged in transport service provision either through buses or vans. Due to these similarities, we focus mainly on regulation regime in Asian context, as provision of school transport in European or American context is starkly different. The regulatory system of those countries were studied where private individual operators are providing school transport in large numbers rather than private companies being involved like in GCC countries (Henry et al., 2012).

### 3.2.1 School transport regulations in India

In India, school buses are regulated under a set of rules and standards framed after Supreme Court of India issued “Guidelines on Safe Transport Facilities for Children to School” in wake of safety mishaps of school transport (Directions of the Supreme Court of India for School Bus). The regulations were legislated at federal level and the education board (CBSE) framed rules for transport services being provided by schools (Guidelines for Transport Facilities in Schools, 2017). These regulations are limited to school buses, but every state in India has incorporated them according to their own Regional Transport Authority’s (RTA) decision. The aspects of regulations covered in Guidelines for Transport Facilities in Schools, 2017 are detailed and comprehensive and have been broadly categorized in the table below. Among other things the regulations also cover social safety factors that protect children against any harassment.

As CBSE regulations apply mainly on the school provided buses, for private vans the regional transport office (RTO) issues permit to driver for ferrying children to school. Most states, including Maharashtra and Punjab do not allow school vans to transport children without a permit. In India the enforcement of regulations is coordinated between educational institutes and regional transport office often through school transport committees. The school committee plays an important role in India for regulation of school vans (Ranjan, 2018). Private schools in addition to incorporating these regulations, issue their own transport policy as provision of transport by private schools is a common practice in India.

Contrastingly in case of Pakistan, citing education as the priority of schools, in interviews with private school principals, transport provision and regulation was described as a matter irrelevant and outside to school’s purview. Although enforcement of regulations in India may be weak, the framework of regulation is much more formal and integrated between educational institutes, educational authorities and Transport authorities.

**Table 3.1. School Transport Regulations in other Countries**

Country	Level of Legislation	Mode regulated	Aspects of regulation	School Van
India (Gautham et al., 2020)  <i>Guidelines on Safety and Security of Transport Facilities for School (SC)</i>  <i>CBSE 2017</i>	Federal (CBSE rules and Supreme Court Guidelines) Provincial level (RTA) - Enforcement (RTO)	School Bus School Van	<i>School Bus</i> Vehicle Safety Bus design Driver license Use of CCTV and GPS Seating capacity Social safety Speed governor (40km/h)  <i>School Van</i> RTO issues Permit	- Issued permit when linked with schools in some States - Some States ban school's from using school van 12 seating limit
Sri Lanka (Whether, 2017)	Federal level - Enforcement Department of Motor Traffic	School Bus	Safety standards Service related and procurement regulations	Only required to register
China (J. Li et al., 2012)	Federal level – Enforcement at Local level	School Bus	Bus safety standards Registration Seating specifications School siting regulations Speed monitoring device  <i>School Bus Safety Ordinance 2012</i>	Required to register and comply with bus safety standards
United States (NHTSA, 2022)	Federal and State level Education and transport departments - Enforcement at local level	School Bus School Van	Bus safety standards Bus design Seating capacity Seatbelt provision Driver Requirements GPS Speed monitoring  <i>School Bus Safety Standards 1977 under FMVSS</i>	Schools can operate if complies with Bus safety standards

### 3.2.2 School Transport Regulations in Sri Lanka

The provision of school transport in Sri Lanka is as old as 1958. Back then students were given a 60% waiver on bus tickets. In 1970s, a dedicated school bus service was initiated for school transport. Following the privatization of urban transport, private bus operators gained more share in this service and gradually the government service declined to a very small fleet (Kumarage et al., 2022). As school buses quality deteriorated, school vans entered

the business, such that as per one estimate around 10,000 school vans operated in Colombo alone (Sohail, 2003). Hence, this service was replaced and integrated into School bus program called “Sisu Seriya”. Under this program regulation were made for service quality, safety and entry to business for private bus contractors (Kumarage et al., 2022). Some scholars argue that regulation of buses was done in a manner that led to reduction in use of buses and eventually less providers stayed in business. That is one of the reasons why school vans proliferated to such an extent that now more than 30,000 vans operate in Sri Lanka as per one estimate (Whether, 2017). Apart from registration with Motor Traffic office, no other regulations are there for school van operators (Sohail, 2003). Given the high ridership of school vans researchers have been calling for improving safety and reliability of service (Dias et al., 2022; Sohail et al., 2006).

### **3.2.3 School Transport Regulation in China**

School transport regulations in China are also a recent phenomenon and a response to tragic accidents of school buses. Although mostly private schools provided transport in 1990s now school transport is provided by public schools as well (Deng & J Kurgan, 2012). The regulations apply on schools, companies as well as individual operators. The technical aspects regarding interior design and seating are complemented with other laws as well, so that manufacturers of bus also comply (J. Li et al., 2012). The regulations are enforced by the local government. The use of school vans has reduced as manufacturers have also shifted to school bus manufacturing.

### **3.2.4 School Transport Regulations in United States**

United States is one of the first to adopt dedicated school transport and regulations. The idea of yellow-colored buses for schools has its origin in US. Hence, the regulatory framework for school buses was adopted as early as 1974 (NHTSA, 2022). Apart from technical bus safety standards, the regulations also define guidelines for requirements from driver. By definition, under these regulations, vehicle carrying more than 10 children is considered a bus. Hence, vans are allowed to ferry children if they comply with technical standards defined for bus services. Individual operators are also allowed to operate, as long as they are registered and the vehicle is up to the bus safety standards defined in motor vehicle safety standards of federal government (NHTSA, 2022). The regulations however, vary at state level.

The discussion above illustrates that regardless of scope of regulation and extent of its enforcement, legislative cover for such regulations exists and role of government departments is also defined for enforcement. Among all these countries level of transport provision either by schools or government is very high in contrast to Pakistan. Regardless of these disparities, the similarity in presence of individual transport operators in these countries can provide guidance on how this mode of transport can be regulated.

### 3.3 Private School Van Issues in Light of Regulatory Practices in Pakistan

The issues identified in interviews with children, parents and school management are analysed in light of regulatory role of existing rules and policies as well as role of respective stakeholders.

#### 3.3.1 Application of Motor Vehicle Ordinance and Rules for Public Service Vehicle

Under section 44 of Motor Vehicle Ordinance, all public service transport vehicles are required to register with regional transport authority. Only then a permit is issued to use a vehicle for commercial purpose. Although all private school vans are engaged in commercial activity, they do not register with Regional Transport Authority. One reason being that as per Motor Vehicle Ordinance the permits issued for public service vehicles are along specified routes, whereas private school vans are operating along different routes, from residence to schools not stop to stop. Van drivers expressed that they do not want to register as a motor cab because it is a hired service. *"If I register and get a permit then my car's status would become motor cab or equal to a wagon service. As a pick and drop service, that doesn't suit us."*

Therefore, periodic fitness check of the vehicle by motor vehicle examiner is not done for private school vans neither other service standards defined for public service vehicles are followed by them or enforced. The ITP official noted

*"With respect to school vans we take action when there is a complaint, often time we take joint action with Transport Secretary Islamabad as they are supposed to direct actions on such matters. Otherwise, private pick and drop vehicles are not recognized as commercial vehicles since they don't pay commercial tax to government like paratransit local wagon service."*

The exception being motor vehicle rule 102, which specifies how children are to be counted in number of passengers permitted in a commercial transport. A child less than 12 years of age is to be considered half. The number of passengers boarding a vehicle is determined by Islamabad Transport Authority and enforced by Islamabad Traffic Police.

The above discussion illustrates that the urban transport regulations are not entirely enforced on privately operated school vans. While other countries have devised specific rules and standards for school transport vehicles and drivers, Pakistan lags behind in such legislation. The school vans in other countries are required to at least register with the regional transport authority if they comply with school transport safety standards. In Pakistan, no such requirement is there for anyone engaged in this business. There is a need for rules and regulations that set safety standards as a school transport vehicle, driver registration and vetting as a school transport driver, seating space management and regular vehicle fitness inspection.

In interviews with drivers, two categories of operators were identified. It was found that some private school van operators acquired the vehicle under *"Punjab Sasta Rozgar Scheme"* and are liable to pay tax to the local authorities of both Islamabad and Rawalpindi.



### 3.3.2 Government policies that have indirectly supported Private van business

This research finds that some government policies have indirectly promoted this business. In interview with drivers, some drivers informed that they acquired vehicle under Punjab Rozgar scheme. Although such policies are not directly aimed at such services, one can see how policies have unexpected effects. The drivers having vehicle under this scheme informed that a regulatory structure exists for their vehicles and occasionally inspection of vehicle is done too. *“Since I acquired this vehicle under Punjab government scheme, I am annually paying token tax of about 1250 Rupees to RTA and 1850 Rs for passing of vehicle by motor vehicle examiner. Additionally, we have to get permit from Islamabad Transport Authority and pay for that as well since it is a requirement to get separate approval for driving in ICT.”*

Two such schemes are discussed below:

- *Apna Rozgar* Scheme in Punjab 2014-2015: 50,000 vans were distributed among beneficiaries on loan based scheme. Suzuki Motors (PSMCL) was selected for supplying and manufacturing of vehicles as the company manufactures light commercial vehicle in Pakistan. Some people raised concern why entire project was handed over to Suzuki motors as AL Hajj motors, also manufactures vehicles in Pakistan (A. S. Khan, 2014).
- Prime Minister's *Kamyab Jawan* Youth Entrepreneurship Scheme (PMYES): This scheme also provided commercial vehicles on loan based through different banks. AL Haj FAW motors also provided vehicles under this scheme.

**Table 3.2. Regulatory oversight in terms of Urban Transport Regulatory Framework**

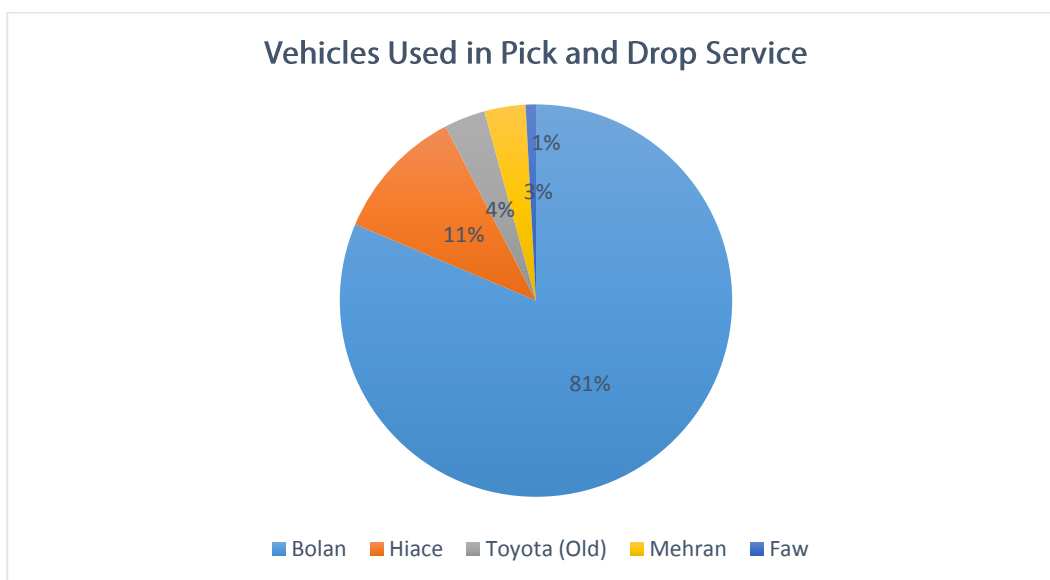
Regulatory attributes	Private	CM Punjab Scheme
Role of government (Regulator, Promotional, Prohibitive, Limited)	Limited Seating capacity and license inspection	Regulator and promotional
Legal Status	Not registered as Public Service Vehicle (Not recognized as a public service vehicle under Motor Vehicle Ordinance 1965)	Legal Public Service Vehicle Light Transport Vehicle (LTV)
Routes	Flexible (Purview of driver)	(RTA and ITA approved)
Fare	Driver's decision	Driver's decision
Vehicle fitness check	Not required as it's not registered	Annual
Priority in transport regulatory system	Low	Medium
Number of permitted passengers	8-10	8-10
License category	No commercial driving license	Light Transport Vehicle license
Use of CNG	Do not use Self-complied (Most use petrol due to unavailability of CNG at gas stations, infeasible economically and for engine efficiency)	

Compared to other private school van vehicles, the oversight of existing urban transport regulatory framework over scheme-based vehicles is extensive and same as those applied on commercial vehicles registered with regional transport authority. In table 3.2. the regulatory aspects of both categories are discussed. As the scheme-based drivers have registered with transport authority they have to get passing from motor vehicle examiner every six months and car engine and lights everything is checked. Given these observations, it can be said that compared to unregistered driver's enforcement of urban transport regulations is higher in for scheme based vehicles.

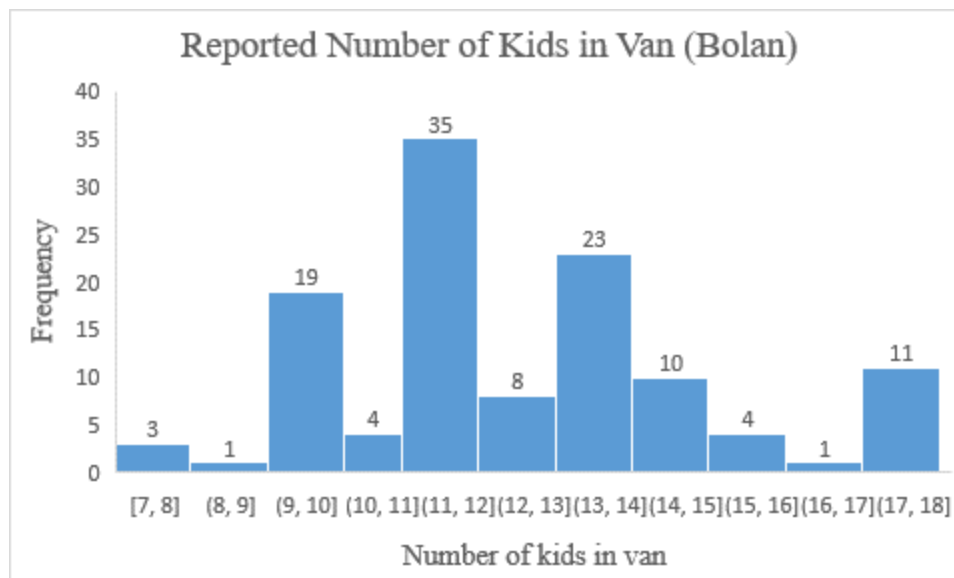
In interview with official from Islamabad Transport Authority, concerns were raised about registration of Rozgar scheme beneficiaries with ITA. It was pointed out that all drivers who acquired vehicle under this scheme do not register with the authority and only do so willingly. On the other hand, drivers interviewed expressed, dissatisfaction over having to pay tax both to the Islamabad Transport Authority as well as Rawalpindi Transport Authority. The requirement to register in both cities comes from the fact that vehicle is acquired under a provincial scheme.

### 3.4 Seating (Space, Design and Occupancy)

Students were asked how many kids including them travelled in the same van to grasp an idea about the occupancy in vehicle. From descriptive statistics it was revealed that most kids reported 12 number of kids in a Bolan van. However, total number of kids who reported more than 12 number of kids in van, is more than total number of kids who reported less than 12 number of kids. (See Figure 3.2.) As the most used vehicle in pick and drop service is Bolan, our main focus of analysis under this heading is also on the same type. (See Figure 3.1.)



**Figure 3.1: Vehicles Used in Pick and Drop Service**



**Figure 3.2: Reported number of kids riding in a van (Bolan)**

The number of kids in van also varies depending on the age group of children, but ascertaining which age group children are riding was beyond the scope of study and difficult to gather. As the age of children increases, number of kids in van decreases. The exception where 17-18 children are boarding a van, is due to children being of younger age under 7th grade.

Given that 10 number of children is the seating limit for Bolan, a number of van operator seem to be violating the prescribed limit. The service providers increase vehicle space by changing seating arrangement to accommodate more children.

### 3.5 Perception about seating

The seating comfort levels, and space are factors that were common among children and parents when asked to describe seating and about negative aspects related to van. Where children described seating space in negative terms, they discussed seating arrangement, crowding, seat comfort levels and space for bags. Some children also mentioned that they think a different vehicle should be used for transport of children.

An 11-year-old boy described his experience as “In summers kids feel very suffocated as barely any wind passes through at the backseat. Girls sit on the middle seats and front seats but no wind passes through till the last bench.” Similarly, a 12-year-old girl who travel with 13 other school children said that “I feel too many kids are in the van, as if the door would open because of the pressure.” A 12-year-old boy who attends a private school mentioned that sometimes he had to stand in van (in a bending position) due to lack of space.

### 3.6 Seating arrangement

Seating space in Bolan is managed in three ways. One in a box like arrangement along the sides of vehicles, two, three benches across the vehicles that could either be facing forward or one of them could be facing towards the opposite end of vehicle, and three, along with

two seats on opposite ends, two one person stools are kept in van without being fixed. As the seating space is larger for sideways box like arrangement, van drivers use this to accommodate more passengers. Some kids mentioned that the benches in their van are not fixed and would move which made them very uncomfortable. The negative aspect of box like seating is that there's no support at back.

*"We have sideways seating not three benches so there's no support or cushion at back. Therefore, the rod behind driving seat hurts my back sometimes."*

Also, there's no space for placement of bags. In some vans bags are either put on the roof or hung outside on a hook. A boy whose bag was hung outside showed his bag which once fell off. (Figure3.3) *"My bag fell off and we stopped the van but the strap of my bag broke and some of my books got damaged too"* The issue of bag placement also reduces the space for seating. *"If we sit with our bags on shoulder, then only bag can be placed."*



**Figure 3.3: Bag torn after falling off from van**

Although Suzuki Bolan is used for carrying logistics primarily, how this vehicle is being modified to transport passengers and especially children is an important area to be studied by transport design and plan experts.

### 3.7 Seating regulations and compliance

As per ITP representatives consulted in this study, the seating limit for children in a Bolan is 8-10, whereas for a Hiace its 18. The drivers who were interviewed are aware of these seating limitations, but everyone doesn't comply with them. The issue of incompliance lies in the fragmented market structure as large number of independent operators are involved in the business. The competition as per some drivers makes it hard to comply. A driver who picks children in Zone V described this dilemma as lack of unity: *"If I choose to follow the seating limit and raise the fare on my route accordingly, other divers have an opportunity to charge less and board more kids on the van. There's no unity among drivers over these matters."*

The enforcement of seating regulations is also limited as Islamabad Traffic Police occasionally checks the number of passengers after instructions from Islamabad Transport Authority or complaints from other sources. This reactionary approach has limited impact.

### 3.8 Vehicle fitness and maintenance

The condition of vehicle and the model being used effects travel experience of users and their safety. Among parents of both users and non-users concern was shared about vehicle maintenance and fitness. As kids cannot comment on technical aspects of vehicle maintenance, they were asked how often their van breakdowns or how is the condition of doors and locks. The majority of children reported that it happens very rarely that the van would breakdown. Among reasons for van breakdown tyre puncture and vehicle heating up

were the main problems due to which children would get late and go with another driver mid-way. The condition of doors is also an important concern as the door gets stuck. School principals also showed concern about this issue. Principle of a private school said. "Vehicle condition of van isn't appropriate as it is a private vehicle. Inspection of private vehicles rarely happens." *A government school also shared these observations and said "I don't recommend private service at all, why because I believe only 10% of such operators properly maintain their vehicle and ensure safety. Some drivers use CNG as well. On the other hand, government buses are regularly maintained and are a responsibility of school management."*

The reason for lack of regulatory oversight over such matters has been discussed under section 3.2.1. earlier. Motor vehicle fitness examiner office (MVFCO) is responsible for vehicle inspection of public service vehicle only, while private vehicles have no such safety requirements to fulfill (Communication, 2019). Also MVFCO lacks technical and institutional capacity and is run more as a revenue earning body. (NTRC, 2020)

Additionally, the problem also lies in vehicle manufacturing standards in Pakistan which are beyond the immediate scope of urban transport regulation but we will consider a few things. The locally manufactured vans are not required to follow UN technical safety standards, worse come the vehicles are not even at par with safety standards of the manufacturing company in parent country (Communication, 2019).

### **3.9 Driving behavior**

The private school van drivers are often challenged for over speeding. Moreover, parents and children have also shown concern for driving behavior. This does not imply that all van drivers drive rashly rather an issue of not having speed governors or monitoring devices in Pakistan. Although public service vehicles are required to have speed devices it is not being enforced in Pakistan. In contrast, school transport vehicles in India, China and US are required to have speed monitoring devices.

### **3.10 Role of School Management**

The school management does not see itself as responsible for transport related matters. The parents on the other hand mentioned that transport provision should be responsibility of the school. The private schools keep record of CNIC copy of the driver, the children he picks up and address. Although this does help in social safety concerns the driving license or vehicle registration are not checked by schools or parents hiring the private operators. In such a scenario schools were asked about their possible role in keeping data of drivers and transport provision.

In case of transport provision, school principals of private schools described route management issues, lack of interest, financial constraints, additional responsibility on administrative staff and additional responsibility of children's safety as reasons for not providing transport. Furthermore, there's no such requirement from schools under PIERA regulations either, neither any data is maintained for those private schools which are providing any transport facility.

*"We don't have any specific requirement from them to provide any transportation service.*

*Although we have certain other mechanisms where we assess the performance of these schools, we ask them if they provide any transport. For instance, in fee determination policy.”*

As for devising a mechanism of regulation of private van service, the official commented “*You know a minimum standard can be devised as prerequisites for people offering transport to students by transport regulators. We can work out on the quality and safety factors excluding the cost dimensions. If such standards are chalked out at local administration level and forwarded to us we can recommend them to private education institutes.”*

On the other hand, school management is more concerned with education quality and consider transport an outside matter. In this scenario, role of school management committees in school bus regulation enforcement in India, offers one approach to engaging schools on this matter (Guidelines for Transport Facilities in Schools, 2017). This way the issue of accountability of drivers can also be resolved to some extent.

### **3.11 Social safety (Harassment)**

The issue of social safety also came up in conversation with all stakeholders. The issue was described by PEIRA official as “It would sidetrack this conversation from regulation but I would like to highlight the issue of harassment. Such incidents happen. Although we are trying to enlighten people and children in schools as a policy of PEIRA such issues are encountered by children in different spaces while travelling etc.

Also, this harassment issue is not confined to public transport, even when people have arranged private drivers, children do face such situations or while walking towards the school they are vulnerable.”

These concerns were shared by parents and children as well. The fact that unregistered individual operators are running van service makes their accountability difficult. Parents recommended vetting of drivers or special licensing regime for drivers who are responsible for school transport. However, none of the parents among van users themselves have tried to check the CNIC, license or any vehicle fitness related document while booking the service. Although, it’s not the responsibility of parents to check these things, the lack of immediate attention to such matters shows the level of concern shown by parents.

### **3.12 Fuel Safety concerns**

The use of CNG cylinders in public transport has been banned by OGRA since 2019 (Kiani, 2019). Although MVO 1965 and Motor Vehicle rules lag behind in legislation with respect to these concerns, provinces have amended these laws as transport is a provincial subject. For instance, Sindh Assembly has made amendments in the MVO 1965 section 39 regarding vehicle fitness certificate of transport vehicles. The section 39A added in The Provincial Motor Vehicles (Amendment) Act, 2021 directs examination of transport vehicles using CNG, LPG or LNG as fuels and categorically mentions examination of “school vans” along with public service vehicles. However, federal level motor vehicle laws and rules do not mention school van anywhere. Despite this legal gap, ITA conducts joint operation with ITP and inspects the vehicles for using cylinder.

Given private pick and drop service is not registered as a public transport vehicle, it was asked from drivers and transport authority official whether the use of CNG cylinder is common, also whether the cylinder's being used confirm with standards of Hydrocarbon Development Institute of Pakistan. The drivers were well aware of the HDPI standards, but none admitted to be using CNG although they had CNG kit installed. The drivers reported that new Euro model of Bolan doesn't have good mileage for CNG, neither CNG is available for them in ICT.

The ITA official reported that some drivers are still using CNG as fuel. He informed that given the recent hike in petrol price, the public service vehicles have started using CNG again. The drivers are filling up cylinders from nearby localities in the outskirts of Islamabad such as Taxila to avoid restrictions in ICT.

### 3.13 Enforcement issues

Apart from the legal gaps in enforcement, other issues have also been identified in the regulatory regime. The joint inspection campaign against school vans is led on direction of ITA by ITP and ITA personnel. It is primarily focused on CDA sectors of Islamabad due to shortage of staff. For enforcement purposes ITA has only ten personnel who have to attend to complaints as well as violations of public transport services. Given ITA falls under district administration, the funds available to the department are also limited and assistant commissioner is usually given additional charge of Secretary ITA. The issue of human resource is also raised by ITP and more elaborately discussed in a recent traffic assessment study of Islamabad. Against an increase of about 610% in registered vehicles, the number of ITP personnel has remained same i.e. 691, leaving 231 points uncovered in traffic management (IPRI, 2022). Only six people are available for vehicle inspection in MVFCO, as reported by ITA. To resolve such issues of inspection, under public private partnership, vehicle inspection and certification stations (VICS) have been established in each district of Punjab and Sindh (Communication, 2019). Two VICS are established in Rawalpindi district and local public transporters from Islamabad are also being advised by ITA to get certification from these stations (The Nation, 2019). The ITA official informed

*"VICS is managed by a private company, and they have proper machinery through which they pass the vehicle to check its fitness. We are advising public service vehicles registered with ITA to get fitness certificate from there."* These stations are technologically well equipped and school vans should also be required to get fitness certification from there.

The social benefit of having a transport service available for school commute are realized by government entities and is one of the reasons why school van or other pick and drop services are being allowed to operate regardless of the violation of section 44 of MVO. It is agreed by transport authority that there is need for regulations that specifically address concerns of school van service. The public transporters who are registered with the authority object over those who are not paying tax yet allowed to operate. Whereas pick and drop service operators, object that if drivers of ride sharing services like Uber and Careem do not register and pay tax why should a van driver who is barely earning 30,000 a month at average be regulated. As per ITA van drivers are asked to register but they do not want to same was observed by van drivers. Although ride sharing services may not be registered with the

transport authority, these drivers are accountable to the company and have proper complaint mechanisms against them. The issue with pick and drop service is that they are independently operating not registered even with a company or school. Therefore, there is no data available for them and no check on service quality.

As for traffic management, ITP informed that traffic plans are made primarily for government schools or private schools in H-8 sectors. In case of private schools traffic plans are difficult to implement as schools have been established in residential areas. For the same reason ITP requested CDA and DC to shift those schools. Such policy actions are more oriented towards catering to increasing motorized trips. If schools were in residential spaces, why weren't active modes of transport promoted to cater traffic issues? The issues of traffic management and planning shouldn't be solely approached to cater to more cars entering an area, rather how those traveling on car can be shifted to active modes of travel should also be considered.

### **3.14 Recommendations**

This exploratory study was an attempt to understand how school transport needs of children in Islamabad are being met and the issues associated with it from the perspective of school management, parents, children, local authorities and transport service providers. An initial inquiry into experiences and perceptions of children in this research has provided necessary information regarding the issues and benefits that are identified by children if they travel on a private van service. To aid this inquiry perspective of parents and non-van users has also been helpful. Additionally, this study tried to understand the role school management could be interested in with respect to regulation of private van service, as the practice of keeping driver details by private school already helps assuring some sort of safety to parents and children. Although private schools are yet reluctant in provision of transport, all school officials interviewed in this study expressed concerns regarding vehicle and social safety of van service. At the same time, the role private vans play in providing transport for school children cannot be denied.

The school travel behavior for private and government school students differs as more private school students use personal car than government school students. The underlying reasons for these differences were explored for school related factors, distance, household factors and safety concerns for each mode of travel. It was observed that majority of children driven by parents reside in walkable distance from home. Hence, distance alone cannot explain school travel mode choice rather land use indicators and attitude towards other transport modes have to be factored in. Among private school student's prevalence of mode of car use is more than government school students primarily because of household factors and availability of school bus service. This study concludes that private van service is serving at least 35% students in government and private schools. The perception among parents and children varies about school travel as for some it is a source of convenience and alternative. While in terms of travel experience school children described experience in both positive and negative aspects. One positive aspect highlighted by both parents and children is social interaction and learning. Some parents also view that learning to share space and travel with other people is an important part of social learning for their children. Among negative



aspects safety and comfort concerns were shared by parents and children which helped identify issues that are important for regulation of transport service. However, when asked about whether parents themselves checked driving license or vehicle registration papers all parents said they never inquired about that. School management sees transport matters of private van service, as parents and transport authorities'/district administration's concern alone. Hence, although many school principals shared their own concerns of safety of children traveling in vans the schools are not interested in play much of a role.

The issues identified for regulatory concerns were important in discussion with government authorities and van drivers. The existing regulatory framework is MVO 1965 and MVR 1969, the newly drafted model road safety act is also applicable in Islamabad. However, much of its regulatory provisions are not very different with respect to private service vehicles. As vans are hired service and do not operate on regional transport authority defined routes, they are not registered as a public service vehicle with the transport secretary. Also no school transport specific safety standards exist in Pakistan unlike other countries discussed in this research. Therefore, existing urban transport regulatory practices were analysed and even in that case there's weak enforcement. The interview with government regulatory and enforcement agencies for transport revealed that there's no regular inspection of private van service as there's no legal precedent except for issuing challan or confiscation of vehicle for being not registered. However, as a lot of families depend on this service, such harsh measures are not desirable. Instead, private van operators are given penalty for violation of passenger limits for (overloading), not having a permit and vehicle fitness certificate or use of CNG, when crackdown is done by authorities. The main gap in regulation is of legal nature as the vans are not registered as public service vehicle and hence not mandated to acquire motor vehicle fitness certificate or vehicle fitness inspection. Also the issues of lack of enough staff in ITA and ITP impedes implementation across ICT restricting it mainly to CDA sectors.

### **3.14.1 Policy Recommendations**

In such a scenario this research has come up with following recommendations:

### **3.14.2 Concentration of regulations regarding an on safety and service quality aspects**

Federal level legislation defining safety standards for school transport service can be instrumental. Such a legislation should integrate school transport policy so that education institutes are also engaged in implementation. Private van service contributes to provide transport to a lot households including those which come from middle income families and those which do not own any personal vehicle. Therefore, the role of service providers shouldn't be ignored. Furthermore, the providers themselves come from low income background and are providing service under very difficult circumstances. Harsh regulations can harm both dependent users and providers. Therefore, the focus should be on safety related aspects and driver vetting for criminal background and awareness among families to report in case of any unreasonable behavior.

### **3.14.3 Modification inside the vehicle**

While much of the focus of regulations debate is on seating capacity, the ergonomics of interior design and space of a van cannot be ignored. As it has been identified during the FGDs with children, seating arrangement affects comfort levels and physical safety of child. Along with lack of space for placement of baggage in van, the modification done to increase seating by adding stools and M.S. bench is inappropriate for use by children. As the most commonly used vehicle for school van service is a Suzuki Bolan, an ergonomics-based study should be conducted for it in future to identify suitable seating layout and capacity according to children's needs. One such study was conducted in India for van vehicles being used to transport children and a seating layout was proposed according to the comfort and spatial aspects best suited for children (Neha Chourasia, 2019). A user centered approach, ergonomics, takes into account human factors as well as purpose for which transport vehicle is being used and user needs in transport design (Woodcock, 2012). For a vehicle being used to transport children such details should be studied by future researchers and transport policy experts.

### **3.14.4 Addressing social safety issues**

It has been a recurrent theme pointed out by concerned parents, children and educational institutes that safety of girls in terms of harassment while walking to school or riding in a local transport or private transport is a grave issue that also needs attention while considering school transport issues. When asked about the major concern regarding school travel, PEIRA representative also highlighted the same issue. He remarked that it is not just about the driver's behavior it may be other passenger's behavior or while a child is walking that such untoward situations arises. The evidence from a study conducted in New Delhi India also found correlation between girl's choice of college and perceived route safety (Borker, 2021). This study corroborates the argument that harassment is an important concern in terms children's travel to school. With an already low enrolment rates of girl child, such issues exacerbate the accessibility concerns regarding education.

For this purpose, registration category of school van service license and vehicle should be created under MVO 1965, whereby data is maintained by excise department regarding which people are involved in this business activity. School management should play an active role in having this registration exercise and parents be encouraged to hire those drivers who are registered with the authority.

### **3.14.5 Promoting active school travel**

One of the findings of the study for selected schools is that a lot of students reside in walkable distance of school but use motorized modes of school travel. Policy makers and futures study on this subject should explore how a behavioral change can shift these school trips to active modes of transport. There is a need to adapt those urban planning practices that make our cities and towns walkable and give rights to pedestrians. Promoting active modes of transport shall not only benefit children in terms of healthy lifestyle, it is also an environmentally viable option. While Twin Cities air quality index is worsening, transport sector is the main contributor to high air quality index (Haroon, 2022). In such a scenario

promoting active travel for school shall have implication for not just present but also creating a sentiment among future adults to adopt to more environment friendly means of travel.

### **3.14.6 Reducing motorbike usage by underage children**

The practice of using motor bikes among minor aged boys is becoming very common. The use of helmets should be made mandatory and enforced not just by police but schools should also be instructed to observe whether students are following these instructions. Also it should be pointed out, that while motorcycle use has become common, bicycle use has significantly reduced. Whether this pattern is due to traffic safety concerns or social behavior should be further investigated.

### **3.14.7 Increasing human resource and research practice in enforcing government entities**

The government departments are understaffed and hence find hurdles in implementation. As Islamabad's population is growing at a very fast rate there's a need to increase number of personnel deployed in field and efficient use of information communication technologies.

For future studies, a study on trip generation by schools shall provide necessary evidence to CDA, transport departments and educational institutes on how much traffic is being generated by school trips. Given Islamabad's urban plan, a GIS based study on school travel for future research might provide important insight on school travel.

## REFERENCES

- Abbasi, K. (2021, February 3). School committees to run FDE buses on cost-sharing basis. DAWN. <https://www.dawn.com/news/1605145>
- Adeel, M., Yeh, A. G. O., & Zhang, F. (2016). Towards an inclusive public transport system in Pakistan. *Transport and Communications Bulletin for Asia and the Pacific*.
- Adeel, M., Yeh, A., & Zhang, F. (2014). Gender, mobility and travel behavior in Pakistan: analysis of 2007 Time Use Survey. 5th International Conference on Women's Issues in Transportation-Bridging the Gap, 41–46.
- AEPAM. (2021). Pakistan Education Statistics 2017-18. <http://library.aepam.edu.pk/Books/Pakistan Education Statistics 2017-18.pdf>
- Ali, N., Javid, M. A., & Rahim, A. (2020). Predicting Transit Mode Choice Behavior from Parents' Perspectives: A Case Study in Lahore, Pakistan. *Jordan J Civil Eng*, 14(4), 476–489.
- Alotaibi, O., & Potoglou, D. (2018). Introducing public transport and relevant strategies in Riyadh City, Saudi Arabia: a stakeholders' perspective. *Urban, Planning and Transport Research*, 6(1), 35–53. <https://doi.org/10.1080/21650020.2018.1463867>
- Anund, A, & Dukic, T. (2011). From user wishes to system architecture safety for children going to and from school by bus. 2011 11th International Conference on ITS Telecommunications, 327–331. <https://doi.org/10.1109/ITST.2011.6060076>
- Anund, Anna, Dukic, T., Thornthwaite, S., & Falkmer, T. (2011). Is European school transport safe?—The need for a “door-to-door” perspective. *European Transport Research Review*, 3(2), 75–83. <https://doi.org/10.1007/s12544-011-0052-7>
- Barker, J. (2003). Passengers or political actors? Children's participation in transport policy and the micro political geographies of the family. *Space and Polity*, 7(2), 135–151. <https://doi.org/10.1080/1356257032000133900>
- Barker, J., Kraftl, P., Horton, J., & Tucker, F. (2009). The Road Less Travelled – New Directions in Children's and Young People's Mobility. *Mobilities*, 4(1), 1–10. <https://doi.org/10.1080/17450100802657939>
- Barker, J., & Weller, S. (2003). “Is it fun?” developing children centred research methods. *International Journal of Sociology and Social Policy*, 23(1/2), 33–58. <https://doi.org/10.1108/01443330310790435>
- Baslington, H. (2008). Travel Socialization: A Social Theory of Travel Mode Behavior. *International Journal of Sustainable Transportation*, 2(2), 91–114. <https://doi.org/10.1080/15568310601187193>
- Baslington, H. (2009). Children's perceptions of and attitudes towards, transport modes: why a vehicle for change is long overdue. *Children's Geographies*, 7(3), 305–322. <https://doi.org/10.1080/14733280903024472>
- Beirão, G., & Cabral, J. A. S. (2007). Understanding attitudes towards public transport and private car: A qualitative study. *Transport Policy*, 14(6), 478–489.

- Borker, G. (2021). Safety first: Perceived risk of street harassment and educational choices of women. World Bank.
- Bryman, A. (2016). Social research methods. Oxford university press.
- Burgmanis, G. (2012). Children's Everyday School Travel and Mode Choice in a Post Socialist city: the case of Riga, Latvia. *International Proceedings of Economics Development and Research*, 31, 47-56.
- Carter, N., Bryant-Lukosius, D., DiCenso, A., Blythe, J., & Neville, A. J. (2014). The use of triangulation in qualitative research. *Oncology Nursing Forum*, 41(5), 545-547. <https://doi.org/10.1188/14.ONF.545-547>
- Cascajo, R. (2018). User perception of transfers in multimodal urban trips: A qualitative study. *International Journal of Sustainable Transportation*, 13(6).
- Guidelines for Transport Facilities in Schools, (2017). [https://www.cbse.gov.in/cbsenew/Examination\\_Circular/2017/43\\_CIRCULAR.pdf](https://www.cbse.gov.in/cbsenew/Examination_Circular/2017/43_CIRCULAR.pdf)
- CDA. (n.d.). Islamabad Captial Territory Map. CDA. <https://www.cda.gov.pk/housing/ictmap.asp>
- Cervero, R., & Golub, A. (2007). Informal transport: A global perspective. *Transport Policy*, 14(6), 445-457.
- Christiansen, L. B., Toftager, M., Schipperijn, J., Ersbøll, A. K., Giles-Corti, B., & Troelsen, J. (2014). School site walkability and active school transport – association, mediation and moderation. *Journal of Transport Geography*, 34, 7-15. <https://doi.org/https://doi.org/10.1016/j.jtrangeo.2013.10.012>
- Clifton, K., & Handy, S. (2001). Qualitative Methods in Travel Behaviour Research. *Transport Survey Quality and Innovation*. <https://doi.org/10.1108/9781786359551-016>
- Communication, M. of. (2019). National Guidelines for Vehicle Licencing. <http://www.roadsafetypakistan.pk/download/national-guidelines-for-vehicle-licencing.pdf>
- Crawford, S. B., Bennetts, S. K., Hackworth, N. J., Green, J., Graesser, H., Cooklin, A. R., Matthews, J., Strazdins, L., Zubrick, S. R., D'Esposito, F., & Nicholson, J. M. (2017). Worries, 'weirdos', neighborhoods and knowing people: a qualitative study with children and parents regarding children's independent mobility. *Health & Place*, 45, 131-139. <https://doi.org/https://doi.org/10.1016/j.healthplace.2017.03.005>
- Cresswell, T., & Merriman, P. (2011). *Geographies of mobilities: Practices, spaces, subjects*. Ashgate Publishing, Ltd.
- D'Haese, S., De Meester, F., De Bourdeaudhuij, I., Deforche, B., & Cardon, G. (2011). Criterion distances and environmental correlates of active commuting to school in children. *International Journal of Behavioral Nutrition and Physical Activity*, 8(1), 88. <https://doi.org/10.1186/1479-5868-8-88>
- De Vos, J., Mokhtarian, P. L., Schwanen, T., Van Acker, V., & Witlox, F. (2016). Travel mode choice and travel satisfaction: bridging the gap between decision utility and experienced utility. *Transportation*, 43(5), 771-796. <https://doi.org/10.1007/s11116-015-9619-9>

- Deng, F., & J Kurgan, G. (2012). On the road to safe school transport in China. The World Bank.
- Dias, C., Abdullah, M., Lovreglio, R., Sachchithanantham, S., Rekatheeban, M., & Sathyaprasad, I. M. S. (2022). Exploring home-to-school trip mode choices in Kandy, Sri Lanka. *Journal of Transport Geography*, 99, 103279. <https://doi.org/https://doi.org/10.1016/j.jtrangeo.2022.103279>
- Direction of the Supreme Court of India for School Bus. (n.d.). Track School Bus. <https://www.trackschoolbus.com/school-bus-rules-and-regulations/india>
- Docherty, I., Marsden, G., & Anable, J. (2018). The governance of smart mobility. *Transportation Research Part A: Policy and Practice*, 115, 114–125. <https://doi.org/https://doi.org/10.1016/j.tra.2017.09.012>
- Easton, S., & Ferrari, E. (2015). Children's travel to school—the interaction of individual, neighbourhood and school factors. *Transport Policy*, 44, 9–18. <https://doi.org/https://doi.org/10.1016/j.tranpol.2015.05.023>
- Ehebrecht, D., Heinrichs, D., & Lenz, B. (2018). Motorcycle-taxis in sub-Saharan Africa: Current knowledge, implications for the debate on “informal” transport and research needs. *Journal of Transport Geography*, 69, 242–256. <https://doi.org/https://doi.org/10.1016/j.jtrangeo.2018.05.006>
- Ermagun, A., & Levinson, D. (2016). Intra-household bargaining for school trip accompaniment of children: A group decision approach. *Transportation Research Part A: Policy and Practice*, 94, 222–234. <https://doi.org/https://doi.org/10.1016/j.tra.2016.09.012>
- Farinloye, T., Mogaji, E., Aririguzoh, S., & Kieu, T. A. (2019). Qualitatively exploring the effect of change in the residential environment on travel behaviour. *Travel Behaviour and Society*, 17, 26–35.
- Faulkner, G. E. J., Buliung, R. N., Flora, P. K., & Fusco, C. (2009). Active school transport, physical activity levels and body weight of children and youth: a systematic review. *Preventive Medicine*, 48(1), 3–8.
- Faulkner, G. E. J., Richichi, V., Buliung, R. N., Fusco, C., & Moola, F. (2010). What's “quickest and easiest?": parental decision making about school trip mode. *International Journal of Behavioral Nutrition and Physical Activity*, 7(1), 62. <https://doi.org/10.1186/1479-5868-7-62>
- Ferrari, E., & Green, M. A. (2013). Travel to School and Housing Markets: A Case Study of Sheffield, England. *Environment and Planning A: Economy and Space*, 45(11), 2771–2788. <https://doi.org/10.1068/a45423>
- Fishman, E., Washington, S., & Haworth, N. (2012). Barriers and facilitators to public bicycle scheme use: A qualitative approach. *Transportation Research Part F: Traffic Psychology and Behaviour*, 15(6), 686–698. <https://doi.org/https://doi.org/10.1016/j.trf.2012.08.002>
- Fusch, P., Fusch, G. E., & Ness, L. R. (2018). Denzin's paradigm shift: Revisiting triangulation in qualitative research. *Journal of Social Change*, 10(1), 2.
- Fusco, C., Faulkner, G., Moola, F., Buliung, R., & Richichi, V. (2013). Urban School Travel: Exploring Children's Qualitative Narratives about Their Trip to School. *Children, Youth and*

Environments, 23, 1–23. <https://doi.org/10.7721/chilyoutenvi.23.3.0001>

Fusco, C., Moola, F., Faulkner, G., Buliung, R., & Richichi, V. (2012). Toward an understanding of children's perceptions of their transport geographies: (non)active school travel and visual representations of the built environment. *Journal of Transport Geography*, 20(1), 62–70. <https://doi.org/https://doi.org/10.1016/j.jtrangeo.2011.07.001>

Fyhri, A., & Hjorthol, R. (2009). Children's independent mobility to school, friends and leisure activities. *Journal of Transport Geography*, 17(5), 377–384. <https://doi.org/https://doi.org/10.1016/j.jtrangeo.2008.10.010>

Gautham, M. S., Gururaj, G., Nadig, K., Roy, A., & Nair, L. (2020). School safety assessment in Bengaluru and Kolar districts, India. *International Journal of Injury Control and Safety Promotion*, 27(3), 336–346. <https://doi.org/10.1080/17457300.2020.1778038>

Gristy, C., & Johnson, R. (2018). Home-to-school transport in contemporary schooling contexts: an irony in motion. *British Journal of Educational Studies*, 66(2), 183–201. <https://doi.org/10.1080/00071005.2017.1346229>

Grosvenor, T. (2000). *Qualitative research in the transport sector*.

Guion, L. A., Diehl, D. C., & McDonald, D. (2011). Triangulation: establishing the validity of qualitative studies: FCS6014/FY394, Rev. 8/2011. *Edis*, 2011(8), 3.

Hanson, S. (2015). *Transportation Geographies and Mobilities Studies: Toward Collaboration*. In *Transport, mobility, and the production of urban space* (pp. 3–11). Routledge.

Haq, N. ul, & Rizwan, M. (2020). Rethinking mobility (urban transport policy) in Pakistan. <https://pide.org.pk/research-category/urban-monograph-series/>

Haroon, M. (2022). *Sustainable Urban Transportation - Mr. Kamran Ahmed - Index (SUTI) for Twin Cities*. <https://policycommons.net/artifacts/2281740/sustainable-urban-transportation-mr/3041812/>

Hasan, S. (2019, February 10). Society: Pick and drop bombs? *DAWN*. <https://www.dawn.com/news/1462917>

He, S., & Giuliano, G. (2015). Factors affecting children's journeys to school: a joint escort-mode choice model. *Transportation*.

Hennink, M. M. (2013). *Focus group discussions*. Oxford University Press.

Henry, K., Younossi, O., Al-Dafa, M., Culbertson, S., Mattock, M. G., Light, T., Rohr, C., Al-Dorani, S., Al-Ibrahim, H., Al-Naimi, M., Constant, L., Makki, M., Mansour, G., Moini, J. S., Roshan, P., Sorensen, P., & Tsang, F. (2012). APPENDIX B. Overview of School Transportation in Other Gulf Cooperation Council Countries. In *Qatar's School Transportation System* (pp. 99–106). RAND Corporation. <http://www.jstor.org/stable/10.7249/j.ctt3fh1xk.16>

Hensher, D. A., Stopher, P., & Bullock, P. (2003). Service quality—developing a service quality index in the provision of commercial bus contracts. *Transportation Research Part A: Policy and Practice*, 37(6), 499–517. [https://doi.org/https://doi.org/10.1016/S0965-8564\(02\)00075-7](https://doi.org/https://doi.org/10.1016/S0965-8564(02)00075-7)

Hisam, Z. (2006). *Collective Care Arrangements in the Informal Labour Market: Road*

- Transport Workers in Pakistan. *Economic and Political Weekly*, 41(21), 2099–2106. <http://www.jstor.org/stable/4418265>
- Humberto, M., Filipe, M., & Giannotti, M. (2022). Incorporating children's views and perceptions about urban mobility: Implementation of the "philosophy with children" inquiry approach with young children. *Travel Behaviour and Society*.
- Ikeda, E., Mavoa, S., Cavadino, A., Carroll, P., Hinckson, E., Witten, K., & Smith, M. (2020). Keeping kids safe for active travel to school: A mixed method examination of school policies and practices and children's school travel behaviour. *Travel Behaviour and Society*, 21, 57–68. <https://doi.org/https://doi.org/10.1016/j.tbs.2020.05.008>
- Imran, M. (2009). Public transport in Pakistan: a critical overview. *Journal of Public Transportation*, 12(2), 4.
- IPRI. (2022). Study Launch: Assessment of Traffic Congestion and Management Issues in Islamabad. IPRI. <https://ipripak.org/study-launch-assessment-of-traffic-congestion-and-management-issues-in-islamabad/>
- Javid, M. A., Okamura, T., Nakamura, F., & Wang, R. (2013). Comparison of commuters' satisfaction and preferences with public transport: A case of wagon service in Lahore. *Jordan Journal of Civil Engineering*, 7(4), 461–472.
- Khan, A. S. (2014). Pak Suzuki gets order for 50,000 cabs. DAWN.
- Khan, M. I., Yasmin, T., & Khan, N. B. (2016). Safety issues associated with the use and operation of natural gas vehicles: learning from accidents in Pakistan. *Journal of the Brazilian Society of Mechanical Sciences and Engineering*, 38(8), 2481–2497. <https://doi.org/10.1007/s40430-015-0410-9>
- Kiani, K. (2019). CNG, LPG use by public transport banned. DAWN.
- Kostelnik, M. J., Stein, L. C., & Whiren, A. P. (1988). Children's self-esteem: The verbal environment. *Childhood Education*, 65(1), 29–32.
- Krueger, R. A. (2014). *Focus groups: A practical guide for applied research*. Sage publications.
- Kumarage, A. S., Kandanaarachchi, T., & Karunarathne, A. (2022). Review of the "Sisu Seriya" School Bus Service. *Journal of South Asian Logistics and Transport*, 2(1).
- Larsen, J. (2014). Distance and proximity. In *The Routledge Handbook of Mobilities* (pp. 125–133). Routledge.
- Li, J., Zhang, K., Guo, J., & Jiang, K. (2012). Reasons Analyzing of School Bus Accidents in China. *Procedia Engineering*, 45, 841–846. <https://doi.org/https://doi.org/10.1016/j.proeng.2012.08.248>
- Li, M., Zou, M., & Li, H. (2019). Chapter 5 - Urban Travel Behavior Study Based on Data Fusion Model (Y. Wang & Z. B. T.-D.-D. S. to T. P. Zeng (Eds.); pp. 111–135). Elsevier. <https://doi.org/https://doi.org/10.1016/B978-0-12-817026-7.00005-9>
- Li, S., & Zhao, P. (2015). The determinants of commuting mode choice among school children in Beijing. *Journal of Transport Geography*, 46, 112–121.



<https://doi.org/https://doi.org/10.1016/j.jtrangeo.2015.06.010>

Lin, J.-J., & Yu, T.-P. (2011). Built environment effects on leisure travel for children: Trip generation and travel mode. *Transport Policy*, 18, 246–258. <https://doi.org/10.1016/j.tranpol.2010.08.008>

Litman, T. (2007). Valuing Transit Service Quality Improvements. *Journal of Public Transportation*, 11. <https://doi.org/10.5038/2375-0901.11.2.3>

Litman, T. (2017). Introduction to multi-modal transportation planning. Victoria Transport Policy Institute Canada.

Lu, M., Sun, C., & Zheng, S. (2017). Congestion and pollution consequences of driving-to-school trips: A case study in Beijing. *Transportation Research Part D: Transport and Environment*, 50, 280–291. <https://doi.org/https://doi.org/10.1016/j.trd.2016.10.023>

Lucas, K. (2013). Qualitative Methods in Transport Research: The ‘Action Research’ Approach. In J. Zmud, M. Lee-Gosselin, M. Munizaga, & J. A. Carrasco (Eds.), *Transport Survey Methods* (pp. 427–440). Emerald Group Publishing Limited. <https://doi.org/10.1108/9781781902882-023>

Malta Government. (n.d.). School Transport. <https://schooltransport.edu.mt/>

Mansoor, H. (2019, February 7). Sindh-wide drive against CNG cylinders in school vans to begin next week. *Dawn*. <https://www.dawn.com/news/1462224>

Maria, S. I., & Imran, M. (2006). Planning of Islamabad and Rawalpindi: What went wrong. *Proceedings of the 42nd ISoCaRP Congress, Istanbul, Turkey*, 14–18.

Mars, L., Arroyo, R., & Ruiz, T. (2016). Qualitative Research in Travel Behavior Studies. *Transportation Research Procedia*, 18, 434–445. <https://doi.org/https://doi.org/10.1016/j.trpro.2016.12.057>

McDonald, N. C. (2008). Children’s mode choice for the school trip: the role of distance and school location in walking to school. *Transportation*, 35(1), 23–35. <https://doi.org/10.1007/s11116-007-9135-7>

McMillan, T. (2013). Children and Youth and Sustainable Urban Mobility. Thematic Study Prepared for Global Report on Human Settlements.

McMillan, T. E. (2005). Urban Form and a Child’s Trip to School: The Current Literature and a Framework for Future Research. *Journal of Planning Literature*, 19(4), 440–456. <https://doi.org/10.1177/0885412204274173>

Mehdizadeh, M., Nordfjaern, T., & Mamdoohi, A. (2018). The role of socio-economic, built environment and psychological factors in parental mode choice for their children in an Iranian setting. *Transportation*, 45(2), 523–543. <https://doi.org/10.1007/s11116-016-9737-z>

Right to Free and Compulsory Education and School and College Management Committee Rules, (2021). <http://fde.gov.pk/school-college-management-committee/>

Morrow, V. (2008). Ethical dilemmas in research with children and young people about their social environments. *Children’s Geographies*, 6(1), 49–61.

<https://doi.org/10.1080/14733280701791918>

Murray, L. (2009). Making the journey to school: The gendered and generational aspects of risk in constructing everyday mobility. *Health, Risk & Society*, 11(5), 471–486. <https://doi.org/10.1080/13698570903183889>

Naqvi, Z. (2019, January 29). PMERP completed: Last batch of 70 buses handed over to schools. *Express Tribune*. <https://tribune.com.pk/story/1899047/pmerp-completed-last-batch-70-buses-handed-schools>

Neha Chourasia, A. (2019). Kids on Board?! Rethinking Safety and Comfort of Kids in School Vans BT - Research into Design for a Connected World (A. Chakrabarti (Ed.); pp. 955–966). Springer Singapore.

NHTSA. (2022). School Bus Safety Ammendments. <https://www.nhtsa.gov/road-safety/school-bus-safety#:~:text=Federal Motor Vehicle Safety Standard,the need to buckle-up>.

Nikitas, A., Wang, J. Y. T., & Knamiller, C. (2019). Exploring parental perceptions about school travel and walking school buses: A thematic analysis approach. *Transportation Research Part A: Policy and Practice*, 124, 468–487. <https://doi.org/https://doi.org/10.1016/j.tra.2019.04.011>

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods*, 16(1), 1609406917733847. <https://doi.org/10.1177/1609406917733847>

NTRC. (2020). International Expert Consultations: Road Safety Legislative Assessment Pakistan. <https://doi.org/NTRC-335>

Orsini, A., & O'Brien, C. (2006). Fun, Fast and Fit: Influences and Motivators for Teenagers Who Cycle to School. *Children, Youth and Environments*, 16.

Ortúzar, J. de D., & Willumsen, L. (2011). *Modelling Transport*, Fourth Edition. <https://doi.org/10.1002/9781119993308.fmatter>

Pakistan Bureau of Statistics. (2017). *Sixth Population & Housing Census-2017*.

Pakistan Bureau of Statistics. (2021). *Social Indicators of Pakistan*. [https://www.pbs.gov.pk/sites/default/files/social\\_statistics/publications/Social\\_Indicators\\_of\\_Pakistan\\_2021.pdf](https://www.pbs.gov.pk/sites/default/files/social_statistics/publications/Social_Indicators_of_Pakistan_2021.pdf)

PARUSEL, S., & McLAREN, A. T. (2010). Cars before Kids: Automobility and the Illusion of School Traffic Safety. *Canadian Review of Sociology/Revue Canadienne de Sociologie*, 47(2), 129–147. <https://doi.org/https://doi.org/10.1111/j.1755-618X.2010.01227.x>

Pati, S. (2017). Roads Near Schools and Their Design Safety Analysis of an Indian City. *International Journal of African and Asian Studies*.

Pooley, C. G., Turnbull, J., & Adams, M. (2005). The journey to school in Britain since the 1940s: continuity and change. *Area*, 37(1), 43–53. <https://doi.org/https://doi.org/10.1111/j.1475-4762.2005.00605.x>

- Porter, G., & Turner, J. (2019). Meeting young people's mobility and transport needs: Review and prospect. *Sustainability*, 11(22), 6193.
- Rahman, M. S. U., & Shah, N. A. (2018). ANALYSIS OF SCHOOL TRIPS IN DHAKA CITY: A CASE STUDY ON PRIMARY SCHOOL STUDENTS. *PLAN PLUS*, 8(1).
- Ranjan, S. (2018). Action against non-registered school vans. *The Bridge Chronicles*. <https://www.thebridgechronicle.com/pune/action-against-non-registered-school-vans-20594>
- Rawat Station Starts Issuing Fitness Certificates To Commercial Vehicles. (2019, May 27). *The Nation*. <https://nation.com.pk/2019/05/27/rawat-station-starts-issuing-fitness-certificates-to-commercial-vehicles/>
- Ross, N. J. (2007). 'My Journey to School ...': Foregrounding the Meaning of School Journeys and Children's Engagements and Interactions in their Everyday Localities. *Children's Geographies*, 5(4), 373–391. <https://doi.org/10.1080/14733280701631833>
- Save Life Foundation. (2021). National Study on Safe Commute to School. <https://savelifefoundation.org/2021/10/05/commute-to-school/>
- Sersli, S., Rothman, L., & Winters, M. (2019). Getting at Mode Share: Comparing 3 Methods of Travel Mode Measurement for School Travel Research. *Journal of School Health*, 89(5), 365–372. <https://doi.org/https://doi.org/10.1111/josh.12743>
- The Provincial Motor Vehicles (Amendment) Act, (2021). <http://sindhlaws.gov.pk/setup/Publications/PUB-21-000028.pdf>
- Singh, N., & Vasudevan, V. (2018). Understanding school trip mode choice – The case of Kanpur (India). *Journal of Transport Geography*, 66, 283–290. <https://doi.org/https://doi.org/10.1016/j.jtrangeo.2017.12.007>
- Sohail, M. (2003). Partnerships to improve access and quality of public transport - a case report: Colombo, Sri Lanka. [https://assets.publishing.service.gov.uk/media/57a08d0ce5274a27b20015c7/Partnerships\\_to\\_improve\\_access\\_transport\\_-\\_Sri\\_Lanka.pdf](https://assets.publishing.service.gov.uk/media/57a08d0ce5274a27b20015c7/Partnerships_to_improve_access_transport_-_Sri_Lanka.pdf)
- Sohail, M., Maunder, D. A. C., & Cavill, S. (2006). Effective regulation for sustainable public transport in developing countries. *Transport Policy*, 13(3), 177–190.
- Syed, W. H., Jabbar, A., Sheikh, M. U., Yasir, A.-U.-H., Janssens, D., & Galland, S. (2017). A new traffic route analyzer for commuter's guidance in developing countries: application study in Islamabad, Pakistan. *Journal of Ambient Intelligence and Humanized Computing*, 8(3), 395–404. <https://doi.org/10.1007/s12652-017-0453-0>
- Syed, W. H., Yasar, A., Janssens, D., & Wets, G. (2014). Analyzing the Real Time Factors: Which Causing the Traffic Congestions and Proposing the Solution for Pakistani City. *Procedia Computer Science*, 32, 413–420. <https://doi.org/https://doi.org/10.1016/j.procs.2014.05.442>
- Tetali, S., Edwards, P., & Roberts, G. V. S. M. I. (2016). How do children travel to school in urban India? A cross-sectional study of 5,842 children in Hyderabad. *BMC Public Health*, 16(1), 1099. <https://doi.org/10.1186/s12889-016-3750-1>

- Thorntwaite, S. (2016). A Report on School Transport Provision across the UK 2010-2016.
- Uddin, M., & Al Noor, M. (2018). IMPACT OF SCHOOL INDUCED TRAFFIC ON URBAN INTERSECTION IN DHAKA CITY UNDER TRAFFIC CONDITION OF BANGLADESH. *International Journal of Advanced Research*, 6, 848–855. <https://doi.org/10.21474/IJAR01/8070>
- Uddin, R., Mandic, S., & Khan, A. (2019). Active commuting to and from school among 106,605 adolescents in 27 Asia-Pacific countries. *Journal of Transport & Health*, 15, 100637. <https://doi.org/https://doi.org/10.1016/j.jth.2019.100637>
- UITP. (2021). Key insights into transforming the informal transport sector.
- Van Acker, V., Goodwin, P., & Witlox, F. (2016). Key research themes on travel behavior, lifestyle, and sustainable urban mobility. *International Journal of Sustainable Transportation*, 10(1), 25–32. <https://doi.org/10.1080/15568318.2013.821003>
- Van Ristell, J., Enoch, M., Quddus, M., & Hardy, P. (2013). Expert perspectives on the role of the bus in school travel. *Proceedings of the Institution of Civil Engineers-Municipal Engineer*, 166(1), 53–58.
- Westman, J., Olsson, L. E., Gärling, T., & Friman, M. (2017). Children's travel to school: satisfaction, current mood, and cognitive performance. *Transportation*, 44(6), 1365–1382. <https://doi.org/10.1007/s11116-016-9705-7>
- Whether, B. (2017). Tuk-tuk, school van regulation in Sri Lanka can create a bus-style fiasco – . *Economy Next*.
- Woodcock, A. (2012). User-centered Transport Design and User Needs. In *Design for Transport: A User-Centred Approach to Vehicle Design and Travel*.
- Xiao, Z., Lin, T., Liao, J., & Lin, Y. (2021). School Travel Inequity between Students from Public and Private Schools in the City of Shenzhen, China. *Journal of Advanced Transportation*, 2021, 5032726. <https://doi.org/10.1155/2021/5032726>
- Ye, R., & Titheridge, H. (2017). Satisfaction with the commute: The role of travel mode choice, built environment and attitudes. *Transportation Research Part D: Transport and Environment*, 52, 535–547. <https://doi.org/https://doi.org/10.1016/j.trd.2016.06.011>
- Yumita, F. R., Irawan, M. Z., Malkhamah, S., & Kamal, M. I. (2021). School Commuting: Barriers, Abilities and Strategies toward Sustainable Public Transport Systems in Yogyakarta, Indonesia. In *Sustainability* (Vol. 13, Issue 16). <https://doi.org/10.3390/su13169372>
- Zafar, Z. I., Anjum, G. A., Anjum, N., Iftikhar, N., & Manzar, S. (2015). An environmental evaluation of school transport in Islamabad: A case study of sector H-8. *Pakistan Journal of Engineering and Applied Sciences*.
- Zhang, R., Yao, E., & Liu, Z. (2017). School travel mode choice in Beijing, China. *Journal of Transport Geography*, 62, 98–110. <https://doi.org/https://doi.org/10.1016/j.jtrangeo.2017.06.001>
- Zwerts, E., Allaert, G., Janssens, D., Wets, G., & Witlox, F. (2010). How children view their travel behaviour: a case study from Flanders (Belgium). *Journal of Transport Geography*, 18(6), 702–710. <https://doi.org/https://doi.org/10.1016/j.jtrangeo.2009.10.002>

# CHAPTER 8

## BIKE-SHARING: A GLOBAL PERSPECTIVE AND A SUSTAINABLE MOBILITY SOLUTION FOR PAKISTAN

Saba Anwar and Zainab Fatima

### 1 Introduction

Bike Sharing is a mode of transportation designed for short trips starting from 0.5 km to 3 km. There are two types of bike sharing one with the docks i.e. picking up a bike from a defined station and leaving it on another station near his destination. The other one is dockless where the rider can pick a bike within an area identifying its location from the app and can leave the bike after using it in the area that is allowed by the app.

Bike sharing due to its sustainable mode of transportation has become popular globally and because of its convenience it has changed the methods of travelling in urban areas from the use of private to public transport. In this process, bikes are provided to the public on rents for a short journey on defined routes, through automated stations with the help of mobile applications. The users can rent the bike from the designed stations on the basis of their demand and choose the desired available route, reach their destination and return the bike on the designed station at the drop off points marked by the bike riding service providers and the process of renting a bike is totally digital and done through mobile apps where they can pay the rent and get the code to unlock the bike.

These bikes are economic friendly because they are charged on solar energy and hence help in reducing the carbon emissions and also improve the air quality. It also helps in reducing urban pollution, promotes green energy and reduces the problems of traffic. If designed in such a way that it connects the other public transports through multi-modes transportation network, it can help commuters in covering short distances between transit stations and their final destinations. It reduces the chances of congestion in urban areas by providing an alternative to the small vehicles and motorbikes on main roads, by reducing traffic volumes and freeing up the road spaces. As a result, the need for private vehicle and public transport reduces making the traffic smoother, shorter time of commute and improved urban mobility. With affordable rental options, bike sharing provides opportunities to the locals and tourists to explore the inner part of cities and tourist destinations at their own choices.

### 2 History of Bike-sharing

Although the notion of bike sharing, sometimes known as bicycle-sharing systems, has numerous historical precedents, the current version of bike sharing as we know it today did not emerge until the late twentieth century. The concept of bike sharing is to make bicycles temporarily available for public use, particularly in urban areas.

A number of significant discoveries led to the conception of bike sharing. The Netherlands'

Amsterdam "White Bicycle Plan" from 1965, The Dutch NGO Provo intended to leave unlocked bicycles with the color white painted on them in public areas all across Amsterdam. Despite being short-lived and flawed, the concept provided the framework for effective bike-sharing programs.

The "Bycyklen" system, the world's first extensive urban bike-sharing system, was first introduced in Copenhagen in 1995. It necessitated the use of specialized bicycles, with rental options available at automated bike racks located around the city.

The "Vélo'v" system, inaugurated in Lyon, France, in 2005, was the first extensive bike-sharing scheme with widespread popular backing. It was an innovative service that allowed consumers to pick up and drop off bikes at various sites throughout the city. It was a well-liked and profitable model.

In the 2000s, the notion of bike sharing gained hold, and cities throughout the world began to build their own bike-sharing schemes. Among the primary factors fueling the global expansion of bike sharing are:

1. Environmental concerns and a focus on sustainable mobility solutions have raised interest in bike sharing as a more environmentally friendly alternative to autos.
2. Fitness and health: Using rented bikes to get around and exercise is a practical and beneficial alternative.
3. The use of GPS, smartphone apps, and smart locks has made operating bike-sharing systems and keeping track of bike availability easier, among other technological developments.
4. Due to traffic congestion and a lack of parking spaces, several municipalities were compelled to take into account bike-sharing as a way to reduce the number of cars on the road.

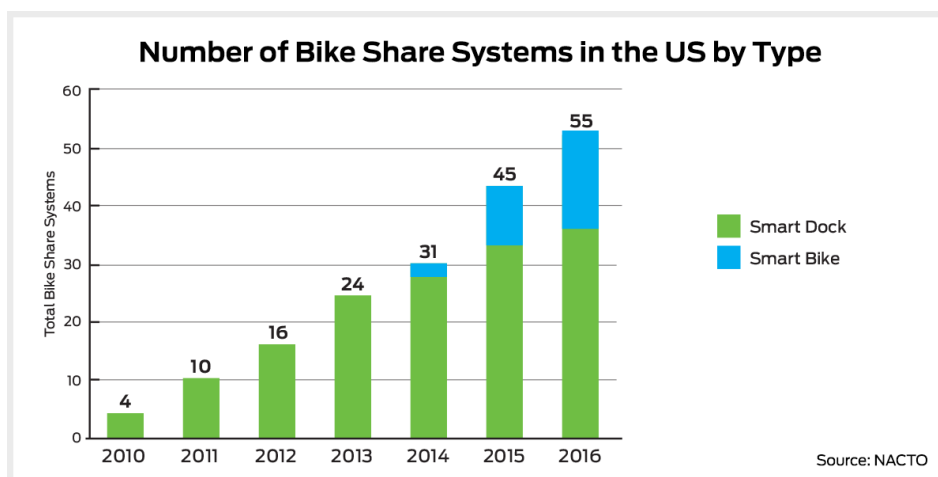
A global movement was created when bike sharing became popular and showed its practicality in various areas. There are currently bike-sharing programs in numerous nations in Asia, Europe, North America, and other regions of the world. These systems come in a wide range of sizes and shapes, from publicly financed initiatives to for-profit businesses. Additionally, although some bike-sharing programs use conventional docking stations, others use dockless systems that let customers locate and unlock bikes using smartphone apps.

## **2.1 Bikesharing in United States**

In United States of America, an estimate of over 88 million journeys of bike sharing have been taken since 2010, and it is expanding across the country at more incredible rate. Over 28 million rides were taken by travelers in 2016 alone, surpassing Walt Disney World's annual attendance and matching the yearly ridership of the whole Amtrak system. In 2010, 1,600 bikes were distributed across the nation as part of the country's first contemporary bike share program. Smaller systems proliferated and major systems were introduced in 2013, which led to a rapid increase in the number of bikes from 7,400 in 2012 to 19,900 in 2013 and over 42,000 in 2016. This has resulted in more individuals around the country having

access to one of the most affordable transportation options.

**Graph 1: Number of Bike Share Systems in US by type**



## Evolution of Smart-bikes

Since the initial smart bike systems were introduced in the U.S. in 2014, the use of smart bikes—which integrate all essential technological components within the bike itself as compared to the dock—has greatly expanded. The percentage of systems using smart bikes has increased overall, and the technology is used by the overwhelming majority of the latest systems that debuted in 2016. While 31% of all platforms utilized smart bike tech in 2016, barely 13% among all bike sharing in operation were smart bikes, the majority of the bigger systems, particularly new ones, are still using smart docks.

## Initial Companies

There were several startups, including Ofo and Mobike, that produced the first generation of dockless pedal bikes. Lime, a second forerunner of dockless pedal bikes, swiftly shifted to electric modes. The scooters then descended in droves. By the time the dockless revolution truly took off in 2018 there were a dozen enterprises contending for both our visual attention and our pedestrian space. After six recorded e-scooter tragedies in 2018, it became clear that dockless electric scooters were not able to compete with conventional bike sharing in terms of safety. Additionally, e-scooters were seriously hurting people who weren't riders, leading to a class-action lawsuit being filed against the two biggest businesses, Bird and Lime. Around the same time, many safety advocates who had spent years fighting for the rights of Americans injured on American streets began working for the scooter companies.

## Takeover by Ride-Hailing Companies (Private companies)

Then, in 2018, the bike-share companies started getting purchased by the ride-hailing giants. Jump, formerly referred to as 'Social Bicycles', was acquired by Uber. Jump operated certain bike-share programs, but its main product was an extremely popular dockless electric bike. The majority of the nation's strongest bike-share systems, namely Citi Bike, were now under

Lyft's control after the company acquired 'Motive', which was one of the largest operators of bike sharing in US at that time. Later, scooters were also added by Uber and Lyft. According to NACTO, by the end of that decade, several communities had privately sponsored transport options before publically funded ones, and many inhabitants appreciated the opportunity for more transit options.

## **Uber became a Public Company**

Just one month after Uber declared its intention to go public in May, 'Jump' bike pricing in LA doubled from 15 to 30 cents per minute. Not just in LA, but in many other cities where Uber operates jump bikes, customers have seen considerable pricing rises over the past year. Then, in September 2019, Uber stated that it was taking its electric Jump bikes out of Atlanta and San Diego, two important micro mobility markets. Since the company lost \$5.2 billion in its first quarter after removing its bikes from Dallas and San Antonio earlier that year, many have questioned whether bikes still rank highly for the company.

## **2.2 Bikesharing in United Kingdom**

There have been three distinct generations of bike-sharing systems during the past 45 years. The first generation of bike-sharing programs were introduced on July 28, 1965, in Amsterdam with the Witte Fietsen, or White Bikes program. Public transportation was supplied with regular bicycles colored white. A bike may be found, ridden to the desired location, and then left for the subsequent user. Bikes were stolen or taken for personal use; therefore, things did not turn out as expected. Within days, the program was over.

## **Evolution with Second Generation of Bike Sharing Rides**

A second wave of bike-sharing programs began in Denmark's Fars and Gren in 1991, and Nakskov in the year of 1993 (Nielsen 1993). There were only a few stations and 26 bikes in Nakskov for these small programs. In 1995, Copenhagen launched Bicyklen or City Bikes, the first massive second-generation bike-sharing scheme with numerous improvements over the first generation. At designated locations across the City Centre, the Copenhagen bikes could potentially be borrowed and returned in exchange for, say, a coin deposit. They were especially made for heavy-duty utility use and had solid rubber tires and wheels bearing advertising plates. Although the service is run by a charitable organization and has more stations than the prior generation, the bikes still get stolen because the users are anonymous.

## **Initial Companies**

As a result, bike-sharing evolved into a new generation with better customer tracking. Students could hire bikes using a magnetic stripe card through the first of this new type of third generation bike-sharing schemes, called Bikeabout, which debuted in 1996 in England at Portsmouth University. Third-generation bike-sharing systems had undergone a lot of technological improvements to become smarter, including electronic locking bike racks or locks, access to mobile telecommunications systems, smart card technology and fobs, and



on-board computers. Those bikes were smart and user friendly and attractive as can be seen in the picture below where a bike introduced by Uber in United Kingdom can be seen.



## **Bikesharing in France**

A number of new bike-sharing series were launched every year, notably Rennes' (France) Vélo à la Carte in 1998 and Munich's Call a Bike in 2000. The third generation of bike-sharing did not, however, truly took off until 2005 with the launch of Velo'v, which JCDecaux did in Lyon with 1,500 bikes. This third-generation bike-sharing program was the biggest one till that date, and it had a significant impact (First generation bike-sharing program was started in England).

By the end of 2005, Lyon's bigger sister, Paris, had 15,000 subscribers and saw the 6.5 times per day on average that the bikes were being used. Two years later, Paris launched Vélib', a city-wide bike-sharing package, with about 7,000 bikes. Since then, the program has grown to 23,600 bikes. The scope of this ambitious project and its greater-than-expected success altered the history of bike-sharing and sparked a large global interest in this form of transportation.

In countries such as Brazil, China, Chile, New Zealand, Taiwan, South Korea, and the U.S., new bike-sharing programs were started in 2008. These schemes were not just launched in Europe but it was the start of third-generation bike-sharing in different parts of the world. There were roughly 60 third generation projects worldwide at the end of 2007. There were roughly 92 programs by the end of 2008. There are roughly 120 programs available right now.

## **Evolution**

In its first two years, Vélib' reportedly made 50 million trips, according to the City of Paris. When compared to 2008, 46 percent of survey participants reported using their own vehicle less frequently in 2009. In 2008, 21% of survey participants used Vélib' to go to the bus, train, or metro, while 25% used it to get back from other transport modes. In 2009, 28% of people started and ended their multiple transit trip with Vélib'.

## 2.3 Bikesharing in Pakistan

### History

Karachi adopted the trend of bike sharing on 18th of July, 2017. The commercial and economic centre of Pakistan, Karachi, is one of the world's most crowded cities. Its population has grown by more than 4% yearly since 1998, and the Asian Development Bank (ADB) projects that it will peak at 31 million by 2030. As the city's affluence rises, more people are choosing to own cars and motorcycles, which is causing more traffic congestion. Because public transport is unreliable, people spend a lot of time and money trying to get about, which has allowed major ride-sharing companies like 'Uber' and 'Careem' to build a presence in Pakistan's major cities. New two-wheeled rival Bykea has entered the ride-sharing market. By taking advantage of the huge number of motorcyclists now on the road, it puts commuters in the fast lane. The CEO of Bykea, Rafiq Malik, claims that Pakistan has 15 million motorcycles and 30 million smartphone users. We essentially give bike owners the opportunity to use a bicycle they already own to produce a major or extra source of income, claims Malik.

### 1 ezBike: Pakistan's First Smart Dockless Electric Bike Sharing Initiative

The ezBike service, launched in 2020 only offered Islamabad first and claimed that it would be accessible in all significant cities throughout the country within a year. During the opening event, the minister recommended ezBike as a fantastic option, especially for working women. The bikes would be accessible at metro-bus terminals in the twin cities. In an effort to revolutionize urban mobility, Roamer Technologies, a company located in Islamabad, introduced ezBike, an app-based service that distributes electric bikes throughout the city and makes them available for use by the general public. Users may locate and reserve nearby electric bikes using the ezBike smartphone app, ride them to their destinations on their own, and then park them in a designated spot so that the next user can use them. The entire process—registration, booking, and payment—was digital. The bike used to be unlocked for 5 rupees, and users must pay 5 rupees per minute of riding. Furthermore, stops can be made during trips so that customers would be able to run errands while paying a reduced cost of Rs. 2 per minute.

During the inaugural ceremony, Amin-ul-Haque, the minister of information technology, said that the introduction of ezBike in Pakistan is a significant milestone. He contends that information technology holds the key to Pakistan's future and that technical innovation is necessary for progress. He asserted that electric car technology is the biggest game-changer for the transportation market and that the government will support such businesses. The ezBike facility, according to him, would be extremely helpful to the general population and essential to the empowerment of women. He announced that the government would continue to support programs that the public would deem worthwhile. According to Mohammad Hadi, CEO of Roamer Technologies, only 10% of Pakistanis own a car, and

mobility is still a major problem. He asserted that ezBike will provide everyone in Pakistan with access to shared vehicles. This form of transportation would be the most affordable, practical, and environmentally beneficial in Pakistan. Bike-sharing businesses are revolutionizing urban mobility all over the world, with over 100,000 bikes deployed in 88 sites. The business plans were to use more than 2,000 electric bikes in the upcoming year.

But, unfortunately it didn't work in Islamabad and was cut out all of a sudden. The reasons behind that are unknown and needed to be studied.

## 2 NUST University Initiative

On May 28, a piece was written on the Pakistani company Cykiq that rents out bicycles. On a campus that spans more than 700 acres, travelling has been a busy activity for the staff and students at NUST, Islamabad. Most students who live on campus hitchhike or walk long distances between departments, cafeterias, and libraries. During the daily drill, several junior students started developing efficient plans for arranging NUST visitors and residents. An automated system for renting bikes on college campuses is Cykiq, a ride-sharing company. Numerous colleges in Europe and business campuses in America have successfully established shared-biking programs for students and employees. Now ready to transform Pakistan's university campuses and public transport system is our incredibly local startup, Cykiq. Bikes not only offer a viable option for a communal mode of transportation but are also effective for short distance trips. In an interview with TechJuice, Ans Shehzad, the Chief Operating Officer of Cykiq, goes over the startup's history and rapid growth.

### The Beginning

After some time, the co-founders learned the solution. As soon as they started working, they released a public survey to determine how their target market would respond. At NUST, there was already an intracommunity transport system, but it had predetermined routes and wasn't always available. It lacked the independence and exclusivity required for commuting. As a result, the team obtained support and encouragement to launch Cykiq when they provided the college administration with a green and cost-effective solution. Both docking and non-docking bikes are included in the bike sharing programme. To ride a bike on the docking system, users must unlock it from a source station; once unlocked, the bike can only be parked at a destination station. Cykiq's initial docking system was developed and produced domestically by the company's staff. The testing phase of the project started with two stations and ten cycles. Both stations were positioned adjacent to departments and to the hostel, respectively. With the opening of this facility, 15-minute walks were reduced to a 3- to 4-minute cycle ride. According to Shehzad, the service seemed to be rather limited for a school with 5000 students.

The testing phase of the project started with two stations and ten cycles. Both stations were positioned adjacent to departments and to the hostel, respectively. With the opening of this facility, 15-minute walks were reduced to a 3- to 4-minute cycle ride. Shehzad asserts that because the service was only implemented at two stations, it appeared to be quite limited for a campus with 5000 dwellings and a daily attendance of 12000 day-scholars, staff

members, and visitors. The 20 participants shared the 10 cycles approximately once every month. As a result, Cykiq decided against pursuing the building of further stations and instead chose to increase the system's cycles.

## **More Cycle Injection and User Comprehension**

The introduction of Cykiq's shareable locking mechanism, which provided users with access to the same set of locks, and the release of new bikes happened at the same time. In four months, they moved from having 10 cycles to 30 cycles, and in five months, they increased to 50 cycles. At this point, the system was run manually. They started user profiling with all these 50 cycles to understand better the demands of their market segment. They observed that female riders made up 60% of their user base. Additionally, the service became well-liked by the blue-collar employees who typically walked rather than hitchhiked long distances. They were not anticipating much traction now that summer vacations had started. They found that because people preferred to ride bikes in the heat to walking large distances, they were fully booked the entire summer. Progress stagnated as the team members' final year was occupied by academic duties. But as soon as they had their degrees, they returned to their full-time startup jobs.

Technology Advancements and Regional Manufacturing Cycles:

It was essential that the bikes underuse was robust and upheld a certain level for public use in order to minimize the requirement for maintenance. Cykiq consequently made the decision to produce its own unisex bicycles. They teamed up with Sohrab, one of Pakistan's premier and oldest bicycle makers. Sohrab received the drawings from Cykiq, and 100 cycles were produced on-site in Lahore. Cykiq had 150 cycles in its fleet as of December 2017.

Additionally, the team abandoned docking stations in favor of a non-docking architecture. In this model, the bike and lock are equipped with every technology. Users benefit from enhanced convenience since they are not restricted to a specific spot to pick up and drop off their transportation. In comparison to building whole stations, the non-docking model requires more capital.

Including the new model, Cykiq unveiled a complimentary smartphone app for Apple and Android customers to access the bikes. The lock would appear once they scanned the QR code. The app plus smart locks can also be used to track bicycles. Although the locks were created in-house, Cykiq is having them made in China due to the restrictions of domestic production.

The three locking mechanisms offered by Cykiq at this time are:

1. The manual lock that operates with button having 4-digit combination.
2. Locks with automatic Bluetooth.
3. Automated lock house based on GPS.

## **Creating a Pricing Model and a Payment Wallet**

Cykiq's main issue was introducing an online payment system. The crew used to deposit cash payments initially, but as they scaled up, it became impractical. They included EasyPaisa and SimSim wallet, but their users complained and demanded that they add another software to access the service. As a result, Cykiq made the decision to launch their own wallet, CyWallets. Users on campus could easily and conveniently charge their wallets from any cafeteria on campus. Shehzad reveals that their package prices are really reasonable. A half-hour trip will only cost you PKR 15 if you only need a bike for one day. If you use the service frequently, you can choose the 5-ride plan for PKR 70. Additionally, there are weekly packages starting at PKR 150 and monthly packages costing PKR 300 to PKR 500.

## **Numbers, Financial Support, and Collaborations**

Since December 2017, Cykiq rides have travelled more than 10,000 kilometers. There have been over 3000 downloads of the Cykiq app. The number of daily bike-hailers using the app ranges from 150 to 200. As a capital-intensive business, Cykiq has had trouble finding finance locally. Beginning with their own money, they bootstrapped their way up to 30 cycles of growth. Later, they were able to get a seed money, but now they are looking outside of their own country for assistance. Additionally, they are seeking franchise alliances with business and private organizations. Recently, they and the Ghulam Ishaq Khan Institute (GIKI) reached an agreement on a franchise. The startup will turn a profit if they sell three more franchises. The business has also selected China as a source for specially made cycles that are more robust for usage by the general population. The test batch has arrived, and once Cykiq launches its operation in GIKI, it will place an order for bulk manufacturing. They will also begin a feasibility assessment for the University of Karachi.

## **What's next for Cykiq?**

Shehzad believes that academic institutions present a niche for Cykiq because ride-hailing services are not permitted on campus and short-distance transportation is necessary. In order to take advantage of this, the company has been investigating prospective opportunities at institutions in KPK, Punjab, and Sindh. He also acknowledges that while public universities clearly need such solutions, they might not be able to use them because of a lack of finance. Therefore, in order to expand the reach of the solution beyond institutions, Cykiq is also searching for business partnerships. Since public transportation is now more efficient, getting from metro stops to the intended location still requires travelling. Therefore, for such short-distance commuting, public cycles can also be provided in place of using a ride-hailing service. In order to build relationships with the government, Cykiq is also trying to implement bicycle lanes as part of the Peshawar Metro Project.

Hamza Afridi, the startup's CEO and manager of technology and strategy is in charge of Cykiq. Ans Shahzad, is in charge of all business operations, legal matters, and alliances. Senam Khan and Ammara Tariq, two industrial designers on the team, are in charge of user-centric marketing and design. Shehzad explains that the team also includes a qualified financial analyst and company developer. It takes a lot of effort for a startup to manufacture 100 cycles locally and introduce its own wallet. One of the Pakistani companies, Cykiq, is laser-

focused on solving local problems and understanding its market since it wants to upend Pakistan's public transport infrastructure.

## **Ride-sharing and Policy Makers**

For authorities working to improve urban mobility in various ways, programs for renting out bikes can be very helpful. The following are some methods in which city bike sharing could assist transportation regulations:

1. By promoting Sustainable Transport: the use of bicycles as a more environmentally friendly form of transportation, which, due to bike sharing, lowers greenhouse gas emissions and urban air pollution. Governments may help cities achieve their environmental goals by supporting and rewarding bike sharing.
2. By reducing congestion: Fewer vehicles on the road reduce traffic congestion and enhance traffic flow. Bike-sharing can be advantageous since it offers an alternative to private vehicles. For city dwellers, this might mean shorter commutes and increased productivity.
3. It improves public health: Regular riding can have a positive impact on public health by promoting physical activity, reducing obesity, and reducing the risk of cardiovascular diseases. In order to create communities that are healthier and more active, governments can embrace bike sharing as a public health initiative.
4. Bike sharing improves first- and last-mile connectivity by reducing the gap between transit hubs and destinations. Public transportation use is encouraged and reliance on private vehicles is reduced as a result of this integration with other modes of mobility.
5. By reducing Infrastructure cost: Since building and maintaining bike lanes and bike-sharing stations is typically less expensive than building new roads or expanding the public transportation system, infrastructure costs are decreased. Policymakers may more efficiently manage resources by investing in bike-sharing infrastructure.
6. Supports Tourism and small enterprises: Bike sharing can entice tourists and visitors because it provides an easy and pleasurable way to explore a city's sights and attractions. This helps the tourism industry and small businesses. This could be advantageous for nearby companies, such as cafes, restaurants, and shops.
7. Urban Planning and data collection: Bike sharing programs provide useful data on traffic patterns, popular routes, and peak times. Policymakers can make transportation and urban planning decisions using this information to better understand urban mobility trends.
8. Promotes Equity: Bike sharing systems can be created to promote accessibility for marginalized communities by making sure that stations are spread out throughout various neighborhoods. It offers an affordable and flexible mobility option for folks who might not own cars or have restricted access to public transportation.
9. Creates a culture: Making cycling a popular mode of transportation through bike

sharing can help towns develop a cycling culture. As more individuals choose cycling as their primary form of transportation, policymakers should implement additional initiatives to support bikers, such as bike-friendly infrastructure and traffic safety measures.

10. Disaster Resilience: During crises or natural disasters that disrupt conventional transportation systems, bike sharing can provide as a viable fallback option for mobility, ensuring that people can still get around the city.

To fully appreciate the benefits of bike sharing, Policy makers should consider incorporating it into a comprehensive urban transportation strategy that complements existing public transportation options and is consistent with the city's long-term development goals. With proper planning, infrastructure expenditures, and public awareness campaigns, bike sharing can be a valuable component of an efficient and sustainable urban transportation system.

## **Conclusion**

Bike sharing system has changed the modes of transportation and reduced traffic and pollution in different parts of the world. Bikes that use solar energy for charging are environmental friendly and are cost effective. The world is now shifting towards fourth generation of ridesharing and Pakistan has just started the process of introducing, although it has directly started with third generation and if keeps integrating the system in different cities and universities it can soon adopt fourth generation of bike-sharing. It will reduce the chances of congestion, will shift the modes of transport from private vehicles to public use of transport and can lower the need of petrol and other fuel requirements. Although, it will demand investment in the beginning, but once implemented in Pakistan properly, it can generate revenue, can solve the problems of fuel imports, will protect the environments and will resolve the mobility issues within the cities. By actively participating in the execution of these policies and encouraging environmentally friendly programs like bike sharing, policymakers may significantly help to the preservation of the environment and the welfare of future generations.

## References

- (2012). Bike Sharing in the United States: State of the Practice and Guide to Implementation. US: Toole Design Group.
- CHANDLER, M. (2023, February 14). Discerning Cyclist. Retrieved from discerningcyclist.com: <https://discerningcyclist.com/history-of-bike-sharing-schemes-future-predictions/>
- DeMaio, P. (2004). Will Smart Bikes Succeed as Public Transportation in the United States? *Journal of Public Transportation*, 7(2), 1-15. Retrieved from [https://pdf.sciencedirectassets.com/781838/1-s2.0-S1077291X04X07025/1-s2.0-S1077291X22003848/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjELb%2F%2F%2F%2F%2F%2F%2F%2F%2F%2FwEaCXVzLWVhc3QtMSJIMEYCIQC4sV%2FOFoZqcXmef1SAtgI4c%2ByvF4PPbB%2F8%2F%2Fbuy2wWNwlhAM](https://pdf.sciencedirectassets.com/781838/1-s2.0-S1077291X04X07025/1-s2.0-S1077291X22003848/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjELb%2F%2F%2F%2F%2F%2F%2F%2F%2F%2F%2FwEaCXVzLWVhc3QtMSJIMEYCIQC4sV%2FOFoZqcXmef1SAtgI4c%2ByvF4PPbB%2F8%2F%2Fbuy2wWNwlhAM)
- DeMaio, P. (2009). Bike-sharing: History, Impacts, Models of Provision, and Future. *Journal of Public Transportation*, 41-56.
- Ejaz, M. (2015, MARCH 30). PAKISTAN INK. Retrieved from pakistanink.wordpress.com: <https://pakistanink.wordpress.com/2015/03/30/a-cykiq-solution-for-on-campus-transport-at-nust/>
- FLORET, M. (2014, September 26). 4CITIES. Retrieved from 4CITIES UNICA EUROMASTER IN URBAN STUDIES:[https://www.4cities.eu/wpcontent/uploads/2015/11/MAt thesis\\_4CITIES\\_FLORET\\_M ATTHIEU\\_Cohort1.pdf](https://www.4cities.eu/wpcontent/uploads/2015/11/MAt thesis_4CITIES_FLORET_M ATTHIEU_Cohort1.pdf)
- Henley, J. (2005, August 12). Rentabike moves up a gear from curiosity to runaway success. *The Guardian*. Retrieved from *The Guardian*: <http://www.guardian.co.uk/world/2005/aug/12/>
- Jamal, S. (2020). EZBike: Pakistan's first electric bike service launched in Islamabad. Dubai: Gulf News. Retrieved from <https://gulfnews.com/world/asia/pakistan/ezbike-pakistans-first-electric-bike-service-launched-in-islamabad-1.74609706>
- Kalina, J. (2011, August). Intelligent Energy Europe. Retrieved from europa.eu: [https://trimis.ec.europa.eu/sites/default/files/project/documents/20140310\\_134132\\_30917\\_Final\\_Project\\_Report.pdf](https://trimis.ec.europa.eu/sites/default/files/project/documents/20140310_134132_30917_Final_Project_Report.pdf)
- NACTO. (2019, April 17). NACTO. Retrieved from National Association of City Transportation Officials: <https://nacto.org/bike-share-statistics-2017/>
- Nielsen, J. (1993). Usability Engineering. San Francisco: Morgan Kaufmann.
- Paul DeMaio,. (2009). Bike-sharing: History, Impacts, Models of Provision, and Future. *Journal of Public Transportation*, 41-56. Retrieved from <https://www.metrobike.net/wp-content/uploads/2013/10/Bike-sharing-Models-of-Provision.pdf>
- Qucit. (2020, September 30). Bike sharing, a French success story that continues to grow in cities. Retrieved from Qucit: <https://medium.com/@qucit/bike-sharing-a-french-success-story-that-continues-to-grow-in-cities-fe446995deb5>
- Reuters. (2017, SEPTEMBER 22). THE EXPRESS TRIBUNE. Retrieved from Tribune.com: <https://tribune.com.pk/story/1512892/campus-bikes-help-female-students-zip-across-nust>
- Statista. (2023, May 24). Statista. Retrieved from Statista.com: <https://www.statista.com/outlook/mmo/shared-mobility/shared-rides/bike-sharing/pakistan>



Susan A. Shaheen, Stacey Guzman, Hua Zhang. (2020). Bikesharing in Europe, the Americas, and Asia: Past, Present, and Future. *Transportation Research Record Journal of the Transportation Research Board* 2143(1316350), 1-18. doi:10.3141/2143-20

Walker, A. (2019, December 16). CURBED. Retrieved from VOXMEDIA: <https://archive.curbed.com/2019/12/16/20864145/bike-share-citi-bike-jump-uber>

# CHAPTER 9

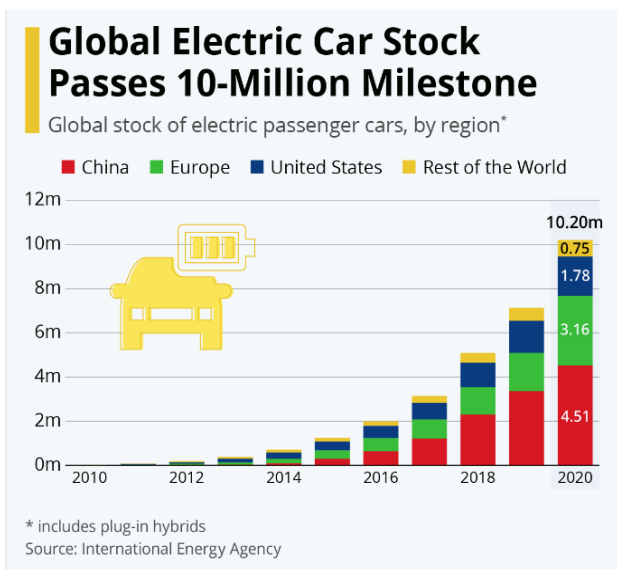
## ELECTRIC VEHICLES IN PAKISTAN: POLICY AND CHALLENGES

Saba Anwar and Aamina Abid

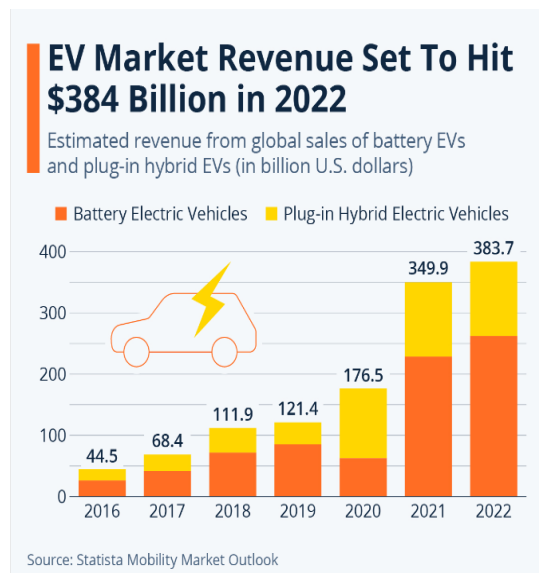
### 1 Introduction

During the past century, energy use has risen linearly across the globe due to several interconnected reasons. These include rapid population growth, associated GDP growth, and urbanization, which have all contributed to increase in the demand for and subsequent use of energy. One of the sectors in which energy usage has been the highest has been transport, where petroleum derivatives have been the conventional source of energy (Ahuja & Tatsutani, 2009). As such, vehicles have primarily been geared towards petroleum usage and have been designed as such as well.

Petroleum vehicles, however, contribute significantly to global warming in the form of exhaust emissions and are responsible for environmental pollution as well (Ahuja & Tatsutani, 2009). Due to this, the global vehicle market is undergoing a change as concerns over climate change are growing and countries are moving towards adopting more sustainable practices (Haddadian et al., 2015). This has been observed in the form of the rise of production of and demand for electric vehicles both for private car users as well as for public transport as can be seen from figures 1 and 2.



Source: (Richter, 2021)



Source: (Fleck & Richter, 2022)

The shift towards EVs is occurring because EVs are being touted as an alternative to reduce vehicle emissions as well as dependence on fossil fuels. Not only this but shifting to EVs also

offers several benefits such as improved air quality, reduced greenhouse gas emissions, and enhanced energy efficiency. There has been an increase in the demand for EVs because of this as EVs produce lower or zero emissions compared to traditional internal combustion engine vehicles, making them a cleaner transportation option. Not only this but in countries where electricity generation is done primarily by non-renewable sources, a shift towards EVs can also help in reducing their fossil fuel imports (Dai et al., 2022). Around the globe, governments have been facilitating the transition by adopting measures such as providing financial incentives and subsidies for EVs, expanding charging infrastructure networks, and supporting R&D for battery technology advancements (Dai et al., 2022). They have also been encouraging the EV industry through subsidies and regulations, which include tax incentives, grants, and rebates to make EVs more affordable for consumers. Government regulations and targets for reducing greenhouse gas emissions have played a significant role in the transition to EVs (Nilsson & Nykvist, 2016). Many countries have set ambitious goals to phase out the production and sale of internal combustion engine vehicles in the coming years. These targets have further accelerated the adoption of electric vehicles globally. Public private partnerships have also been important for this transition as private companies have the necessary capital which is required for such a change to take place at a large scale while governments provide the regulatory framework and business environment to facilitate the transition (Nilsson & Nykvist, 2016). Additionally, advancements in technology and improvements in EV infrastructure have contributed to the shift towards electric vehicles. The development of more efficient batteries, increased driving range, and the expansion of charging infrastructure have addressed previous concerns about limited range and charging accessibility (Rowlatt, 2021). These developments have made electric vehicles more practical and convenient for everyday use resulting in the increased demand for and usage of EVs. However, EV adoption has been uneven globally, with factors like government support, consumer habits, and charging infrastructure influencing the pace of adoption in different regions. As the first generation of EVs nears the end of its lifecycle, considerations regarding battery recycling and the second-hand EV market have emerged as new challenges.

## **2 Electric Vehicles in Pakistan**

The same trends regarding adoption of electric vehicles can be observed in Pakistan as well, although at a limited scale. Pakistan's energy sector is also undergoing an energy transition. This energy transition is the most evident in the housing and the transport sectors. In the transport sector, there has been an increase in EV usage for private consumers and public transport both. This shift is in its early stages and a majority of vehicles still operate on fossil fuels. However, there is potential that this shift becomes larger. At the helm of this shift is the EV policy of 2019 which proposed several measures for increase in EV use in Pakistan.

## **3 National Electric Vehicles Policy 2019**

The EV policy targets four categories of vehicles for increased use which include cars, two, three, and four, wheelers, buses, and trucks. The policy has aimed to achieve its targets by 2040, which can be seen in table 1 below.

Table 1: Electric Vehicle Penetration Targets

EV Category	Medium-term Target	Long-term Target	Ultimate Target
<i>Cars (Including Vans, Jeeps, and small Trucks)</i>	100,000	30% of new sales (approximately 60,000)	90% of new sales
<i>Two, Three Wheelers and Four Wheelers</i>	500,000	50% of new sales (approximately 900,000)	90% of new sales
<i>Buses</i>	1,000	50% of new sales	90% of new sales
<i>Trucks</i>	1,000	30% of new sales	90% of new sales

The aim of the policy is to generate an EV market and increase the demand for and the number of EVs in the market, which at present stands at twenty million (a, 0). The following incentives have been adopted by the government in line with the policy to achieve this.

1. GST for all locally manufactured EVs would be below 1% up to seven years.
2. EVs would be exempt from registration fees and the annual token tax.
3. For imported two and three wheelers, the GST has been set at 1% for the first five years of the policy.
4. Provisions have been extended for import of swappable battery-based two and three-wheeler EVs
5. For buses and trucks, the government will purchase these vehicles themselves and provide them to the end user. This will be done through competitive bidding for use for a concessionary period.

Apart from this, the import duty on electric vehicles has also been reduced further from 25% to 10% (Farooqi, 2021).

## EVs in Pakistan

Although the EV sector is in its early stages in Pakistan, some initial steps have been taken for their introduction in both the private as well as public sector. Along with this, a modest charging infrastructure is available in the country, the details of which are as follows:

### Charging Infrastructure and Costs

The following table shows the different types of chargers that are available in Pakistan and the associated energy requirements and charging time for each. Level 3 chargers are commercial chargers due to their faster charging times.

Type	Volts Required	Charging Time
Level 1	120	24 hours
Level 2	208-240	8 hours
Level 3	480	1-1.5 hours

Source: Free Wire Technologies 2020

## (a) Private Sector EVs

In the private sector, MG's ZS EV is the only 4 wheel EV manufactured in Pakistan, which costs 950-1000 PKR to be fully charge at a Level 3 charger and 500-600 at a Level 2 charger (S Ali, 2021). The cost for this comes down to 2-4 PKR per km, which is one-third that of gasoline substitutes in Pakistan (S Ali, 2021).

## (b) Public Sector EVs

In the public sector, hybrid electric buses are being imported and run in major cities of Pakistan under the Bus Rapid Transit Systems. Peshawar's BRT features diesel-electric hybrid buses whereas in Karachi electric buses were imported and are being on the BRTS routes (2023). At present, electric buses are being run on three routes in Karachi under the banner of Peoples Bus Service (2023). These buses have the capacity to cover a distance of 240 km on a single charge of 20 mins and will be charged from solar panel energy making them close to completely environmentally friendly (2023).

## Potential and Opportunities

If adopted on a mass scale, EVs present Pakistan with several opportunities, which are as follows:

- The adoption of EVs will help in the utilization of electricity. By 2025, Pakistan is expected to have a capacity of producing 62,000 MWs of electricity whereas demand is expected to peak at 40,000 MWs (LUMS Energy Institute & USPCAS-E, 2019). By not utilising this spare capacity, capacity payments of unutilised electricity are expected to be around 1,500 billion PKR by 2025 (LUMS Energy Institute & USPCAS-E, 2019). Therefore, increase in the number of EVs in the Pakistani market will allow for the usage of this spare capacity as well as the curtailment of the unutilized capacity payments bill.
- Shifting towards EVs in both the private and public sector has the potential of reducing the fuel import bill of Pakistan due to decreased use of petroleum for vehicles. This will in turn alleviate some of the burden on the foreign exchange reserves of the country which are under great stress due to hyper-inflation and loss in the rupees' value in comparison to the dollar.
- By transitioning to EVs and using domestically produced electricity, Pakistan can enhance its energy security as well. It can reduce its reliance on imported fossil fuels, which can be vulnerable to supply disruptions. However, this is only possible if Pakistan's energy mix for electricity production shifts towards renewable energy sources.
- EVs can also significantly reduce air pollution in the country and improve the air quality, which at present is one of the worst in the world. EVs produce zero tailpipe emissions and hence, do not contribute to poor air quality and public health (Dai et al., 2022).
- EVs are also more energy-efficient and have lower operating costs compared to

traditional internal combustion engine vehicles (Dai et al., 2022).

- As the EV industry grows in Pakistan, it can also create new job opportunities in manufacturing, research and development, maintenance, and charging infrastructure installation and management.

## Challenges

While there are several opportunities which require massive efforts to be realized, there are also several challenges, which are as follows:

### 1. Charging Ports

While EVs are cheaper to operate, they still require a nation-wide charging network so that they can be fully adopted by the public. Inter-city commute on EVs remains limited due to lack of charging stations on highways. At present, there are two charging stations along the M-2 motorway from Lahore to Islamabad (Business Recorder 2021). However, intercity commute between other cities and in other provinces is still not possible, which limits the potential of EV adoption. Alongside this, apart from in major cities such as Karachi, Lahore, Islamabad, Faisalabad, and Peshawar, the government has not adopted any policy measures to increase the number of charging ports. Even in these major cities, charging ports can only be found at a few fuel stations, which means that people would have to travel extended distances to find a charging port.

### 2. Environmental Impact of Batteries

While EVs are a shift towards an environmentally sustainable solution, the batteries used in EVs pose several environmental challenges. These batteries are lithium based, which requires mining of lithium. Due to the boom in EV adoption, there has been an increase in the unsustainable mining of lithium around the world, which has also resulted in deforestation and terrain alteration due to the use of dynamite and heavy machinery, thereby permanently damaging local ecosystems in the process (Balch, 2020). Along with this, EV batteries suffer from up to 3% degradation annually in terms of battery health and life (Balch, 2021). This results in more charging cycles and potentially more CO<sub>2</sub> emissions if energy is not renewably sourced, which is the case for Pakistan. Additionally, disposing of used batteries is another issue as lithium-ion batteries require dedicated recycling facilities (Rowlatt, 2021). At present, there is no existing recycling industry in Pakistan which poses hazard risks and possibility of pollution.

### 3. Electricity Consumption and Source Pollution

Increased EV proliferation will require increased electricity consumption, which will in turn require more electricity to be generated. At present, the energy-mix of Pakistan is

heavily skewed towards fossil fuel as only 24% of the total power generated comes from renewable sources of energy (Iqbal, 2020). Not only is electricity generated from fossil fuels more expensive but it also detrimental to the environment due to emissions during production. Unless the energy mix is shifted towards renewable sources of energy, the adoption of EVs will increase environmental pollution as electricity demand increases. Along with this it will also result in an increased import bill for Pakistan as Pakistan imports its fuel for the generation of electricity.

## 4. EV Import and Local Production

At present, there is no local production of EVs taking place in the public sector. All the buses being operated have been imported. Widespread adoption and proliferation of EVs based on the import model is not possible or sustainable for an ailing economy like Pakistan and hence, without local production EVs cannot achieve their true potential in the country.

## Recommendations

In order to create an EV market in the country and for widespread adoption, the following steps may be taken.

- Installation of level 1 and level 2 chargers closely located so that private users can charge their vehicles at lower prices and with ease.
- Smart charging options to be introduced at charging stations so that consumers can save money by charging their EVs during off-peak hours.
- Shifting from non-renewable to renewable sources of energy for electricity generation so that the net effect of shifting towards EVs is positive.
- Establishment of a recycling facility for lithium-ion batteries to ensure proper disposal of EV batteries.
- The EV policy only covers a period of 5 years (till 2024). Developing new markets and inducing a change in buyer choices is a time-consuming activity. EV policy for the short-term signals uncertainty regarding future policy expectations, thus, discourages people from adopting it. Therefore, a long-term flexible policy is needed.
- Import in the initial phases followed by local production of two and three-wheelers should be encouraged to access low and middle income families.
- Creation of a local EV market starting from production to maintenance is needed through policy incentives and duty-free imports.

## References

- Ahuja, D., & Tatsutani, M. (2009). Sustainable energy for developing countries. SAPI EN. S. Surveys and Perspectives Integrating Environment and Society, (2.1).
- Ali, S. (2022, January 13). MG Zs Ev - Expert Review of Affordable Electric Vehicle. PakWheels Blog. <https://www.pakwheels.com/blog/mg-zs-ev-expert-review-of-affordable-electric-vehicle/>
- Anwar, I. (2020, December 8). Pakistan will have 30PC electric vehicles by 2030. DAWN.COM. <https://www.dawn.com/news/1594548>
- Arshad, N., & Ullah, N. (2019, January). Electric Vehicles in Pakistan: Policy Recommendations. LUMS. <https://web.lums.edu.pk/~eig/pdf/evReport.pdf>
- Balch, O. (2020, December 8). The curse of “white oil”: Electric vehicles’ dirty secret. The Guardian. <https://www.theguardian.com/news/2020/dec/08/the-curse-of-white-oil-electric-vehicles-dirty-secret-lithium>
- Barthold, L. (2021, November 18). What’s the difference between EV charging levels? FreeWire Technologies. <https://freewiretech.com/difference-between-ev-charging-levels/>
- Business Recorder. (2021, July 17). Two EV charging stations inaugurated alongside M-2 Motorway. Brecorder. <https://www.brecorder.com/news/40107859>
- Dai, Z., Liu, H., Rodgers, M. O., & Guensler, R. (2022). Electric vehicle market potential and associated energy and emissions reduction benefits. *Applied Energy*, 322, 119295.
- Ding, N., Prasad, K., & Lie, T. T. (2017). The electric vehicle: a review. *International Journal of Electric and Hybrid Vehicles*, 9(1), 49-66.
- Farooqi, T. (2023, January 28). The wait is over! Pakistan’s auto policy 2021-2026 is here. Dispatch news Desk. <https://dnd.com.pk/pakistans-auto-policy-2021-2026-is-here/249336>
- Fleck, A., & Richter, F. (2022, September 9). Infographic: EV market revenue set to hit \$384 billion in 2022. Statista Daily Data. <https://www.statista.com/chart/28211/electric-vehicles-revenue-projections/>
- Haddadian, G., Khodayar, M., & Shahidehpour, M. (2015). Accelerating the global adoption of electric vehicles: barriers and drivers. *The Electricity Journal*, 28(10), 53-68.
- Ministry of Climate Change. (2019). National Electric Vehicle Policy. Ministry of Climate Change. <https://policy.asiapacificenergy.org/sites/default/files/National%20Electric%20Vehicle%20Policy%20%282019%29.pdf>
- The News International. (2023, March 24). Electric bus service to be launched on new routes in City. The News. <https://www.thenews.com.pk/print/1053598-electric-bus-service-to-be-launched-on-new-routes-in-city>
- Nilsson, M., & Nykvist, B. (2016). Governing the electric vehicle transition–Near term interventions to support a green energy economy. *Applied energy*, 179, 1360-1371.



Richter, F. (2021, May 4). Infographic: Global Electric Car Stock Passes 10-million milestone. Statista Daily Data. <https://www.statista.com/chart/17178/global-electric-car-ownership/>

Rowlatt, J. (2021, June 1). Why Electric Cars will take over sooner than you think. BBC News. <https://www.bbc.com/news/business-57253947>

Yu, X., Li, W., Gupta, V., Gao, H., Tran, D., Sarwar, S., & Chen, Z. (2022). Current Challenges in Efficient Lithium-Ion Batteries' Recycling: A Perspective. *Global Challenges*, 6(12), 2200099.



PIDEpk



PIDE official



pide Islamabad



pide Islamabad



PIDEpk