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Impacts of Bus Rapid Transit (BRT) on Residential Property Values: A Comparative Analysis of Islamabad (Pakistan) BRT Systems

Maryam Kusar[1]
[1]Department of Civil Engineering, COMSATS University Islamabad, Abbottabad Campus, Pakistan
maryamkousar@cuiatd.edu.pk

Abdul Waheed[2]
[2]Department of Urban & Regional Planning, National University of Science & Technology, H-12 , Islamabad. Pakistan
waheedabdul@nit.nust.edu.pk

Tahir Ali Akber[3]
[3]Department of Civil Engineering, COMSATS University Islamabad, Abbottabad Campus, Pakistan.
drtahir@cuiatd.edu.pk

Qandeel Fatima Gillani[4]
[4]Department of Civil Engineering, COMSATS University Islamabad, Abbottabad Campus, Pakistan.
qandeel@cuiatd.edu.pk

Muhammad Faisal Rehman[5]
[5]Department of Architecture, University of Engineering & Technology Peshawar, Abbottabad Campus, Pakistan
faisal.rehman@uetpeshawar.edu.pk

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Abstract

Bus rapid transit (BRT) grows in popularity in Pakistan in recent years. It is advanced and cost-effective transportation system mostly used in the world due to its high speed and low cost. Rawalpindi BRT Bus Transit was implemented in 2015 which connects Islamabad and Rawalpindi. Different researchers have reported mixed impacts of BRT on adjacent communities and businesses around the world. The Socioeconomic and physical impacts of Rawalpindi BRT is very important issue for the people residing along the BRT corridors. However, no such research highlighting the physical impacts of BRT, is available in the context of Pakistan. Thus, the main objective of the study was to evaluate social, economic, and physical impacts of BRT before and after its construction on adjacent communities and businesses. Study was conducted through questionnaire survey with a sample size of 500 respondents. The study findings revealed that BRT has positively influenced the livelihood of people by creating jobs and other opportunities. It has reduced trip length and trip duration since its emergence. It has also decreased the encroachment land and increased the parking spaces. Further BRT has become the favourite mode of transport for people. Secondly, there is limited park and ride facilities available at BRT stations along with poor feeder routes.

Keywords: Bus Rapid Transit (BRT), Property Values, Traffic Impacts, Comparative Assessment, Urban Development, Transport System

1. Introduction

Urbanization, at a very rapid rate, creates different challenges around the world, one of them is Urban transportation infrastructure. Urban transport planning systems play is prime factor in development of sustainable cities. A recent study conducted by Stott et. al (Thondoo, Marquet, Márquez, & Nieuwenhuijsen, 2020), estimated that more than 50% population will live in cities by 2050, creating a necessity of serious a serious consideration towards the of the role of transportation and problem associated with its impacts (Kugelman, 2013).

Development is seen as an essential element in any country's vision within the world, however it is able to have fundamental effects on the environment, social and environmental life of equivalent countries positively and negatively (John A Dixon, 2010). New venture can however bring developments but also on the other hand can influence the lifestyle of people residing close by (Wanjiku, 2014). Development is considered a multi-dimensional method involving modification in structure and acceleration of economic growth (Fernando Diaz Orueta, 2008). Transportation system and development process have a significant relationship between them. It is a principle of urban planning that transportation networks help shape the spatial configuration of urban areas (Vinha, 2005). It is however expected in general that road development projects must be economically viable, socially acceptable and environmentally sound (Wanjiku, 2014). It is also essential to reconsider urban transport policies in those cities which are already encountering high rates of death, disease and discrimination.

The need of an efficient, productive, and an economical transport system cannot be undermined in any country. A good transport system is eco-friendly, improves livelihood and increases productivity. Besides, it provides easy opportunity of movement to all who otherwise suffer a lot of inconvenience while travelling in overcrowded wagons and creaky buses. As for most of the people travelling through vans and public buses remains difficult and gruelling exercise.

Pakistan is one of the fastest urbanizing country in South Asia. Urban population in Pakistan has risen from 17 percent in 1951 to 37 percent in 2010. According to the projections almost half of the total population in the world will be living in urban areas in next 10 to 15 years (Kugelman, 2013). In contrast, the history of BRT in Pakistan is not long as Bus Rapid Transit systems was first introduced in Lahore in February 2013 by Government of Punjab. The objective was to provide quality bus service to the residents of Lahore. It was followed up by Rawalpindi-Islamabad BRT bus Service in June, 2015. Rawalpindi-Islamabad BRT is 22.5km long starting from Saddar, Rawalpindi and ends at Pak Secretariat, Islamabad. Multan BRT Bus Service was third BRT system in Pakistan which was started in January 2017 and is 18 km long starting from Bahauddin Zikriya University and ends at Kumharanwala Chowk. These BRTS were introduced to provide accessible, reliable, and speedy transportation services to the people of different cities of Pakistan.

Previous studies recognize that Rapid transit, especially BRT systems, have influenced urban growth and property values, producing a diversity of urban forms and city patterns. Transportation system have vividlychanged the urban landscape in the past century (ChengHe Guan, 2018). Researchers have studied the association between BRT system accessibility and neighbourhood property values in a variety of context (Dong, 2017). As neighbourhood becomes closer to the BRT stations the property values go up (Haotian Zhong, 2016). BRT also has the capability to improve the accessibility of the nearby land. It can also have a positive impact on travel behaviour change**.** After 6 years BRT line 1 in Beijing has shown positive effects on the property values along the corridors (Taotao Deng, 2013).

As the scope of this paper is to evaluate the social and economic impacts of BRT construction on business and residential community living along the route of BRT in order to explore future transportation project and policies. This study aims to investigate the interactions among BRT system accessibility, commercial property value, encroachment land and availability of parking spaces. The next section briefly reviews the current literature on accessibility, property value, and urban form. The methodology section introduces my study area and research design. The results section presents our findings and analysis are presented. The first discussion section focuses on property rents and property values along the BRT corridors. The second and third discussion section focuses on availability of parking spacing and impacts of BRT on land use respectively. The fourth discussion section focuses on change in activity along the corridors of BRT while fifth discussion section focuses on impacts of BRT on encroachment land. The conclusion section presents and discusses the major findings of this study and suggests future research avenues.

2. Literature Review

According to Economic theory and literature people are willing to pay higher housing costs to lower their costs of transportation to areas of economic activity (Perk, 2017). Environment quality is an indicator of regional quality of life, subsidizing the well-being and health of the general public and sustainability of natural and urban setting. The true impact of BRT isn't merely the physical system however the enhancements it creates in lives of people. Evaluating the projected impacts on economic development, traffic levels, social interactions and urban

form all help to regulate whether the BRT system will enhance real value. Transportation projects characteristically bring positive environmental impacts through the decrease of private vehicle use and consequent related emissions (SU, Singh, & Baghini, 2014). According to extensive analysis urban properties respond absolutely to transportation developments. Usually this takes the shape of higher property values (Cervero & Kang, 2011).

In Seoul, Korea found new BRT's created extremely limited land value rewards. Land markets take advantage of the accessibility of the BRT's mainly helping higher-density inhabited uses (Cervero & Kang, 2011). Dwellings which were in 300 meters of the BRT stations knowledgeable about land worth of 5 to 10 percent, whereas retail and alternative non-residential uses which were in radius 150 meters of the BRT stations benefitted in increase of 3 to 25 percent.

High-quality BRTs, like all urban transport will have an effect on the standard of living, efficiency, health and safety of individuals residing in cities (Dittmar, Bond, Hurst, & Kasser, 2014). BRTs reduces emission of greenhouse gases as it has positive environmental impacts that subsidize air pollution and climate change. Decrease in emissions of vehicles can be attained in numerous ways by enhancing the bus service, fuel efficiency and reducing vehicle kilometres travelled. BRT systems also offer valuable public health benefits to society in three main ways: reduced road fatalities and injuries, reduced personal exposure to harmful air pollutants, and increased physical activity for BRT users (Winkler, Meyerson, & Carrigan, 2014).

BRT systems have further impacts associated with land use, urban development, crime rates, employment and even public tax revenues (Cervero, 2004). BRTs might also accelerate changes within the varieties of residential, industrial, office, retail or the density of areas close to stations. Additionally, to put up existing demand of travel along corridor, BRT might persuade higher-density growth along the stations as a result of magnified convenience and better pedestrian volumes. In Seoul, new BRT facilities resulted in demand in market for higher-density residential lands (Cervero & Kang, 2011). In developing countries car ownership is continuously rising, leading to problems such as air pollution and congestion, deteriorating public transport facilities. Income per capita and ownership of private vehicle has also a strong association with each other which means if the income is higher it becomes more inexpensive to have a car.

3. Methodology

To investigate the factors that influences the daily life of business and commercial community of study area due to development of BRT project, a survey was conducted in the form of questionnaires . the collected data is analysis with the help of ground theory and Microsoft excel. Representation of data was done by using graphic mode porigin pro 8 software.

3.1 Study Area

Rawalpindi-Islamabad BRT bus Service is Bus Rapid Transit service that is provided to occupants of twin cities of Rawalpindi and Islamabad. It starts from Flashman Hotel, Sadder and finishes at Pak Secretariat, Islamabad. Presently there is just a single course which is 22.5 km long however two future extension of this route is being planned which will connect the primary course (Jalil, 2018).

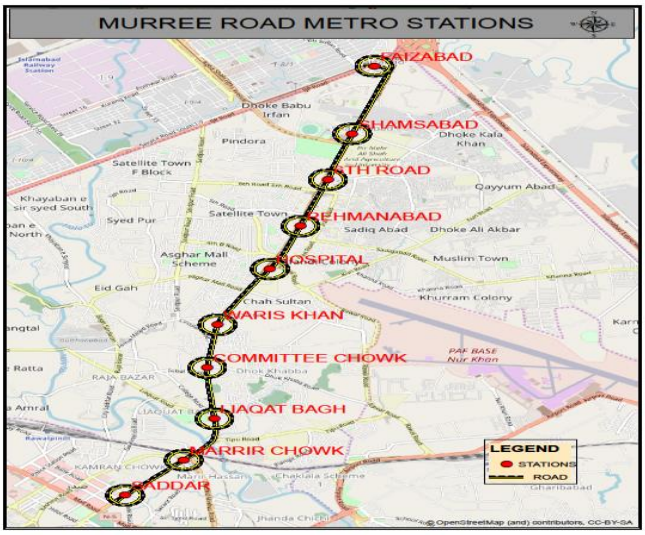

Figure 1 : Bird Eye View of Study area for this research (Haider, Rehman, Khan, Ilyas, & Khan, 2021).

The whole area of BRT under Rawalpindi region was taken under study which starts from Faizabad station to Flashman Hotel Sadder. The length of the total route of BRT in Rawalpindi is 8.6km. This whole length was divided into 10 zones with a buffer of 500m on both sides also the stations were surveyed alternatively to cover maximum area along the sides. This research was hybrid as both qualitative and quantitative was accessed for the analysis.

3.2 Research Instruments

Number of different indicators were adopted for this study. These indicators were adopted due to their relevance to the study after literature review of different reports, journal articles and previous approaches. These indicators were used for developing questionnaires for field survey expert opinion survey and checklist of observatory survey.

The indicators considered in social impacts are usability of BRT, Number of accidents, crime and interaction between the people due to BRT. Privacy and safety were also considered as the main indicator in social impacts. Furthermore, the indicators which were considered in economic impacts were income, employment rate, economic and financial loss, fuel consumption, shops rents and no of customers. The data collected from these indicators was then evaluated using Statistical Analysis.

Performance of BRT in social block is being evaluated by the use of increased road safety, travel convenience, and safety and privacy. The assessment of these measures will provide with the understanding of the BRT implementation effects on the Society.

4. Results and Analysis

A comprehensive data was collected among commercial area around BRT routes and its analysis is presented in given below.

4.1 Property Rents

Transport infrastructure development is usually perceived as impetus for economic process (Gelaro et al., 2017). Making new roads or growing existing ones will increase the attractiveness of the land they undergo and encouraging new urban facilities. These facilities in this way increase the demand of land use which therefore increases its value(Morimoto, 2013). Transportation cost verifiably includes the chance that urban infrastructures, like public transport, can form land and real estate prices. Location rent can be isolated using nearness to stations or mass transit lines, looking on the kind of public transportation. According to Burgess (2008),(Burgess, 2008) land values is one of the foremost sensitive indexes of mobility and increased mobility acts as a driving force of change in a city (Taotao Deng, 2013). Public infrastructure impacts the urban patterns and spatial dissemination of urban property values (Damm, Lerman, Lerner-Lam, & Young, 1980), (Kugelman, 2013).Reduction in land values and travel time are interconnected. Businesses and residents are always prepared to pay more price to be near to transportation stations (Carrigan, 2013).

Transportation development will have a positive result on the probability or timings of land developments. A high-quality transport system will greatly advance the accessibility of its catchment area by shortening time of travel. Thus, the locations which are close to transport stations usually have a high level of accessibility to a transit system and it tend to be necessary for new development or redevelopment. In common with alternative methods of Mass Transit systems, such as Subways, LRT and BRT systems tend to influence land development. A growing body of evidence suggests that BRT systems have a positive impact on property value uplift (Rashed & Jürgens, 2010).

Survey was conducted to illustrate about the property rents along the corridors of BRT. Real estate agents were chosen with good reputation in the market. It was easier to access them compared to Government officials and developers. They were approached by making direct contact to their workplaces around BRT stations. After they showed interest they were asked about the land values change along the corridors of BRT from 2005-2018.

As per collected data from the survey, it illustrates that 45.7% of people responded that shop rents have increased after the BRT construction. Also, there was a yearly increment of 10% in shop rents but now after the construction due to increased economic activity the owners have now increased the average yearly increment and experts believe that in future the rent will increase. Also, the shop rents immediately increased in the areas close to the BRT station. According to 9.1% of the people rents has decreased. The rent mainly decreased in the area which is far from the BRT station and is not much accessible while 16.9% of people responded that the shop rents are same and there is no impact of BRT construction on the rents. Table 1 shows the value of commercial property before and after BRT project.

Table 1: Commercial Property values

Property size (sq. ft)	Value (Million)				Rent (Million)			
	2005	2010	2015	2018	2005	2010	2015	2018
1 Shop (900)	10	50	50	70	0.05	0.2	0.35-0.4	0.35-0.4
Commercial Unit(800)	16	32	50	50	0.15	0.35-0.4	0.6-0.7	0.6-0.7
Commercial Plot(272.3)	0.5	1	2	2	N/A	N/A	N/A	N/A

According to table 1, data collected from the real estate personals there is no big difference between the values and rents of property before and after the BRT. The commercial enterprise is divided into three main categories which are single shop, commercial unit and commercial plot. The standard size of one shop is 900 sq. ft and the value of this was 50 million in 2015 and was increased to 70 million in 2018 whereas the rent almost remained same between 0.35-0.4 million. Furthermore, the value of commercial unit remained same in 2015 and 2018 which was 50 million where as in 2005 it was of 16 million which was increased to 32 million in 2010. Also, the rent increased from the period 2005-2018. The rent of a commercial unit was 0.15 million in 2005, 0.35-0.4 million in 2010 and increased to 0.6-0.7 million in 2015 and 2018. Commercial unit usually consists of four floors with an area of 800 sq. ft. Finally, the commercial plot value also increased during this time period. The value of commercial plot was 0.5 million in 2005, 1 million in 2010 and 2 million in 2015 and 2018. The value of commercial plot in 2015 and 2018 remained same.

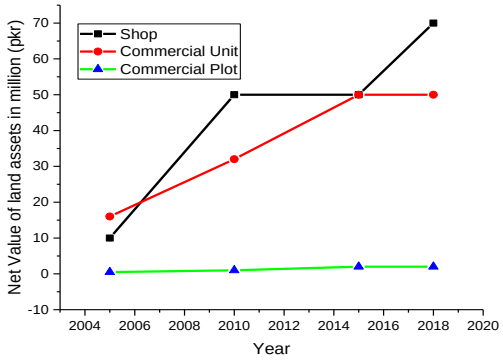

Figure 2: Trend in commercial values of land assets around BRT

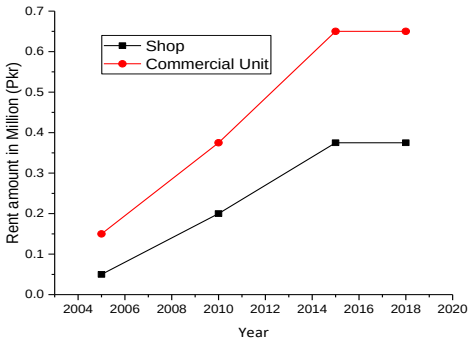

Figure 3 Trend in rent amount of properties around BRT

Following are the primary findings collected from discussion with local real estate agents:

- The rise in property value due to T mostly occurred after its emergence and happened with within distance of 500m from the BRT station
- Accessibility was enhanced in the properties adjacent to BRT station.
- BRT was important to many customers interest in the local area. From the real estate agent's perspective, majority of the people would like to pay a premium for land near the BRT corridor.
- According to 77% of respondents, BRT has become a driver for property development along its corridor.

Property values increase as a result of improved accessibility to employment hubs and economic centres. People are willing to pay a premium for access to goods, services, employment, education and recreation, and studies have shown premiums for both residential and commercial properties. It is thought that BRT has a considerable impact on transit-supportive land development. Travel time savings has made lands near BRT more desire for development. Due to accessibility enhancement many commercial projects were built after the execution of the BRT.

4.2 Parking spaces

According to the survey, 39.7% of the people responded that parking spaces are same before and after the construction of BRT while 36.9% of the people responded that parking spaces increased after the BRT.

According to some people it only increased on few places like murree road area because murree road region was one of the congested areas along the Rawalpindi BRT

corridor which has now improved a lot after the construction of BRT.

On the other hand, 23.1% people responded that parking spaces were reduced due the BRT construction which is mainly due to the area conversion of that area into shops and roads. Also, some people think that encroachment land has increased which therefore decreases the parking spaces.

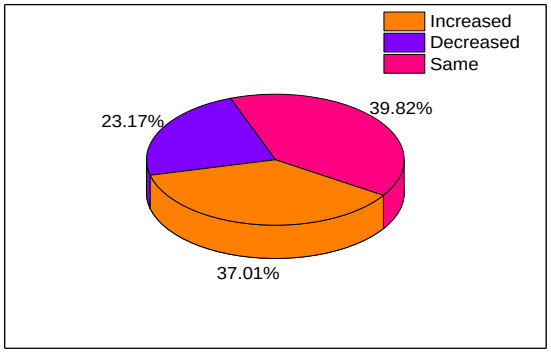

Figure 4 Responses recorded among local community regarding effects of BRT on Parking spaces

Thus, the above pie chart concludes that parking spaces are almost same or increased after the construction of BRT. In addition, reducing on street parking has not resulted in diminished revenues. Reports in Toronto and Vancouver have shown that businesses consistently overestimate the percentage of customers who drive to their stores. Automobiles occupy significantly more space per customer than other modes of transit, which have much smaller footprints. Fewer parked cars on roadways also increases the visibility of storefronts to pedestrians. Another advantage to transit users is their transportation costs decrease, providing them with more disposable income to spend elsewhere.

4.3 Impacts of BRT on Demographic structure of Land.

In order to evaluate the effects of BRT on Land Usage of area another survey was conducted.

Questions were designed on base of land acquiring during BRT construction and change in demographic pressures. feedback was recorded in native and business communities.

According to the survey conducted in native community, only 0.68 % people responded that their land was affected due to the construction of BRT whereas 99.32 % of the people responded that there was no impact of BRT on their land. On the other hand 4.02 % business owners responded that their lands were used during construction of BRT . however, 95 .98 people in business community responded that they were not disturbed in term of land use during BRT construction.

The difference between responses native and business community is subjected location of Land around BRT route. Construction sites were situation near commercial areas , as per requirements of BRT routes, due to which some of their shops could acquired by construction authorities in order to facilitate the construction process. Figure 4 and 5 shows the graphical representation of their responses.

It is also important to mention that no landmark or heritage structure was lost during the construction of BRT. It was considered by the construction authority to preserve the heritages and landmarks which are situated in BRT routes.

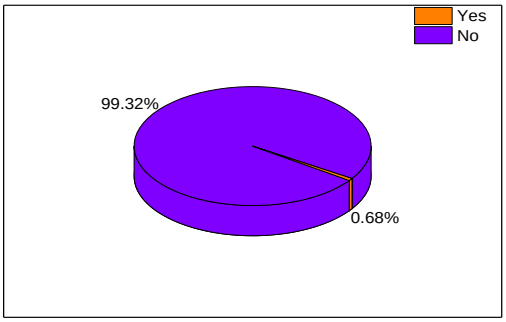

Figure 5: Responses recorded from Local community regarding whether their Land was acquired during construction of BRT.

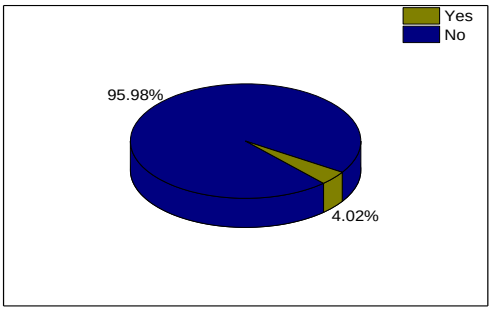

Figure 6: Responses recorded from business community regarding whether their Land was acquired during construction of BRT.

Finally, the last component discusses regarding land use was change in demographic pressure before and after the construction of BRT at BRT routes.

Majority of people (almost 94.74%) responded that remained same before and after the construction. There was no change because already the area along the BRT in Rawalpindi region is much crowded and congested that there is no land available for overcrowding. Whereas only 5.4% responded that demographic pressure of land has increased after the construction of BRT. This was the response of business community around the BRT route area.

Responses of Native community was also more or less same as per business community when it comes to increase in demographic pressure. 93.53 % responded that demographic pressure of the area has no change due to construction of BRT. While 6.57 % thought that construction of BRT led towards the spatial growth in residence area. Figure 6 and 7 shows the graphical representation of their responses.

A slight change in demographic pressure which was recorded in both community responses was subjected to relocation of many shops before the construction of BRT. Hugh number of running business shops were acquired before the construction of BRT by the authorities because these places were in the middle of master plan approved by govt: authorities for BRT construction. These Business owners were paid heavy compensation packages by govt: authorities.

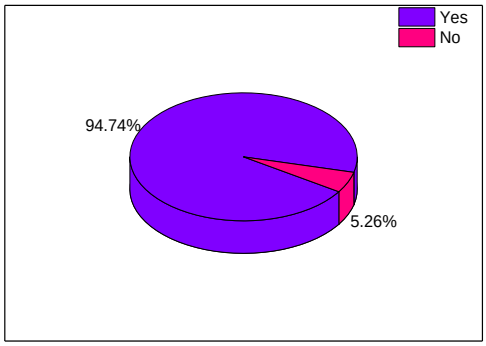

Figure 7: Responses recorded from business community regarding whether Demographic structure of land remain same before and after the construction of BRT.

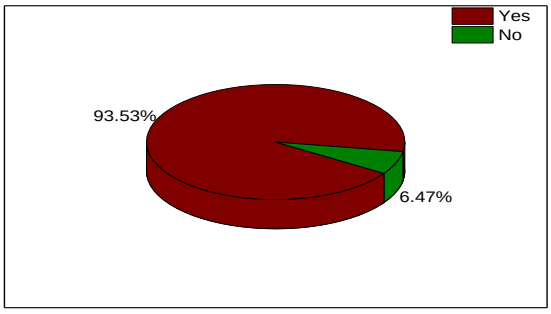

Figure 8: Responses recorded from Local Community regarding whether the Demographic structure of land remain same before and after the construction of BRT.

4.4 Impact of BRT Construction Activity on lives of inhabitants.

A construction site has intrinsic consequences that can cause disruptions in lives of citizens who are living in the vicinity of that construction site. However, with the use of proper management and modern technologies at construction sites, impact of construction activity upon the lives of habitants can be minimized. Another survey was conducted to estimate the impacts of BRT construction activity on lives of people living in nearby areas. As previously mentioned, respondents were divided into two category. Business community and native community.

When asked from business community through questioner that has construction activity of BRT influenced their daily life routine. Most respondents, 85%, answered in nay. However, 13.49 % of business community living in proximity of BRT construction site responded in affirmative manner. Figure 8 shows the graphical representation of recorded responses among business community.

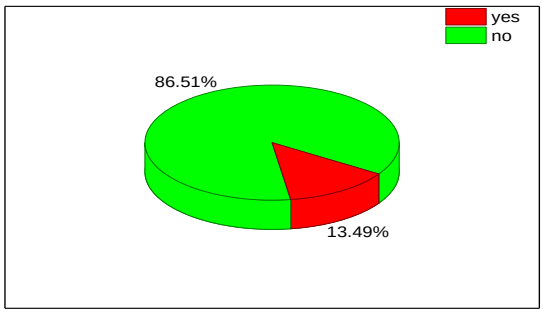

Figure 9 : Responses recorded regarding effects of BRT construction activity among business community living in vicinity of BRT route.

On the other hand, domestic community responded in slightly diverse manner.43.07 % People showed their concerns that their routine life patterns were deeply affected by that on-going construction activities. However, 56.06 % people responded that their lives were not disrupted by construction activity. Figure 9 shows the graphically representation of their recorded responses.

A proper planning and use of modern technology can decrease the impact of construction activity upon residents' lives, however, it can never be completely diminished.

Construction company plays a vital role in reducing the impact of production activity upon community. The mind set of their officials and technology available with their engineers usually determine both the planning process and the expected outcome.

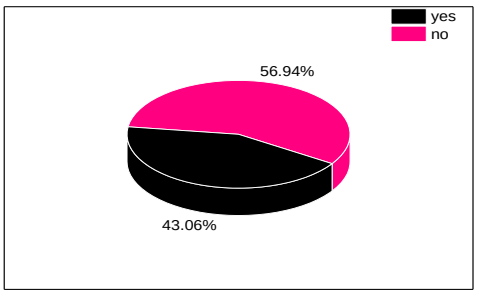

Figure 10 : Responses recorded regarding effects of BRT construction activity among domestic community living in vicinity of BRT route

Local people felt more disturbance during construction activity as compared to business community. As that was affected during the construction of BRT because mostly business community is situated along the roadsides and was directly affected during the construction. So, after the completion of BRT people rebuilt their shops.

4.5 Impact of BRT on Encroachment Land

Urban unpretentiousness is a by-product of development.For prime example , consider land encroachment and spatial growth between public and private spaces at especially at the fringes of huge buildings. . In a third world country like Pakistan, small hawkers usually establish their daily stalls in parking areas pathways of these buildings and create a chaotic ,impasses for pedestrians .

Encroachment of any land or property, whether it is public or private, is illegal in every country of the world. Construction of BRT also impact the mass-encroachment that was practiced by small vendors previously along the route of BRT. The main reasons for encroachment are that Pakistan is a third world country and have minimum wage rate per which consequently makes more difficult for people to purchase land on their own for their small business set-ups. Another reason is also poor law and order situations and compromised moral principles.

Characteristics	Business N	Community n	Total n(%)
Encroachment Land			
Increased	19	11	30(6)
Decreased	173	100	273(54.6)
Same	148	21	169(33.8)

Figure shows the impact of BRT bus transit construction over the land encroachment rates in the area. According to the survey, 57.84 % of people responded that they noticed encroachment of land in nearby vicinity has decreased after the construction of BRT.6 % respondent feel that construction of BRT did not reduced the illegal occupation of land by the shop owners and hawkers, in fact their businesses have increased by 6 %. 35.81 % respondent stated that they feel no change in the area.

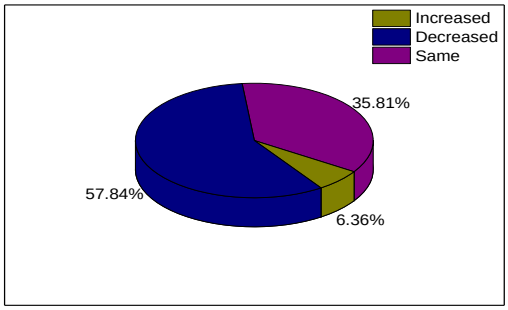

Figure 11: Rate of Land encroachment before and after construction of BRT

Construction company of BRT made sure that they designed the Route in such architecturally advance manner which use the free land and thus rates of land encroachments were reduced as there were no free lands available to occupy illicitly ,after the construction of BRT.

Figure 11: traffic situation of city roads before and after the construction of BRT are shown in figure A , B, C and D respectively.

5. Conclusions

Identifying and determining transportation issues is one of the main tasks confronting governments in developing countries like Pakistan. Ever- growing Travel needs of people can only be cater properly by providing them a self-sustain, economical commute system like BRT. BRT can offer operational availability over other local transport means like rikshaw, and it also has economical advantage when compared with any cab services. Urban Transport system, like BRT has transformed large amounts of valuable non ecological land into an efficient commute system, leading to major impacts on local and business community in proximity. Construction of BRT not only increased the values of property in that area but it also provided extra parking spaces and reduced the land encroachment opportunity for street hawkers in that region.

This study analysis can help urban transport agencies to optimise their BRT operations and provide better public transport services.

6. Credit authorship contribution statement

Abdul Waheed: Conceptualization, Designing a Methodology, Supervision.

Mariyam Kausar: Formal analysis, Investigation, Data curation.

Qandeel Gillani and Faisal Rehman: Writing , Visualization. Technical writing, Review & editing,

7. Declaration of Competing interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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