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Effects of road infrastructure development on residential property value and land development shifts in a peri-urban area of Karachi, Pakistan

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Abstract: The introduction of road infrastructure development projects often triggers expectations of shifts in property values. Extensive research has already been conducted regarding the impact of such projects on property values and land development in developed regions. However, there is a research gap when it comes to developing countries like Pakistan. Therefore, this study aimed to investigate the influence of the road infrastructure development project, the M-9 Motorway, on residential property values and land development in a mega residential project in Bahria Town Karachi (BTK), Pakistan. This study employs a mixed-methodology approach, incorporating qualitative methods (interviews) and quantitative analysis (questionnaire surveys and property data analysis). Statistical tools such as Statistical Package for Social Sciences (SPSS), the Pearson correlation coefficient, and the Chi-square goodness of fit test were used for correlation and hypothesis testing. This research reveals that proximity to a major road infrastructure project directly impacts property purchase prices, rents, and land development in BTK, either positively or negatively. The obtained results align with both expectations and the existing literature. Although these findings should not directly apply to other locations and contexts, they can be considered suggestive indicators for planning purposes.

Keywords: M-9 Motorway, Bahria Town Karachi, road infrastructure development, land development, property value, mega residential project.

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1. Introduction

The development of large-scale projects, such as road infrastructure initiatives is critical to a country's and region's economic development; hence, the kilometres length of roadways in a country is usually used as a benchmark to assess the level of growth (Aldagheiri, 2009). The careful development of the road infrastructure brings about more than just reducing transportation expenses and covering both financial and time-related aspects. It also plays a pivotal role in harmonizing various regions within the country and, on a global spectrum, contributes to a heightened understanding of neighbouring areas, as highlighted by Luo *et al.* (2022).

In addition, road infrastructure initiatives engage a diverse range of stakeholders, potentially resulting in various transformations within neighbouring areas (Erkul *et al.*, 2016). These infrastructure projects have demonstrated their capacity to enhance mobility, improve access to employment opportunities, social amenities, and vital services like educational institutions and healthcare facilities. Additionally, they expand markets for agricultural products and services, contributing to overall economic growth (Pradhan & Bagchi, 2013). An underlying assumption is that constructing new roads or expanding existing roads offers opportunities for land development, social development, economic growth, and overall community well-being, thereby enhancing the quality of life for residents in proximity to such projects (Doan & Oduro, 2012). Consequently, whether through new developments or upgrades, road construction is presumed to exert a multifaceted impact on population dynamics, urban morphology, land development, economic status, and environmental sustainability (Mackett & Edwards, 1998). Hence, Global South's Governments are significantly utilizing these initiatives to enhance the competitiveness of their cities. This calls for a strategic expansion and restructuring of their road networks, which in turn draws in investments (Khanani *et al.*, 2021).

In contrast, the influence of road infrastructure on property values has been a topic of intense debate spanning more than a century. Numerous studies have examined the correlation between transport infrastructure and property values, with much of the empirical research stemming from developed nations like the USA, UK, Canada, and Japan (Gatzlaff & Smith, 1993; Parker *et al.*, 2002; Ryan & Montgomery, 2005; Khanani *et al.*, 2021). Conversely, in rapidly growing cities of developing countries, like Tian (2006) states, there is consistently high demand for road infrastructure investment that often leads to escalated land prices but remains unmet.

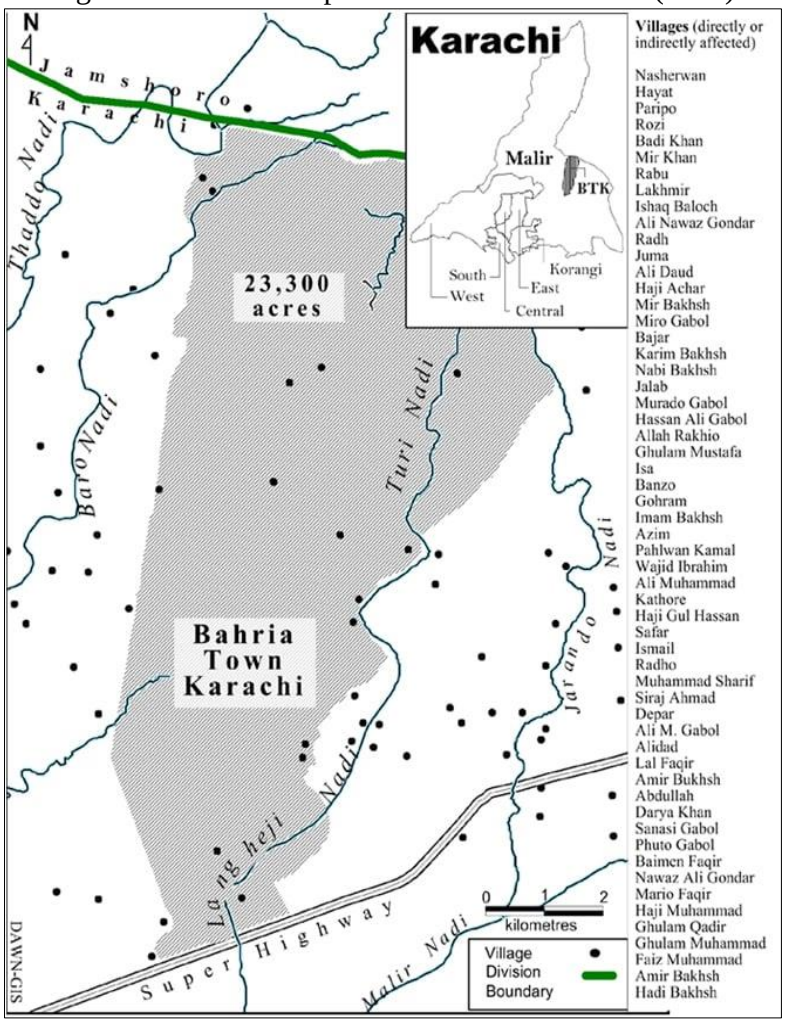
Pakistan, a developing country, has initiated many mega road infrastructure projects under the China Pakistan Economic Corridor (CPEC) agreement. A network of motorways is developing throughout the country to boost the region's economy. In addition to these initiatives, real estate is a significant and rising industry in Pakistan's economy. In one year, Pakistan invested $5.2 billion in construction. In Pakistan, Bahria encourages the real estate growth sector (Khan *et al.*, 2014). The expansion of Pakistan's private real estate market has been reinvigorated after the launch of the Bahria projects. All private real estate developers in the country are fascinated by Bahria projects (Khan *et al.*, 2014). This is due to incentives provided by Bahria developers to real estate brokers. Bahria Town started its first project in Karachi because Karachi is the economic hub of Pakistan (Aslam *et al.*, 2021).

Bahria Town Karachi (BTK) is located on the city's northwestern outskirts. It is located 9 kilometres from the toll plaza on the M-9 Motorway (originally Karachi-Hyderabad Super

Highway) and covers over 44,000 acres (Zafar, 2018) (Figure 1). The government proposed the conversion of the Karachi-Hyderabad Super Highway to the M-9 Motorway to enhance connectivity and boost the region's economy. The Hyderabad-Karachi M-9 Motorway is a part of the CPEC. A six-lane, 136-kilometer-long highway connects the two main cities in Sindh, Karachi and Hyderabad (News Desk, 2020).

The construction of the M-9 Motorway coincided with the beginning of BTK; hence, both projects are said to have a close link. On the other hand, BTK always strives to enhance its citizens' living standards and has used various techniques to achieve this goal (Datta, 2017). One of the plans was to connect Bahria Town with the M-9 Motorway. Management of Bahria Town proposed the construction of the M-9 motorway junction, which began in May 2018 and finished in 2020 (News Desk, 2020). The primary goals of this interchange were to raise the value of the town's property, boost the development of land and enable convenient access to other parts of the city and country. It was thought that the construction of the interchange and associated infrastructure at Bahria Town would considerably improve not only the quality of life of Bahria Town residents and the convenience of transportation for Karachi's residents but also positively affect the property value and land development (Li & Rama, 2023).

Figure 1: Location map of Bahria Town Karachi (BTK)



Source: Zaman and Ali (2016)

However, limited research has been carried out to explore the effects of road infrastructure on property values and land development in the land markets of developing nations, primarily due to restricted access to transactional data (Tian, 2006). Thus, a comprehensive evaluation of the effects of road infrastructure development on property values and land development is vital in developing countries. Furthermore, the development of road infrastructure facilities does not guarantee complete benefits. Proximity to major roads can adversely affect land users, resulting in disturbances such as noise pollution, air contamination, and heightened vehicular traffic (Tian, 2006). As stated by Khanani *et al.* (2021), the effects associated with the proximity of road infrastructure projects encompass various favourable and adverse outcomes. The nature of these outcomes depends upon the complicated relationship between various contextual elements, including social dynamics, spatial considerations, economic factors, and environmental aspects. Consequently, a rigorous evaluation of the impacts of road infrastructure development on property values and land development should discover the extent to which positive and negative consequences arise from such investments (Cervero & Duncan, 2001). Therefore, the key objective of this research was to investigate the impact of the road infrastructure project, M-9 Motorway, on the residential property value, rents, and land development of BTK.

2. Literature study

Recent research has increasingly explored the significance of road infrastructure in the context of development. This body of literature often combines economic theory with geographical data, including specific details about the location of transportation road networks (Redding & Turner, 2015). There is a widespread consensus that inadequately planned and executed infrastructure projects can negatively affect an area's economy and environment (Paraskevadakis *et al.*, 2016). As a result, the advancement of road infrastructure plays a pivotal role in the overall development of regions. It not only facilitates enhanced market connections but also has a positive impact on the land market. Moreover, well-constructed roads contribute to the engineering progress of a region and lay groundwork for increased urban housing construction (Bryzhko & Bryzhko, 2019).

Jedwab and Moradi (2016) also indicated that road infrastructure projects involve considerable investments to achieve economic prosperity by facilitating the movement of goods and services between locations. In Sub-Saharan Africa, road infrastructure currently serves as the primary mode of transportation for approximately 75% of cargo and passengers (Beuran *et al.*, 2015). Notably, approximately 50% of the roads within the Sub-Saharan region remain to be constructed, underscoring the continued significance of road infrastructure development in urban areas. This development can potentially influence these cities' socio-economic and physical landscape and their surrounding peri-urban regions (Gachassin *et al.*, 2010; Cobbinah *et al.*, 2015).

Khanani *et al.* (2021) conducted a study examining the effect of road infrastructure projects on peri-urban areas in Kisumu, Kenya, and Accra, Ghana. Their findings revealed that these projects led to an increase in residential development in both cities. Improved road infrastructure played a pivotal role in escalating housing rents and land values, rendering peri-urban settlements along these routes appealing to real estate developers. Furthermore, there was an increase in access to amenities and services, coupled with the broadening of employment prospects in these areas. However, the road infrastructure projects also resulted in

gentrification, displacing poor residents to outlying areas and consequently altering social cohesion and integration to some extent. The benefits of the road projects were more favourable for the wealthy landowners while disadvantaging the less affluent. Given that the impacts of road infrastructure varied based on location and socio-economic class within peri-urban areas, Khanani *et al.* (2021) recommended a combination of place-specific and people-centred policies to address the consequences of such projects.

On a different note, Holvad and Preston (2005) assessed the effects of the M6 toll road on industrial land development and employment in the Birmingham area of the UK. They formulated and tested two hypotheses, one suggesting a positive effect of the M6 toll road on industrial land development and the other positing an indeterminate or negative effect. The study's results indicated that the toll road indeed spurred industrial land development, especially for sites with convenient access to the road, and the development effects decreased as driving distance from the road increased. Deng and Nelson (2010) asserted that locations near major roads with high accessibility to transit systems tend to be favourable for new developments or redevelopment. They further stated that improved road infrastructure could positively influence the timing and likelihood of land development. Enhanced road infrastructure could significantly reduce travel times, thereby improving the accessibility of the surrounding area. Similarly, Smith and Gihring (2006) argued that locations that are more accessible generally command higher property values. Therefore, it can be inferred that proximity to a major road infrastructure project could lead to increased property values, as the economic benefits stemming from transportation improvements are reflected in higher land values and property prices. This suggests that the impacts of transport infrastructure development on land development manifest in two main ways: an increase in property values and an acceleration of land use development (Deng & Nelson, 2010).

In conclusion, the existing literature covered all the variables for developing mega-road infrastructure projects. It became evident that road infrastructure projects contribute to the escalation of housing rents and land prices, stimulate economic growth, enhance employment opportunities, foster land development, and positively influence the socio-economic and physical aspects of developed cities. However, it is worth noting that the impact of road infrastructure on house rents, land prices, and land development was not accessed in the existing literature. Therefore, investigating pre-planning, implementation, and post-planning phases is crucial to gauge the potential favourable or unfavourable impacts of transport infrastructure projects across a range of aspects like house rents, land prices, and land development, particularly in developing countries (Paraskevadakis *et al.*, 2016).

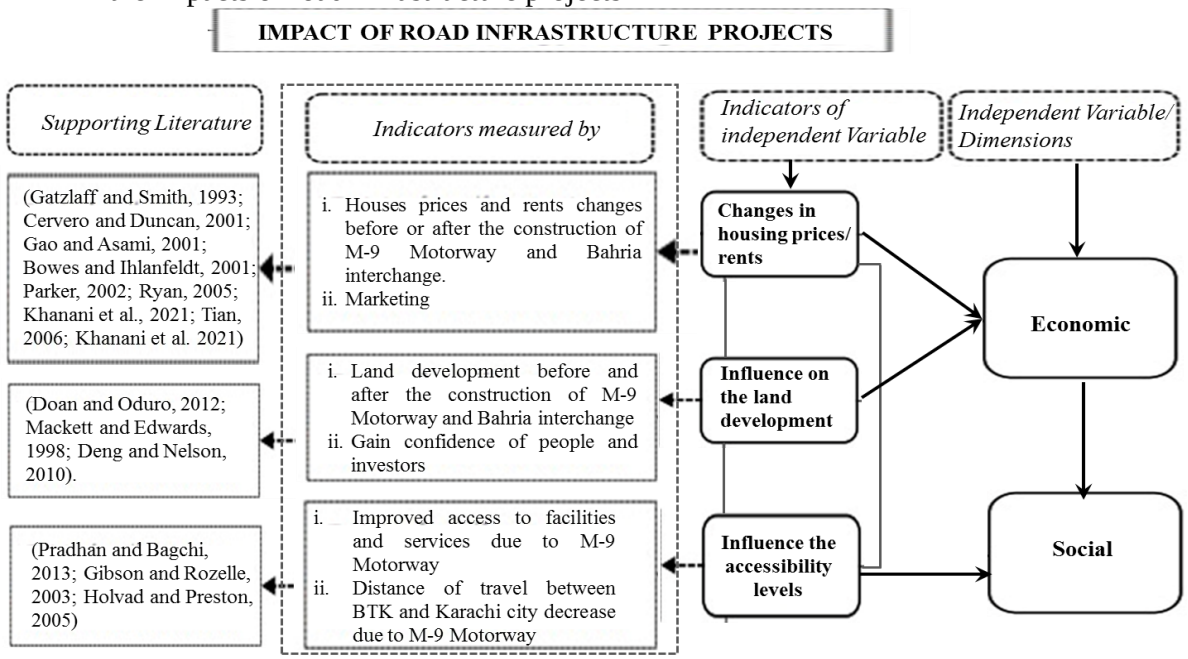
The following hypotheses are examined in this study based on the evidence from previous research:

- There is no significant difference in property prices in BTK before and after the M-9 Motorway (HI) construction.

- There is no significant difference in the pace of development in BTK before and after the construction of the M-9 Motorway (H2).

- There is no significant influence on the accessibility of people to the city and other services after the construction of the M-9 Motorway (H3).

Figure 2: Conceptual framework based on the literature review, showing determinants to evaluate the impacts of road infrastructure projects



Source: Authors

3. Methodology

This research employed a mixed-methods strategy, incorporating various techniques such as a case study, surveys, focused interviews, and a field survey. The chosen case study was BTK. The initial phase involved a preliminary visit to BTK in 2016, followed by three more detailed visits: one during the construction of the M-9 Motorway on April 17, 2016, and another after the completion of the M-9 Motorway on October 25, 2019, and third visit in March 12, 2021. The case study was observed using field notes and photographs during these visits. Primary data was collected at the household level through a structured questionnaire with a sample size of 37. Demographic information and opinions on accessibility and services were investigated. A simple random sampling technique was used to ensure unbiased results and reliable generalizations.

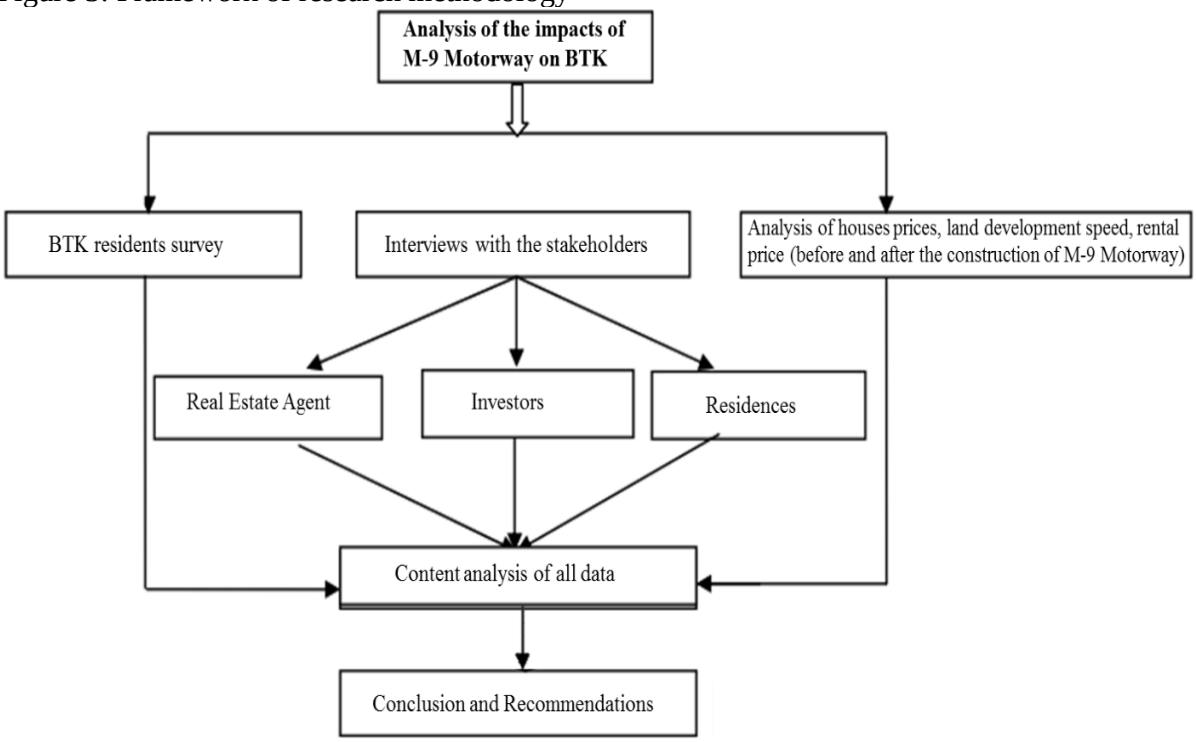
In addition, detailed structured interviews were conducted with ten investors and three state agents. One state agent with significant experience in BTK provided statistical data on land value, occupancy, and rental value.

The questionnaire was organized into three sections corresponding to the mentioned indicators, encompassing a total of 14 closed-ended questions. These questions aimed to gather specific responses within defined ranges for consistency. The survey's initial section focused on demographic information, while the second section explored households' views on the impact of the M-9 Motorway construction on housing prices, rental costs, and development pace. The third section evaluated the accessibility facilitated by the M-9 highway construction.

Data from closed-ended questions were coded and analyzed using Statistical Package for the Social Sciences (SPSS). Three independent variables were cross-tabulated to identify statistically significant correlations in the data analysis. The resulting subsets of these

independent variables are displayed in Table-1. The Pearson coefficient was used in bivariate correlation analysis to establish relationships between study variables. Chi-square tests were employed to understand the connections between the M-9 Motorway and factors such as housing and rental values, city accessibility, services, and land development.

Figure 3: Framework of research methodology



Source: Authors

4. Framing the case study

The development of Bahria began in Pakistan by constructing housing developments in the country's north, focusing on three main cities: Islamabad, Rawalpindi, and Lahore. After receiving excellent feedback from the community, entrepreneurs, and real estate developers, it laid a stone over the country's southeast. Bahria launched projects in rural Sindh, specifically Nawabshah and Sukkur, as well as in Karachi (Shaheen *et al.*, 2016). Considering BTK, which is currently under construction and encompasses among the amenities residences, villas, flats, retail malls, large Jamia Mosque for each sector, schools, university, hospital, cricket stadium, indoor and outdoor sports facilities, five-star hotel, golf course, Bahria Sports City, cinema, and theme park (Mehta, 2016).

At the time of the launch of the BTK project, all types of filing, including No Demand Certificate (NDC), provisional certification, and file transfer, were handled at Bahria Icon Karachi. Due to the considerable distance between Karachi and Bahria Town, they faced difficulties with registration and consultation during phase I development, so the office was relocated to Bahria Town (Chugtai, 2021). One of the primary causes of the office relocation in Bahria Town was the construction of the M-9 Motorway. The M-9 Motorway is a gift for them; otherwise, surveying the project area would have been extremely difficult and time-consuming for the users.

If considering the start of the BTK project, plots in Bahria Town were allotted by ballot for a non-refundable processing fee of Rs. 5,000. To make money, Bahria Town Karachi agents advertised the project in such a way that the demand for plots grew, and the price of receipts for application forms skyrocketed to one hundred thousand rupees. There was no master plan in place at the time the project was announced. As a result, the availability of the actual land was unknown, and it remains so to this day (Khan *et al.*, 2014). According to sources, Bahria Town purchased the land following the booking procedure.

Figure 4 depicts how the property was acquired first, then infrastructure was designed, followed by the construction of residences, and finally the houses were handed over to the landowners. The registration mechanism is being carried out in such a way that real estate developers have appointed their workers privately in BTK. As a result, the transfer of files is done without any trouble, such as tax clearance.

They do temporary certification before delivering the files for the NDC transfer procedure. As a result, Bahria Town's rapid expansion differs from traditional city planning, which necessitates patience and modest improvements over extended time periods (Murray, 2016). It may be appreciated by comparing the early pace of development to the present rate as well as the relationship between development and the construction of the M-9 Motorway.

The planning procedure for BTK unfolded as follows: To begin with, the design firm "Designers East" conceptualized the master plan by formulating schematic design concepts. These concepts drew inspiration from international guidelines, yet they lacked a connection to our local surroundings. They incorporated features such as green areas, linear parks, urban infrastructure, and recreational amenities (Nazir & Yousuf, 2021).

The current master plan for BTK was finalized in 2015, as shown in Figure 4, with all amenities and facilities responding to the local context (Karim, 2022).

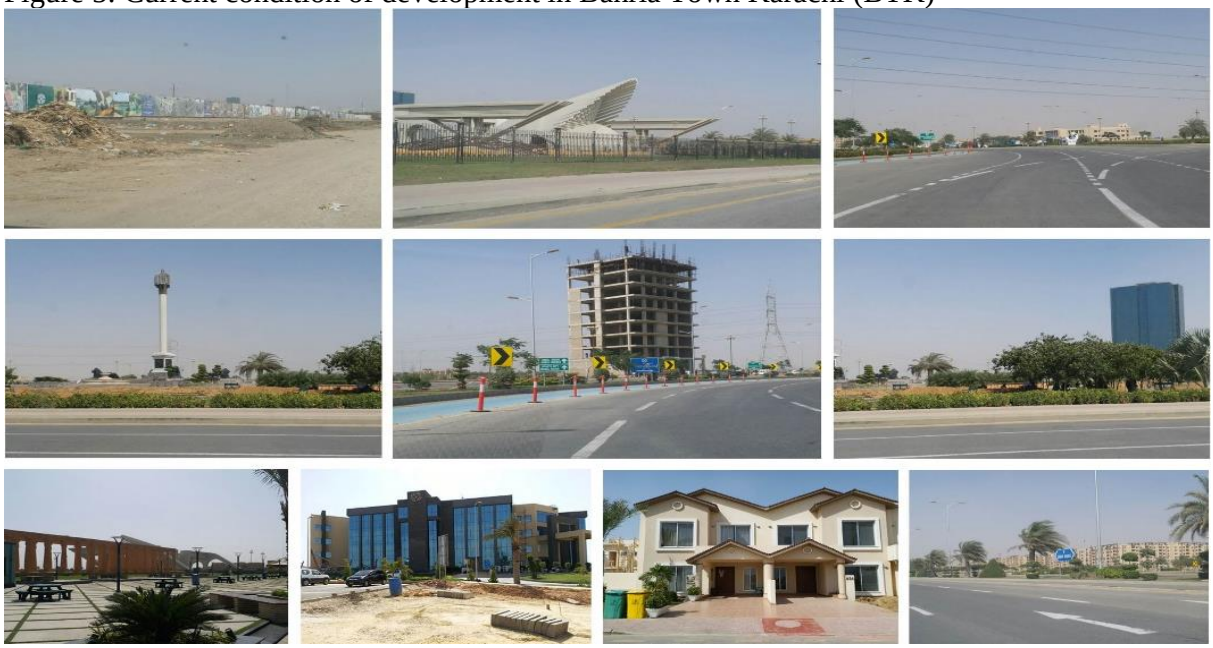
Figure 4: (a) Initial developments in 2015, and (b) Master plan in 2015

(a) (b)

Source: (a) https://www.property365.pk/bahria-town-karachi-latest-progress-update-may-21-2015/
(b) https://manahilestate.com/master-plan-map-bahria-town-karachi-project-available-online/

Figure 5 clearly shows that the development work just after the inauguration of BTK was slow, but the development speed increased after initiating other projects like the M-9 Motorway and the incentives given by the administration of Bahria to the public.

Figure 5: Current condition of development in Bahria Town Karachi (BTK)



Source: Authors

One of the issues BTK faced was its transportation network's connectivity. This is mainly for the people living at a distance of 90 kilometres from the city, with an already unfavourable connection to the peri-urban areas, as well as regular traffic congestion and service disruptions. Assuming that people would live and work in BTK using present modes of transportation will almost certainly result in the downfall of BTK. To address the issue, Bahria Town launched the Blue Line transit plan. However, the BRT administration claims that construction on this proposed scheme is not continuing at the rate necessary to sustain the development. Commuting through the superhighway, which is a crowded arterial, for its sustenance will result in the development's eventual collapse. Fortunately, with the construction of the M-9 Motorway, this problem has been remedied. The M-9 Motorway facilitated commuters' trips between Bahria Town and Karachi (Mysorewala, 2021).

The M-9 Motorway is an extension of the National Highway Authority (NHA) existing 136 km Karachi-Hyderabad Superhighway, for which M/s Binapuri Pakistan Pvt. Ltd. (BPL) was appointed. The project is being carried out by a private-sector partnership on a Build-Operate-Transfer (BOT) basis. The proposed 134.35 km M-9 Karachi-Hyderabad route begins at 13+000 km (Project Chainage 0+000) of the NHA beneath the flyover/exchange (Figure 6). It further accommodating the Lyari Motorway on the Lyari River and finally ends at 149+000 km (Project Chainage 136+000) in the intimacy of the cloverleaf junction on the Hyderabad Bypass (Pakistan Property Services – Real Estate Marketing Agency in Pakistan, 2021).

The article titled “Opening Ceremony of Bahria Town newly built interchange M-9” defined the scope of the project as it was designed to strengthen the current road structure by converting the current four-lane Karachi-Hyderabad Superhighway into a six-lane highway with controlled access and the finest motorway (M-9) and its related amenities (UPN, 2020).

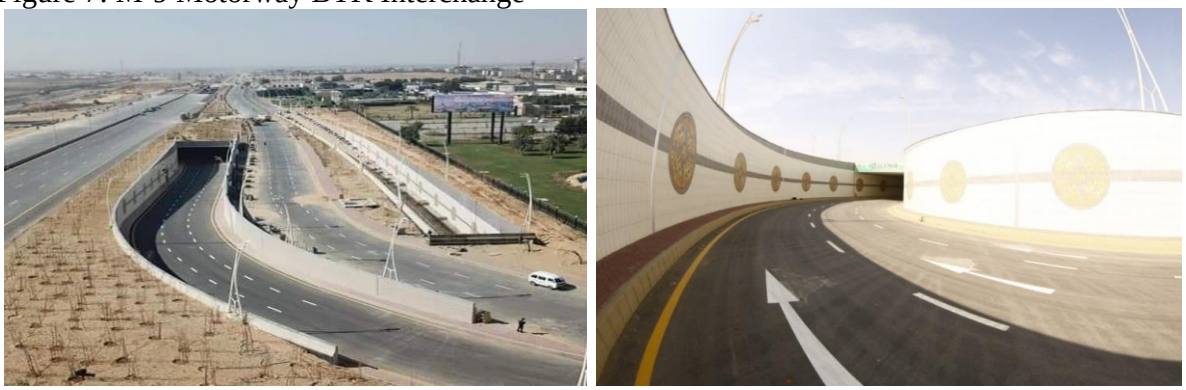
Figure 6: (a) Extension of M-9 Motorway, and (b) Extension of M-9 Motorway

(a) (b)

Source: https://www.slideshare.net/giap0083/m9-final-report-070712

In addition, the article further described the M-9 Motorway BTK Interchange. BTK has begun construction of an interchange on the M-9 Motorway by awarding the contract to Frontier Works Organisation (FWO). The newly constructed special interchange on the M-9 Motorway is now open to the public. The Bahria Town M-9 Intersection is Pakistan's only major national infrastructure project that has been built and backed solely by a private real estate investor (UPN, 2020). This megaproject will benefit travellers in general, not just commuters in Bahria Town. The 8 km project comprises three underpasses, many slide roads, access roads, service roads, an M-9 segment that goes across the interchange, an expansion of a preexisting overpass, the erection of a new overpass, and a causeway. The 35 hectares of land on which the proposal is being built are a stunning combination of horticulture and infrastructure, with components like trees, shrubs, and flowers nicely blended with a road network, pavements, and pathways (Figure 7). A new drainage system is also included in the project. The portion of M-9 that runs through the junction has been extended to four lanes for added convenience. An 8 ft high grill and a 3 ft railing have been built to divide the interchange region. The Bahria Town M-9 intersection supports the town's state-of-the-art road network, which includes a 400-foot-wide, 18-lane Jinnah Avenue inspired by Dubai's Sheikh Zayed Road (UPN, 2020).

Figure 7: M-9 Motorway BTK Interchange



Source: https://bahriatown.com/bahria-town-karachi-opens-the-newly-built-m9-interchange-for-public/

5. Findings and discussion

This study is structured into three main sections. The initial section focuses on the analysis of changes in housing prices and rents. The subsequent section presents findings regarding the pace of land development in relation to the construction of the M-9 Motorway. The final section delves into the impact of accessibility to various services within the city. Analysis of the

respondent sample reveals a male majority, constituting 70% of the overall sample, in contrast to the female respondents, who make up 30%. In terms of age distribution, the largest group (40%) falls within the 25–34 age range, while a smaller percentage falls within the 35–44 bracket (38%), and the 45–54 bracket (18%). Considering the younger respondents, who represent 4% of the target population, Following the completion of the field survey and questionnaire, it becomes apparent that a significant portion of respondents (70%) possess a bachelor's degree or higher educational qualification. In comparison, 26% have completed their matriculation, and 4% hold a Higher Secondary School Certificate (Table-1). This highlights that the sample participants in this study have a substantial level of education and rely on their employment to meet their life's necessities.

Table-1: Socio-demographic characteristics of respondents

Characteristics		Bahria Town Karachi (N = 50)
Gender	Male	70%
	Female	30%
Education level	Matric	26%
	Secondary level	04%
	University	70%
Age	18-24	4 %
	25–34 Years	40%
	35–44 Years	38%
	45- 55 Years and above	18%

Source: Author's

Table-2: Descriptive statistics of variables

Description	Range	Mean	Std. Deviation	Variance
Gender	1	1.30	.463	.214
Age	35.00	35.7800	8.64797	74.787
Education	2	1.34	.557	.311
Houses prices and rents were high after M-9 Motorway construction	2.00	1.6800	.89077	.793
Houses prices and rents were high before M-9 Motorway construction	1.00	1.5400	.50346	.253
Marketing of Bahria Town Karachi is boost up by M-9 Motorway construction	2.00	2.4200	.64175	.412
Distance of travel between Bahria Town Karachi and Karachi city decreased by M-9 Motorway construction	8	7.44	2.187	4.782
M-9 Motorway construction improved access to facilities and services	5.00	2.3200	1.62179	2.630
The pace of land development is high due to M-9 Motorway construction	3.00	1.3200	.76772	.589
The rate of land development is high due to confidence development by M-9 Motorway construction	2.00	1.9200	.69517	.483

Source: Authors

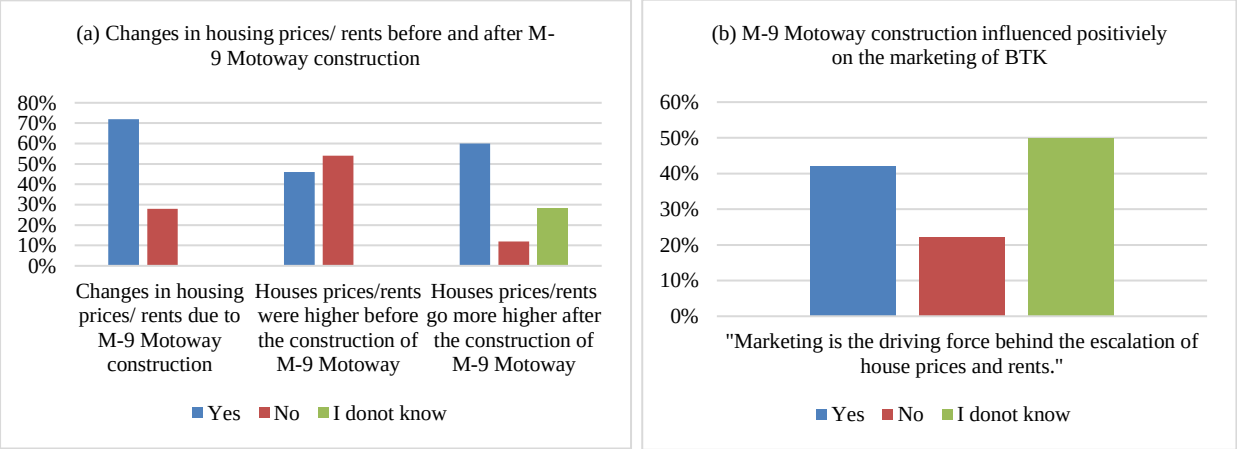
5.1. Changes in housing prices/rents

Most individuals (72%) reported observing changes in residential prices and rents due to the construction of the M-9 Motorway (Figure 8a). Out of our surveyed participants, 46% indicated that prices were higher prior to the M-9 Motorway construction, while 60% stated that prices had increased after the construction of the motorway (Figure 8a). The outcomes presented in Table-6 indicate, at the 0.01 level of significance, a weak positive correlation between the marketing of BTK and house prices and rents subsequent to the completion of the M-9 Motorway construction ($r = 0.077$, $p < 0.01$). Additionally, the analysis of Chi-square (χ^2) also reveals a weak positive association between residential property values, rents, and construction of the M-9 Motorway (X^2 (2, N = 50) = 0.444[a], $p < 0.00001$) (Table-3).

Consequently, it can be concluded that the construction of the M-9 Motorway is associated with an increase in prices, although this connection is not particularly strong. Consequently, it can be concluded that the M-9 Motorway's construction alone is not a dominant driver of the price surge; other influencing factors are also at play. These findings contradict those put forth by Khanani *et al.* (2021), who asserted that improved roads notably contributed to the upsurge in housing rents and prices. These outcomes support Hypothesis 1, suggesting no significant difference in property prices in BTK, before and after the construction of the M-9 Motorway. Numerous factors could account for this phenomenon, with one of the primary factors being individuals' preference to reside in proximity to their workplace and essential amenities, often requiring reliance on Karachi for their daily routines. Conversely, due to the considerable distance between the city and the case study area, those who have established businesses within the case study vicinity showed a preference for residing there. This scenario might evolve in future, particularly as BTK continues to develop complete amenities within the area.

Furthermore, 42% of the participants stated that marketing plays a pivotal role in the surge in housing prices and rental rates (Figure 8b). Nevertheless, the connection between marketing efforts and the construction of M-9 exhibits a weak positive correlation (r =.132). Consequently, it is evident that the development of M-9 did not notably strengthen the marketing of BTK, thereby lacking a substantial impact on housing prices and rental rates (Table-6).

Figure 8: (a) Changes in the prices of houses and rent in relation to M-9 Motorway, and (b) Relationship between M-9 Motorway and marketing of BTK



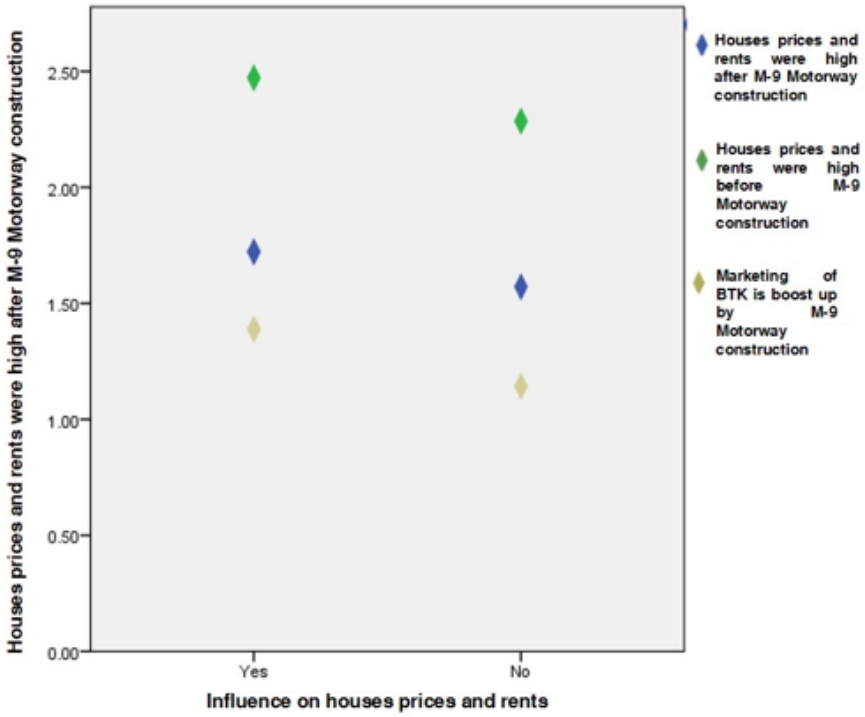
Source: Authors

Table-3: Chi-square test of influence of M-9 Motorway construction on the houses prices and rents

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.444[a]	2	.801
Likelihood Ratio	.457	2	.796
Linear-by-Linear Association	.289	1	.591

a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is 1.68

Figure 9: Graphical presentation of correlation between M-9 Motorway, houses prices and rents and marketing of BTK



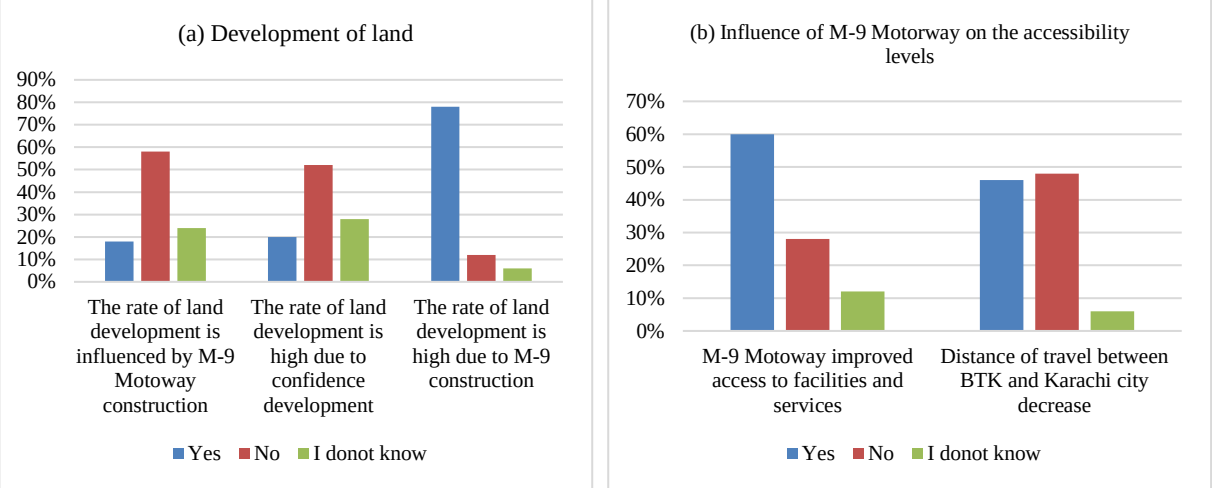
Source: Authors

5.2. Factors influencing the development of land of BTK

Regarding the influence of M-9 motorway construction on the land development of BTK, the findings of this study highlight several points. Firstly, it is evident that the pace of land development in Bahria Town, Karachi, is significantly impacted by the construction of the M-9 Motorway, with 58% of respondents indicating this connection (Figure 10a). Furthermore, a large majority (78%) attribute the heightened pace of development to the construction of the M-9 Motorway (Figure 10a), while a minority (20%) suggest that the motorway has strengthened investor confidence, leading to increased investment and subsequent land development (Figure 10a). In terms of correlation, a weak positive relationship is observed between the pace of land development and M-9 Motorway construction (r = .259), as well as between M-9 Motorway construction and the confidence of individuals to invest in BTK (r =.077) (Table-6). These outcomes collectively illustrate that the pace of land development is high due to M-9 Motorway construction, but there is not a significant difference in the development of land. Shifting focus to hypothesis 2, there is no significant difference in the pace of development in BTK before and after the construction of the M-9 Motorway. The Chi-square (χ^2) analyses underline a noteworthy positive correlation (X^2 (6, N = 50) = 8.155[a], p < .00001) (Table-4). These findings harmonize with previous research by Deng and Nelson

(2010), who argued that transport infrastructure development accelerates land use development. A possible explanation for these results could be the strong connectivity that the case study area now has due to the M-9 Motorway, potentially attracting greater investment into the region.

Figure 10: (a) Relationship between M-9 Motorway and pace of development, and (b) Relationship between M-9 Motorway and accessibility level



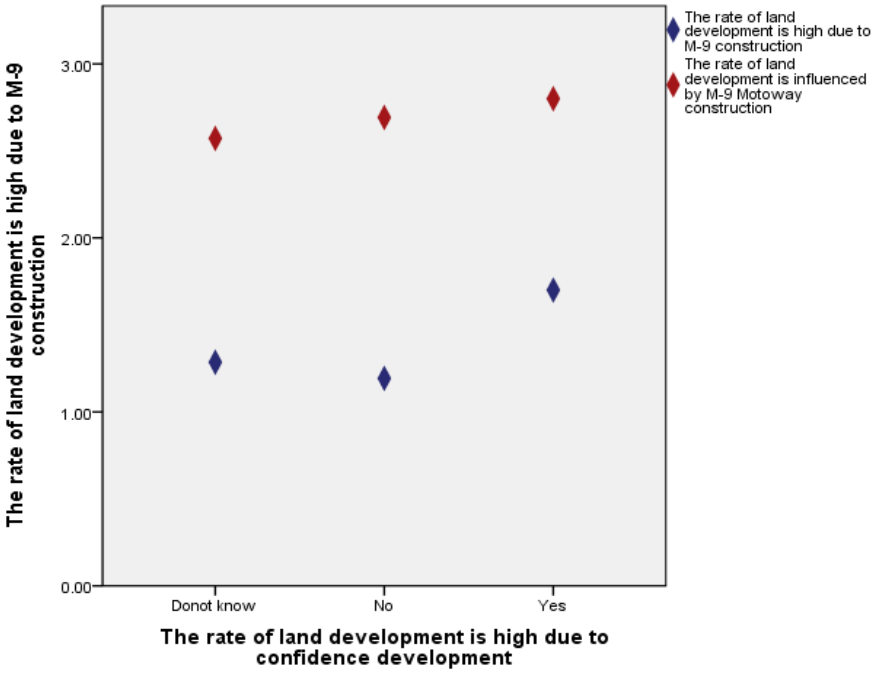
Source: Authors

Table-4: Chi-square test (N=50) for the link between M-9 Motorway and pace of development

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.155[a]	6	.227
Likelihood Ratio	10.444	6	.107
Linear-by-Linear Association	.290	1	.591

Source: Authors

Figure 11: Graphical presentation of correlation between M-9 Motorway and pace of development of BTK



5.3. Influence of M-9 Motorway on the accessibility levels in BTK

The relationship between the distance of travel from BTK to Karachi and the construction of the M-9 Motorway exhibits a negative correlation (correlation coefficient r = -0.131, p < 0.00001) (refer to Table-6). This suggests that the development of the M-9 Motorway did not lead to a reduction in travel distance between BTK, and Karachi. This result implies that the public is already familiar with this fact, as evidenced by 48% of respondents (refer to Figure 10b).

Table-5: Chi-square test (N=50) for the relationship between M-9 Motorway and accessibility level

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	15.736[a]	16	.472
Likelihood Ratio	18.441	16	.299
Linear-by-Linear Association	.839	1	.360

a. 25 cells (92.6%) have expected count less than 5. The minimum expected count is .20

Conversely, a significant positive correlation is observed between the construction of the M-9 Motorway and enhanced accessibility to facilities and services (X^2 (16, N = 50) = 15.736[a], p < 0.00001, as shown in Table-5). This outcome contradicts Hypothesis 3. Residents of BTK have found that the construction of the M-9 Motorway has improved access to the city's services and conveniences, as affirmed by 60% of the participants (see Figure 10b). Therefore, there is a need to develop more road infrastructure projects to enhance mobility and improve access to employment opportunities, social amenities, and vital services like educational institutions and healthcare facilities (Pradhan & Bagchi, 2013; Gibson & Rozelle, 2003). This result also indicated that there are no proper amenities and services developed in BTK, and people are going to the city for their jobs and educational institutes.

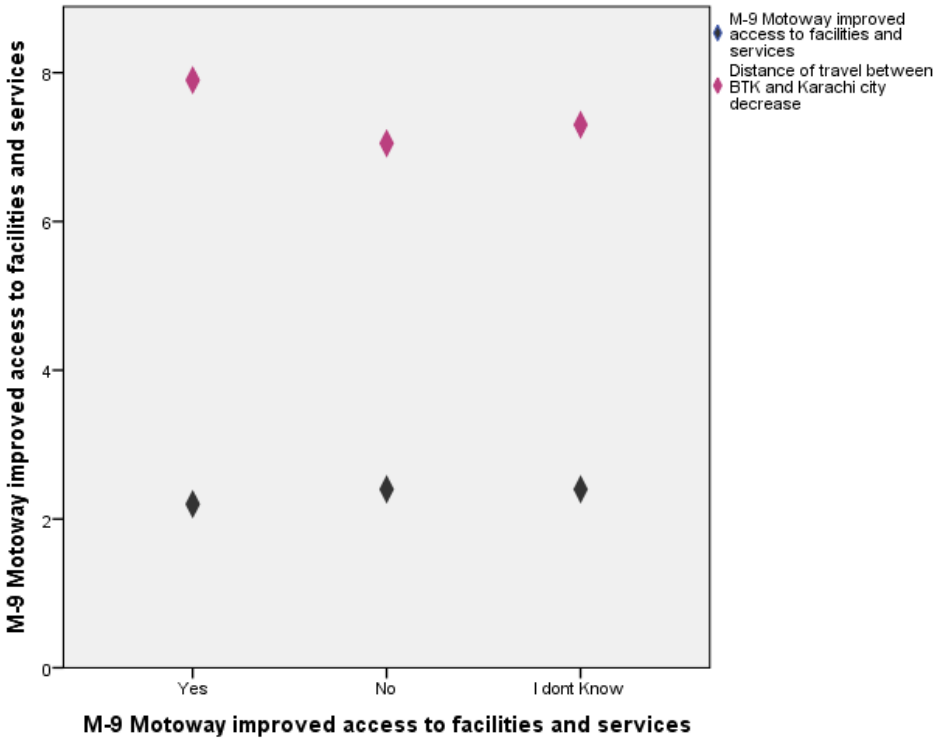
Table-6: Correlation between the variables and significance level at p<0.01

		Houses prices and rents				Pace of land development in Bahria Town Karachi			Social influence in terms of travelling distance and accessibility to the city	
		A4	A5	A6		A7	A8		A9	A10
A1	Pearson Correlation	-.229	-.077	-.132	A2	.259	.077	A3	-.131	.564**
	Significance (1-tailed)	.055	.298	.181		.035	.298		.183	.000

*. Correlation is significant at the 0.01 level (1-tailed). (N = 50)

A1- Influence of M-9 Motorway on the houses prices and rents
A2- Influence of M-9 Motorway on the pace of land development construction
A3- Influence of M-9 on the access to facilities and services and travelling distance
A4- Houses prices and rents were high before M-9 Motorway
A5- Houses prices and rents were high after M-9 Motorway
A6- M-9 Motorway enhance the marketing of Bahria Town Karachi.
A7- The pace of land development is high due to M-9 Motorway construction
A8- M-9 Motorway construction helped in building the confidence of people to invest in Bahria Town Karachi Karachi
A9- Distance of travel between Bahria Town Karachi and Karachi city decrease due to M-9 Motorway construction
A10- M-9 Motorway improved access to facilities and services for the residents of Bahria Town Karachi

Figure 12: Graphical presentation of correlation between M-9 Motorway and accessibility level of BTK



Source: Authors

6. Conclusions

The transportation network of a developing country is an important driver of its economic growth and progress. It involves a significant government investment to enable the smooth flow of goods, services, and people, leading to benefits across various sectors. Countries that prioritize and invest significantly in infrastructure enjoy improved connectivity, efficiency, and economic opportunities. Pakistan recognizes the importance of a well-developed transportation system, with the China-Pakistan Economic Corridor (CPEC) being a major initiative in this regard. A significant project within CPEC is the construction of motorways, including the M-9 motorway, which has had a profound impact on Bahria Town Karachi (BTK).

This study explores the effects of the M-9 Motorway on the housing scheme in BTK. It highlights the influence on property prices, land development pace, and accessibility to city services. The M-9 Motorway contributes to more efficient land development and provides residents with better access to amenities. While it doesn't seem to substantially affect property pricing or rental values, other factors like urban proximity and demand of housing play a more dominant role. This underscores the need for a deeper understanding of the broader socio-economic context. Hence, Pakistan’s initiatives like CPEC, the M-9 Motorway, and connection of M-9 Motorway with BTK project illustrate the interplay between infrastructure, urban development, and economic progress. These efforts highlight the significance of strategic planning and efficient connectivity.

The research has limitations, including potential recall bias due to reliance on memory, and the focus on a single case study. Extending research to other communities near similar road projects would enhance its applicability. Despite these limitations, the study offers insights into

the impacts of road infrastructure projects on land development. This is valuable for real estate developers and governments, enabling them to strategize better land development, improve regional accessibility, and enhance property values for future endeavours.

The study has certain limitations. It examined two distinct timeframes: one before the M-9 project's construction and the other after its completion, gathering input from participants for both periods. However, relying on memory can introduce recall bias, as recent events are often remembered more vividly than past ones. The research utilized a case study approach to explore the impacts of road infrastructure projects. Therefore, it is essential to conduct further research involving a broader range of communities near similar projects to determine if the findings are unique to this study or applicable to a wider context.

Despite these limitations, the study's results, combined with insights into the relationship between land development and road infrastructure, can contribute to improving future projects. These findings have the potential to benefit real estate developers and government bodies. They offer a way to assess the benefits of developing land near significant road projects, enabling the formulation of strategies to enhance land development, improve regional accessibility, and increase property values in future developments.

Declaration of conflict of interest

The author(s) have affirmed the absence of any conflicts of interest concerning the research, authorship, and/or publication of this article.

Author contributions

HN and MSR, Conceptualization; MSY and MSR, Data collection, HN, Data curation; RMM and HN, Formal analysis; HN, RMM and MSY, Methodology; HN and MSY, Project administration; HN and MSR, Software; HN and MSY, Visualization; HN and RMM, Writing - original draft; HN and MSR, Writing, review and editing.

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