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# Exploring Factors Causing Traffic Congestion through Average Index Method: A Case Study of Hyderabad City

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**Abstract:**

*The rapid growth in population and economic activity has primarily led to increased traffic congestion. The system of managing and planning transportation triggers chaos. The study aims to determine the major factors behind Traffic congestion. High urbanization rate, encroachments, public dependency upon private vehicles and giving of public transport, Lack of awareness, and monitoring of transportation adequacy, etc. In this regard, hotspot areas are highlighted, and the factors are ranked, which are assessed using a Likert scale rating-based questionnaire conducted by experts and respondents of Hyderabad, Sindh. These factors are analyzed by applying the Average Index Method Technique, and the sites are identified by generating the Road Network maps on ArcGIS. Findings reveal a clear concept about traffic congestion and the factors blocking traffic flow in the study area. It further explores that the top-ranked factor for traffic congestion, with an average index of 4.50, is Encroachments on roads and Footpaths, whereas the lowest average index is 3.30, Location of Hospitals and other amenities near main roads. This research can help reduce traffic congestion in Hyderabad and other cities with similar scenarios.*

***Keywords:*** *Traffic Congestion; Average Index Method; Likert Scale; Factors.*

## I. INTRODUCTION

Rapid population and economic expansion are the primary contributors to traffic congestion, which complicates transportation planning and management in emerging nations [1]. Around the world, traffic congestion is increasing and has both direct and indirect detrimental effects on society [2]. It may reduce the efficiency and quality of transportation. As traffic congestion worsens, the road system fills up and the vehicle flow becomes unbalanced, leading to various issues for its users, including accidents, breakdowns, environmental pollution, delays in time and money, and logistical performance. Most of the traffic congestion's negative impacts are linked to irregularities and inconsistencies in the transportation planning strategy [3]. Urban transportation planning has received more attention over the past few decades in both the scientific community and the larger policy environment. As a result, this study's use of the average index method will help identify several factors that contribute to traffic congestion. Numerous legislative initiatives have been developed in Europe, and local governments now recognize the need to include transportation planning in their overall urban planning procedures [4].

## II. LITERATURE REVIEW

### *A. Background of the Study:*

Planning for urban transportation strengthens cities. Therefore, realistic planning techniques that appropriately take user travel habits into account [5]. Constantly increasing traffic is an issue for urban areas because people use private automobiles more often than public transportation [1]. The megacities of Pakistan, such as Karachi and Lahore, control the movement of vehicles by manual or automatic signalized systems that result in a smooth traffic flow. However, cities continue to struggle with increased traffic congestion despite significant investments in road infrastructure. Hyderabad is among the most urbanized cities in Pakistan. For local travelers, traffic congestion is a major issue that contributes to several problems, including stress and irritability, accidents, injuries, delays getting to work, pollution, urban deterioration, effects on the supply of products and services, delays for ambulances, etc. With time, difficulties

and the volume of traffic are expanding [1]. Therefore, it is challenging for the government to regulate these issues in the future; if they are not swiftly addressed, the scenario can get more serious. To protect the existing and future traffic-associated problems, transportation planning has to be improved [6].

A way to reduce the externalities of urbanization includes social exclusion, noise pollution, traffic congestion, and health disparities. Climatic Change and active transport can help life quality by improving physical and mental prosperity [7]. A natural occurrence involves the way cars impede one another's progress as demand for a finite amount of space on the road reaches maximum capacity [8]. There are two categories of traffic congestion: recurrent and non-recurrent. High demand for the freeway's traffic causes predicted recurring traffic jams. On the other side, irregular traffic jams are brought on by events like car accidents, stuck cars, spills, and other debris on the road, bad weather, and construction zones [9]. Urban congestion should be seen in the context of urban nuances and agglomeration benefits. Traffic congestion in cities is typically caused by booming urban commercial growth, occupancy, housing, and social initiatives that encourage people to want to live and work relatively close to one another and draw businesses to benefit from the productivity benefits resulting from this. There are various signs that urban road users are willing to put up with congested roads, even though they are not thrilled about the idea, if they receive different benefits from residing and doing business in their cities. We are unable to move freely due to congestion, which also hinders and generally disturbs business across metropolitan regions. It's important to note that living in an urban location has advantages other than freedom of movement. A wide range of activities, people, services, commodities, markets, opportunities, concepts, and networks are accessible in cities. These benefits are frequently offered through either increased speed or closeness. Congestion may slow down traffic, but in some areas, such as congested metropolitan centres, it may also be reasonably anticipated and accepted.

### *B. Traffic Congestion in Hyderabad:*

Despite its growth and expansion, Hyderabad lacks effective transportation planning. The situation in Hyderabad is concentrated in its suburbs, where traffic is quickly growing. To use the facilities already in place, people go to Hyderabad from various parts of Sindh [10]. However, as shown in Figure 1, the available roadways are quite small and do not have enough room to support the automotive traffic. Furthermore, it shows that some of the primary causes of traffic congestion include road encroachments, illegal hawkers, reduced setbacks on buildings, illegal parking of cars on major thoroughfares, a lack of traffic control devices, and a lack of pertinent transportation laws and regulations. The accompanying images, which were shot in various parts of the city and demonstrate several traffic congestion issues in Hyderabad, also show people breaking traffic laws. Commuters break the law despite being aware that this is a one-way road, clogging up traffic. Displaying both the loading and unloading of cargo.

**Figure 1: Violation of Traffic rules by drivers.**


**Figure 2: *Traffic is beyond the capacity of existing roads***

**Figure 3: Poor maintenance of roads, open main holes**

**Figure 4: Construction/Maintenance activities for roads**

Concluding, Figure 1 shows that the traffic is exceeding the capacity of existing roads. That is causing severe traffic congestion. Also shows the unavailability of a traffic warden to solve this traffic jam. Commuters are also facing delays in time and environmental pollution. Figure 2 shows the construction and maintenance work underway. Local authorities did not provide any safety measures, which is very dangerous at night because at night it is invisible to commuters. Figure 3 shows the poor maintenance of the drainage system and which overflows, also creating problems for commuters. Figure 4 shows the open main holes on major roads, which are very dangerous for the users, and also do not have space for pedestrians.

### *C. Factors That Are Causing Traffic Congestion:*

The Economic Research Centre (2007) said that the components of the blockage are divided into macro-level and micro-level components. While macro-level features are linked to the general traffic desire for road usage, micro-level factors are associated with traffic on the road. The macro-level factors are what is causing the congestion on the micro-level (road). Niaz Ali [11] additionally recommends that a few factors that contributed to traffic congestion were traffic volume that exceeded the designated limits of the roadways, dynamic changes in the roadway limit at crossing sites, and vehicle after-the-fact behaviour. The are changing perspectives on provincial finances, occupational designs, income level, expanding private vehicles, and land use designs. A. I Mirza [12] During working/business and school hours, there is a lot of traffic. Due to the availability of necessities and commercial services, non-mechanized traffic is moderate at peak hours. This results in a higher flow of mechanized and non-mechanized parking on the main road, which causes traffic congestion. High levels of two, three, and four-wheeler convergence at peak hours. As indicated by [13], consider that one of the primary causes of traffic congestion is ongoing road construction speculation. Results, insufficient or no resources available to deal with transportation, and manage the traffic management framework. Tauha [14] in his exploration distinguished the factors contributing to an increase in traffic congestion, including encroachment on pavements and footpaths, illegal roadside stops, Wrong road design, and no signalization. Improper product stacking or emptying, inadequate road support, Pathways are absent, and stringent legal execution is inaccessible.

Bigazzi [2] in his exploration of Traffic Congestion advised that when private vehicles are used and relied upon more, more journeys are created, causing traffic jams on the roads. Matin [1] His study suggests that other factors, such as excessive luggage loads and outdated cars, are also to blame for traffic jams on the road and a slowdown of the flow of traffic. However, Hyderabad's high accident rate is also linked to the city's poor road design, lack of maintenance, and people who are less aware of road safety precautions. Another contributing component to blockage, as recommended by Herman [15] and referred to by Downie [16], is that road halting, which takes up a substantial amount of space, has become a problem with space that hurts urban populations by raising interest in urban areas. He adds that the high urban adaptability rate raises the possibility of obstruction. Driving in urban locations is difficult because of traffic congestion and a decline in open-road travel skills caused by high vehicle use. Undoubtedly, the over-reliance on automobile traffic has greatly increased interest in the basis for transportation. Sadly, the availability of transportation infrastructure has never kept pace with the expansion of flexibility requirements. As a result of the traffic space constraint, a small number of cars expend the majority of their energy in traffic. [17]. Additionally, Hyderabad's traffic jam is a result of the city's diverse automobiles, restricted road limits, parking spaces, broken traffic signs, and drivers' actions. [18] [19] List a few actions that might be taken to manage the clog risk. According to them, the associated issues may be resolved by the use of open transport, traffic signal synchronization, occurrence regulation, clog assessment, and other convincing approaches available in managing blockage conditions. Dr. E. F., in his study of Traffic Congestion study used GIS to provide solutions to Traffic Congestion. Firstly, by enables the traffic information to help commuters choose the appropriate route for their destinations in peak hours. Secondly, managing the traffic congestion by the graphical response to queries. All such reviewed literature indicates several factors of traffic congestion using different techniques. However, some factors extracted from the reviewed literature are mapped graphically in Table 1.

**Table 1: Empirical Evidence from Previous Studies**

| | Factors Causing Traffic Congestion | Empirical Evidence |
|---|---|---|
| **1** | Encroachments on roads and footpaths | [21] |
| **2** | Irregular/unauthorized street parking | [12, 22] |
| **3** | Careless Behavior of Commuters/Drivers | [1, 23, 24, 25] |
| **4** | Violation of traffic rules by drivers | [1, 23, 24] |

| | | |
|---|---|---|
| **5** | Multiple business activities on the roads | [23, 26] |
| **6** | Insufficient parking for motorbikes and vehicles | [12, 22] |
| **7** | Lack of a bus, taxi, or rickshaw stop for passenger pickup and drop-off | [22, 23, 24, 25,27, 28] |
| **8** | Poor maintenance of roads | [1, 22, 23, 24, 26,29] |
| **9** | Poor supervision of the traffic police | [1, 24] |
| **10** | People's lack of awareness or sense of traffic | [1, 24, 25] |
| **11** | Insufficient preparation for providing suitable detours during construction or maintenance | [2, 12, 22, 27, 30] |
| **12** | Excess of private vehicles due to inefficient public transport | [2, 22,24, 25, 26,28] |
| **13** | Schools are located on main roads and near markets | [12, 24, 29] |
| **14** | Short/narrow width of roads | [1, 30] |
| **15** | Accidents on the road and poor management by the relevant authorities | [1, 22, 23, 24, 26, 29] |
| **16** | Construction of new buildings and shopping centers near main roads | [26, 30] |
| **17** | Movement of heavy vehicles within the business area during the daytime | [2, 12, 22, 23, 24. 26.27, 29, 30] |
| **18** | Lack of traffic signals | [23, 24. 27] |
| **19** | Traffic is beyond the capacity of existing roads | [22, 23, 26, 30] |
| **20** | Accumulation of rainwater in urban streets during rainfall | [1, 22, 23, 24, 26, 29] |
| **21** | Mixed land use activities and mixed vehicles | [23, 24, 26, 30, 31] |
| **22** | Construction/Maintenance activities for roads and other services | [2, 12, 22, 26, 27, 30] |
| **23** | Lack of intra-city roads | [1, 30] |
| **24** | Unauthorized loading and unloading of goods | [1, 12, 27, 31] |
| **25** | During off timing of educational institutions | [12, 24, 29] |
| **26** | Inadequate design of road intersections | [12, 22, 29] |
| **27** | Irregular width of the roads | [12, 22, 29] |
| **28** | Due to social and political rallies | [25] |
| **29** | Use of obsolete/ unfit vehicles | [23, 24, 26, 30, 31] |
| **30** | Improper sign boards and safety measures during construction /maintenance works | [1, 22, 23,24,26, 29] |
| **31** | Improper design of drainage | [1, 22, 23, 24, 26, 29] |
| **32** | Drainage overflow and open main holes | [1, 22, 23, 26,29] |
| **33** | misalignment between services and electric communication | [1, 22, 23, 24, 26, 29] |
| **34** | The spread of growth patterns and urban sprawl cause more travel to be made. | [2, 12, 23, 24, 26, 27,30] |
| **35** | Location of Hospitals and other amenities near main roads | [7, 22, 24, 25, 27, 28] |

The numerous factors shown in Table 1, as other studies considered for Traffic congestion. Reviewed and referred for achieving the purpose of this study, as identification of factors for the problem discussed throughout the study.

## III. METHODOLOGIES AND TECHNIQUES

### *A. Study Area:*

Hyderabad is one of the busiest urban areas, as shown in Figure 5, having a total population of approximately 1.7 million [20]. The area of study interest is selected after deep observations and personal experiences of researchers within the city.

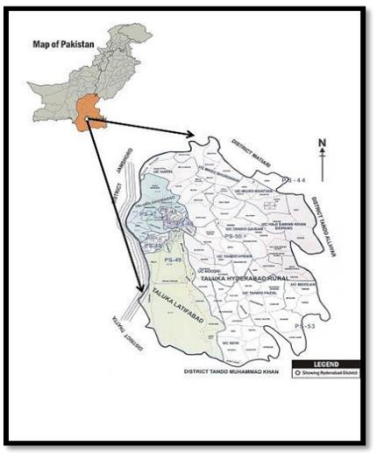


**Figure 5: Location of the Study Area (Source: Magsi and Peerzado 2018)**

For convenience and a better understanding of roads as mapped in Figure 5 using ArcGIS, the general roads of Hyderabad Sindh are digitized by the researcher, and further, for the same purpose bulk of traffic-carrying roads are highlighted in this study later.

Primary data was gathered via interviews, observations, and questionnaire surveys. To get reliable information, in-person interviews were conducted. Around 35 factors that directly or indirectly contribute to traffic congestion were identified from the thorough literature review. The initial survey's structure was decided using a 5-point Likert scale with a range of 5 to 1 (most significant, highly significant, significant, less significant, and not significant). Figure 6 indicates the Research Framework & Statistical Analysis flowchart.

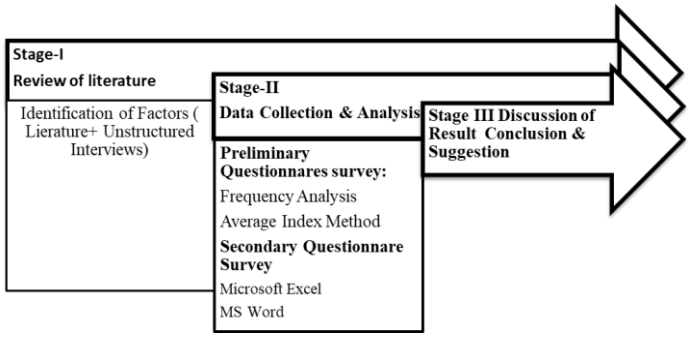


**Figure 6: Research Methodology Flowchart**

About 50 field experts have been given questionnaire survey forms. Out of 50, more than 60% of the questionnaires were filled out. In the questionnaire survey, the respondents were asked to rate the identified factors that contribute to traffic congestion. Distributive frequencies of various actors were calculated in the frequency analysis of the data using the Statistical Package for Social Sciences (SPSS). The data were prepared in visual form using MS Excel and MS Word and were arranged as frequency figures, valid percentages, and percentages given to the total number of respondents.

Further, the average index method was used to rank the factors affecting traffic congestion. The Likert Scale-based survey's respondents were instructed to make circles, five-point scale ratings as: 1 = Not significant, 2= less significant, 3= significant, 4= highly significant, and 5= most significant. The average index method is as follows:

Average Inde = $\frac{\sum_{i=1}^{5} aixi}{\sum_{i=1}^{5} Xi}$ ---------- (3.1)

for a scale rating

Where,

$a_i$ = a constant expressing weight for i,

$X_i$ = variable expressing for frequency of response for

i = 1, 2,3,4,5 shown as follows:

$X_1$ = frequency of response not significant as $a_1 = 1$

$X_2$ = frequency of response less significant as $a_2 = 2$

$X_3$ = frequency of response significant as $a_3 = 3$

$X_4$ = frequency of response, highly significant as $a_4 = 4$

$X_5$ = frequency of response, most significant as $a_5 = 5$

## IV. RESULTS AND DISCUSSION

The questionnaires were filled out by professionals and experts working in various government and private organizations in Hyderabad. The following subsections explain the findings of the data analysis.

### *A. Profession And Experience of Respondents*

The survey was conducted by professionals with the help of questionnaires. The percentage of respondents according to their professions is presented in Figures 7 and 8.

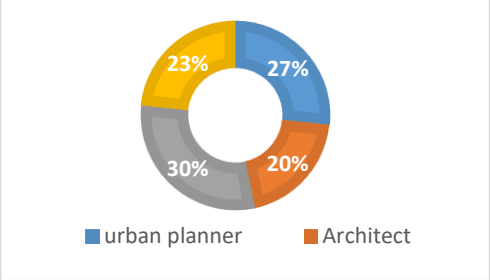


**Figure 7: Occupation of Respondents**

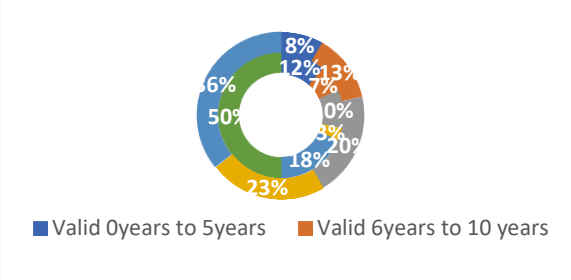


**Figure 8: Experience of Expert Respondents**

Figures 7 and 8 illustrate the percentages of the respondents according to the analyzed frequencies. It clarifies that 30% of Engineers, 27% of Urban Planners, 23% of other professionals, and 20% of architects contributed to the accomplishment of a questionnaire survey by giving responses. The respondents in the questionnaire survey worked in a variety of occupations. Figure 7 illustrates the distribution profile for the various job experience groups in the planning and development industry.

### *B. Data Analysis of the Rank of Factors Using the Average Index Method:*

The average index method is used to analyze the data collected. The method draws attention to the results in the categories on the five-point Likert scale that are ranked. The respondents were asked to score each item in the poll from 5: Most Significant, 4: Highly Significant, and 3: Significant. Priority for the causes contributing to traffic congestion is 2: Less Significant, 1: Not Significant. Table 2 depicts the average mean value and rank of the identified factor. The factors are ranked and arranged in ascending order based on their mean values. The range of average index values is from 4.50 to 3.30.

**Table 2: Average Index Value & Rank of Factors**

| | Factors Causing Traffic Congestion | Average Index | Rank |
|---|---|---|---|
| **1** | Encroachments on roads and Footpaths | 4.50 | 1 |
| **2** | Irregular/unauthorized street parking | 4.50 | 1 |
| **3** | Careless Behavior of Commuters/Drivers | 4.27 | 2 |
| **4** | Violation of traffic rules by drivers | 4.23 | 3 |

| | | | |
|---|---|---|---|
| **5** | Multiple business activities on the roads | 4.20 | 4 |
| **6** | Lack of parking for cars and motorcycles | 4.10 | 5 |
| **7** | Absence of a Bus/Taxi/rickshaw stop for the pick-up and drop-off of passengers | 4.10 | 5 |
| **8** | Poor maintenance of roads | 4.07 | 6 |
| **9** | Poor supervision of the traffic police | 4.03 | 7 |
| **10** | Lack of traffic awareness/sense among the people | 4.03 | 7 |
| **11** | Inadequate planning in the provision of proper diversions during construction/maintenance | 4.00 | 8 |
| **12** | Excess of private vehicles due to inefficient public transport | 3.97 | 9 |
| **13** | Schools are located on main roads and near markets | 3.90 | 10 |
| **14** | Short/narrow width of roads | 3.90 | 10 |
| **15** | Accidents on the road and poor management by the relevant authorities | 3.90 | 10 |
| **16** | Construction of new buildings and shopping centers near main roads | 3.83 | 11 |
| **17** | Movement of heavy vehicles within the business area during the daytime | 3.83 | 11 |
| **18** | Lack of traffic signals | 3.80 | 12 |
| **19** | Traffic is beyond the capacity of existing roads | 3.80 | 12 |
| **20** | Accumulation of rainwater in urban streets during rainfall | 3.80 | 12 |
| **21** | Mixed land use activities | 3.77 | 13 |
| **22** | Construction/Maintenance activities for roads and other services | 3.73 | 14 |
| **23** | Lack of intra-city roads | 3.70 | 15 |
| **24** | Unauthorized loading and unloading of goods | 3.67 | 16 |
| **25** | During off timing of educational institutions | 3.67 | 16 |
| **26** | Inadequate design of road intersections | 3.63 | 17 |
| **27** | Irregular width of the roads | 3.57 | 18 |
| **28** | Due to social and political rallies | 3.57 | 18 |
| **29** | Use of obsolete/ unfit vehicles | 3.53 | 19 |
| **30** | Improper sign boards and safety measures during construction /maintenance works | 3.53 | 19 |
| **31** | Improper design of drainage | 3.47 | 20 |
| **32** | Drainage overflow and open main holes | 3.47 | 20 |
| **33** | Improper alignment of electric communication and services | 3.33 | 21 |
| **34** | More trips are generated due to urban sprawl/dispersed development patterns | 3.30 | 22 |
| **35** | Location of Hospitals and other amenities near main roads | 3.30 | 22 |

The results provide a comprehensive list of the factors of traffic congestion as determined from a literature review and expert interviews. After frequency analysis using the SPSS (statistical package for social sciences), determine the rankings of the variables by utilizing the average index method approach. With an average rating of 4.50, the factors Encroachments on Roads and Footpaths were placed top, and Hospitals and other amenities close to key roadways had the lowest average index score of 3.30. The main factors in this list have been chosen as the most important factors. These are Encroachments on the road 4.50, Unauthorized/irregular street parking 4.50, Careless Driving/Commuter Behaviour 4.27, Driver Violation of Traffic Regulations 4.23, multiple roadside business activity 4.20, Lack of space for motorbikes and automobiles 4.10. Absence of bus, taxi, or rickshaw stops for pick-up and drop-off of passengers 4.10, poor maintenance of roads 4.07, Weak monitoring of traffic police 4.03, people's lack of traffic awareness or sensibility 4.03. Insufficient planning in the provision of suitable detours during construction/maintenance 4.00, Overuse of private automobiles as a result of ineffective public transportation Average index of 3.97, schools

situated close to marketplaces and on major thoroughfares 3.90, short/narrow 3.90, and Road accidents and improper management by relevant authorities' average index 3.90.

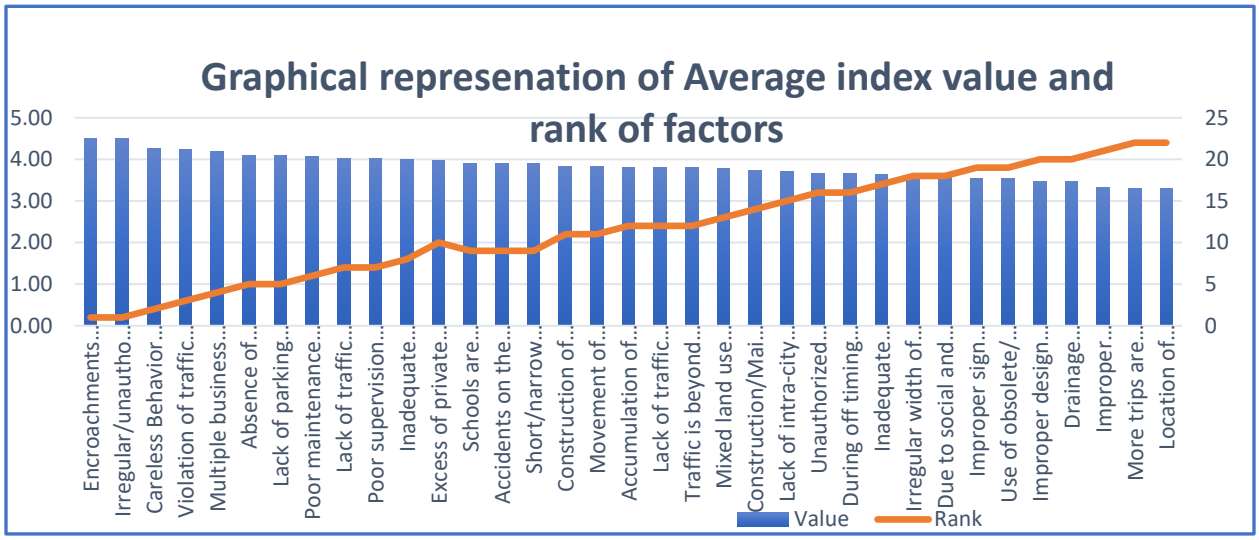


**Figure 9: Average Index Ranking of Numerous Traffic Congestion Factors in the Study Area**

Figure 9 revealed that Traffic congestion in this regard is caused by several identified factors, some of which are underestimated by a lack of monitoring and other conflicts. However, the values for all such factors may vary according to the location, time, and city.

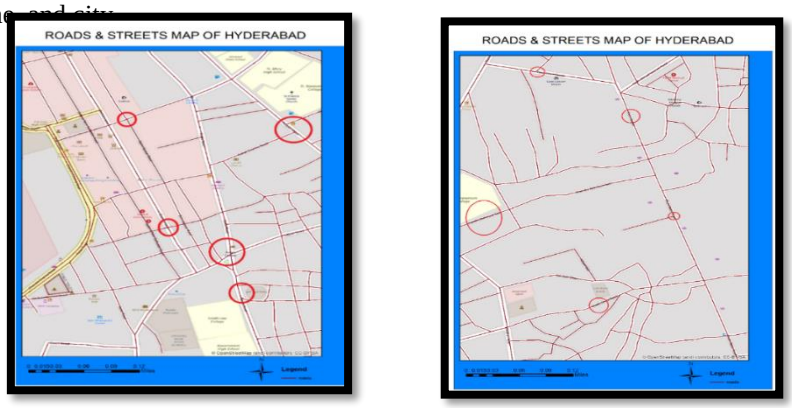


**Figure 10: Highlighted Congested Streets and Roads of Hyderabad**

As depicted in Figure 10 highlights the hotspot areas by encircling the figure's dense traffic congestion with the help of GIS maps of two different areas developed on ArcGIS by the researcher. Areas of Hyderabad such as Gari Khata, Saddar, City Gate, and Auto Bahn are the most congested areas due to several factors discussed in this study.

## V. Conclusion and Recommendations

### *A. Policy Implications:*

The main objective of this research work was to determine the factors causing traffic congestion in Hyderabad city and suggest measures to help reduce traffic congestion and improve transportation planning. This study found prominent factors responsible for traffic congestion: Encroachments on roads and Footpaths, Irregular/unauthorized street parking, Careless Behaviour of Commuters/drivers, Violation of traffic rules by drivers, and Multiple business activities on the roads. Other factors are a Lack of parking for cars and motorcycles, the Absence of Bus/Taxi/rickshaw stops for pick and drop of passengers, Poor maintenance of roads, Poor supervision of traffic police, and a Lack of traffic awareness/sense among the people, etc. Considering the identified prominent traffic congestion factors, this study put forward the following policy implications:

1. The Encroachments on roads and Footpaths are highly endorsed by the experts as the key factors causing traffic jams in the main areas of Hyderabad. So, the development agencies should remove the encroachments to avoid the traffic congestion.
2. Irregular/unauthorized street parking on main roads is also considered the main factor of traffic congestion. Government agencies, i.e., Sindh Building Control Authority (SBCA), should not permit any Commercial Buildings without a parking space as per requirements.
3. The Careless Behavior of Commuters/drivers is also considered an Important factor. It should Strict implementation of regulations and imposition of penalties.
4. Violation of traffic rules by drivers is also one of the important factors. Authorities should arrange seminars and signboards regarding the Knowledge of traffic rules.
5. Multiple business activities on the roads are also an important factor in traffic congestion. Urban planners, transport planners, and architects should consider that multiple business markets may be discouraged in areas where the width of the road is not. Vertical development should be restricted according to road width, considering identified factors, and implementation of the above-mentioned policy implications will not only help in overcoming Traffic Congestion in the selected study area but will also be helpful for situations having similar scenarios.

The primary variables affecting traffic congestion have been found in this study. The socio-economic impact of traffic congestion has also been evaluated. Additionally, certain crucial strategies for reducing traffic congestion and enhancing transportation planning have been developed. The primary variables discovered through a questionnaire survey and statistical analysis include Encroachments on roads and footpaths, and illegal or unpermitted street parking. Furthermore, Reckless driving and commuter behavior, motorist infractions of traffic laws, several commercial activities on the highways, a lack of parking for motorcyclists and vehicles, and the absence of a bus, taxi, or rickshaw stop for passenger pickup and drop-off. Road upkeep issues, inadequate control of the traffic police, People's lack of awareness or sensitivity for traffic, a lack of planning for effective detours during construction or repair, and Schools are closed along major thoroughfares.

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