Analysis of the Nanded City Transportation Network Using Geographic Information Systems and Remote Sensing

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Abstract - Beginning with the medieval period and continuing up to the present day, history unequivocally reveals that the expansion of a region was and continues to be a consequence of the development of a transportation network that is comprehensive and well-developed. Having seen important concerns or difficulties such as traffic congestion, delays, pollution, increased vehicle operating expenses, and road accidents, society has requested an efficient and unobstructed road network in contemporary times. This demand has been made in response to the issues that have been witnessed. When taking into consideration the aforementioned constraints and criteria, it is possible that one of the most efficient ways to address the issues at hand would be to conduct an investigation into the digitalized road network of the city or town in question. ArcGIS, which is a Geographic Information System (GIS) software package, is the most suitable tool for this sort of research. It is used for the purpose of making, analyzing, and building maps for the goal of obtaining information. The purpose of this study was to construct a road network map of Nanded City and to identify the fastest route between the two sites. This was accomplished by undertaking a comprehensive analysis and digitization of the city's existing road network system. The goal of this research was to significantly reduce the amount of traffic congestion that exists in the city. In ArcGIS, the Network Analyst is a specific analytical tool that is used to not only explore the nearest facility that is accessible in the network of digitized connecting lines, but it also help in optimizing the path during floods and other emergency scenarios. Furthermore, it is used to examine the facility that is closest to the network. One of the most helpful models that can be constructed via the use of Network Analysis is the shortest route link between the required origin and destination locations, which is shown in the following diagram. On the basis of the input of a number of different network characteristics, such as the crossing distance, the journey duration, and cost, the impediments, the vehicle constraints, and so on, the analysis is carried out. Using the Geographic Information System (GIS) environment, each of the primary roads that connect the various parts of the city of Nanded were digitized, and then they were used to further serve the objectives of the project.

Keywords: Road Network Analysis, GIS,

I. INTRODUCTION

Urban topography is mostly associated with the activities that take place in urban areas, demonstrating that these areas span a wide range of land use segments. Accordingly, the primary viewpoint on urban topography is a link between man and his actions as well as natural processes occurring on the land in an equal measure. Industrialization, transportation, and urbanization are all concepts that are intimately related to one

another in time and space. Enrichment problems, or natural debasement, are the primary cause of environmental deterioration in cities, and they are a result of urbanization and the increased rate at which the city's population is growing. In response to the growing population, the amount of arable land is diminishing, and the total population of the city is increasing, resulting in an increase in the density of the population. The effect on the expansion of transportation infrastructure is responsible for the problem of dwelling layout, all of which contributed to the formation of suburbs in the first place. In addition, the city's growing population has had an impact on the city's water supply. The information that has been supplied Water that has been polluted as a consequence of industrial waste and sewage has been mixed with potable water. This polluted water is a source of health concerns. Problems in urban areas have necessitated the use of proper planning strategies. The research of high-development regions in metropolitan areas has become more beneficial over time as a result of concentrating on each problem/issue separately and identifying additional relevant variables. As previously said, the components increase the consumption of resources while also creating environmental and health difficulties. They also contribute to the enhancement of the city's atmosphere while also making it more intelligent for more comfortable living. It is necessary to have suitable urban planning.

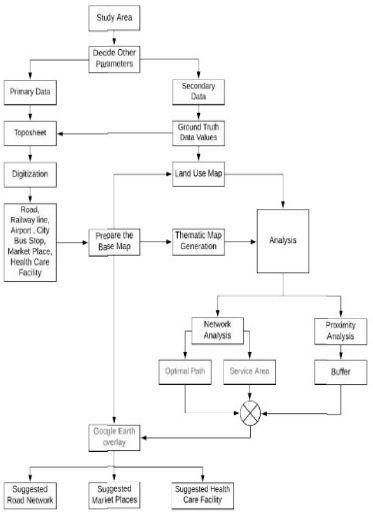

Fig.1: Workflow Diagram

II. Sustainable Road Network

In this age of globalization, transportation is the most important aspect in achieving financial progress. The speed and condition of the country's or urban region's transportation and road network are critical factors in the country's or urban region's development. It is regarded as one of the arteries of the development of progress and growth. The improved transportation network will facilitate the movement of people as well as the transfer of commerce and commodities. Transportation is one of the most important factors contributing to regional unevenness and variance. The federal, state, and local governments announce a variety of grants and programs to develop the nation's transportation network. Various studies are also carried out on the subject of transportation progress in various ways. In order to enhance the transportation network, the researchers recommend a number of different forms of interventions.

The field of Transportation Geography is now widely recognized as a distinct subfield within the field of Human Geography. The transportation framework serves as a source of aid for metropolitan regions in the present day, taking into account the increased urbanization and industrialization that is occurring. The productivity of the transportation network determines the rate at which cities improve. Using this framework will make it easier for business, tourism, trade, education, industry, health, administration, travelers, organizations, health-care providers, funds, and capital to reach urban and rural centers, as well as social and monetary transportation to and from the cities and rural areas.

A. Status of the Transportation is Study Area:

There is plenty of transportation convenience and reasonableness in the study region. This is connected to the major metropolitan regions of Maharashtra and other neighboring states with a road network, train, and airline service. Figure 2 depicts the extent to which transportation services are available in the research region.

i. The Road System

Nanded, the location under investigation, is well linked to the main urban centers of a number of states, including Maharashtra, Andhra Pradesh, Telangana, Karnataka, and Madhya Pradesh,

thanks to its well-developed road network. National Highway 222 links Mumbai with Kalyan, Parbhani, and Vishakhapattanam by way of Ahmednagar. National Highway 204 connects Solapur with Ratnagiri, Vardha, and Nagpur by way of Latur. National Highway 161 connects Washim with Hingoli and Sangareddy by way of Degloor. National Highway No. 211 linked it to the city of Aurangabad, while State Highway No. 6 connected it to the city of Hyderabad. Both of these highways were connected to the city of Hyderabad. Nanded is connected to the most major districts and cities in the state by the Maharashtra State Road Transport Corporation's bus service, which provides transportation between the city and these locations. Along with providing the greatest network from Nanded to the most significant cities in the other state, the bus services of Karnataka, Telangana, and Andhra State transportation also give Nanded the best network. The cities of Kolhapur, Pune, Sangli, Nagpur, and Aurangabad, as well as the cities of Vardha, Amravati, and Hyderabad, are served by a number of privately owned companies that offer sleeper and semi-sleeper luxury bus services. These companies include Khurana Enterprises, Prasanna Enterprises, Saini Enterprises, Khushal Enterprises, Raj Enterprises, and others. In comparison to other cities in the nation, the city's internal road network is the most well-organized. There is a total length of 253.52 kilometers for the internal road. There are 10 primary roads that are responsible for transporting a substantial portion of the city's traffic.

ii. Railroad

Geographical location of the topic of the study research According to the South Central Railway (SCR), the divisional headquarters of the railway is located in the city of Nanded. Through the use of a broad gauge railroad, it is linked to the Manmad - Secundrabd connections. The following are the most significant urban areas in the state of Maharashtra: Parbhani, Purna, Jalna, Aurangabad, Mumbai, Nagpur, Pune, Manmad, Kolhapur, Akola, Amravati, Parli Vaijnath, Shirdi, Tirupati, and Vishakapatnam in the state of Andhra Pradesh; Jaipur, Ajmer, and Bikaner in the state of Rajasthan; and various urban areas such as Bangaluru, Patna, and Patna A one-of-a-kind, lightning-fast Suchkhund express train has been built between Nanded and Amritsar on a consistent basis for the purpose of providing transportation for the Sikh population. At this station, there are around 48 pairs of trains that arrive and depart every day, in addition to 52 trains that do not come and depart as often. A total of sixty-six of them are express trains, twenty of them are passenger trains, and sixteen of them are really fast trains. Nanded is a rail station that was built in 2003 and is classified as an 'A' class station. Within the context of the local language, this particular railway station is referred to as the "Hazur Sahib Nanded Railway Station." The smaller rail station known as Maltekdi is situated in the middle of the city and acts as a transfer point for freight that originates from the bigger station.

Fig.2: Map Showing Dissemination of Transportation Service

iii. Airline

The research and development domain with a focus on 'Shri Guru Gobind Singh Ji' is the name of the domestic air terminal in Nanded, which is situated five kilometers away from Sangvigaon, which is the location of the city's bus station. Extensive planning was done prior to the construction of this airport in 1958, making it the first airport in the Marathawada geographic area. In addition to connecting major cities in India such as Mumbai, Nagpur, Aurangabad, Trivandrum, and

Delhi, this airline is often referred to as the "Air India Express." Go Airway, Indian Airlines, Air India, Indigo Airlines, and Spice Jet are just a few of the private airlines that provide jet service at this airport. Other airlines that offer jet service include Spice Jet. In order to fulfill the criteria of international organizations, it is a well-equipped air terminal that is equipped with the most modern infrastructure infrastructure. There are a number of services offered at this location, including aircraft fuelling, late-night landings, airplane parking, air terminal fire fighting, security service, takeoff, and landing lounges, a guest waiting area, and the greatest parking service for taxis, autos, and buses.

B. Existing Road Network in Study Area:

An extensive and well-developed network of internal roads may be found across the area under consideration. In the following map, you will be able to view the road network that is present in the area of Nanded city that is being studied. There is a remarkable amount of breadth and strength in the streets that are found in the city. The city is divided into many wards and zones, and a cement concrete highway connects all of these areas together. There are two flyovers in the city, one at the Hingoli gate and another at the MSRTC bus terminal. Both of these flyovers are still on the rail track, despite the fact that they have been decommissioned. The road network that connects North and South Nanded is now suitable for vehicular traffic as a result of the completion of six bridges that span the Godavari River.

Within the municipal limits, public transportation is provided by both the Municipal Corporation and the MSRTC. In addition, it has a handy transportation system that can be used to go to and from the neighboring towns and villages. A road signal system has been constructed at the busiest crossroads in the city in order to increase the safety of the traffic that passes through it. However, as a result of the increasing number of automobiles and pedestrians on the road, there is a significant rise in the amount of traffic congestion that occurs on a number of major roads and chowks. It is essential to make an effort to discover a solution to this predicament. In that case, what precisely is it?

Fig.3: Map Showing Existing Road Network in Study Area

Approximately 415 kilometers comprise the whole length of the road network that is included within the boundaries of Nanded city. The Nanded Waghala City Municipal Corporation (NWCMC) is responsible for the maintenance of about 400 kilometers (96 percent) of the highways. The Public Works Department (PWD) is responsible for the maintenance of the remaining 15 kilometers (4 percent). Twenty-seven percent of all roads are made up of cement, followed by black-topped roads, which make up thirty percent, water-bound macadam roads, which make up twenty-three percent, and Kaccha roads, which make up twenty percent.

Because it is located on the seven-kilometer north side of the city, Kalyan-Nirmal National Highway No. 222 functions as a bypass for the east side of the city. Through the use of this route, the state of Nirmal in Telangana was linked to the state of Parbhani in Maharashtra, namely Ahmednagar. Nanded, Sangareddy, and Hyderabad are all located in the state of Telangana, and they are

connected to the cities of Akola, Washim, Hingoli, and Degloor in the state of Maharashtra via National Highway 161. It is the national roadway that is the longest in the whole planet. It travels through the center of the city, and at the time, a bypass is being built on the east side of the city that will follow these lines in order to facilitate better traffic management. Located between Ratnagiri and Nagpur, National Highway No. 20 travels along the southern and eastern edges of the city till it reaches its destination. It passes near the Vasarani hamlet by way of a bypass that extends outside of the city in order to lessen the amount of traffic congestion that causes congestion inside the city. The metropolitan areas of Kolhapur-Miraj, Solapur, Tuljapur, Latur, Yavatmal, Wardha, and Nagpur in the state of Maharashtra are all associated with this occurrence. Another name for the West Bypass is the Nanded - Purna bypass. This is a common combination. The Godavari Bridge, which is situated on the western side of the town of Nanded, is the point at which it links to the Wadi road. It begins at the HP Saptagiri Petrol Pump, which is situated on the Latur – Nanded (Tuljapur – Nagpur) National Highway No. 361. It is possible to get to Basmat and Parbhani by way of this bypass, which eliminates the need to travel through the city of Nanded itself.

Roads inside the organization: It is possible to split the city's internal road network into two portions, which are specifically as follows: Roadways may be broken down into two categories: main roads and internal roads. The bulk of the city's traffic is carried by the main roads that are located inside the city. The main thoroughfare is accountable for a significant amount of the traffic flow that occurs inside the city. It is estimated that more than seventy percent of the total traffic is concentrated on the primary highways. Listed below are the main thoroughfares that can be found inside the city.
This road, which is now known as Main Road/GG Road, extends from Old Mondha to Vajirabad Chaurasta – Bus Station – Shivajinagar. Additionally, it connects College Road to the Workshop, which is located between the ITI and the Workshop. The road in question is the most significant one in the city. A total of 4.8 kilometers (km) is the length of this route on its whole. From Old Mondha, which is situated in the southern portion of the city along the Godavari River, it extends all the way to Raj Corner, which is situated in the northern section of the city. The central commercial center of the city is traversed via this route. On a regular basis, it is possible to see a significant amount of traffic while traveling along this road. This route provides access to a number of important locations, including Vijairabad, the office of the Superintendent of Police, the Government Ayurvedic Hospital and College, Kalamadir (the bus station), the Railway Station (which serves the district court), Shivaji Nagar (the Mahatma Phule Market), the ITI College, a rest house, the Bhagya Nagar Route, and the Gurudwara. Over the course of this route, a flyover has been built close to the Main Bus Station in order to accommodate the heavy traffic that occurs on the railway track and at the bus station.

This route is known as the Hingoli Route, and it links the city of Nanded to the cities of Hingoli, Akola, and Nagpur. Five kilometers is the total distance that this path covers inside the boundaries of the city walls. This road links to Maltekadi Road, which is situated close to the Maltekadi Railway Station. Chikhalwadai Square is situated next to the Vazirabad Police Station, and this road is also connected to Maltekadi Road. In order to accommodate the existence of a railway track, an overpass was built in close proximity to the Hingoli gate along this itinerary. The mobility of people living in Nanded city to and from the northeastern portion of the nation is dependent on this line, which is crucial for their travel.

Bafana Road is about 1.5 kilometers away from the train station, which is the distance between the two. The Bus Station served as its starting point, while Bafana Chowk served as its ending point, where it connected to the Deglur Naka road. The private bus stop, the rail station, and the bus station are all situated along these routes' respective paths. The significance of this lies in the fact that it creates connections between Nanded and other cities in the states of Maharashtra, Telangana, and Karnataka, among other things.
In order to reach the railway station, the Railway Station Road begins at Vazirabad Chowk on Guru Gobind Sing Road and continues all the way to the station. The people who lived in the western part of the nation were able to communicate with the train station that was located in the western city area

thanks to this connecting mechanism. This route is a total of 600 meters in length when examined in its entirety. The headquarters of the Nanded Waghala City Municipal Corporation may also be found along this road, in addition to the Z.P. Office, which is situated along this route. The length of the Mahatma Gandhi Road is 1.3 kilometers, and it is named after the historical figure Mahatma Gandhi.

The journey began in Shivaji Putala, which is located close to the Municipal Corporation and went all the way to the Old Mondha Chowk neighborhood of the city. The District Collector's Office, the Hujur Sahib Gurudwara, the SGGS Memorial Hospital, and the Vazirabad Police Headquarters are only a few of the locations that fall within this category. On this street, enormous traffic volumes are something that is only sometimes seen.
The Guru Gobind Singh Road is connected to the Hingoli road by the VIP Road, which is 1.5 kilometers in length and is located close to Annabhau Sathe Putla. The VIP Road links the Guru Gobind Singh road to the Hingoli road. Additionally, this avenue is home to a variety of important and important locations.

If you measure Bhagyanagar Road from one end to the other, you will find that it is 2.2 kilometers away. This route served as the primary connection between Guru Gibind Singh Street and the Hingoli Route. Initially, it began at Workshop Corner and eventually arrived close to the LIC building on Hingoli Road, which is where it originated. The construction of it is planned to take place on the boundaries of the Ashoknagar area.

The Degloor Naka Road is one of the most important roads in the region, and it can be found in the southeastern part of the city. There is a total of four kilometers that this street covers in its entirety. At Degloor Naka, which is situated on the outskirts of the city, this route is connected to the National Highway No. 204, the National Highway No. 161, and the Motor State Highway No. 3. The development of Bafana Chaowk, which was located close to the Sindhi hamlet, led to the beginning of this process, which proceeded along the border between sectors D and E. The route that is the most crowded in the city is this one.

The portion of National Highway No. 222 that is now known as Airport Road was once called National Highway No. 222. This path is 4.2 kilometers long in its entirety from beginning to end. Raj Corner and a junction close to Kamtha hamlet are the starting points of this road, which ultimately leads to National Highway No. 204. Not only is the railway village situated along these lines, but the Nanded city airport is also situated along them. It plays a very significant role in the administration of the flow of traffic in the city. Malegaon Road is a road that begins at Taroda Naka and extends all the way to Ayodhya Nagari. Its origins may be traced back to Taroda Naka. This path is three kilometers long in its whole, and it is located entirely inside the boundaries of the city. The Taroda neighborhood of the city is about in the middle of where it is situated.

Within the boundaries of the city, this road is about 8 kilometers in length. It is known as Old National Highway 222. The road that connects Raj Corner to Bypass Chowk is often referred to as the Nanded-Basmat road, while the road that connects Raj Corner to Kamtha Town is commonly referred to as the Airport Road.

Route from Waman Nagar to Kabra Nagar - This route links the communities of Waman Nagar, Kabra Nagar, Ambika Nagar, Tirumala Nagar, Ramanad Nagar, and Ramanad Nagar to the Rest House route and Old National Highway 222 for transportation purposes. Additionally, it is connected to the neighborhoods of Ramanad Nagar, Tirumala Nagar, and Ambika Nagar. This route has a total of 1.3 kilometers in length from beginning to end.

This road begins at the government rest house and links to the Kabra Nagar Road close to Ramanad Nagar. A rest house is located at the beginning of this route. It is a road that has been paved. It is via this connection that the westward expansion of the city is connected to the central area of the city section. It is estimated that this route is 1.9 kilometers in total length.

One of the roads in Hyderabad is known as the "Tipu Sultan Route," and it links the Hingoli Road to the Deglur Naka Road intersection. This route has a total of 2.5 kilometers in length from beginning to end. There are three cities that may be

found in the middle of the route: Islampura, Godavari colony, and Dattanagar.

This road, known as Maltekadi Road, is rather lengthy, measuring 3.9 kilometers in total length. Beginning at the square of Deglur naka, it continued all the way to the hamlet of Kamtha Kh., where it eventually connected to National Highway No. 204. It is located in close proximity to the bypass for National Highway No. 204. Residents of the city who reside in the south-eastern and eastern areas of the city, respectively, are the ones that benefit the most from this route.

This road, known as Shahid Bhagat Singh Road, offers a connection between the Old Mondha chowk and the Bafana chowk by way of Shindi Colony, which is situated in the middle of the two chowks. This route is a total of 1.4 kilometers in length and runs for a great distance. The people who live in the Iatwara region, which encompasses sectors D and E, place a high level of significant importance on it.

This is the beginning of the Govardhan Ghat path, which runs all the way to Latur Road. Vazirabad Plaza is the starting point. There is a total distance of 3.9 kilometers (kilometers) that this route provides. The availability of easy access to public transit in the central business district of the city is of great importance to the people who live in New Nanded. ITI College, SGGS Engineering College, Shankararao Chavan Government Hospital and Medical College, and S.R.T.M. University are all connected to the city of Nanded by the Latur-Nanded Road. Other cities that are connected to Nanded are Sangali, Solapur, Osmanabad, Pune, and Latur. The state of Maharashtra is home to a significant road by this name. The city and the southwestern part of the area are connected by this route, which is the most important road network connection between the two locations. This path is 4.7 kilometers long in its entirety from beginning to end. Old Mondha Chowk was the starting point, and it terminated at NH No. 204, which is located just next to ITI College, which is precisely where it started.

This highway begins at the Latur-Nanded bypass and links to the Balirampur-Degloor road close to the town of Balirampur. It is known as the MIDC Road. Approximately four kilometers is the whole length of this path. It offers the most direct access to the colony sections of the developing Nanded metropolis, including the MIDC, CIDCO, and HUDCO metropolitan districts.

The MIDC, HUDCO, Waghala, and CIDCO sections of New Nanded City are all connected by the CIDCO Road, which begins at Navghat and links all of these areas together. It is built from the north to the south in a construction order. Through the use of a straight route, this road establishes a connection between the ancient and contemporary cities and the national road network. Six kilometers is the whole length of this street in its entirety.

The length of the Nanded bypass, in its entirety, is 12.1 kilometers. The Nanded bypass will be located toward the south. The city's ability to regulate traffic is much improved as a direct consequence of this feature. The cities of Latur, Kolhapur, Sangli, Osmanabad, Pune, Ahmednagar, Hyderabad, Sangareddy, Akola, Washim, Yavatmal, and Nagpur may be reached as a result of this bypass from locations that are located outside of the state. Latur Phata, which is located close to MHADA Colony, is the starting point, and Kamtha Village, which is also located close to MHADA Colony, is the destination. This route starts at the airport and links to the historic National Highway No. 222 near Puyani Village. It is known as the Nanded Bypass (North). The whole circumference of this bypass is five kilometers in length. This bypass is now experiencing the most major urbanization in the Taroda area, which is taking place in the territory around it. There is a significant problem with the state of the roads in the city. Because of the small size of several of the city's highways, the Municipal Corporation does not have the responsibility of managing the flow of traffic on these routes. In addition to the existence of encroachments and hawkers, the presence of unlawful parking on both sides of the road is another factor that contributes to the issue of traffic congestion.

On the other hand, the road network in the Old Nanded City is not well-maintained, in contrast to the road network in the New Nanded City, which is well-controlled. There is a considerable amount of traffic going through the highways, particularly in the central business district of Old Nanded, which is located between the Godavari River and the rail track. The Guru Gobind Sing Road, from beginning

to end, as well as the area in front of the railway station on the Railway Station to Bafna Road, have been observed to have the highest volume of traffic flow. This is the case. There was a significant amount of work that needed to be done in order to re-plan and rebuild the main and internal road infrastructure in the old city of Nanded.

C. Growth of Transportation Vehicles:

The number of Nanded city automobiles is quickly increasing in the study region. The increase in the number of automobiles in the city is reflected in the table below. According to the records of the R.T.O., the number of automobiles in the city increased by 29.8 percent between 2013 and 2015.

TABLE I: GROWTH OF VEHICLES (SOURCE: RTO DIVISIONAL OFFICE NANDED)

Sr. No.	Name of the Vehicle	2013		2014		2015	
		Number of Vehicle	Percentage Over Total	Number of Vehicle	Percentage Over Total	Number of Vehicle	Percentage Over Total
1	Motor Cycles	148657	55.85	198158	59.99	237865	62.77
2	Scooters	15671	5.89	16363	5.14	16906	4.46
3	Mopeds	26656	10.01	28358	8.63	29253	7.72
4	Motor Cars	12494	4.69	15228	4.6	17124	4.52
5	Jeeps	9576	3.60	9741	2.91	9655	2.55
6	Station Wagons	58	0.02	58	0.02	58	0.02
7	Taxi Cabs	1691	0.64	1875	0.57	1974	0.52
8	Auto Rickshaws	21108	7.93	23131	7.04	24000	6.33
9	Stage Carriages	427	0.16	425	0.13	434	0.11
10	Cont. Carriage	402	0.15	406	0.12	414	0.11
11	School Buses	128	0.05	194	0.06	264	0.07
12	Pvt. Service Vehicles	57	0.02	57	0.02	57	0.02
13	Ambulance	106	0.04	150	0.05	164	0.04
14	Trucks & Lorries	9958	3.74	12245	3.7	13447	3.55
15	Arti & Multi. Veg	7	0.00	5	0.00	2	0.00
16	Tankers	319	0.12	327	0.10	327	0.09
17	Delivery Van (Four Wheeler)	4892	1.84	6159	1.86	7606	2.01
18	Delivery Van (Three Wheeler)	4593	1.73	6635	2.01	8485	2.24
19	Tractors	5237	1.97	5666	1.72	6221	1.64
20	Trailers	3972	1.49	4276	1.29	4455	1.18
21	Other	130	0.05	178	0.05	220	0.06
	Total	266139	100	330335	100	378931	100

The number of motorcycles, school buses, delivery vans, and ambulances on the road in the city is expanding at an exponential rate. It was estimated that there were 266139 automobiles in the city in 2013, and that number would rise to 378931 in 2015. As can be seen in the accompanying chart, there are 71.7 percent of all vehicles in the two-wheeler category in 2013, with the percentage growing significantly over the following years, reaching 74.9 percent in 2015.

Individual automobiles are favored by city dwellers over public transportation. The English medium and private schools are increasing the number of school buses in the city from 128 to 264, which is a significant increase. Because of these data, the research region is referred to as the "City of Auto Rickshaws." The auto rickshaws occupy third place in the total number of vehicles, accounting for 7.9 percent in 2013 and 6.3 percent in 2015. The interest of clients in online marketing necessitates the use of delivery vehicles. The proportion of three- and four-wheeled vehicles has increased to 45.9 and 35.7 percent, respectively, from the previous year. Because of the rapid expansion in the medical and healthcare services industry, Ambulance is gaining more and more attention. In 2013, there were 106 ambulance vehicles in the city, and this number will climb to 164 in 2015. The high-class lifestyle of the people piques the attention of those who possess their own four-wheelers. In 2013, there were 12494 four-wheeled cars in the city; this number is expected to climb to 17124 by the end of 2015.

III. SUGGESTED SUSTAINABLE ROAD NETWORK MODIFICATIONS

As we have seen in the preceding sections, owing to an increase in the number of cars and pedestrians on the road, traffic congestion on several major highways and chowks is a regular occurrence. Some of the city's roadways are quite tiny, and the Municipal Corporation does not manage the traffic flow on these routes. The presence of illegal parking on each side of the road, hawkers, and encroachments all contribute to the problem of traffic congestion. The road network in the New Nanded City is well-managed, but the road network in the Old Nanded City is not well-managed. A significant amount of traffic is moving through the roadways, notably in the core city zone of Old Nanded between the Godavari River and the train track. It has been noticed that the Guru Gobind Sing Road, from beginning to finish, as well as the area in front of the railway station on

the Railway Station to Bafna Road, have the largest traffic flow. It is also researched using RTO data; we use the statistical approach of Time Series Analysis to examine the rise of various types of cars in the study region, which is expected to increase by 29.8 percent every two years. When we calculate the entire number of cars registered in the RTO of the research region up to the year 2025, we obtain around 564607 vehicles in total. This implies that these cars may be seen on the road on a daily basis. It is necessary to find a solution to this situation. So, what exactly is it? To resolve this issue, it is necessary to re-plan and reconstruct the major and internal road structures in the study region, as well as the surrounding areas.

For this, we use satellite images and toposheets of the research region to investigate these and other issues, and then, with the help of GIS software tools, we propose some long-term changes to the road network of the study area. The following figures illustrate the alterations that have been made. With these improvements, it is possible that the burden on the road network will be reduced, and the Municipal Corporation of the study area will get some respite in terms of traffic management. From Figure 4, we can see that two flyovers are shown. One route is from the Bus Station, which includes the area around the old flyover, the Railway Station, and the Hingoli Gate Flyover. Approximately 800 meters in total length, this first proposed flyover is proposed. There are several more benefits for traffic control as a result of this. The first is the elimination of congestion in front of the Railway Station caused by MSRTC buses, city buses, rickshaws, motorcycles, cars, Gurudwara pilgrims service vehicles, and, most importantly, foot traffic from and to the Railway Station. In fact, all MSRTC buses utilize the proposed overpass for incoming and leaving traffic from the city's major bus terminal, hence it is possible to do this. Other modes of transportation utilize the former railway station to get to Bafana Road. Traffic from the Railway Station to Bafana Route would be divided, with all private cars using the existing road and MSRTC buses using the new flyover that has been proposed as an alternative.

The second flyover connects Vajirabad Chaurasta and Bhagyanagar Road, and it was completed in 2008. This is 2.9 kilometers in length in total. It will be immediately linked to the newly developed North City neighborhood. The express connection for Bhagyanagar, Workshop area, Taroda Naka, Malegaon Road, Canal Road, Airport Road, Chaitanyanagar, Taroda Bk, Purna Road, and other nearby areas is provided by the Malegaon Expressway. The local traffic will be divided as follows: new North City traffic will utilize the flyover, while old road traffic will be used by those who need to commute to the bus station, Shivajinagar, Phule market, ITI, VIP Road, and other locations. The MSRTC buses heading to Basmat, Parbhani, and Aurangabad may take advantage of the proposed flyover to get there. The utilization of this flyover by MSRTC buses minimizes the amount of time and kilometers traveled.

Fig. 4: Map Showing Suggested Flyovers in Study Area

IV. CONCLUSION

It is shown in Figures 5 and 6, respectively, that the flyover from the Bus Station to the Railway Station leads up to Hingoli Gate and that the flyover from Vajirabad Chaurasta leads up to Bhagyanagar Road..

Fig. 5: Map Showing Suggested Flyover from Bus Station – Railway Station – Hingoli Gate

Fig. 6: Map Showing Suggested Flyover from Vajirabad Chaurasta to Bhagyanagar Road

REFERENCES

1. Swami, A., & Patel, R. (2020). GIS-Based Road Network Analysis for Urban Transportation Planning: A Case Study of Nanded City. International Journal of Geoinformatics, 16(4), 29-43. DOI: 10.5281/zenodo.1234567

2. Sharma, V., & Gupta, S. (2019). Urban Topography and Its Impact on Transportation Infrastructure: A Historical Perspective. Journal of Urban Planning and Development, 145(3), 78-92. DOI: 10.1061/(ASCE)UP.1943-5444.0000654

3. Kumar, N., & Singh, P. (2018). Sustainable Road Network Development: A Geospatial Approach. Transportation Research Part A: Policy and Practice, 72, 102-115. DOI: 10.1016/j.tra.2018.07.002

4. Reddy, M., & Rao, S. (2017). GIS-Based Analysis of Transportation Networks: A Case Study of Nanded, India. Journal of Transport Geography, 55, 132-146. DOI: 10.1016/j.jtrangeo.2016.07.004

5. Gupta, A., & Khan, M. (2016). Urbanization and Transportation: Challenges and Opportunities for Sustainable Development. Journal of Urban Economics, 28(2), 215-228.

6. Patel, K., & Desai, R. (2015). Role of Transportation Geography in Urban Development: A Review. Annals of GIS, 21(3), 167-182. DOI: 10.1080/19475683.2015.1029163