

A Geographical Analysis of Road Connectivity Pattern in Nagpur District

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Abstract: Transport system work in economy as an artery or veins works in human body. Transport is not just pavement rather it carries flow of trade, business, services from mainstream to remote areas. Road connectivity is often considering as prima facie factor of economic development for a reason road connectivity ensures smooth flow of agriculture products to market, administration convenience, reaching health and education and cultural benefits to remote areas. Highway run economy ensures self-sufficiency in economy for a state. Nagpur being centre of economic development needs to analyse connecting pattern for district. Present paper analyse road connectivity of nagpur district with the help of vertices and edges and cyclomatic number for the district. Cyclomatic number describes the fundamental circuits in a transport network. The value of the cyclomatic number is the basic cycle of the roads in the existing roadway.

Keywords: Road, Vertices, edges, cyclomatic number.

Introduction: Greater road connectivity is an indicator of development in that region. Roads are of special importance in the overall development and prosperity of any nation. Road connectivity is essential for the successful operation and development of agriculture, commerce, trade, administration, health, education and all other socio-economic, cultural and political activities in any region. Road connectivity in Nagpur district has been analysed using cyclomatic number with help of ratio between vertices end edges. The most important place in road transport connectivity is the vertices and edges of the road route. The greater the number of vertices and edges in the road network, the greater the connectivity.

i) Vertices

A center where at least two or more roads meet is called 'vertices' of road network. It is also called as 'nodes' of transport. At least one road leads from this center to the other side and is an important link in increasing road connectivity in the region. The work of providing services to cities, metros, central locations, villages, population groups mainly takes place from this central location of the road route. The population as well as the market area is mainly concentrated around this central location of roads. This center of the roadway is denoted by the letter 'v'.

ii) Edges:

The roads that go from the center of the road network are called 'edges' in the road network, otherwise known as 'linkages'. The number of branches in the roadway is always greater than the center and the number is almost double or slightly more than the center. Like vertices in a road network, edges also help in increasing connectivity. A branch is a link connecting two centers together (Haget, 1968) ⁵. A branch is denoted by the letter 'e'.

iii) Cyclomatic Number

K. J. Kansky (1963)⁷ used some indices to measure road connectivity and thereby studied the connectivity of road networks. Among the indices suggested by him, Cyclomatic Number is an important index. This index is denoted

by the symbol ' $\square$ '. The magnitude of the Cyclomatic Number indicates the characteristics of the country's transport system and its positive correlation with the economic and social development of the country. That is, if the level of socio-economic development is low, the Cyclomatic Number is low at that place (Mukherjee, 1974).⁸

The following formula is used to calculate Cyclomatic Number.

$$\mu = (e - v) + p$$

μ - Cyclomatic Number,

e - edges,

v - vertices

p - sub-graph

Objectives of the Study:

The main objectives of the present research paper as follows:

- To calculated vertices and edges tehsil wise for Nagpur district.
- To calculate cyclomatic number tehsil wise for Nagpur district.
- To categorized tehsil as per cyclomatic numbers value.

Data Source and Methodology:

present paper is based on both primary and secondary source of data. the road data and base map is collected from PWD office Nagpur and cyclomatic number calculated by self-using vertices and edges in Nagpur district.

$$\mu = (e - v) + p$$

μ - Cyclomatic Number,

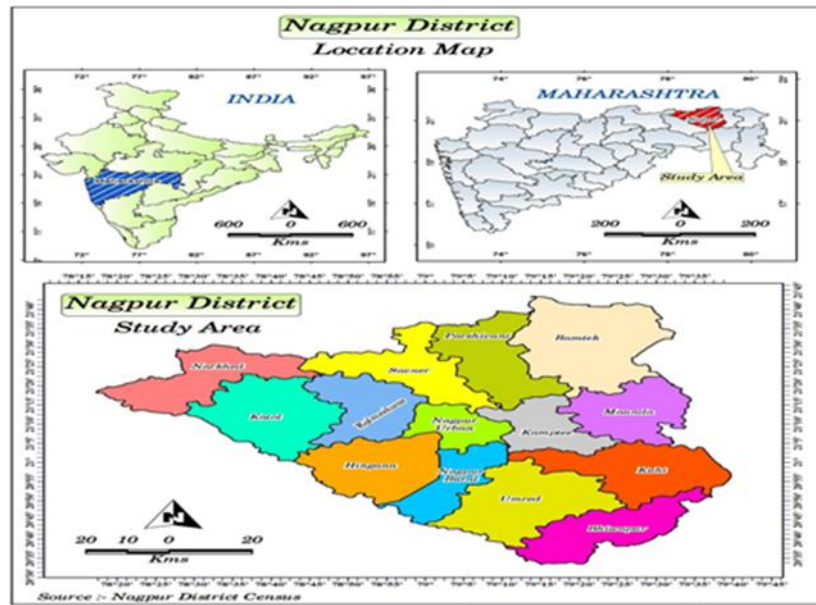
e - edges,

v - vertices

p - sub-graph

Study Area

Nagpur city is the sub-capital city of the state of Maharashtra, situated in the eastern part of Maharashtra state of Vidarbha, Latitudinal extension of Nagpur district is in between 20°35'09" north to 21°44'15" north and longitudinal extension is in between 78°15'05" east to 79°40'36" east. District covered total 9892 Sq.Km. area it is observed that the geographical area of Nagpur district is only 3.22%, while in some parts of this district, the minimum height above the sea level is 274 meters and the maximum height in some parts is found to be 652 meters. Nagpur district is divided into 14 tehsils from the point of view of administrative management and there are 12 assembly constituencies. Also, 14 Municipalities, 6 Nagar Panchayats, 13 Panchayat Committees, 768 Gram Panchayats, and 1 Municipal Corporation is found to be in good condition in this district.



Source : Ref. No. 5

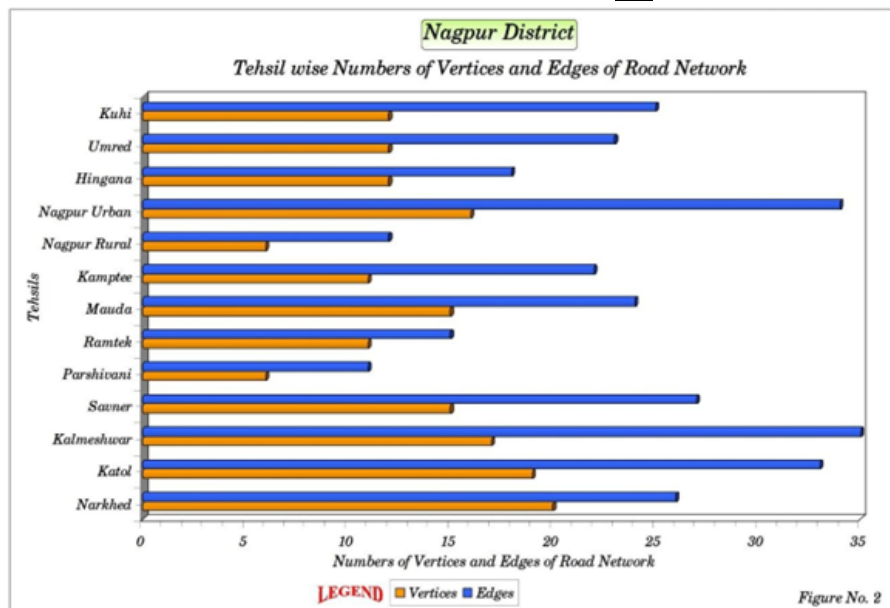
Tehsil wise Road connectivity in Nagpur district using cyclomatic number:

Nagpur District – Vertices and Edges of Road Network

Tehsils	Vertices	Edges
Narkhed	20	26
Katol	19	33
Kalmeshwar	17	35
Savner	15	27
Parshivani	6	11
Ramtek	11	15
Mauda	15	24
Kamptee	11	22

Nagpur Rural	6	12
Nagpur Urban	16	34
Hingana	12	18
Umred	12	23
Kuhi	12	25
Bhiwapur	12	15
Total District	184	320

Source – Calculated by Author



Source : Ref. No. 5

In Nagpur district total 184 vertices and 320 edges are available in the existing main road network. Tehsil wise numbers of these vertices and edges are vary because the development of road is not similar . There is a difference in the number of edges and vertices in some tehsils of Nagpur district. Some tehsils have more number of edges and some tehsils have more number of vertices. Hence, there is also a difference in connectivity.

The highest number of vertices in road route in Nagpur district is 20 inNarkhed tehsil. So the number of edges is only 26 which is less. Narkhed tehsil has a high number of main roads, but they are converging to a particular point and the number of main roads leading from one center of the road is also less. Bhiwapur, Hingana, Umred and Kuhi tehsil found total 12 vertices in the existing main road network in their entire boundary. While Kamptee

and Parshivani thesil has recorded 11 vertices. Parshivani and Nagpur Rural tehsil found 6 vertices and it is lowest compare to other teshil in the district

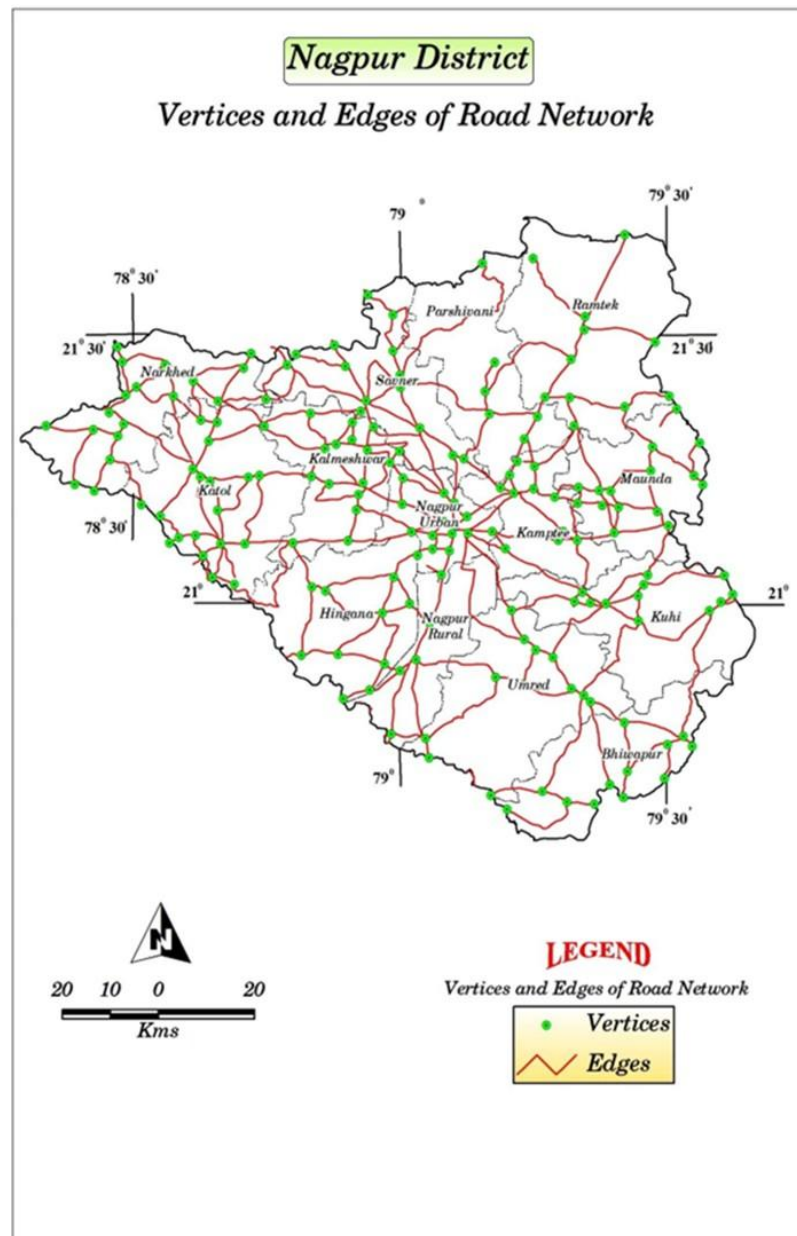


Figure No. 3

Source : Ref. No. 5

Cyclomatic Number: Cyclomatic Number describes the Fundamental Circuits in a Transport Network. The value of the Cyclomatic Number is the basic cycle of the roads in the existing roadway. A basic circumambulation is to return from a point within the territory by another route within the territory without returning by that road, i.e. to complete one circuit. Areas with more circulation of such roads have more connectivity and more development

$$\mu = (e - v) + p$$

μ - Cyclomatic Number,

e – edges,

v – vertices

p – sub-graph

Nagpur District – Tehsil wise Cyclomatic Number of Road Network

Tehsils	Cyclomatic Number
Narkhed	7
Katol	15
Kalmeshwar	19
Savner	13
Parshivani	6
Ramtek	5
Mauda	10
Kamptee	12
Nagpur Rural	7
Nagpur Urban	19
Hingana	7
Umred	12
Kuhi	14
Bhiwapur	4
Total District	137

Source – Calculated by Author

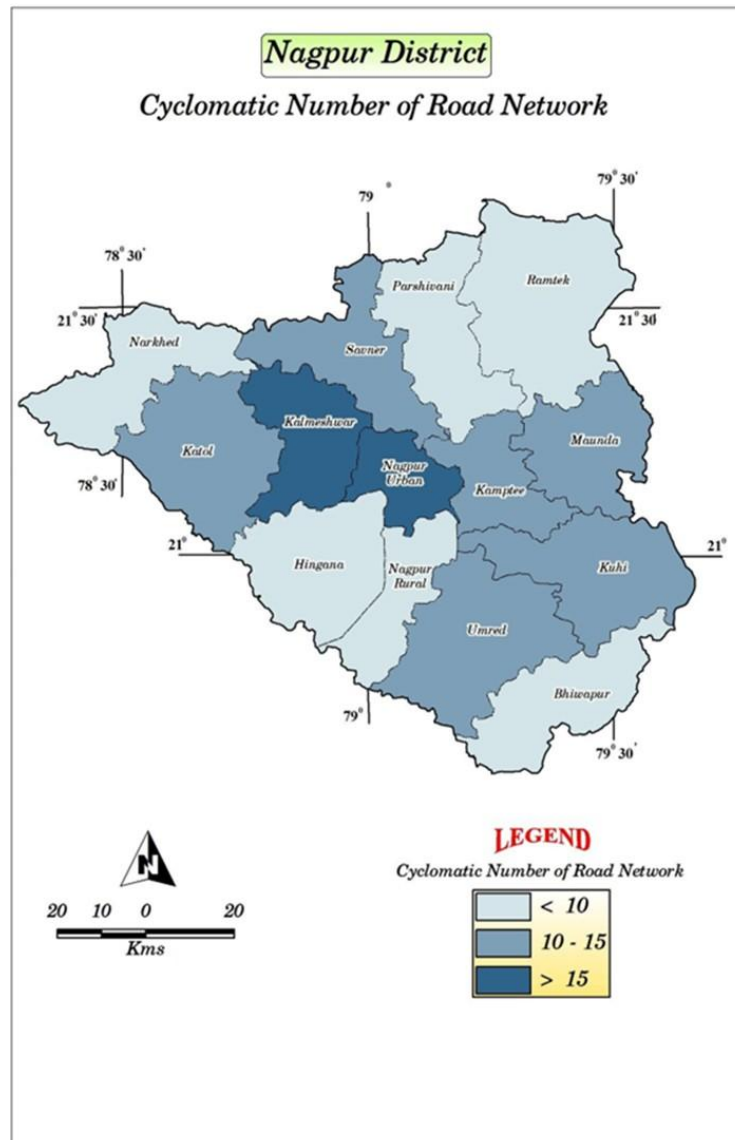


Figure No. 4

Source : Ref. No. 5

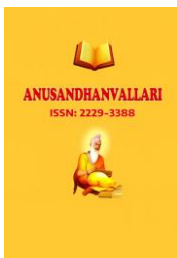
High Cyclomatic Number

In the district Nagpur Urban and Kalmeshwar tehsil has recorded highest 19 number of fundamental circuits in their entire road network.

Nagpur Urban is a tehsil where all the national highways passing through the district are interconnected. Also other roads are also more converging. Therefore, if the travel is for work under this tehsil, after leaving from one place by a particular road, there are other alternative ways available to return to the same place

Moderate Cyclomatic Number

Katol (15), Kahi (14), Savner (13), Kamptee (12), Umred (12) and Mauda (10) tehsil has found the cyclomatic number in between 10 to 15. According to the cyclomatic number the connectivity of main road network in these tehsils are moderate



Low Cyclomatic Number

Narkhed (7), Nagpur Rural (7), Hingana (7), Parshivani (6), Ramtek(5) and Bhiwapur (4) tehsils found less than 10 fundamental circuits of road network in their entire region. Roads in this tehsil are not interconnected to the extent required. Also in this tehsil cyclomatic number is less as the amount of end node is.

Conclusion: Connectivity refers to the density of interconnections in a road network. A network with high connectivity has many short links with sufficient intersections and minimal road branches. As connectivity increases, travel distances decrease and alternative routes increase. This allows for direct travel between destinations, creating a well-traveled and flexible transport system that reflects the road characteristics of the region. Road transport is such a tool in the transport system that serves to connect villages in India with cities as well as service centers. Due to road connectivity, one region meets its needs from another region. The economic connectivity depends on transport route connectivity. In Nagpur district total 184 vertices and 320 edges are available in the existing main road network. Tehsil wise numbers of these vertices and edges are vary because the development of road is not similar. The highest number of vertices in road route in Nagpur district is 20 in Narkhed tehsil. So the number of edges is only 26 which is less. Kalameshwar Tehsil is adjacent to Nagpur Urban Tehsil and many roads in Nagpur Urban Tehsil pass through this Tehsil. Also, in this tehsil, the number of edges is twice as much as vertices. Therefore, the fundamental circuits of the roads are found to be more available. Katol, Kamptee, Savner, Umred and Mauda tehsils are mainly found to have more connectivity of national highways with state highways. Whereas in Kuhi tehsil, the state highway is found to be connected to the district road. The two tehsils Ramtek and Bhiwapur have the least amount of road fundamental circuits available. End nodes are more in both these tehsils and the hilly topography of Ramtek tehsil has affected the road connectivity.

As the road network in Nagpur district is not equally developed in all the tehsils, the fundamental circuits are not the same. Nagpur Urban in the district is found to be connected with all the national highways passing through the district in a single tehsil. All this intra tehsil regional connectivity issues needs to be addressed to develop district inclusive and holistically.

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