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THE PATTERN OF ROAD CONNECTIVITY INDEX IN AURANGABAD DIVISION

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Abstract

Road connectivity plays an important role to the development of any region. Road network is an essential factor for the development of the region. Present paper has been attempts the Road connectivity index pattern of the Aurangabad division in Maharashtra state. The study examines the district wise indices of road connectivity and of the study region.

Keywords: *Road connectivity, road network, cyclomatic, beta, gamma, alpha*

Introduction:

Connectivity refers to the density of connections in path or road network and the directness of links. A well-connected road or path network has many short links, numerous intersections, and minimal dead-ends (transportation.ky.gov).

Road transport infrastructure being the highest contributor to economic growth, many economies have opted to allocate more funds and resources in rehabilitating, expanding and maintaining the existing roads while building new roads (Omondi Sarah Anyango, 2011).

Road connectivity means the network of road connected with each other and more connected region found develop than less road connectivity region. K.J. Kansky (1963) had defined the road network that a set of geographic locations interconnected in a system by a number of routes. Kansky (1963) had studied the structure of transportation networks, and has provided a number of indices which can be used for this purpose.

The present paper reveals the district wise study of road connectivity indices, i.e. cyclomatic, beta, alpha and gamma in the Aurangabad division.

Objectives

The specific objectives of the present study are to study the road structure and to calculate district wise indices of road connectivity of the study region.

Data Source & Methodology

Present research paper is based on the graphical analysis of road network. Road network map of the region collected from the P.W.D. Divisional Office, Aurangabad. The connectivity indices Cyclomatic Number, Beta Index, Gamma Index and Alpha Index have been calculated by following formulas suggested K.J. Kansky (1963),

i) Cyclomatic Number () : $= e - v + p$

ii) Beta Index () : $= e \div v$

iii) Gamma Index () : $= e \div 3 (v - 2)$

iv) Alpha Index () : $= e - v + p \div (2v - 5)$

Where, e = edges, v = vertices, p = number of sub-graphs

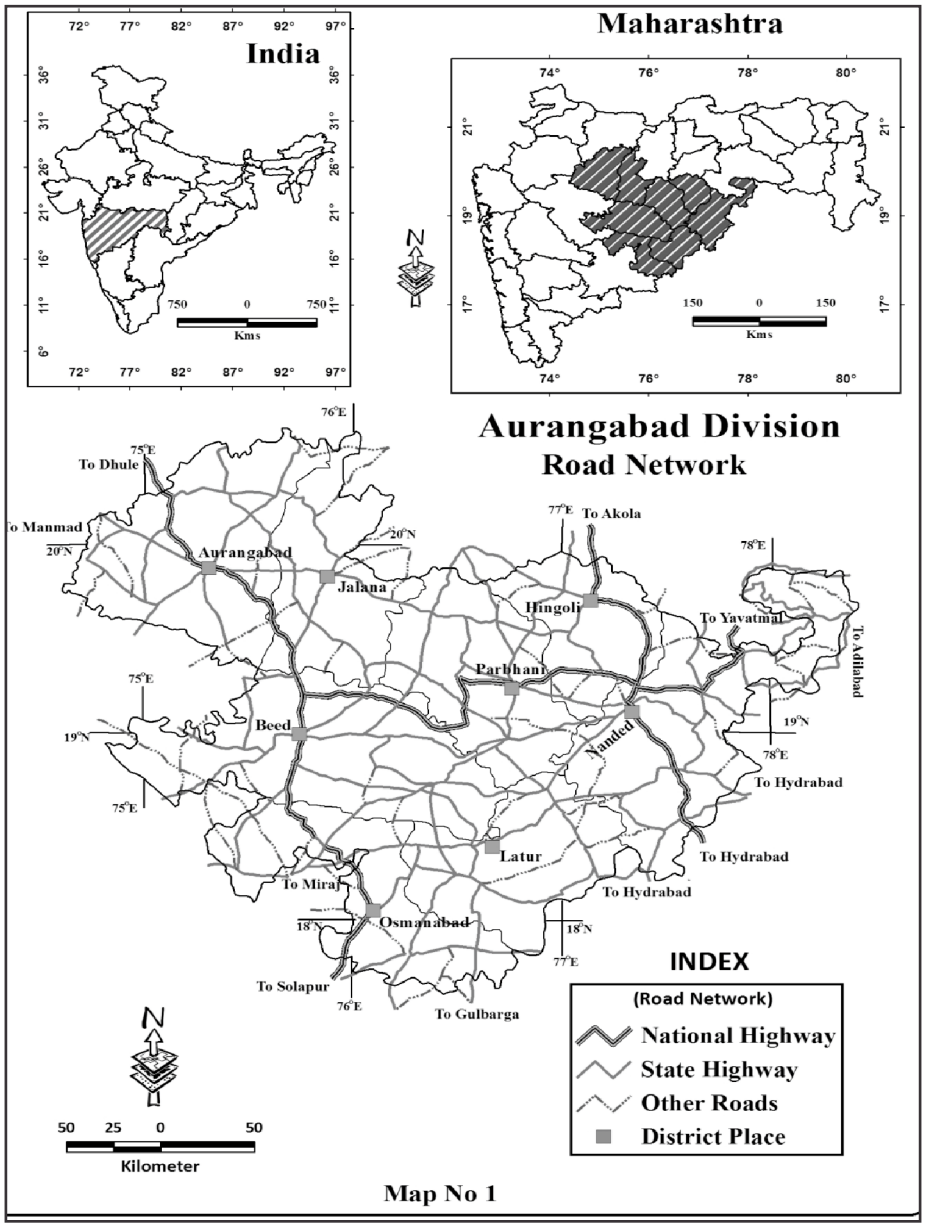
The calculated indices are sum together to determine the overall pattern of road connectivity in the study region. The connectivity indices shown the table and overall connectivity pattern shows in the map of the study region.

Study Region

Aurangabad division is situated in Maharashtra state and consist is total eight district Aurangabad, Jalana, Parbhani, Hingoli, Beed, Nanded, Osmanabad and Latur respectively. Aurangabad is the major division in the Maharashtra state and also known as 'Marathwada region'.

The division lies in between 17036'40" N to 20036'45" N latitude and 74036'46" E to

78025'19" E longitudes. Total population of the division is 18731872 according tothe census year 2011 and total road length of the division is 60092 kms (Map No1).
Yavatmal, Washim Buldhana and Jalgaon districts are located on north, Nashik, Ahmadnagar and Solapur towards west and the southeast boundary of the region is the state boundry of Andhra Pradesh and Karnataka.



Map No 1

Edges and Vertices

Edges and Vertices of the road network are also known as Nodes and Linkages. The connection center of two more roads is known as vertices or nodes and the connection of road between two nodes is known as edges or linkages.

In the Aurangabad Division highest edges and vertices are found in Nanded district, the district having 36 vertices and 63 edges. Beed district has the second maximum number of edges (54) and vertices (30), Aurangabad district has third number vertices viz 28 and edges are 46. The geographical area of these entire three district as are than other districts of the region and compare highest larger to their area the numbers of main road's edges and vertices are not sufficient.

Jalna and Hingoli districts observe the lowest number of main roads connections, these districts have below 15 vertices and below 30 edges. Other districts have 15 to 21 vertices and up to 42 edges in the region (Table no 1).

Map No 2 shows the edges and vertices of the road network in the Aurangabad division.

Connectivity Indices

Table No 1 shows the district wise distribution of number of edges and vertices also the connectivity indices of the study region.

Cyclomatic Number

The cyclomatic number is non-ratio, however useful index of measure the network complexity (Bhendkar S and Others, 2011). Cyclomatic number represents the available number of fundamental circuits of road network.

In the division total 156 fundamental circuits are observed in the existing main road network. The highest numbers of circuits are observed in Nanded (28) district and then Bid (25) district. The number of edges and vertices are also higher in these districts. Bid, Nanded, Osmanabad, Parbhani districts having more than 20 fundamental circuits and remaining district found below 20 circuits and Hingoli (14) is the lowest in the region.

Osmanabad district has low number of edges and vertices but good ratio of them and therefore no of circuits is sufficient in the district.

Table No 1
Aurangabad Division: Edges, Vertices and Connectivity Indices of Road Network

			1	2	3	4	1 to 4 Summation
Name	**Vertices**	**Edges**	**Cyclomatic No**	**Beta Index**	**Alpha Index**	**Gamma Index**	**Connectivity Pattern**
Aurangabad	28	46	19	1.64	0.37	0.59	21.61
Bid	30	54	25	1.80	0.45	0.64	27.90
Hingoli	10	23	14	2.30	0.93	0.96	18.19
Jalna	12	26	15	2.17	0.79	0.87	18.82
Latur	18	36	19	2.00	0.61	0.75	22.36
Nanded	36	63	28	1.75	0.42	0.62	30.79
Osmanabad	15	35	21	2.33	0.84	0.90	25.07
Parbhani	21	42	22	2	0.59	0.74	25.33
Total	**170**	**325**	**156**	**1.91**	**0.47**	**0.64**	

Source:- Author

Beta Index

Beta index is another indicator to analyse of connectivity of road network suggested by K.J. Kansky (1963), higher value of beta index indicates more connectivity. The simplest measure of connectivity is beta index which can be found dividing the total number of edges of a network by the total number of the vertices.

The beta index of the study region is calculated 1.91 and it indicates there are averagely 1 to 2 roads passing from every nodes of the existing network. Osmanabad (2.33), Hingoli (2.30) and Jalna (2.17), district found the beta index value more than 2 and Latur observed exact index 2. In these entire district there are 2 to 3 roads averagely passing through every nodes of the network. Other districts in the region have less than index 2 and Aurangabad district (1.64) is the lowest of them. The connectivity according to beta index is low in the Aurangabad district, this district having large geographical area but compare to their area and demand the connectivity found low in the district.

Alpha Index

The alpha index is a ratio measure of the number of the actual circuits, to the maximum of in a given network. The range of the index is from a value of 0 for a minimally connected network to a value of 1 for a maximally connected one. The district has been divided into four regions on the basis of obtained alpha values (Sarkar, D, 2013).

Alpha index is the modified form of cyclomatic number. This is the ratio of the observed number of fundamental circuits to the maximum possible numbers of circuits in a given network, is considered as the best measure of network connectivity (Bamford and Robinson, 1978).

The alpha index of the study region is calculated 0.47 i.e. there are 47% chances to completed fundamental circuits in existing road network of the region. The maximum value found in Hingoli (0.93) and then Osmanabad (0.84) district. The lowest value occurred in Aurangabad (0.37), Nanded (0.42) and then Bid (0.45) districts. There are fewer chances to complete new circuits in these districts because these districts having maximum number of edges and vertices but not sufficient ratio of them compare to other districts in the region.

Gamma Index

Connectivity as measured by the Gamma index is expressed in terms of a graph theoretic range, that varies from a set of nodes having no interconnection of one centre to a set of nodes in which every node has an edge connecting it to every other node in the graph (Shing, 2003, quoted by Sarkar, D., 2013).

As per K.J Kansky the gamma index is simply the ratio between the edges and vertices of a given transportation network. This is the ratio of the observed number of edges to the maximum of edges in a planner graph.

The value of gamma index in the study region is uneven, the region's values is calculated 0.64. Districtwise values observed 0.59 to 0.96, Hingoli district (0.96) is the highest and Aurangabad district (0.59) is lowest in the region.

Connectivity Pattern

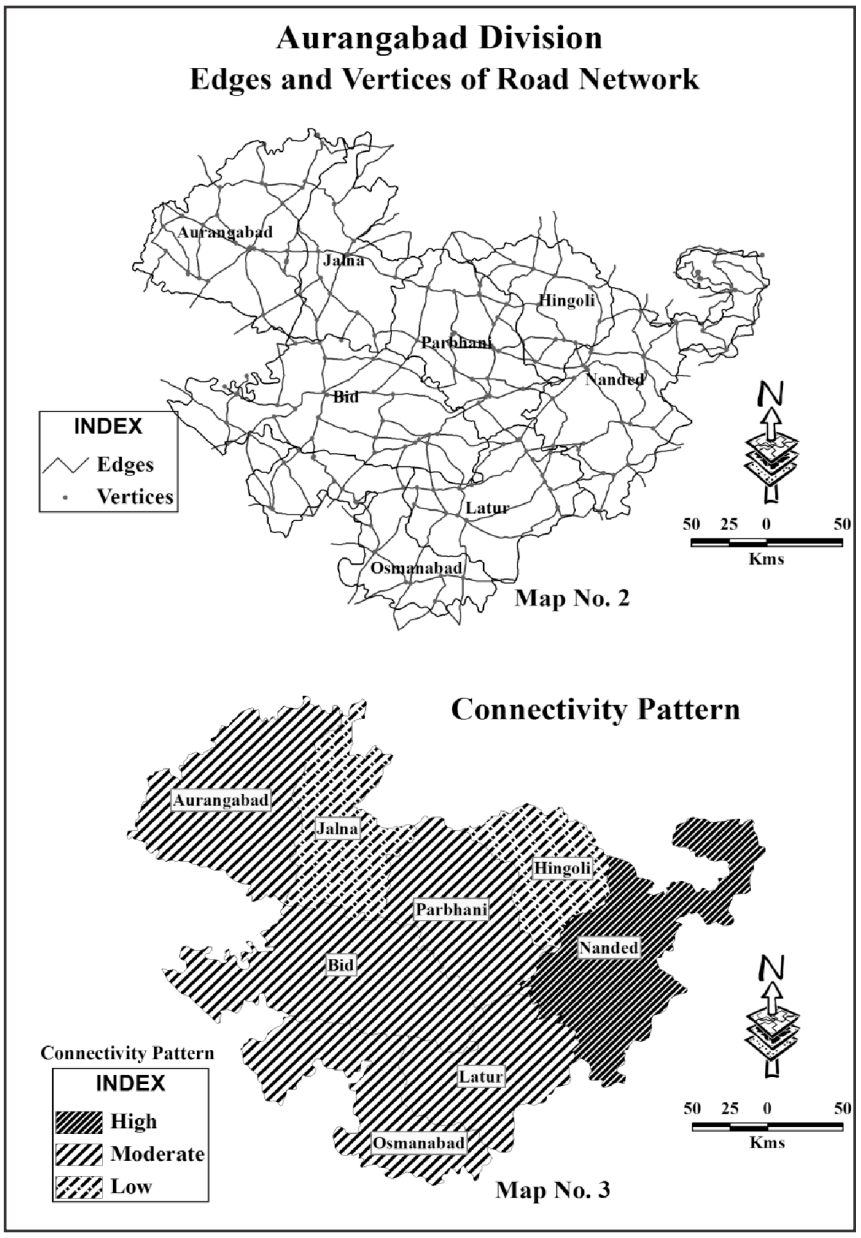
Connectivity pattern of the road network is the aggregate score of calculating indices of the study. It shows the region of high, moderate and low connectivity of the network. Below score of 20 districts consider as low connectivity, 20 to 30 as moderate and above 30 considered as high connectivity of existing road network of the region.

Nanded district recorded the high connectivity pattern of major road network in the region. This district observed the maximum number of edges and vertices also maximum no of fundamental circuits i.e. cyclomatic number. Cyclomatic number is the main index of connectivity and it indicates the development of the region (Map No 3).

Aurangabad, Beed, Latur, Osmanabad and Parbhani district observed the moderate

connectivity pattern. The edges and vertices are near same in these districts Aurangabad and then Latur district s the lowest pattern in the moderate group (Table no 1).

Hingoli and then Jalna district recorded lowest pattern of road connectivity in the existing network. These to districts having low number of edges and vertices of the region also there cyclomatic number is also found lowest in the study region. The development of these two districts is lower than other districts of the division.



Conclusions and Suggestions

The connectivity of the road network in the region is uneven because the distribution of main road network is also uneven. The geographical area of every district is not uniform and according to the area and existing network the edges and vertices are also not sufficient and district wise distribution is also uneven.

There are differences found in the index of cyclomatic number and other indices, the maximum cyclomatic number districts records low indices of other indicators. Hingoli and Jalna district observed the low cyclomatic number but found good other indices. Cyclomatic number is the main and important indicator of connectivity because it shows the network circuits and also a indicator of development. Therefore there aggregate score is found lowest in the region.

The overall connectivity pattern of the region is not sufficient and till need to developed. The construction of main roads in every district according to their area and demand is essential for the future development of the study region.

References

1) Bamford C. G. and Robinson H. (1978) - Geography of Transport, Macdonald and evans Ltd., Estover, Plymouth

2) Bhendkar S, Charthad N, Waindeshkar A and Kale H (2011), “Areal Connectivity In The Districts Of Vidarbha Region”, Maharashtra Bhugolshastra Sanshodhan Patrika, Pune, Vol. XXVIII, No. 1, Jan-Jun 2011, pp 70-73

3) Deshpande Sadhana (2007) - "Road Connectivity and Road Development in Vidarbha, Maharashtra State", The Deccan Geographer vol-45, No. 1, pp. 37-45. http://shodhganga.inflibnet.ac.in

4)

5) Kansky K.J. (1963) - "Structure of Transportation Network Relationship between Network and Regional Characteristics.”University of Chicago" Chicago

6) Omondi Sarah Anyango, (2014), “The Role Of Road Transport Infrastructure In Enhancing Regional Integration: The Case Study Of Kenya's Road Network”, A Research Project Submitted In Partial Fulfillment of the Requirement for the Award of the Degree of Masters of Arts in International Studies, University Of Nairobi, Institute Of Diplomacy And International Studies, Oct-2014, pp 1-67.

7) Sarkar, D. (2013), “Structural Analysis Of Existing Road Networks Of Cooch Behar District, West Bengal, India: A Transport Geographical Appraisal”, Ethiopian Journal of Environmental Studies and Management, Vol. 6, No.1, 2013, pp 74-81.

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