punjab geographer

A JOURNAL OF THE APG, INDIA AND ISPER INDIA, PANCHKULA

VOLUME 12 OCTOBER 2016

PUNJAB GEOGRAPHER : ISSN- 0973–3485 Volume 12 October 2016

LEVELS OF ROAD CONNECTIVITY IN HARYANA: 2011

Subodh Rani
K.V.Chamar

Abstract

Road transport invariably plays an important role in the reconstruction of any area. Since, roads provide a strong stimulus to the development of a nation, it is realized that there is a need to evaluate and examine the road connectivity levels in Haryana. All nodes having minimum population of 10000, district and tehsil headquarters and settlements having crossings of three or more national highways, state highways and major district roads have been selected for the analysis. Structural indices like cyclomatic number, alpha, beta and gamma have been used to analyze the spatial variations in road connectivity in the state. Further, aggregate transport scores (ATS) have been calculated by summing up the values of alpha, beta and gamma indices. It is found that the districts located in the foothill areas of Aravalli and Siwalik Hills have recorded low level of road connectivity, whereas districts namely Bhiwani, Sirsa, Mahendragarh, Ambala, Rohtak and Jhajjar have witnessed high level of road connectivity.

Introduction

A road is a symbol of motion. A road network is usually established in a region with a view to facilitate economic and social interaction in space both at the intra and inter-regional levels. It plays an important role in shaping the economy of an area. The term road network is considered as referring to spatial pattern of road transportation facilities in a region. Robinson and Bamford (1978) defined the connectivity of a network as 'degree of completeness of the links between nodes'. The route connecting two nodes or vertices in a topological network is called arc or link or edge, while the points which form the basic elements in a network are commonly known as nodes or vertices. Greater degree of connectivity makes a transportation system more efficient. By measuring the degree of road connectivity, a transport geographer may identify the levels of road network efficiency to suggest measures for its improvement.

Kansky (1963) developed several descriptive indices for measuring the connectivity of transport network. Taaffe and Gauthier (1973) defined the connectivity of network as the degree of connection between all vertices. Mukerji (1974) tried to seek a correlation between road transport network and levels of urbanization in Rajasthan at district level by calculating aggregate transportation scores. Ramachandran (1975) critically examined a series of graph theory techniques like cyclomatic number, diameter, alpha, beta, gamma, theta, eta, pie and iota to measure the road connectivity. Likewise, Bhaduri (1992) measured the degree of road connectivity in West Bengal by calculating alpha, beta and gamma indices and observed that highways were designed to provide a number of alternate

connections to cities within the state. Similarly, Saxena (2002) examined the pattern of road transport connectivity in Rajasthan and observed that the better transport development was along the National Highway No. 8, connecting cities like Jaipur, Ajmer and Udaipur. Singh (2003) observed that there was no relationship between road connectivity and economic development in Orissa state and concluded that variations in transportation facilities were due to topography and obstacles created by rivers with large tributaries and distributaries. Further, Kaushik and Kumar (2013) analyzed the road transport connectivity pattern by calculating cyclomatic number, alpha, beta and gamma indices to find out aggregate transport scores in Haryana and correlated it with urbanization, agricultural output and economic development. They observed that road connectivity is better in eastern part of the state as compared to western part.

It is well known that the green revolution in India occurred during 1960s and the Punjab-Haryana plain mostly benefitted from it. Most of the settlements were connected with the market centers to ensure a continuous flow of materials which increased the number of Mandi towns in Haryana too. Gradually, industrial units started establishing and urbanization promoted the growth of new centers as 'nodes' for efficient transport system in Haryana. A better road transport system provides social advantages, diffusion of innovations and regional development. Therefore, in the present research work, an attempt has been made to examine the levels of road connectivity in Haryana.

Objective of Study

The main objective of the present study is to identify and analyze the levels of road connectivity in Haryana.

Study Area

Haryana is an important agricultural State located in the north-western part of India. Administratively, the state is divided into 22 districts. As per the Census of India, 2011, the total population of the state is 25.3 million comprising about 13.5 million males and 11.8 million females. There are 154 urban centers accommodating 28.92 per cent of the total population of the State. Physiographically, the central part of Haryana is largely plain and featureless, whereas the western part is traversed by numerous sand dunes. There are also some hills of Siwalik system in the north-east and Aravalli Hills in the south. Although, Haryana is an agricultural state, yet its economy also relies on manufacturing, retailing and information outsourcing. Ambala, Yamunanagar, Sonipat, Gurgaon and Faridabad are big industrial hubs of Haryana. Presently, Haryana is having a well-knit system of 27258 km roads comprising national highways (1462 km), state highways (2521 km), major district roads (1471 km) and other district roads (21804 km). Road network of the state is presented in Fig. 1.

Database and Methodology

In the present study the nodes have been identified on the basis of: (i) settlements having minimum population of 10000 persons (ii) all district headquarters and tehsil headquarters, and (iii) settlements having crossings of three or more national highways, state highways and major district roads. Thus, 226 nodes have been identified (Table 1; Fig. 2). Furthermore, the edges crossing the district boundaries have been counted twice by assuming a node on the boundary for that particular district. For example, the edge connecting Sirsa and Fatehabad has been counted for both the districts, though a node does not actually exist at the end of the district boundary. Thus, a node

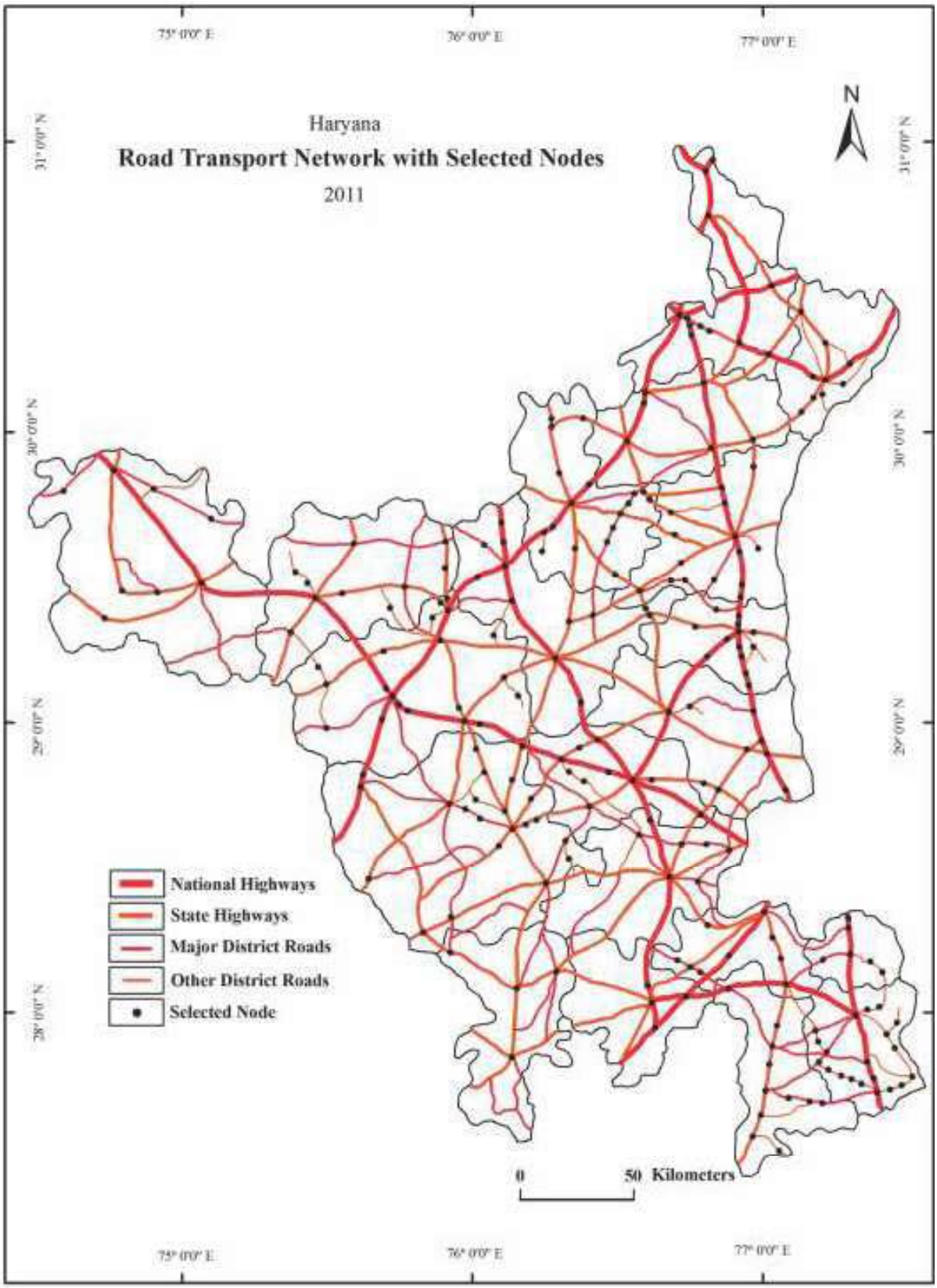
Haryana
Road Transport Network with Selected Nodes
2011
N
National Highways
State Highways
Major District Roads
Other District Roads
Selected Node
0
50 Kilometers

Fig. 1

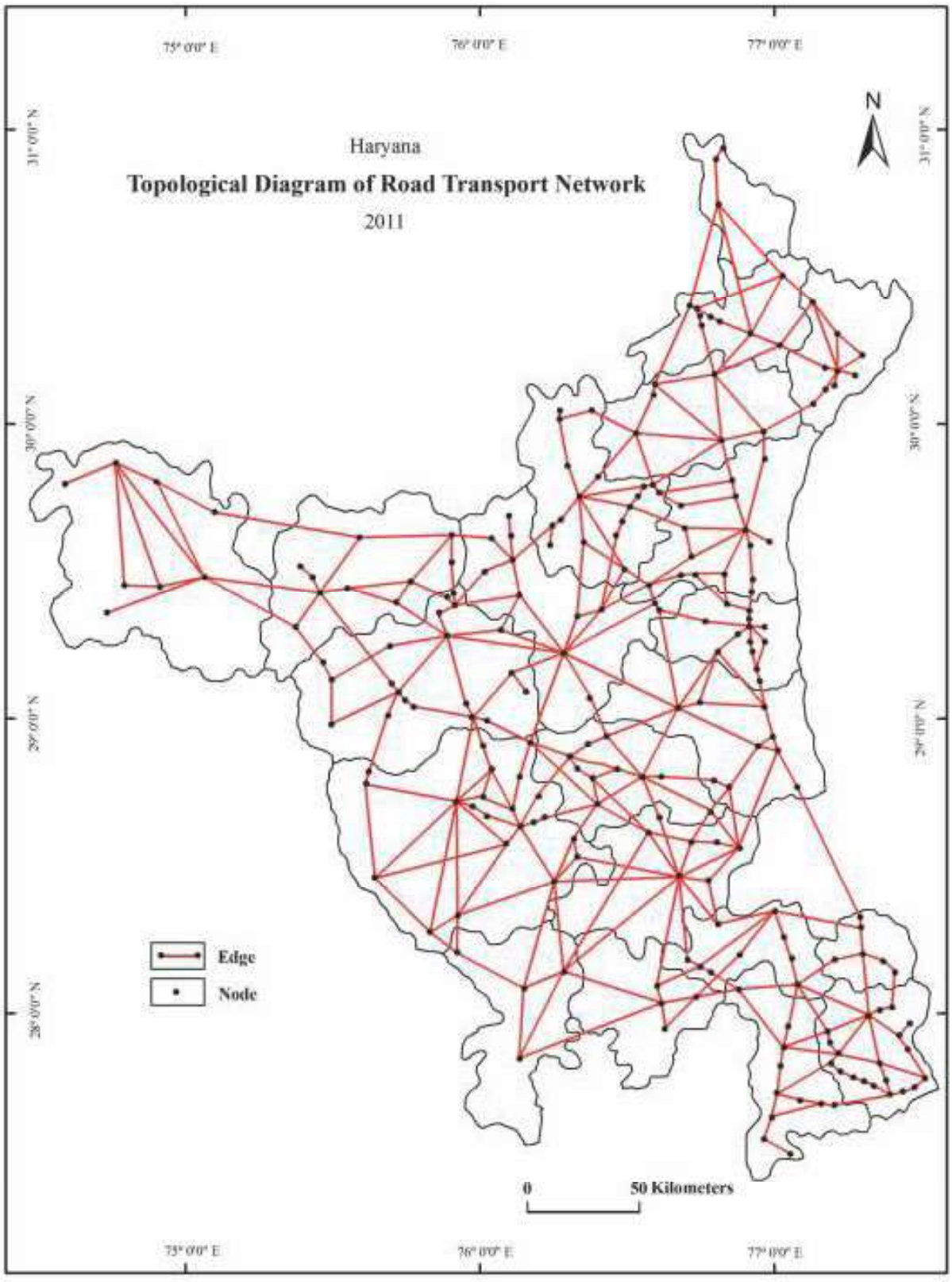
Haryana
Topological Diagram of Road Transport Network
2011
N
Edge
Node
0
50 Kilometers
75° 0'0" E
76° 0'0" E
77° 0'0" E
31° 0'0" N
30° 0'0" N
29° 0'0" N
28° 0'0" N

Fig. 2

Table 1
Haryana: District-wise Identified Nodes of Road Connectivity, 2011.

District	No. of Nodes	Name of the Identified Nodes
Panchkula	03	Kalka, Pinjore, Panchkula.
Ambala	09	Naraingarh, Babiyal, Jandli, Kardhan, Ambala, Ambala Cantt., Ambala Sadar, Saha, Barara.
Yamunanagar	09	Buria, Kansepur, Sasauli, Radaur, Yamunanagar, Jagadhari, Bilaspur, Sadaura, Chhachhrauli.
Kurukshetra	06	Shahbad, Ismailabad, Thol, Pehowa, Thanesar, Ladwa.
Kaithal	18	Bhagal, Cheeka, Guhla, Siwan, Keorak, Batta, Mator, Balu, Rajaund, Kaithal, Kalayat, Karora, Pai, Pharal, Dhand, Pabnawa, Kaul, Pundri.
Karnal	15	Nilokheri, Taraori, Indri, Kunjpura, Karnal (Rural), Kachhwa, Jundla, Karnal, Nissing, Balla, Salwan, Munak, Assandh, Kohand, Ghraunda.
Panipat	13	Madlauda, Dadlana, Sewah, Panipat Taraf Ansar, Panipat Taraf Makhdum Zadgan, Ugra Kheri, Panipat Taraf Rajputan, Kheri Nangal, Panipat, Chulkana, Bapoli, Samalkha, Israna.
Sonipat	09	Khanpur Kalan, Gohana, Ganaur, Morthal Khas, Sonipat, Kundli, Sisana, Kharkhoda, Bahalgarh.
Jind	12	Dhamtan Sahib, Dhanauri, Ujhana, Danoda Kalan, Narwana, Uchana, Alewa, Naguran, Jind, Julana, Muana, Safidon.
Hisar	20	Sadelpur, Adampur, Nang Thala, Bir Hisar, Balsmand, Pabra, Uklana (Rural), Bithmara, Uklana Mandi, Gangwa, Satroad Khas, Satroad Kalan, Barwala, Hisar, Kapro, Petwar, Narnaund, Hansi, Dhana, Hansi (Rural).
Fatehabad	10	Ratia, Samain, Tohana, Bhuna, Gorakhpur, Birdhana, Hijrawan kalan, Hijrawan Khurd, Bhattu Kalan, Fatehabad.
Sirsa	08	Chutala, Mandi Dabwali, Rori, Kalanwali, Sirsa, Jiwan Nagar, Rania, Ellenabad.
Bhiwani	23	Barsi, Baliali, Bawani Khera, Dhanana, Chang, Kelanga, Kharak Kalan, Bamla, Tigrana, Bapora, Dinod, Devsar, Bhiwani, Mundhal Kalan, Tosham, Barwa, Siwani, Behal, Loharu, Bond Kalan, Ranila, Charkhi Dadri, Badhra.
Rohtak	10	Bahelba, Nindana, Mokhra Khas, Maham, Bohar, Bahu Akberpur, Titoli, Rohtak, Kalanaur, Sampla.
Jhajjar	07	Dighal, Beri, Chhara, Mandothi, Badli, Bahadurgarh, Jhajjar.
Mahendragarh	04	Satnali, Narnaul, Mahendragarh, Kanina.
Rewari	04	Rewari, Dharuhera, Bawal, Kosli.
Gurgaon	09	Pataudi, Hailey Mandi, Badshahpur, Gurgaon, Bahora Kalan, Farrukhnagar, Manesar, Bhondsi, Sohna.
Faridabad	06	Dhoj, Tigaon, Tilpat, Faridabad, Ballabgarh, Chhainsa.
Mewat	11	Taoru, Ghasera, Malab, Nuh, Sakras, Biwan, Ferozepur Jhirka, Nagina, Singar, Pingwan, Punahana.
Palwal	20	Alawalpur, Chandhat, Barauli, Kushak, Palwal (Rural), Palwal, Mandkola, Chhainsa, Rupraka, Utawar, Kot, Ali Meo, Hathin, Aurangabad, Banchari, Sundhad, Hodal (Rural), Bhiduki, Hassanpur, Hodal.
Haryana	**226**	**All of above mentioned.**

Source: Compiled by Authors

Table 2
Haryana: Observed Attributes of Road Network Structure.

District	No. of Nodes			No. of Edges		
	Actual	Assumed	Total	Actual	Assumed	Total
Panchkula	03	03	06	02	03	05
Ambala	09	05	14	09	09	18
Yamunanagar	09	03	12	10	04	14
Kurukshetra	06	10	16	08	11	19
Kaithal	18	09	27	19	12	31
Karnal	15	08	23	17	10	27
Panipat	13	07	20	13	08	21
Sonipat	09	10	19	10	13	23
Jind	12	14	26	12	18	30
Hisar	20	12	32	22	17	39
Fatehabad	10	08	18	11	10	21
Sirsa	08	03	11	10	03	13
Bhiwani	23	11	34	33	18	51
Rohtak	10	12	22	12	15	27
Jhajjar	07	12	19	09	15	24
Mahendragarh	04	06	10	04	08	12
Rewari	04	06	10	04	06	10
Gurgaon	09	10	19	08	12	20
Faridabad	06	05	11	05	05	10
Mewat	11	07	18	11	07	18
Palwal	20	06	26	24	08	32
Haryana	**226**	**167**	**393**	**253**	**212**	**465**

Source: Compiled by Authors

has been assumed in both the districts which mean that the inter-district edge is considered as two edges. Consequently, the total number of nodes and edges increased to 393 and 465 respectively (Table 2). Finally, aggregate transport scores have been computed by adding the value of three indices i.e. alpha, beta and gamma. ArcGIS (version 9.3) software has been used to prepare the maps.

Calculation of Cyclomatic number (μ)

The cyclomatic number of a transport network is defined as the number of circuits in a network. A circuit is a route which starts from a vertex and comes back to the same vertex without passing through any of the edges more than once. The number of circuits in a connected network equals the total number of edges minus the number of required edges, i.e. one less than the nodes or vertices. A highly connected topological graph will have higher values of μ and vis-à-vis. Algebraically, the cyclomatic number has been computed as:

$$\mu = e - v + p \quad (1)$$

where, μ= cyclomatic number, e = number of edges, v = vertices (nodes) and p = non-connected sub graphs.

Calculation of Alpha Index (α)

One of the most useful measures of the connectivity of a road network is alpha index. This index is an adjusted form of cyclomatic number. It is the ratio between the number of circuits in a network system and the total possible circuits in a network. The index varies between zero to one; higher values indicate

higher levels of connectivity of the network and vice-versa. It is measured as:

$$\text{Alpha} = e - v + 1/½(v^2 - v)-(v-1) \quad (2)$$

where, values of e and v are as per equation 1.

Calculation of Beta Index (β)

The beta index is a simple index which records the relationship between two individual elements of a network. This index gives the average number of edges available per vertex. It is mathematically expressed as:

$$\text{Beta} = e/v \quad (3)$$

where, values of e and v are as per equation 1.

The beta index will be 0.0 in a network consisting only nodes with no edges or arcs. Its value increases with the degree of transport network connectivity.

Calculation of Gamma Index (γ)

It is a relative index of network connectivity expressed as a ratio of actual number of edges to the total number of edges possible in the network. The numerical range for the gamma index varies between 0 and 1. It is calculated as:

$$\text{Gamma} = e/3(v-2) \quad (4)$$

where, values of e and v are as per equation 1.

Calculation of Aggregate Transport Scores

A consolidated picture of the levels of road connectivity has been presented by applying the technique of Aggregate Transport Scores. As cyclomatic number is an absolute value and other three indices have relative values, therefore only the values of Alpha, Beta and Gamma indices have been added to calculate the aggregate transport scores in the present study.

Results and Discussion

Cyclomatic Number, Alpha, Beta and Gamma Index of Road Connectivity

The district-wise scores of cyclomatic number have been calculated and presented in Table 3. The maximum value (18) of cyclomatic number is recorded by Bhiwani district and minimum (zero) by Panchkula and Faridabad districts, respectively. The state average (total sum of cyclomatic number/number of units) of cyclomatic number is 4.4. The districts, namely Panchkula, Yamunanagar, Kurukshetra, Panipat, Fatehabad, Sirsa, Mahendragarh, Rewari, Gurgaon, Faridabad and Mewat recorded cyclomatic number less than the state average, whereas districts like Ambala, Kaithal, Karnal, Sonipat, Jind, Hisar, Bhiwani, Rohtak, Jhajjar and Palwal have the values above state average. The district Bhiwani (18) has the highly connected network followed by Hisar (8) and Palwal (7) districts. The important state highways No. 12, 14, 17 and 20 pass through Bhiwani district. Therefore, many major district roads (MDR) and other district roads (ODR) have been constructed which connect them with other important places. Moreover, the district has many large sized rural settlements which have automatically increased the total number of nodes as well as edges as compared to Hisar and Palwal districts. The moderate values of cyclomatic number ranging from 5.0-6.0 have been observed in seven districts which mainly comprise the central and eastern parts of the state, whereas very low and low values of cyclomatic number (<5.0) have been observed in eleven districts comprising the northern, western and extreme southern parts of the study area.

The state average of alpha index is 0.04 (Table 3) which indicates that the state does not have a well-connected network. It is observed that more than 65 per cent of districts (14 districts covering the northern, central and extreme southern parts) have the alpha index less than state average. The highest value is

Table 3
Haryana: District-wise Structural Indices and Aggregate Transport Scores, 2011.

District	Actual + Assumed		Cyclomatic Number	Alpha Index (A)	Beta Index (B)	Gamma Index (C)	ATS (A+B+C)
	Nodes	Edges					
Panchkula	06	05	00	0.00	0.83	0.42	1.25
Ambala	14	18	05	0.06	1.29	0.50	1.85
Yamunanagar	12	14	03	0.07	1.17	0.47	1.70
Kurukshetra	16	19	04	0.04	1.19	0.45	1.68
Kaithal	27	31	05	0.01	1.15	0.41	1.57
Karnal	23	27	05	0.02	1.17	0.43	1.62
Panipat	20	21	02	0.01	1.05	0.39	1.45
Sonipat	19	23	05	0.03	1.21	0.45	1.69
Jind	26	30	05	0.01	1.15	0.42	1.58
Hisar	32	39	08	0.01	1.22	0.43	1.66
Fatehabad	18	21	04	0.03	1.17	0.44	1.64
Sirsa	11	13	03	0.07	1.18	0.48	1.73
Bhiwani	34	51	18	0.03	1.50	0.53	2.06
Rohtak	22	27	06	0.03	1.23	0.45	1.71
Jhajjar	19	24	06	0.04	1.26	0.47	1.77
Mahendragarh	10	12	03	0.08	1.20	0.50	1.78
Rewari	10	10	01	0.03	1.00	0.42	1.45
Gurgaon	19	20	02	0.13	1.05	0.39	1.57
Faridabad	11	10	00	0.00	0.91	0.37	1.28
Mewat	18	18	01	0.01	1.00	0.38	1.39
Palwal	26	32	07	0.02	1.23	0.44	1.69
Haryana	**393**	**465**	**4.4**	**0.04**	**1.15**	**0.44**	**1.63**

Source: Calculated by Authors

recorded by Gurgaon (0.13) district followed by Mahendragarh (0.08), whereas lowest value has been observed in Panchkula and Faridabad districts (0.00 each). According to this index, districts namely Gurgaon, Mahendragarh, Sirsa, Yamunanagar and Ambala are comparatively better connected (above 0.04) by roads as compared to other districts.

Beta index in the state varies between 0.83 and 1.50 recorded by Panchkula and Bhiwani districts, respectively (Table 3). The average value of beta index for the state is 1.15. Approximately, 29 per cent districts (six districts) have recorded beta index less than state average, whereas beta index values for 71 per cent districts (fifteen districts comprising the central, western and eastern parts) are above the state average.

The values of gamma index in the state ranges between 0.37 (Faridabad) and 0.53 (Bhiwani). The gamma index computed for the state as a whole is 0.44. About 53 per cent districts of the state have recorded gamma index more than the state average. Very high values of (above 0.49) gamma index have been recorded by Bhiwani, Mahendragarh and Ambala districts, while high values (0.47-0.49) have been observed in the districts namely Yamunanagar, Sirsa and Jhajjar. Similarly, moderate values (0.44-0.46) of gamma index have been recorded by districts namely Kurukshetra, Panipat, Fatehabad, Rohtak and Palwal. Low gamma index (0.41-0.43) has been found in the central part of the state comprising the districts like Jind, Kaithal and Karnal. Likewise, very low value of gamma index (below 0.41) has been recorded mainly in the south eastern part of the state comprising the districts of Faridabad, Mewat and Gurgaon.

Levels of Road Connectivity

The aggregate transport scores in the state vary between 1.25 and 2.07 recorded by Panchkula and Bhiwani districts, respectively (Table 3). The value of aggregate transport scores for the state as a whole is 1.63. There are twelve districts (57 per cent) in the state which have the aggregate transport scores more than the state average. The whole range of the levels of road connectivity has been divided into three broad categories:

(i) Areas of High Level of Road Connectivity

The districts recording aggregate transport score values more than 1.70 are included in this category of high level of road connectivity (Fig. 3). This category is occupied by six districts out of the total 21 districts of the state. Bhiwani district (2.07) has attained the highest level of road connectivity in the state by having the highest values of beta (1.50) and gamma (0.53) indices (Table 3), followed by Ambala (1.85), Mahendragarh (1.78), Jhajjar (1.77), Sirsa (1.73) and Rohtak (1.71) districts. Bhiwani, Sirsa and Mahendragarh districts have many large sized rural settlements which have increased the number of nodes as well as edges, resulting higher road connectivity.

(ii) Areas of Moderate Level of Road Connectivity

The districts recording aggregate transport score values between 1.51 and 1.70 are included in areas of moderate level of road connectivity (Fig. 3). The moderate level of road connectivity is observed in ten districts namely Yamunanagar (1.70), Sonipat (1.69), Palwal (1.69), Kurukshetra (1.68), Hisar (1.66), Fatehabad (1.64), Karnal (1.62), Jind (1.58), Kaithal (1.57) and Gurgaon (1.57) which mainly comprise of the western, central and southern parts of the study area. Most of these districts have large areal extent and moderate size of rural settlements. Gurgaon and Palwal districts situated in southern peripheral boundary of the state have large

number but small size of rural settlements, therefore level of road connectivity is moderate.

(iii) Areas of Low Level of Road Connectivity

The districts recording aggregate transport scores values less than 1.51 are included in this category (Fig. 3). Low levels of road connectivity have been recorded in five districts namely Panchkula (1.25), Faridabad (1.28), Mewat (1.39), Panipat (1.45) and Rewari (1.45) (Table 3). The low levels of aggregate transport scores recorded by these districts can be attributed to very low level of alpha index witnessed by these districts. Alpha index is a ratio of the observed number of fundamental circuits to the maximum number of circuits which may exist in a transportation network; hence its value depends more upon the number of edges in a network. For example, in two networks having same number of vertices but different number of edges, the better connectivity will be found in a network having more edges which shows the fair complexity of a network. In Haryana, all the districts having low values of alpha index have recorded less number of edges as compared to other districts, hence low level of road connectivity. In fact, Panchkula and Faridabad districts by recording zero alpha indices have emerged to be the areas of very low level of road connectivity (below 1.30) in the state. Similarly, very low (0.01) alpha index found in case of Mewat and Panipat districts followed by (0.03) in Rewari district is responsible for pushing these districts in the areas of low level (1.30-1.50) of road connectivity. Spatially speaking, three district of Rewari, Faridabad and Mewat recording low level of road connectivity are located in the south-eastern part, Panchkula is located in the north-eastern part and Panipat in the central part of the study area. It is interesting to note that all these districts are having small size of rural settlements with low capital investments and lack of infrastructural facilities, therefore road connectivity is poor particularly in rural areas.

Conclusions

The study of connectivity by roads gains importance when, one is interested to know the level of socio-economic development in any area, because the roads provide basic infrastructural facilities to promote development. In fact, the roads are cause as well as effect of development. The present study focused on road connectivity in Haryana concludes that there are wide regional disparities in development of roads in the state. The south-western part of Haryana comprising districts of Bhiwani, Rohtak, Jhajjar and Mahendragarh and isolated districts of Ambala and Sirsa have recorded high level of road connectivity. Likewise, central and north-western parts of the state including districts of Yamunanagar, Kurukshetra, Kaithal, Jind, Fatehabad and Hisar and south-eastern districts of Gurgaon and Palwal witnessed moderate level of road connectivity as flat plains and responsive soils stimulated road connectivity in these areas too. On the other hand, Rewari, Mewat, Panipat, Panchkula and Faridabad districts witnessed low level of road connectivity in the state due to very low level of alpha index recorded by these districts. Finally, many large sized settlements have encouraged road connectivity in Bhiwani district and topological constraints for development of roads in Panchkula district have brought these districts on the highest and lowest positions, respectively on the scale of road connectivity. On the whole, 48 per cent districts of the state recorded moderate level of road connectivity followed by 28 per cent and 24 per cent districts witnessing high and low level of road

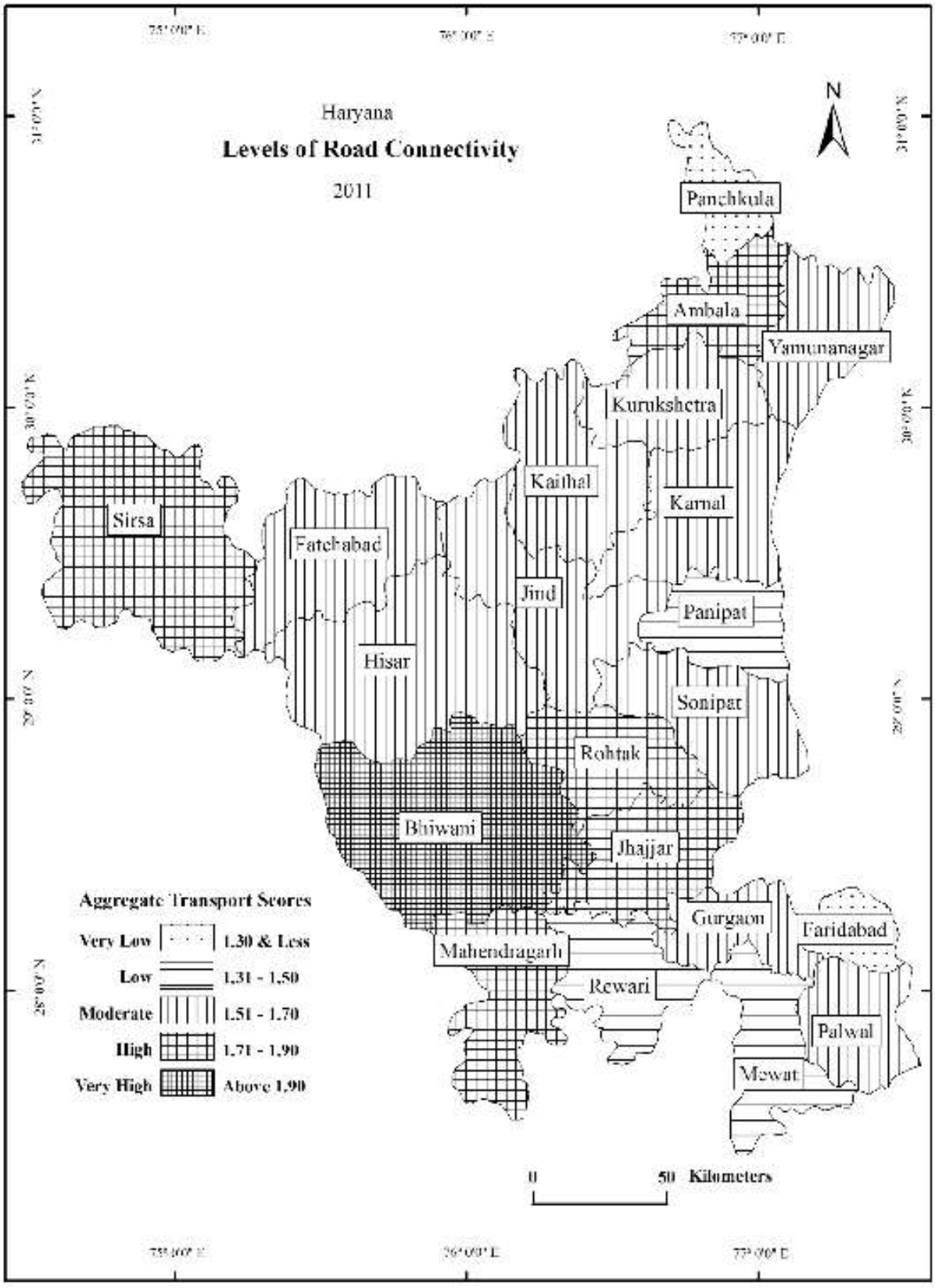
Haryana
Levels of Road Connectivity
2011
N
Panchkula
Ambala
Yamunanagar
Kurukshetra
Kaithal
Karnal
Sirsa
Fatehabad
Jind
Panipat
Hisar
Sonipat
Rohtak
Bhiwani
Jhajjar
Gurgaon
Faridabad
Mahendragarh
Rewari
Palwal
Mewat
Aggregate Transport Scores
Very Low 1.30 & Less
Low 1.31 - 1.50
Moderate 1.51 - 1.70
High 1.71 - 1.90
Very High Above 1.90
0 50 Kilometers

Fig. 3

connectivity respectively in Haryana during the year 2011.

Acknowledgement

The authors are very grateful to the editor and the referees for their encouragement, valuable suggestions and critical comments that helped to improve the quality of this paper.

References

Bhaduri, S. 1992. *Transport and Regional Development*. Concept Publishing Company, New Delhi: 134-137.

Kansky, K.J. 1963. Structure of transportation networks: relationships between network geometry and regional characteristics. University of Chicago, Department of Geography, Research Paper, (84). Quoted by Raza, M. and Aggarwal, Y. 1986. *Transport Geography of India*. Concept Publishing Company, New Delhi: 24.

Kaushik, S.P. and Kumar, S. 2013. Road transport connectivity pattern in Haryana: a geographical analysis. *Indian Journal of Regional Science*, 45(1): 99-108.

Mukerji, A.B. 1974. Road transportation network structure and levels of urbanization in Rajasthan. *The National Geographic Journal of India*, 20 (1): 42-54.

Ramachandran, H. 1975. Analysis of network geometry-an evaluation of connectivity indices. *Geographical Review of India*, 37 (1): 81-86.

Robinson, H. and Bamford, C.J. 1978. *Geography of Transport*. Macdonald and Evans, London: 74.

Saxena, H.M. 2002. Road transport connectivity pattern and economic development in Rajasthan. *Geographical Review of India*, 42 (2): 183-187.

Singh, L. V. 2003. Spatial variation in road transport in Orissa state. In *Geography of Transport Development in India*, eds., Vaidya, B.C., Concept Publishing Company, New Delhi: 221-236.

Taaffe, E.J. and Gauthier, H.L. 1973. *Geography of Transportation*. Prentice Hall, New Jersey Quoted by Saxena, H.M. 2005. *Transport Geography*. Rawat Publications, Jaipur: 60.

Subodh Rani, Research Scholar,
Email: subodhgjjr@gmail.com

Dr. K.V. Chamar, Professor
Email: chamar_kv@yahoo.com
(Author for Correspondence)
Department of Geography,
M.D. University,
Rohtak