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SUMMARY AND CONCLUSION

This chapter is devoted to the conclusions and general observations on the issues which emerge from the discussion of the earlier chapters. The facts have been described systematically as per chapter scheme of the present work.

Chapter I

Transport plays a significant role to bring out the spatial differentiations over the earth surface. It is a major part of daily rhythm of life which plays a dynamic role for the movement of goods and people and also exploits the natural resources and enhances the regional development of any area. Transport geography deals with patterns and modes of transportation, quantitative studies of the movement of goods and people and its relationship with other geographical factors. Transport network analysis plays an important role in highlighting the spatial disparities. Transport Geography, as a discipline, emerged from economic geography in the second half of the 20th century. The linkages and flow between centers, their nature and size, function and accessibility are major consideration in structural aspects of transport geography.

Transportation fundamentally involves two aspects: (a) a vehicle or unit of conveyance, and (b) a medium upon which to move. Means of transportation are based on four elements: road, rail, water and air. The development of each type of transportation varies according to the stage of the development of the country concerned. The first mean of surface transport is road transport. Roads may be defined as convenient way over which vehicles, cyclists, pedestrians etc. may lawfully pass for going from one place to another. A road is a symbol of motion. Roads play a major role in the development of any region. The outstanding characteristic of road transport is its flexibility. In the literature review, all the important aspects related to road transportation like accessibility, connectivity, density and their relationship with the levels of regional development are included.

This chapter deals with introduction, transport geography and its significance, characteristics of road transport, review of literature, objectives of the study, study area,
source of data and research methodology and organizational structure of the study. According to 2011 census, the study area consists of four divisions, 74 tahsils and 154 towns. The total road length in the state was 11516 kms in 1971 which has increased to 27258 kms in 2011. The state has 14 national highways, 31 state highways and 37 major district roads in 2011.

The census data of 1971 and 2011 has been used for the study. Ministry of Road Transport and Highways (MORTH), National Highway Authority of India (NHAI), District Statistical Abstracts, Dept. of P.W.D. & BR and various other government offices are consulted for the required data. Areas lying within bands of a uniform width of 3.0 kms on either side of a national highway and state highway have been treated as fairly accessible and that within 3.0 -6.0 kms from a road as moderate accessible while areas beyond 6.0 kms from a transport artery have been defined as inaccessible. Accessibility is also measured by individual nodes by preparing the topological diagrams of road networks. The node selection is based on the development of road network in Haryana from 1971 to 2011. All urban nodes which are situated either on national highways or state highways and also have a minimum population of 20000 persons have been selected for the analysis.

The analysis of accessibility is done with respect to minimum mileage matrix, nodality matrix, weighted mileage matrix, weighted nodality matrix, gross accessibility matrix and composite accessibility matrix. The rank surface analysis is done by using the technique of isochrones demarcation to bring out salient features of road accessibility in Haryana.

To examine the levels of road connectivity in Haryana, the nodes have been identified on the basis of following criteria: (i) settlements having minimum population of 10000 persons (ii) all district headquarters and tahsil headquarters, and (iii) settlements having three or more crossings on national highways, state highways and major district roads. The connectivity of the network is measured by cyclomatic number, alpha, beta and gamma indices. Aggregate Transport Scores (ATS) have also been computed by adding the value of three indices i.e. alpha, beta and gamma. On the basis of socio- economic characteristics, the study area has been divided into two sub- zones i. e. (1) Eastern Sector (2) Western Sector. Further, these two sub zones have been divided into six micro zones [North- Eastern Zone (1Ai), East- Central zone (1Aii), South- Eastern Zone (1Aiii), in the
eastern sector and West- Central zone (2Bi), Western Zone (2Bii), and South-Western Zone (2Biii) in the western sector] with the help of super-imposition of the generalized regions of socio- economic characteristics.

The levels of road transport development are identified by four indicators: index of road network, total road length per 100 km², total road length per lakh population and number of motor vehicles per Km of total road length at district level. A composite index of road transport development has been prepared by adding the $z$- score values of above four indicators.

Eight indicators of regional development are considered in the present study and further grouped into three broad categories to depict the levels of regional development in the area. Further, $z$ scores of all the above eight indicators have been combined to find out the composite index of regional development in Haryana. To identify the relationship between road transport and regional development, correlation and regression analysis have been used. Maps are prepared with the help of Arc- GIS software (version 9.3).

**Chapter II**

Road transport development is a positive indicator of growth and growth potential of a geographical area. Haryana with an area of 44212 km² is divided into 21 districts and 74 tehsils. The total population of the state as per 2011 census is 25351462 persons of which 65.12 per cent lives in rural areas comprising 6841 villages and 34.88 per cent in urban areas comprising 154 towns. Haryana is predominantly an agricultural state as 55.86 per cent of its total workers are engaged in agriculture and 84.6 per cent of its total area is under agriculture.

Close examination of the road network of Haryana affords a deeper insight into the factors which affected the spatial diffusion of roads. Share of Haryana in National Highways of India (2.47 per cent) is more than its share in population (2.04 per cent) but in case of State Highways (1.56 per cent), Major District Roads (0.31 per cent) and Other District Roads (0.67 per cent), it is much less than its share in population. However, it is must be noted that in case of India, there is much scope for expansion of road length because vast tracks are without roads or have kutcha roads, while in Haryana, there is a little scope for expansion as almost all the villages are connected with metalled roads.
It is observed that the total length of roads in the state was 11516 kms in 1971 including 9107 kms metalled (79 per cent) and 2409 kms (21 per cent) unmetalled, which has increased to 27258 kms in 2011, out of which 26932 kms (99 per cent) roads are metalled and 326 kms (1 percent) are unmetalled. It shows that state has experienced a tremendous growth in metalled roads from 1971-2011. Total road length in Haryana has almost doubled and recorded a growth rate of 136 per cent in the time span of forty years. According to Nagpur plan, road transport is put into four categories in Haryana: national highways, state highways, major district roads and other district roads. Approximately, 80 per cent of the total road length is contributed by other district roads in Haryana. National highways, state highways and major district roads are contributing 5.4 per cent, 9.7 per cent and 5.4 per cent respectively in the total road length of Haryana. However, it is to be noted that National highways and state highways play a major role in the people movement and traffic flow in the state.

District Hisar is having the maximum length of national highways i.e. 144 kms (9.8 per cent of the total national highways) followed by Ambala, Jind and Rohtak with the length of 138 kms, 124 kms and 124 kms respectively. There is no national highway in Mahendergarh district. The average length of national highways in Haryana is 70 kms. Nine districts (mainly comprising east and central parts) are having the length of national highways more than state average whereas twelve districts are below the state average. Bhiwani district is having the maximum length i.e. 400 kms (15.9 per cent of the total state highways) followed by Hisar and karnal with the length of 193 kms and 186 kms respectively. It is also recorded that all these three districts are large sized which might have increased the length of state highways as compared to other districts. There is no state highway in Faridabad and Palwal. The average length of state highways in Haryana is 120 kms. Eleven districts (mainly comprising western, south western and central areas) have witnessed the length of state highways above the state average and remaining ten districts are below the state average.

Bhiwani district has the maximum length of major district roads i.e. 235 kms (15.9 per cent) followed by Sirsa (179 kms) and Mahendergarh (136 kms) districts which are situated in the western part of the state. The minimum length of MDR is recorded in Ambala and Yamunanagar districts as they don’t have any major district road. The average
length of major district roads in Haryana is 70 kms. Nine districts (mainly comprising western, south western and central areas) have witnessed the length of major district roads above the state average and remaining eleven districts are below the state average. District Hisar is having the maximum length of other district roads i.e. 1863 kms followed by Sirsa (1854 kms) and Bhiwani (1773 kms) which are situated in the western part of the state. The minimum length of ODR is recorded Faridabad and Panchkula districts having a road length of 464 kms and 484 kms respectively. The average length of other district roads in Haryana is 1038 kms. Eight districts (mainly comprising northern, western and central areas) have witnessed the length of other district roads above the state average and remaining thirteen districts are below the state average.

Districts Bhiwani, Sirsa and Hisar have the maximum total road length i.e. 2444 kms, 2291 kms and 2249 kms respectively and these all districts are situated in the western part of the state. District Faridabad has the minimum road length i.e. 533 kms followed by Panchkula (601 kms) and Gurgaon (720 kms) which shows that districts located in the peripheral northern and southern parts of the state have very short road length. The average road length in Haryana is 1298 kms. Eight districts (mainly comprising northern, western and central parts) have witnessed the road length above the state average and remaining thirteen districts are below the state average.

**Chapter III**

This chapter describes the physical accessibility, topological networks and road accessibility pattern by individual nodes in Haryana from 1971- 2011. The band of uniform width with on both sides of the roads is the traditional analysis of the accessibility of roads. According to the recommendations of ‘Second Road Development plan’ for India in 1958, popularly known as Nagpur Report, area lying within 4 kms from the transport artery was treated as fairly accessible, those within 8 kms as moderate accessible and area beyond 8 kms was declared inaccessible. Keeping in view the average inter village distance of Haryana (2.74 kms), areas lying within bands of a uniform width of 3 kms on either side of a road (National highway and State highway) have been treated as fairly accessible and 6 kms from artery as moderate accessible while area beyond 6 kms from a transport artery has been defined inaccessible. It is recorded that Haryana is highly
accessible by roads. In 1971, 36 percent of its total area lies within 3 kms as fairly accessible which has increased up to 41 percent in 2011. In 1971, 25 percent area is in between 3-6 kms as moderate accessible which has increased up to 27 percent in 2011. On the other hand, 39 percent area of the state is laid beyond 6 kms termed as inaccessible which has decreased up to 32 percent in 2011. Accessibility has been measured by individual nodes too. The node selection is based on the development of road network in Haryana from 1971 to 2011. All urban nodes which are situated either on national highways or state highways and also have a minimum population of 20000 persons have been selected for the analysis. The analysis of accessibility is done with respect to minimum mileage matrix, nodality matrix (transshipment or break of bulk), weighted mileage matrix, weighted nodality matrix and gross accessibility matrix. It is recorded that there are 25 nodes in 1971 and 62 nodes in 2011. Finally, all the ranks of above five measures have been added and **composite ranks** are calculated in order to find out the overall pattern of accessibility in the state. Jind is the most accessible node of Haryana as it has attained the 1st rank in both decades. Mandi Dabwali is least accessible node in 1971 and Kalka is least accessible node in 2011.

**Chapter IV**

This chapter is a detailed study of the rank surface analysis of accessibility by minimum mileage, nodality, weighted mileage, weighted nodality, gross accessibility, composite accessibility and composite bars. Rank surface is, in fact, a process of generalization, wherein the rank orders are grouped in to categories of equal intervals, and rank lines are drawn for the value of last limit of each class. The pattern of iso-rank lines shows the gradient of changing accessibility. The method is essentially location oriented and can be described in terms of topographic variations of accessibility. The assumption of rank surface is, however, negative to that of the accessibility. It is presumed that as the relief of rank surface increases, accessibility decreases. As, there are 25 nodes in 1971 and 62 nodes in 2011, the categories in the present study are 5, 10, 15….for the year of 1971 and 15, 30, 45…for the year of 2011. By the trend of composite accessibility in the years of 1971 and 2011, it is observed that in 1971, rank surface of high accessibility is found around Jind, Panipat, Kaithal, Karnal and Rohtak which are enclosed by the iso-line of 5.
The rank surface of fairly accessible area is around Thanesar, Narwana, Hansi, Bhiwani and Sonipat. The zone of moderate accessibility is stretched from north to west and west to south comprising Yamunanagar, Shahbad, Hisar, Bahadurgarh and Faridabad. The rank surface of low accessible area is recorded in north (Ambala Cantt.), west (Fatehabad), south- west (Rewari and Narnaul) and south-east (Gurgaon). The least accessible area is again found in the peripheral northern, western and southern parts of the study area.

In 2011, again the central area of the state is representing the rank surface of high accessibility (15). Jind is the most accessible node of the state in both years due to its ideal location. The rank surface of fairly accessible area is enclosed by the iso- line of 30 comprising the nodes like Karnal, Pehowa, Hisar, Jhajjar, Bahadurgarh and Sonipat etc. It is observed that the most of the rank surface of least accessible area in 1971 has been now converted in low accessible area including Mandi Dabwali, Ellenabad, Rania, Sirsa in west, Panchkula, Naraingarh and Jagadhari in north and Firozpur Jhirka, Palwal and Hodal in south. The least accessible area is occupied by two nodes in extreme north including Pinjore and Kalka.

The central part of the study region which is plain fertile land definitely stands superior whereas, the western part with relative poor soil and north eastern region with mountainous range show the low accessibility. The middle part of study area is plain which provide the base for the land transport and Haryana is tremendous growth in land transport especially in road transport after recognized as a separate state. The physiography is too much helpful in the progress.

Chapter V

The term ‘network’ is basically considered as referring to the spatial pattern of transportation facilities in a given region. Network analysis is an important aspect of transport studies as it gives the measures of accessibility and connectivity and also allows comparisons to be made between regional networks in a country and between other countries. The topological diagrams of road network of Haryana for both the years i.e. 1971 and 2011 have been prepared with the help of 53 nodes and 114 edges in 1971 and 226 nodes and 359 edges in 2011. Cyclomatic number, Alpha, Beta and Gamma indices have been used for measuring the levels of connectivity in the study area. 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 considered to calculate the Aggregate Transport Scores in the present study. By this exercise, it is observed that districts namely Yamunanagar, Sirsa, Bhiwani and Mahendergarh have witnessed the growth of many new nodes and edges during this period as these districts have been shifted towards the higher categories of road connectivity. On the other hand, districts like Kurukshetra, Kaithal, Karnal and Palwal have shifted from high to moderate level categories which indicates that ratio of growth between nodes and edges is not proportionate in these districts. Districts like Panchkula, Panipat, Rewari and Faridabad have the lower values of ATS in both years. Overall, it is recorded that western sector of the state has experienced a tremendous growth in the levels of road connectivity as compared to eastern sector. Finally, a more vigorous exercise of road connectivity has been attempted in Haryana. For this, on the basis of socio-economic characteristics in Haryana, the study area has been divided into two sub-zones i.e. (1) Eastern Sector (2) Western Sector. A consolidate picture of the levels of road connectivity in micro zones has been presented by applying the technique of Aggregate Transport Scores. In 1971, the value of ATS is higher in the eastern sector (2.79) as compared to western sector (2.33) whereas in 2011, the value of ATS is higher in the western sector (2.30) as compared to eastern sector (1.94). It is also recorded that zone flanking the Aravalli ranges has low level of road connectivity in both years. Zones comprising the districts namely Sirsa, Fatehabad, Hisar, Bhiwani, Mahendragarh and Rewari districts have experienced a positive growth in the road connectivity. In 2011, Western and East-central zones have the high level of road connectivity in the state having large size of rural settlements and high density of national highways and state highways. North-Eastern and South-Western zones are moderately connected by roads and South Eastern and West Central zones having large number but small size of rural settlements, low capital investments and lack of infrastructural facilities are termed as the low connected zones of the state.

Chapter VI

This chapter analyzes the levels of road transport development as well as regional development and seeks a correlation between them in the Haryana. Development of an
economy is dependent, among others, on the growth of its system of transport. There are four variables chosen for the measurement of the road development and 8 variables to study the regional development levels in Haryana which are fairly representative to draw a connection between road transport network and regional development. Further, the general level of road network development has been calculated with the help of Z-score method. This is measured by transforming and combining the values of above four indicators in to Z-scores, which has provided a reliable measure for the evaluation of transport network development in the state.

Four districts namely, Faridabad, Kaithal, Ambala and Kurukshehra (mainly located in southern and north-eastern parts of the state) by recording exceptionally very high composite index of road transport network development have been distinguished as areas of very high development of road transportation. Panchkula and Jhajjar districts located in the north-eastern and central parts of the state respectively have been included in the areas of high level of road transportation. By recording composite index ranging between -1.50 to 0.50, ten districts namely Yamunanagar, Karnal, Sonipat, Panipat, Rohtak, Fatehabad, Sirsa, Hisar, Rewari and Gurgaon have emerged to be the areas of moderate level of road transport development. Four districts namely Bhiwani, Mahendergarh, Mewat and Palwal recording the composite index between -3.50 to -1.50 are included in the areas having low level of development of road transport. All these districts located in the semi arid climatic belt are agriculturally backward. Socio- economically, Mewat and Palwal are the most backward districts of the state located in the foothills of Aravallis. Very low composite index recorded by Jind district (-5.87) has brought this district under the category of very low level of road transportation development. As the economy of Jind is agricultural based and industries are not very much developed in this district, so the development of roads has been ignored. Here, eight indicators (district-wise) of regional development have been considered in the present study.

Three districts namely, Panchkula, Gurgaon and Faridabad (located in north-eastern and southern parts of the state) by recording exceptionally very high composite index (Above 6.00) of regional development have been distinguished as areas of very high regional development. Such a high composite index recorded by these districts is due to very high percentage of urban population and high literacy rate. Also a large number of
rural development co-operative societies/ lakh persons are recorded in Panchkula. As Faridabad and Gurgaon are located on the periphery of Delhi and Panchkula district, being located close to the state capital of Chandigarh are very prominent industrial districts of the state occupied by the higher strata of society. Sonipat, Jhajjar and Rewari districts located in the central and southern parts of the state respectively have been included in the areas of high level of regional development. By recording composite index ranging between -2.01 to 2.00, four districts namely Ambala, Yamunanagar, Panipat and Rohtak have emerged to be the areas of moderate level of regional development. Nine districts namely Kurukshetra, Kaithal, Karnal, Jind, Sirsa, Hisar, Bhiwani, Mahendergarh and Palwal (mainly comprising the northern, central, western and southern parts of the state) recording the composite index between -6.01 to -2.00 are included in the areas having low level of regional development. Very low composite indexes recorded by Mewat (-9.48) and Fatehabad districts (-6.03) have brought these district under the category of very low level of regional development. Mewat district is dominant by Muslim population. The economy of Fatehabad is agricultural based and industries are not very much developed in this district. That’s why; it has very low level of regional development. Further, all the indicators of regional development are correlated with the Composite index of road transport development to identify the relationship as well as the impact of road transport on the behavior of these indicators. By this exercise, it is recorded that overall correlation between road transport development index and regional development index in the state is 0.448 which is a moderate positive correlation. Only the share of urban population, No. of Medical Institutions per 100 km² and No. of registered working factories per 100 km² are having a positive moderate correlation with the road transport development. Although road transport has been emerged as an important element of infrastructure yet it doesn’t have a major impact on the distributional patterns of development in Haryana.

**Chapter VII**

This chapter is related to summary and conclusion.
SUGGESTIONS

- It has been observed that national highways serve as the corridors for the process of regional development. That’s why, more major district roads (MDR) and other district roads (ODR) in the state should be converted into state or national highways for better development of the region. There is an urgent need to construct new roads as well as expand the existing national highways and state highways especially in the southern and western parts of Haryana. For example, MDR No. 131, 135 and 137 in Mewat and Palwal districts crossing through the nodes like Punhana, Nagina, Hathin and Tinhaon etc. should be converted into state highways to stimulate the level of road development as well as regional development in these districts.

- In Mewat district, there is only one national highway (NH no.71 B) which crosses from the northern part of the district. A new national highway, constructed in the southern part, will definitely enhance the development level of the region.

- In the western part of the state, although the total road length is very high yet the length of national highway is very less. Only two national highways i.e. NH no. 65 and NH no. 10 cross through the entire region here. These national highways should be expanded towards the southern direction. Also, the state highway no. 17 passing through the nodes namely Narnaul, Charkhi Dadri, Bhiwani, Hansi and Barwala etc. should be converted into national highway to improve the regional development level in the western part of the state.

- Finally, it is suggested that for the balanced regional development of the state, it is necessary to remove the existing disparities among different districts in the study area. Government should take necessary steps to improve the behavior of regional development in extreme western and southern parts of the state.

- More emphasis should be laid on the urbanization and development processes by providing infrastructural facilities such as medical, educational, trade, commerce and banking etc. in extreme northern and southern parts covering the districts Panchkula, Rewari, Faridabad, Mewat and Palwal for the creation of new nodes to stimulate the road connectivity in the study area.