CHAPTER-IX

CONCLUSION AND SUGGESTIONS

Road transport network has been one of the essential basic facilities, which needs to be developed and maintained in order to accommodate a growing population and economy, the importance of which was never more prominent than in the Indian subcontinent during British regime and after the independence. During this period, proliferation of road, rail and airline networks in the country has helped to increase the range of cities and reducing the isolation of rural areas. The emergence of these networks meant unprecedented freedom of movement for the population and is closely tied to the continued growth of the economy and urban centres.

The process of growth of urban centres has been found basically to be direction oriented. In other words a city originates and tends to grow predominantly in some desired direction. These directions are mostly affected by transport corridors of that urban centre. Both inter and intra urban transport affects the growth of urban centres in a particular way. So this is an important aspect to study the relationship between development of road transport network structure and growth of urban centres in an area. The main concern of the study is to find out the road transport development and its effect on the growth of urban centres in Rohtak division. The selected area is unique due to its central geographical location in Haryana. Many important roads, highways radiate and pass from here, which link this area to capital of India, Delhi. Because of geographical location of its four districts namely Rohtak, Panipat, Sonipat and Jhajjar in National Capital Region, preferably it can be proposed as region of state headquarter/capital.

The study area is located in the central-eastern part of Haryana state. At present, this area consists of five districts namely Rohtak, Karnal, Panipat, Sonipat, and Jhajjar. The total geographical area is 9,467 Sq. Kms with 25 urban centres of various sizes. The total population of the division is 5,341,007, out of which 71.38 percent (3,812,534 persons) is rural and rest 28.62 percent (1,528,473 persons) is urban.
Main concern of the study is to determine the evolution of road transport in historical prospective because earlier Rohtak division was part of erstwhile Punjab state before 1966. At that time infrastructure facilities like irrigation, electricity and roads were not in good condition. But after the formation of Haryana state all above issues were of prime concern for the government. Many crash programs and policies were adopted for the growth and development of Haryana state. So the second objective of the study is to find the level of road transport development in a relative manner with other aspects like area and population. The growth of population in India is associated with urbanisation. Due to this main concentration of population is found in urban centres so urban centres emerge as foci and nodal centres which attract surrounding population. The connectivity of towns with other surrounding settlements affects its population growth. The shape and pattern of the city is always directed by the main routes of the city. In order to analyze the interrelationship between road transport network and urban processes with a special focus on urban land use of Rohtak city is also a prime objective of present study. The other objective of the study is related with connectivity and accessibility of urban centres, their level of development and their interrelationship with road transport.

The present study is based on both primary and secondary data. Remote sensing data available in the Department of Geography, Rohtak has been extensively used for spatial and temporal study. Temporal collateral data such as twenty six Survey of India toposheets for 1971 on 1:50,000 scale and four toposheets on 1:2,50,000 scale of 1955 have been used. Various road maps from Public Works Department, Chandigarh and land use/land cover maps of the urban centres from Town and Country Planning Office, Chandigarh have been collected. Socio-economic data, Primary Census Abstract (1971 & 2001) and Village and Town directories, (1971 & 2001), have been used for this study.

The evolution of road transport in historical perspective (before 1900 to 2001) concluded that the division had mainly kaccha roads even before 1900. The desires and choices of the people were limited. Country carts and cart tracks were used by common people in the villages for the movement from one village to another. Historically the road development aspect was neglected in Rohtak division and also in
whole of India in the pre-independence period. The roads were built principally from the administrative and strategic points of view. Yet, it must be admitted that the pace of road construction activity was accelerated with the advent of British rule in India. The East India Company, which was mainly a commercial corporation, did not show much interest in making roads in country. By the end of 19th century, the Grand Trunk Road was passing from northern part of Rohtak division to southern part and one another important road Delhi-Hisar-Sulemanki road was traversing division from eastern part to south-western part. These two were only metalled roads in the division and all other roads were unmetalled. The total road length was 230.82 Kms in the end of 19th century.

Under British Rule (1900-1947) some link roads were constructed near main roads namely Rohtak to Gohana, Kharkhoda to Jhajjar, Meham to Gohana, Sampla to Kharkhoda, Sonipat to Kaithal, Panipat to Meerut and Karnal to Indri road. The total metalled road length was 474.66 Kms at that time. In the year 1947, when country became independent, the area falling under metalled roads in Haryana was only 1,895 Kms. According to Nagpur plan in 1943, roads have been classified as National Highway, State Highway, district major-minor and village roads. It may be regarded as the period of scattered nodes and beginning of penetration lines. During this period, most of tahsil headquarters were connected with the main nodes of study area. The total road length of Rohtak division was 893.10 Kms in 1955. In 1955 four important roads were National Highway No.1, Delhi-Sulemanki road, Delhi-Jhajjar-Dadri road and Muzaffarnagar-Panipat-Jind road. The tempo of road construction increased appreciably after 1966. At the end of 1970-71, length of Pacca road in India per 100 Sq. Kms was 12.40 Kms whereas in Haryana, the corresponding figure was 20.90 Kms, and in Rohtak division, it was 21.39 Kms. It can be concluded that Rohtak division had marked good position in comparison to the rest of India in terms of road length per 100 Sq. Kms. During the period of 1955-71, the total length of metalled road was 2,025.46 Kms in the Rohtak division. In 1970, the state government took historic decision to embark upon a crash program of linking every village with metalled road.

With the increase of agriculture production, in 1974 the state government decided upon mobilizing the resources of the Market Committees in form of their
contribution towards construction of roads. Previously Market Committees used to contribute specific roads in their marketing areas but since then they were expected to subscribe substantially to the construction of link roads in the whole of division. This was designed to generate a better rural economy by enhancing the area under road transport and free up and down movement of the villagers. Most of the roads in Rohtak division have been constructed in the period of 1955-2001. That was a very important period for the Evolution of Road Transport Network Structure of Rohtak division.

In 2001, Rohtak, Jhajjar and Karnal are three tahsils which show the highest length of roads. The division’s average road length is 296.7 Kms in 2001. The transport regions have been marked so as to focus the regional inequalities in the pace of road transport development in general. To assess the disparities in the level of development of road transport network in the study region, four variables have been taken into account; 1) Metalled Road Length per 100 Sq. Kms, 2) Other District Road Length per 100 Sq. Kms, 3) Metalled Road per Lakh Persons, 4) Road Development Index.

This study is a systematic analysis of development of road transport network of Rohtak division in a temporal frame (1971-2001) that has brought out several aspects of road network structure acquired over a span of thirty years. Division average for change in metalled road per 100 Sq. Kms is 31.89. Out of seventeen tahsils eight tahsils show more change than the division average. Ganaur tahsil has emerged on the top rank with 59.36 Kms followed by Indri and Nilokheri respectively. On the other hand Kharkhoda tahsil shows very less change in metalled road per 100 Sq. Kms with only 6.36 Kms. It is concluded that Indri, Nilokheri and Tarori tahsils were less developed in road transport in 1971 have shown highest change during the three decades due to attention paid by government. Changes in metalled road length per Lakh persons (1971-2001) result that tahsils having large town of the division are located show a negative change, due to heavy population. Rohtak tahsil has highest percentage population share to the division population but don’t show negative change. It means that during the time span Rohtak tahsil has developed in accordance with growth of population.
After explaining the level of roads and its development in Rohtak division next main concern is related to urban processes. The tempo of growth of urban centres was not uniform across different censual decades; rather, it recorded uneven momentum during 1901-2001. Rohtak division was at a low level of urbanisation in the beginning of 20th century. There was only 11 urban centres in Rohtak division and total aggregate population was 1, 37,506 persons in of 1901 Census. The first decade of 20th century recorded a decline in urban population of Rohtak division by - 20.35 percent. This was in conformity with the pattern of declining population in north-west part of India in general. It was then under the grip of epidemics of plague, cholera and declassification of towns. The tempo of growth of urban centres slowed slightly during 1951-61 and 1981-91, possibly as a consequence of decline in the volume of rural to urban migration. In the period 1971-2001, a number of new urban centres emerged in Rohtak division, such as Panipat Taraf Ansar, Panipat Taraf Makhdum, Panipat Taraf Rajputan, Sankol, Uncha Siwana and Ladrawan. These urban centres are as a result of expansion of industrial and commercial activities in the near by large urban centres.

However, the natural increase of urban population continued to be predominant factor of urban growth in Rohtak division as well as all over in India. The urban population of Rohtak division has been growing at a faster rate than the rural population and more of it is concentrating in a few large urban centres. The rate of population growth in medium and small size towns is slow where as large urban centres, particularly Class I towns and cities are growing at a faster pace.

Urban centres are main focal points as they are centres of trade commerce and industry. National Highways are the main arteries of transport and communication in a country where cities are the controlling centres of economic functions. The spatial pattern of towns in 1971 showed that 50 percent of total number of towns were located and concentrated between Chandigarh to Delhi from north-east to south-east part along the National Highway No.1. National Highway No.1 was one of most important artery of the study area around which about 56.70 percent urban population of the division and 15.45 percent urban population of the state reside. Second one was National Highway No. 10 as Delhi Sulemanki road (Delhi-Multan road) connecting the three urban centres Meham, Rohtak and Bhadurgarh. This zone included about 25
percent of total number of urban centres of the whole division and 33.34 percent urban population of the division.

During the three decadal periods from 1971 to 2001, it is observed that the number of urban centres has increased and also prevailing urban centres have shown growth in their spatial pattern. Out of total 25 towns, fourteen are located along National Highway No. 1 showing 56 percent of total numbers of urban centres located along this corridor with 60.87 percent urban population of the division. This shows a remarkable change which is 1.07 times more in comparison to 1971. Also National Highway No.10 is second most important route occupying 16 percent of total urban centres. The combined population of these urban centres is 28.52 percent of whole division and 07.13 percent of state urban population. On the basis of above discussion it is concluded that National Highway No.1 is cradle of urban centres in three decadal periods emerging nine new urban centres. This route acts as life line for industries of this division. It is important to note that the industries of Panipat, Sonipat and Karnal are entirely depended on this route rather than railway lines. It has been found that state highways and major roads have been constructed while considering gravity of handling goods and movement of people. In addition to this, other district roads and village roads provide better linkages between village and urban centres. Panipat and Bhadurgarh tahsils show high level of road transport in respect of metalled road per 100 Sq. Kms and other roads per 100 Sq. Kms. Due to better linkages and efficiency of the transport, these tahsils give rise to a large volume of interaction, so that the people can go easily to the other nodes. Because of this Panipat and Bhadurgarh tahsils shine with highest newly emerged urban centres in 2001.

Further, analysis was complemented with the computation of Shannon's entropy, which helped in identifying prevalent sprawl zone, rate of growth and its expansion. The computation of Shannon’s entropy helped in delineating regions with dispersed and compact growth and more over expansion of settlements. A total of 86 settlements (population 5000 and above) have been selected to find out the changes in built-up area along highways with in a buffer zone of 4 Kms area. The built up area calculated for temporal data indicates that the total percentage change increase in the built up area is 74.35 percent along the highways in Rohtak division from 1971-2001. It concludes that change in built up area is prominent on National Highway No. 1 and
National Highway No. 10. This results that distribution of built up area in the whole region in 2001 is dispersed then in 1971. The value of Shannon's entropy in Rohtak (tahsil) indicates degree of built up sprawl. This is due to strategic location of Rohtak tahsil rail and road transport. The maximum number of highways passes through Rohtak and Gohana in the whole region. Hence both town shows radial and point location as joining place of highways. To identify the actual growth on National Highway No. 1, Shannon's entropy was calculated for Panipat, Sonipat and Karnal. The degree of dispersion is higher in Sonipat and Panipat, in comparison of Karnal due to heavy industrial growth and migration. Beri, Jhajjar, Kharkhoda, Israna and Samlakha zone are very less dispersed because none of them is industrial area. It is concluded that Rohtak tahsil has highest built up area, sprawl along the highways followed by Sonipat and Panipat respectively. Rohtak tahsil has highest road length both in metalled roads and ODR roads respectively. On the other hand, inspite of the high growth rate of population, Rohtak tahsil always showed good road density (road length per lakh persons). This proves that good transport facilities affect the growth of built up area in Rohtak division.

The results of simple correlation analysis have brought out the degree and direction of association among the set of eleven variables. Among them it is found that all four transport development variables have established a high positive relationship 'r' value above than 0.50. Also eight urban dominated variables show good relationship with each other. But this is not much strong for the small towns of tahsils. On the other hand population of large towns \( P_9 \) shows strong relationship with percentage of urban population \( P_8 \). It means that the urban process variables have clearly established a high degree of association among themselves. The interrelation of these set of variables is some strong, like in metalled road length per 100 Sq. Kms \( P_1 \) and urban population density of tahsil \( P_6 \) its 'r' value is 0.62 in 1971, means high metalled road density generate high level of urban population density. People are attracted to these places because these places provide high level of interaction with other places. But there is a negative relationship between road lengths per lakh person \( P_3 \) and all other variables. An important point emerging from the study is that there is low relationship between metalled road density \( P_1 \) and population share of medium town \( P_{10} \), r =0.27 in comparison of population share of
large towns ($P_9$, $r = 0.18$). It means that the roads connected to large towns are not as appropriate as to the size of population in comparison to medium towns. Also same is true for ODR length density ($P_2$) with population share of large towns ($P_9$, $r = -0.13$) in comparison to population share of medium towns ($P_{10}$, $r = 0.13$). But ODR length density ($P_2$) is comparatively sound for population share of small towns ($P_{11}$, $r = 0.23$). It reveals that small towns have small share of urban population so ODR roads are quite appropriate for its population.

The analysis of relationship between the above twelve variables for 2001, shows drastic changes during the three decades of study. The correlation matrix set for 2001 shows that the variables related to transport become stronger with each other in comparison to 1971 such as metalled road length density ($P_1$) and ODR length density ($P_2$) and ‘r’ value is 0.88 in 1971 and 0.95 in 2001 means both are in position of better development. Also same is true for the variables of urban processes such as the relationship between percentage of urban population to total urban population ($P_7$) and percentage of urban population to tahsil population ($P_8$) is 0.87 in 1971 and 0.94 in 2001. Also the above is true for variables of urban processes such as percentage of urban population to tahsil population ($P_8$) is 0.82 in 1971 and 0.91 in 2001, with population share of large urban centres ($P_9$). This concludes that over a passage of time large urban centres have constituted a very high share of urban population in the division as well as to the total population. They have grown faster in comparison to other classes of towns.

But when we evaluate these figures for transport development and growth of urban centres for 1971-2001 the relationship become weaker with the passage of time. Urban area grows more and more in haphazard way due to other forces, but roads facilities do not grow at the same rate. It means that the degree of association between urban processes and road transport become weaker during the three decades. Both inter and intra urban transport affects the growth of urban processes. The correlation matrices reflect the characteristics of Third World urbanisation. It is in the sense that the term ‘urban explosion’, ‘urban inflation’, over or hyper Urbanisation is used for the contemporary Third World countries. In these countries the urban population has increased beyond the optimum capacity, resulting in over Urbanisation. Above is same for Rohtak division where class I cities grow very fast, urban population has
been growing at a faster rate and more of it is concentrating in a few large urban centres. Their relationship is not much strong rather become weaker from 1971 to 2001. It is concluded that almost all the towns of this division do not have good level of intra and regional transport facilities according to their population size.

Urban transport, both intra and inter-urban plays a key role in influencing the pattern of urban growth and development. The land use and land cover of Rohtak city for the year 1971 indicates that most of the residential area was found along the National Highway No. 10 and city looked in a linear pattern from north-west to south-east.

It is evident that Rohtak city has witnessed large scale changes of land use. The statistics shows that urban area has increased by 1,389 hectares with +88.53 percentage change during 1971 to 2006. Similarly built up area has increased from 936 to 2,543.4 hectares.

The city has witnessed major land use changes among different classes. With the passage of time, the older parts of the city become more and more congested. On the other hand the city has expanded along and between the main roads in a haphazard manner and swallowed the agricultural land into the urban and fringe area. The urban land use change of Rohtak city is dominated by residential class, like all others large urban centres of India.

There is a vast change in the open and agricultural land of Rohtak city between time period from 1971 and 2006. The area under open and agricultural land has reduced to – 217.00 hectares and -34.28 percent of total municipal area. The reduction of open and agricultural area in these thirty five years is because of urban expansion and growth of built up area.

As changes in land use take place much faster along the transport corridors than that in distant areas. It is worth while to study how much changes in land use take place along the major roads in Rohtak city. For this analysis, buffer zone has been created for two different years i.e. for 1971 and 2006. The buffer zone has included distance of 500 meters along the main roads.

Rohtak city has shown a considerable expansion from its original size and also there is significant interchange of land use from open area to other land use classes. These changes are due to the development of the city resulting in increase of area
coverage, specially residential and commercial use. It is clear that the growth of city has taken place along the major roads like National Highway No.10 and National Highway No .71. The built up area in 500 meters zone shows 636.16 hectares in 1971 and 1480.66 in 2006 along the main roads. It has been increased by 132.74 percent with 844.5 hectares. It is evident that there are more prominent changes along National Highway No.10. An increase of 153 percent in commercial and 140 percent in residential area shows its demand for accessible sites on or very close to the main roads. These areas are characterized by high land values. The open and agriculture area has suffered a negative growth because, with increase in population, demand of houses, building and commercial areas consume land from agricultural area.

Residential area has increased in all direction along all the main roads. The main expansion of residential parts along the main roads are DLF Colony along S.H.18, Sham Colony as a result of expansion of Indira Colony along National Highway No.10, Rajender Nagar along Bhiwani Road, Kamla Nagar and Janta Colony along the Jhajjar Road. It shows frontal expansion of residential class along the transportation corridors. There is always a direct relationship between land use location and distance from the city centre. The area near to roads is easily accessible whereas the area far from roads is less accessible. This is the main reason of frontal expansion along the main roads.

The area under educational facilities along the main roads has increased to 104.86 percent with 75.83 hectares. Transport facilities have marked an increase of 40 hectares with 113.63 percent from 1971 to 2006.

Commercial use shows highest percentage change with 153.08 percent in the city. The commercial area has increased mostly along the main roads. Commercial area has expanded rapidly and is characterized by linear pattern along both the sides of roads. This is most prominent on National Highway No.10 and Jhajjar road. These areas enjoy better accessibility and lies in very high land value zone. Due to this factor the commercial areas has pushed the residential area characterized by vertical expansion. Large multiple storey buildings and showrooms have been established in Model Town and other areas.

There are also considerable changes in the Services, Utilities and Administration area along the main roads with 103.67 percent. But industrial
development is more along the roads with 112.67 percent. The growth in residential
area is second highest but utilities show less growth in comparison to others which
indicates haphazard expansion in the city. This shows that the growth of city is not
substantial. It can be concluded that increase in all these above mentioned categories
are on the expense of open and agricultural area. In 1971, the area under open and
agricultural land was 429 hectares but in 2006 this area has been decreased to 269
hectares. With the development of urban area there is a negative change in open areas
and growth of urban centres always feeds upon open area along the main roads and
highways.

The analysis of transport network has become an important part of
geographical studies in recent years. The purpose of the study is to know the road
accessibility and connectivity of urban centres in Rohtak division. Accessibility and
connectivity are one of the most important aspects of network analysis and are
variable qualities with respect to location. There are 1394 settlements in Rohtak
division including 1369 villages and 25 urban centres. In the present study all the
urban centres, administrative centres and settlements having population more than
5,000 have been taken as vertices constituting a total of 212 nodes. The National and
State Highways, major district roads and other district roads are considered as edges
and total edges are 333 in Rohtak division.

The centres or nodes related to road transport network study have been
identified on the basis of the following characteristics:-

1. Urban and industrial centres.
2. Villages with 5,000 and above population.
3. Administrative headquarters of block, tahsil and district.

Out of twenty five urban centres, the divisional headquarter Rohtak ranks first
in connectivity value. Karnal ranks second and third ranking towns are Panipat,
Sonipat Gohana and Beri. Bhadurgarh and Jhajjar are important centres of the
division showing not very high but medium connectivity value in comparison to small
centres like Beri, Ganaur and Kharkhoda. This is an indication of location advantages
as well as higher connectivity. The towns which are located in the central part of the
division show high connectivity value, on the other hand towns located in the
periphery zone show low connectivity values. Rohtak is the nerve centre of the entire southern part of the division where as Karnal and Panipat are main nodal places in the northern part. The study regarding the connectivity evaluation yields good results. The study area namely Rohtak division is a suitable region with good network of roads and 25 urban centres. Some of them such as Rohtak, Karnal and Panipat have more connectivity due to certain cause like locational, commercial, agricultural and industrial aspects. Such studies provide a yardstick to measure the connectivity values of the urban centres and also give some preliminary information for the future transport planning and facilities of urban centres in the region.

Level of nodal accessibility has been taken up for 25 urban settlements of the study area. The indices of nodal accessibility have been calculated with local degree (road) and weighted road capacity. The local degree is higher for Karnal, Panipat, Sonipat, Rohtak, Bhadurgarh and Gohana. It means that these centres are very well connected and act as junction places for different types of roads, where as with low local degree Ladrawan, Sankol, Uncha Siwana, Assan Khurd, Nilokheri, Panipat Taraf Ansar, Panipat Taraf Makdum, Panipat Taraf Rajputan and Klanour are less connected. The road network system of the area consists of different types of roads. The roads are having different lanes, with different width and also have different type of surfaces. Due to these differences, the speed and quantum of the commodity movement are different. National, state, district and other roads have different capacities. It is accepted that National Highway has highest capacity, and then comes State Highways, district and other roads have least. Rohtak and Karnal show very high road capacity ranging from 1.96 to 2.53. It means that these are the base centres for the movement of commodities in the division. On the other hand Sonipat has medium level of road capacity because of the absence of National Highway through its core or centre. After nodal accessibility it can be considered that the Rohtak town is on highest rank with 04.10 and trailed by Panipat, Bhadurgarh, Jhajjar, and Karnal respectively. Above all it is important to point out that all Class I towns and districts headquarters have very high level of nodal accessibility. It means that all the above centres enjoy good position in terms of road connection by different types of roads.

The relative location of an urban centre or of an area in the network of transport offers a particular degree of accessibility to a given centre. Centrally located
vertices are usually having high accessibility in comparison to the peripheral ones. Such variation in connectivity and degree of accessibility can be identified with the help of Shimbel index. This is done with the help of shortest path matrix. The shortest path matrix indicates that the lowest value of Shimbel index is the most accessible while the highest value indicates the least accessible node. Panipat city shows highest accessibility from all others urban centres. Other urban centres like Sankol, indri, Tarori and Nilokheri show lesser accessibility by shortest path analysis, because these are located in the foremost corner.

Associated number is the number of arcs needed to connect a node to the distant node from it; the associated number is highest number of each row. This is also known by centrality index. Panipat and Gohana having low accessibility value are most accessible from all the nodes, where as Karnal, Sonipat, Rohtak, Meham, Ganaur, Panipat Taraf Ansar, and Panipat Taraf Makdum are of medium centrality. Indri, Nilokheri, Tarori, Jhajjar, Klanour, Beri, Bhandangarh and Sankol has high accessibility value, indicating that these are vertices and not in centralized position.

The degree of connectivity and nodal accessibility are important factors which affect the expansion of urban centres. Greater accessibility enhances the strength of urban magnetism and helps to acquire a multi-functional character.

Hullur and Sinha (1974) also worked on this relationship in case of Karnataka but could not find out any such relationship. But when Bhagpati (1984) worked on in the context of Assam state it has been found that there is significant positive relationship (r =0.62) between the population size of the selected towns and their connectivity values. Here we also analyze that the five transport oriented variables and three variables of urban processes.

The relationship of metalled road per Sq. Kms in urban centres (P1) and population size (P6) shows a highly positive correlation and ‘r’ value is 0.85. Also population size (P6) shows same relationship with the local degree roads (P2, r =0.71), weighted road capacity (P3, r =0.71), level of nodal accessibility (P4, r =0.78) and connectivity values (P5, r =0.70). All the above values are significant at 0.05 levels. It means that population size of urban centres is directly influenced by the accessibility and connectivity of that centre with other centres. Roads are the main source of transport in Rohtak division in comparison to railway lines. Most of the industrial
material is transported with help of metalled roads in various areas. The relationship between metalled road per Sq. Kms of urban centres (P1) and urban population density (P7) is positive but weak in relationship in comparison of above describe relationship and 'r' value is 0.50. Also urban population density (P7) shows same relationship with the local degree road (P2, r =0.47), weighted road capacity (P3, r =0.47), level of nodal accessibility (P4, r =0.48) and connectivity values (P5, r =0.44). It means that population size of urban centres (P6) is highly correlated and influenced with these indices in comparison to urban population density (P7). A strong relationship is found between metalled road per Sq. Kms of urban centres (P1) and its urban area (P8) which is shown by ‘r’ value 0.70. Also urban area (P8) shows same relationship with the local degree roads (P2, r =0.65), weighted road capacity (P3, r =0.62), level of nodal accessibility (P4, r =0.70) and connectivity values (P5, r =0.55). Nodal accessibility (P4) and weighted road capacity (P3) show the capacity of traffic flow and movement of commodities between urban centres. Traffic flow means simply the volume of movement of goods, people and messages. It is a core element of circulation system which reflects the complex nature of economic interdependence. The capacity of roads in urban centre always affects urban growth. The size of urban centre and its population is directly linked with degree of efficiency in road transport network.

Rural-urban migration is main cause of heavy pressure on the facilities of urban centres. In urban centres, there are many pull factors which attract the people pushed by other rural centres. It is considered to be a consequence of the push factors and pull factors such as unemployment, rural poverty, unavailability of socio-economic facilities and services.

For a detailed analysis, a set of seven urban facility variables and another set of four road transport variables have been selected to assess the relationship. To evaluate the road transport network characteristic four variables of transport such as connectivity, nodal accessibility and metalled road density measures have been selected. The inter-relationship among all these variables, functional interdependence and complementary characters of development of urban centres have been evaluated, with the help of statistical tools such as correlation coefficient analysis with computer aided program SPSS.
The results point out that there is moderate positive relationship between the variables of road transport and urban facilities in Rohtak division. The 'r' values more than 0.30 are significant at 0.05 levels and below it are less significant or insignificant. Among 'r' values it is found that electrification per 1,000 persons (P_1) shows comparatively good relationship with local degree roads (P_7) 'r'=0.54, 0.44 with weighted road capacity (P_6), 0.51 with connectivity (P_9), 0.39 with metalled road density (P_10) and 0.53 with nodal accessibility (P_11). It means level of electrification in Rohtak division is influenced by road transport facilities.

At the same time, percentage of workers (P_6) shows significant negative relationship with all selected attributes. It is because percentage of work participation rate is influenced by types of activities and in urban areas it is not positive correlated with the selected variables.

On the other hand all other variables show positive relationship with road transport i.e. literacy, education, medical and recreational facilities of the town. But these relations are in less significant association with most of these transport based variables.

At the same time the result of transport based variables have clearly brought out a relationship and a high degree of association among themselves. It is very general thing that all these variables are dependent on each other like metalled road density, local degree roads, weighted road capacity, nodal accessibility and connectivity.

At last we can conclude that the degree of association between road transport and development of urban centres is quite moderate and low in Rohtak division. But we can not say that there is no relationship between variables. On the other hand we can say that there is relationship but not very strong, because this relationship is disturbed by many factors such as urbanisation, population size and population density, growth of population, industrialisation and government policies etc.

**Main Findings and Suggestions:**

1). In Rohtak division Kharkhoda tahsil has been neglected in terms of road transport development. There is scarcity of all types of roads. Generally in a tahsil, major connecting links are other district
roads and Kharkhoda tahsil has least other district roads in terms of length. Due to the above reason, Kharkhoda tahsil is deficient one in road transport network. In order to improve road transport network in Kharkhoda tahsil there should be construction of other district roads.

2). Indri, Nilokheri, Ganaur and Meham have shown very high positive change in metalled road density during the three decades (1971-01). None of these tahsils are industrial and all are located between main district headquarters of the state. These tahsils should be properly developed in terms of industry and employment, in order to ease out the burden of population from overcrowded cities.

3). Panipat and Bahadurgarh tahsils show negative growth in case of metalled road length per lakh persons from 1971 to 2001. This is a very general scenario of tahsils having Class I cities in Rohtak division as well as in state and country. It does not mean that roads have not been constructed in these tahsils, but population growth is more than the growth of roads. The growth of population has become burden on road and urban facilities, so concrete steps should be taken to overcome this situation.

4). We find out that the Class I towns (Rohtak, Panipat, Bahadurgarh, Karnal and Sonipat) grow very fast in comparison to small and medium towns. There is a great need of such policies which encourage small and medium town to grow so as to slow down the expansion of large cities. The strategy would be to induce growth by developing infrastructural facilities in the hinterland. To check the population growth especially in overcrowded with medium and low development towns, the inward migration of people into the cities has to be regulated through preventive measures by the concerned authorities.

5). Gohana town is located on National Highway No. 71A, connecting National Highway No. 10 and National Highway No. 1. The town is located almost in the middle part of Rohtak division and has high level of connectivity and accessibility with other towns. This is a very suitable site for industrial development in order to ease out population pressure on Rohtak, Panipat and Sonipat.
6). Since inception of Haryana state, urban facilities are quite good in Nilokheri. As the urban population increases, the small and medium towns with low development infrastructural facilities become unproductive. The same is also quite true for small towns having good urban facilities like Nilokheri, Indri and Jhajjar. If this trend continues for two or more decades, such small and medium towns will be neglected resulting the overcrowding of larger cities with increase of pressure on their facilities. It is very important that a development strategy should be planned for small towns.

7). It is observed that cities of Rohtak division are growing much faster which are located along the major highways. There is a tendency towards ribbon type of development along the roads. There is a need that the zoning regulation may be prepared and implemented by divisional developments along the major roads and corridors which are stream-lined effectively.

8). A case study of Rohtak city reveals that the open and agricultural land is reducing continuously, because of the demand of urban land for population settlement. Park and open spaces are imperative need of the hour for better environment. These have to be planned and places should be earmarked for this purpose.

9). In Rohtak city the growth of residential area is second highest but administrative and public utilities show less growth, which indicated haphazard expansion of the city. Hence it is concluded that growth of the city is not substantial. Public utilities should be planned in accordance with residential area in order to have a sustainable development.

10). To minimize traffic congestion, the major roads have to be widened, proper circulation planning has to be done, shifting of wholesale markets and shifting of bus stands to outer areas in the large urban centres of Rohtak division needs to be undertaken.

11). Peripheral parts of the Rohtak division seem to be deprived area awaiting further development thrust. Independent economic functions (Special Economic Zones) need to emerge in the towns which will act as booster for development of surrounding areas.
12). The Transport focal points of the sub region are to be identified and planned. Road network in the fashion of ring roads and bypass roads should be developed around which ultimately facilitate the rural area to be linked through transport network of the region. This also will ensure adequate level of development in expanding urban areas.

13). The uncontrolled and unregulated physical expansion of the built up area in the highly accessible areas is serious environment problem. In future, our urban centres will be transformed in the areas of concentric tower with horizontal and vertical expansion. Forestation and plantation become important along the roads for our better environmental conditions.

14). The correlation analysis reveals that there is a positive relationship between road transport and urban processes, but this relationship become weaker with the passage of time due to heavy growth of population. This is an indication of over urbanisation and in order to avoid this, we have to control urban population growth to maintain the growth of roads.

15). With the help of Remote Sensing and Geographic Information Systems various databases can be generated in less time and can be flexibly compared to conventional methods for their better utilisation.