Chapter I. A PERSPECTIVE ON THE PROBLEM

A Focus on the Theme:

Civilisation is by and large the product of circulation, which denotes the flow of people, armies, material goods, capital, messages, thoughts and ideas across the space open to man's activities (Gottman, 1952). There are many media through which this flow is made possible from the circulatory system, which includes the transportation system, an important one. It
has well been said that the roads and the railways are the arteries of any nation, and the traffic that flows along them is the blood stream that gives it life. (Hawks, 1936).

Transport is that it is something which affects almost everyone in the course of their daily activities. Transport by definition implies a movement, and every individual from an early age possesses his own 'built in' ability to move albeit within a limited area. As standard of living in industrial societies increase and the economy becomes more and more complex, the reliance becomes almost totally dependent on transportation.

Transportation is a measure of relations between areas and therefore an essential part of Geography (Ullman, 1954) and it is also further stated that transport is essentially a geographic phenomenon (Eliot Hurst, 1974).

The term 'transportation' denotes that the action or process of carrying goods or persons from one place to another and the means used for such convenience.
The aim of transportation is to set man free in respect to place relations and to make these relations more plastic to social needs (C.H. Cooley, 1894). The social needs and necessities of any region can be achieved only from the quality of transportation system. As human settlements increased in size, the need for improving the circulation of goods and people became ever more acute.

Transport network plays a vital role in the socio-economic development of various spatial locations and in creating new settlements and special links thus had areal interactions and thereby bringing different areas into the mainstream of economic and cultural life. It is pertinent to state that the transportation is becoming an increasingly important aspect in the process of urbanization, industrialization and modernisation thus which have had mutual influences. The development of transport network, in short, could be made possible much larger sizes of population clumps and economic activities thus contributed to a great increase in the built-up area and productivity.
Transportation once provided and developed, it influences profoundly the direction and character of the region's development in turn and hence its planning should form an integrated part of any regional planning. The transport sector may, with some justification, may be regarded as an epitome of relationship between terrain, economic history, social and political systems and levels, and patterns of development (Hoyle, 1973). Hence, transportation is a dynamic character and it is spatially variable. Transportation system is a catalyst in agricultural change, an index in determining market hierarchy and also an essential requirement for mining and modern industrial establishment.

Since most people live away from their normal place of work, transport is demanded because of the need to get quickly and safely from home to work.

In economic language, the demand for transport is a derived demand. Transport is useful in so far as it provides a service and is referred to by economists as being a factor of production. Roads, railways, ships, buses and aeroplanes are various forms of capital but unlike natural resources,
capital is man made since man has to create it for himself. Transport, therefore, is a form of capital good, in just the same way as a piece of factory equipment, but while the latter is a possession which can be used physically to produce goods, transport is a possession which is used to produce a service. Thus, transport provides a means of moving persons or goods from one place to another.

A producer of consumer goods requires transport in order to move goods from his factory to the wholesalers and retailers who sell his goods. Transportation provides link between the supplier and the market. In geography of transportation, transport is a line pattern which describes spatial locations and their interactions and interrelationships. Transport is essentially a spatial phenomenon which seeks to describe the spatial organisation of all economic activities and the overall economic development over a space and time. Transport is really a fundamental asset and it is one type of national resources (man-made) satisfies human wants either individual wants or the nation as a whole including the enjoyment of all.
Modes of Transportation:

Different means of transport may be grouped under three main divisions:


Following the definition of transportation, different modes of transport are to be met with in the different parts of the world. Differences are largely the results of a combination of geographical, economic, social and historical factors. A close examination of the world transport system reveals the following modes of transport.

1. Human porterage and human traction.
4. Railways.
5. Air-transport.
6. Rope ways and cable ways.
7. Pipelines.
8. Inland water transport.
There are four necessary requirements of any mode of transport.

i) The route - this is the way, course or track taken by transport.

ii) The vehicle - this is a requirement for the carriage or conveyance of persons or goods by any means of transport.

iii) The motive power - this is the form of natural or mechanical energy used to drive or propel the vehicle or carrying unit in which transport takes place.

iv) The terminal - since transport is concerned with movement between an origin and a destination, the terminal is necessary for access on or off a particular transport network.

The Growth and Development of Transport Geography:

Transport network is a set of geographical locations or nodes interconnected in a system by a number of routes. In other words, networks are structures designed to tie together nodes via routes, whether they are flows of people, goods, money or information or anything that is moved one place to another.
The study of 'net work Analysis' or transport system and its interaction had its birth in the later period of 19th century. This type of study, in descriptive basis, got its due importance as early as 1850. In 1894 C.H. Cooley has stated that "..... there can be no adequate theory of transportation which has regard only to some one aspect of its social functions, as the economic aspect. This is not only aspect, not can we only truly say that it is more important than the others. All are co-ordinate, equally indispensable to social progress".

In 1850, a German Geographer, J.G. Kohl has created a series of branching networks to serve the settlements in an idealized city region. A century later his ideas were taken up by W. Christaller (1933) in his 'system of central places' in Southern Germany. Their approaches built up a significant descriptive account of transport nodes, stocks, networks and flows.

Until the 1950's most work came from European rather than North American geographers. This early work revealed a difference in approach between them, although they both fall under the general rubric of 'description'. It is significant to note that a few academic exercises which have been
made in transportation geography in North America were concerned with route classification, descriptive mapping of route location and flows. Whereas European Geographers concentrated on modes of transportation and commodities carried.

In 1950, Edward Ullman has attempted to establish a broad base for theoretical approach to transportation. He laid out a three factor typology to explain movement or interaction between two areas. 1. Complementarity, in the cultural or economic sense of a demand in one area that the other area can supply. 2. Intervening opportunity, which can inhibit interaction between the two areas because the demand can be more easily met by a third area; and 3. Transferability, which involves substituting one demand for another when the fractional effects of the distance between the two areas lessens the likelihood of interaction.

The modern era brought data explosion in the field of transportation geography besides the quantitative revolution. New methods of study such as location theory, spatial analysis and regional science and various analytical techniques such as factor analysis and linear programming were
introduced in transportation geography. Another important change that took place during this period is the flow of more studies from North America rather than Europe (Berry, B.J.L. 1959) which introduced the graphic matrix to relate transport with space economy. The matrix analysis of columns and rows leads to the clear understanding of the transport network. The introduction of Quantitative Stream of spatial analysis and varied techniques such as linear programming promoted transportation geography much on scientific approaches. Among various scholars, Garrison and Kansky (1963) introduced the graph theory application in structural analysis of network.

Kansky (1965) defined the transport network as a set of geographical locations interconnected in a system by a number of routes. According to him the transport network analysis includes three components. The first component is the network linkage pattern which is making up transport system, as it facilitates the movement of goods, services and ideas to combine and form flows and the second component is the interrelationship of a network through connectivity and the third component is the flow pattern.
Vasilevskiy (1963) also identified an almost similar approach in network analysis. He dealt with the following three components namely, (i) the study of network by location, structure and evolution, (ii) the flows of network and their significance and (iii) impact of networks and flows in the economic and social system.

In the early part of 1970's much of the studies on network analysis emerged on the basis of graph theory. During 1970, the entire network analysis was reviewed into three approaches namely, (i) the structural pattern of the network and the relationship between topology of network and real world, (ii) evolution approach of network highlighting the factor that made progressive nature on network and (iii) the centrality or the importance of the nodes and their functional importance in the network system. Later, Wheeler (1971) has designed three research frontiers in transportation on the basis of the earlier contributions. They are (i) networks, their location, structure and evolution, (ii) the flows on network and (iii) the significance and impact of networks and flows on the space economy.
The network analysis of the above said three frontiers, exhibit, how changes in accessibility may result in nodal growth or decline. However a decade after Kansky (1963), Taffe and Gauthier (1973) have revised its strong foundation by their structural analysis of transport network. They evaluated some aggregate scores in order to provide a better basis for the comparison, growth, evolution and accessibility of network. Thus one can obviously notice from the above facts that the network analysis, by using graph theoretical measures pertaining to all the three approaches, got its momentum only in the recent past.

For instance, the determination of route development, size and pattern, spatial structure, centrality of the nodes, accessibility of the nodes, efficiency and flow pattern of the network have been explained through various graph theoretic measures.

Contributions of Indian Geographers in the Geography of Transportation:

Geographical studies on transport network system of the country have been mainly attempted on a regional basis.
The first schematic attempt was made by Sourirajan (1929) on the study of Buckingham canal to understand the navigational problems of an inland water ways system in India. He analysed the impact of relief and other geographical factors on inland water transport system and correlated with the economic progress of the region. The study of transportation network system at regional level was first initiated by Subramanyam (1930). He attempted to study the transport network in different parts of South India in which he described the transport network of the region in general.

Majid (1950) has made an attempt to study the relative density of transport lines in different parts of Bihar State. Majid also correlated the state's transport system with market accessibility. Kulkarni (1955) focused an attention on the communication problems of Maharastra State. Kulkarni assessed the importance of transport system in boosting agricultural produce, locating industrial centres, raising the cultural status of the people and evolving a closely woven community by facilitating the communication of ideas and goods. Guha (1955) has made an attempt on the traffic flow in the greater Calcutta area. Sinha (1957)
has examined the transport problems of Orissa State indicated the inadequate development of road transport in that state. Mukherjee (1958) and Singh (1959) discussed the requirements of transport network in West Bengal and Allahabad respectively.

Kayastha (1960) referred to the problem of construction of communication lines in the sub-Himalayan Beas Basin and linked the existing transport facilities with the development of the area. Singh (1961) worked out the railway traffic densities and identified their main patterns in South Bihar.

Research studies at the department of Geography, Banaras Hindu University, Varanasi initiated the studies of regional transport integrating both morphological as well as functional aspects of transportation networks. Singh J. (1964), Agarwala, D.L. (1967), Singh D.N. (1968) have used the above approach in their studies conducted in South Bihar, Uttar Pradesh, and North Bihar respectively. Lakshmi (1967) has identified the pattern of railway traffic flow in Madhya Pradesh.
Recently, some efforts have been made to apply the sophisticated techniques in the area of geography of transportation. The graph theoretic technique has been used to study the network, characteristics of Tamil Nadu region (Ramachandran, 1974). On the flow pattern, a simple transportation model of linear programming has also been applied. A study of the hierarchy of nodes in Punjab region has been studied by Neera (1976) on the basis of station to station movement data obtained from the railways. A study of comparative efficiency of the Eastern and Western railways has been initiated by Naqui (1976) which should eventually reveal the character of two zonal railways for policy considerations. Raza (1976) has collected station to station data of goods traffic of Indian economy which could be revealed from flow patterns.

Recently several studies on geography of transportation have been attempted at micro levels studying different topological aspects namely connectivity, centrality, accessibility, efficiency, flow pattern and etc., at profound level in different parts of the country.
Importance of the present study:

Transportation is the blood stream for any well developed economic system (Hoyle, 1973, Morrill, 1974). Transportation plays a crucial role in the development of rural agrarian economy of any region. The pattern of transport network is significantly very important in the backward areas where agriculture is predominant and which performances and accomplishments are unstable and precarious. In arid and semi-arid tracts, the spatial distribution of population and settlements is generally sparse and very dispersed. The interconnections and interactions of people and places and spatial linkages in dry areas could be examined well with the help of network analysis.

For the development of any backward region in terms of either agriculture, industry, educational or any some other helpful activity, the development of transport network, preferably surface transport, is very essential. It breaks out the traditional outlooks of the people of backward rural areas and develops technological insights and improve the socio-economic conditions of the people. In the present
study, it is very clear in the case of drought prone area of Anantapur district in Andhra Pradesh that transport network has a significant role in the planning and development of the district.

The Problem:

The transportation Geography in a spatial context is stressed by many Geographers (Taffe, 1973, Alan Hay 1973). It deals with the measuring and mapping of traffic flow of goods and passengers, volume and speed, origin and destination etc., in varying environmental conditions affecting movement. The land use of the area plays a major role in determining the traffic. Traffic is a joint consequence of land use. The careful analysis of existing road network becomes an essential one in the case of such growing area of the district to improve their network facilities in order to increase the connectivity and accessibility of its surroundings. Comparatively, the road network could touches intensively all directions and distances as well as all types of human settlements of the region than the other modes of
transport network system. Hither too in the backward areas where agriculture is the predominant source of economy, the road network necessarily plays a significant role in the improvement of socio-economic conditions.

Considering several advantages of road network, the present study, 'Road Transportation in the Drought prone Area of Anantapur district' has been chosen for its analysis. It focuses the spatial organisation of transport network system like accessibility, connectivity, road efficiency and traffic flow. This endeavour is likely to provide greater scope for formulating a better strategy for regional development and planning of a district.

Aims and objectives of the present study:

In the present study an endeavour is made to examine the pattern, efficiency and flow of road network in Anantapur district. The present attempt also aims to understand the existing problems of road transport network in the district at a micro level.
The main objectives in the present study are as follows:

(i) to study the characteristics of existing system of road transport network and their changing structural pattern.

(ii) to identify the growth of road network, if any,

(iii) to analyse the nodal accessibility in terms of node linkage relationship in order to understand the spatial organisation of road network.

(iv) to examine the degree of passenger flow by road.

(v) to measure the road route efficiency in the region, and

(vi) to make suitable suggestions to eliminate for existing imbalances and plan for integrated area development.

Hypothesis:

The following hypothesis are tentative consideration for the present analysis.

1. Higher degree of connectivity and accessibility greater will be the value of centrality of nodes.
2. Higher the degree of dispersion in distribution of human settlements lower will be the degree of connectivity and accessibility.

3. The intensity of flow is decreasing towards the periphery of the network from the urban centres.

4. The intensity and the pattern of traffic flow is directly proportional to density of population and the level of socio-economic conditions of people.

The Scope:

The present study "Pattern of Road Network of Anantapur District" falls in the purview of transportation geography. However in broad conformity it also touches with economic geography, regional science and regional planning. The objective of national planning is not only a technique of transforming geographical space but also integrating and harmonising the development objectives of various sub-national units. Transport network plays a paramount role in achieving this goal especially the development of backward regions.
Selection of the Study area:

Most of the geographers have been worked in transportation geography at a macrolevel i.e., country level or state level (Gautheir, Taffe, Singh et al.), Quite a few number of studies have been made at micro level. The present study is also attempted at micro level taking one district namely, Anantapur, which has been identified as one of the severely drought prone and the most backward region of India, next to Thar desert (Jaisalmer district in Rajasthan). The frequent occurrences of drought, prolonged dry spells and crop failures have had a shattering effect on the agricultural economy of the people of the district. The agricultural development, improvement in the socio-economic conditions and standard of living are all rely on proper communication and transport network system in the district. Agriculture, mining, trade and commerce, industries etc., can be developed with an efficient communication and transport system because transportation system forms the main infrastructure for over all development of the district.
**Data Base:**

In the present study both secondary and primary sources of information have been collected. Pertaining to preliminary data i.e., length, distance, type of roads etc., is concerned, it is generated from the map and is used for the network analysis.

The secondary data is collected from various offices. The data relating to maintenance of roads, distribution of route lengths is collected from the Regional Transport Office. The number of trips generated from each place is collected from various bus depots.

The public sector transport that is Andhra Pradesh State Road Transport Corporation (APSRTC) has yielded data which is collected from the Divisional Officer at Anantapur Town. The data related to economic aspects of the study areas have been collected from chief planning office at Anantapur. Maps pertaining to villages and mandals are collected from Land and Survey Records Department. In addition to these, the data are supplemented wherever necessary by field work.
Methodology:

The road location, distance and capacities of traffic are listed and illustrated diagramatically by means of cartographic representation. However, they have failed to provide a better understanding of structural properties and the spatial interaction patterns of the road network. In order to provide a better basis for comparison and evolution of network through time and to protract structural properties and interaction pattern of road network, cartographic representation is imperative in geographical studies.

The structure of transportation network analysis is carried out by the application of graph theoretic measures of individual elements of network. The development of road network and its spatial organisation in Anantapur district is analysed by the node to node in terms of node linkage relationship. Transport capability has been studied by the number of bus trips at each place. The suitable cartographic techniques are used to illustrate the result of various findings of the present analysis through suitable maps.
Limitations of the Study:

For the purpose of the present study, selection of nodes for the analysis is made on the following basis:

a. all the urban settlements,

b. all the administrative important head-quarters at Mandal level and,

c. all settlements with a population of 5,000 or more.

The selection necessitated since Anantapur district is fairly a large district in Andhra Pradesh consisting 63 Mandal possessing 935 inhabited rural settlements and 11 urban settlements. The selection naturally imposes certain amount of limitation in the study.

For accessibility analysis all the settlements which are located on the map are taken into consideration. Here a National High way, State High Ways and major district roads are taken to measure the degree of accessibility.
For the traffic flow studies only passenger traffic is considered. This is calculated by the number of trips generated from each node.

Organisation of the Dissertation:

The present study is divided into 7 chapters. In the first chapter, the conceptual framework of the problem, review of literature and methodological approach have been incorporated. An attempt is also made to highlight the importance of transportation study and its interdisciplinary nature for regional development. Chapter II briefly highlights the profile of the study area relating to the geographical aspects like location and physiography, socio-economic characters like population, occupation, land use etc. These are discussed with special reference to road transport network. In third chapter, evolution and growth of road network in Anantapur district are discussed. Here an attempt is made to study the factors influencing the road transport network in the district. In fourth chapter, application of graph-theoretic measures, establishment of node linkage relationship, matrix analysis, detour index analysis are attempted to examine the structural patterns of road network in the district. The deve-
velopment of road transport system during the past 30 years is also analysed. In fifth chapter, the nature of road accessibility of all the settlements in the district is measured and discerned. Here an endeavour is also made on traffic flow analysis. In this analysis only number of passenger trips is taken into consideration on the basis of the number of trips plying in each route. In sixth chapter, the problems, perspectives and planning of the region with reference to road transportation are discussed. The last chapter includes summary and conclusion about the present study.