Chapter 1
Introduction

1.1 Context of the Study

The transportation system, particularly the highways, plays a crucial role in the development of any region in two ways. Opportunities of mobility of people and goods are created immediately whereas better accessibility in the long run influences the pattern of growth, land use and the level of economic activities in positive direction. Hence, the study of interrelationship between growth of transportation sector and regional economic development is a matter of practical as well as theoretical importance which has received considerable attention in both developed and developing countries (Banister, 2002). In this thesis, this accessibility issue is studied for a less developed state, Tripura which has lost its connectivity link with the mainland of India during partition in 1947. Before partition, Tripura was very much connected with India’s heartland both by roads and railways. So, no need was felt to connect Tripura with the rest of the states in the northeast. But the partition made Tripura an extreme outpost not only from the heartland of India but also from the northeastern region (NER). After partition, Tripura emerged as a mirror image of the whole NER encompassed with ethno-geographic and bio-geographic location (Barkakati, 1985: Bhattacharyay, 1989). It was land locked- an outpost away from the remaining parts of the country, only connected by tenuous Churaibari corridor. Though it shared some boundary with neighboring Mizoram state but smooth

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1 In 1947, August 15, India got independence and bifurcated as India and Pakistan. At that time, Tripura was a Princely state and formally integrated with India on October 15, 1949.

2 The NER comprises of seven states viz. Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland and Tripura (known as Seven Sisters). Recently, the state of Sikkim is also incorporated into this region.

3 Churaibari is a small town in North Tripura in the Assam border. The land custom point at Churaibari on NH-44 is known as the gateway of Tripura.
transportation was not possible due to the presence of Jampui Hills in Tripura Mizoram border. The remaining boundary is covered by Bangladesh in the whole western, southern and maximum portion of the eastern side.

As mentioned earlier, partition makes Tripura partially landlocked region. There may be several reasons behind this underdevelopment but, undoubtedly, lack of proper communication with the rest of the country as well as with the neighboring north eastern states aggravates the problem. This may be identified as a pseudo landlocked region (Sen, Gupta and Mukhopadhyay, 2013) where being a part of the Indian territory this particular state is not landlocked in true sense but the feasible road distance from the nearest sea port i.e. Kolkata port is more than four times the Arial distance from the same, ultimately, makes this state economically landlocked. After partition, the immediate need was to connect Tripura with the northeastern region. Assam-Agartala road project via Churaibari was found to be the only economically viable project (Das, 2009). The then central government constructed the Assam-Agartala road through the hilly region. As a result, a well-connected native state became an isolated land locked region with its immense geo-strategic importance in the face of political tension between India and Pakistan (Gopalkrishnan, 1991). The demand of Tripura was, however, something different. The Assam Agartala Road (NH-44) project up to Assam border was advocated through the plain land parallel to the international border with the then East Pakistan in western part of Tripura.

This was the view, which took shape historically among the people in Tripura, though no economic viability test of this project is there in the existing literature. Due to the presence of open borders without any fencing, the Central government rejected the demand of the people and constructed the Assam-Agartala road NH-44 through the hilly range covering Baramura, Atharomura, Longtarai valley and Panisagar hill (a part of Sakhangh range). In fact, during 2004 the Asian Development Bank has also proposed realignment of the present NH-44 road network, which is the only lifeline for Tripura. The proposal of realignment of present NH-44 network is more or less similar with the proposal initiated by the people of Tripura in traditional line.
Development of the State requires the existence of viable road network in Tripura. In case, if the alternative to this present NH-44 is implemented either through realignment or by something else, the transport cost for both inflows and outflows of commodities from Tripura will be cheaper. The State Government of Tripura is continuously demanding for transit route through Bangladesh but the latter country was not ready to implement this, at least up to 2009, because of possible threat of loss. Recently, an attempt has been made to establish the connectivity link between Kolkata to the NER of India through Bangladesh. In the absence of a land transit link between India and Bangladesh, the traffic between Kolkata and NER of India is mainly carried by rail and road links through the Siliguri\textsuperscript{4} Corridor and the requirements of additional transport costs for carrying goods is staggering (Sobhan, 2000: Rahamathula, 2004). To transport goods to and from the NER of India through the corridor, a huge amount is being spent as additional costs to transport goods and services to and from NER of India. As such, as a transit/transshipment route through Bangladesh can integrate the northeast India with its mainland and is set to reduce transportation cost significantly.

1.2 Measuring Transport Network Efficiency

There are several ways to measure transportation system performance and most of the methods concerned about three basic aspects namely Vehicle traffic, mobility and accessibility. Out of these three methods, Vehicle traffic is easiest to measure, but this approach only considers a narrow range of transportation problems and solutions. Mobility is more difficult to measure which requires tracking people’s travel behavior. Accessibility is most difficult to measure but most accurately reflects the ultimate goal of transportation, and allows widest range of transport problems and solutions to be considered. Hence, there is no single way to measure transportation performance that

\textsuperscript{4} The NER of India is connected with rest of the country with 22 kilometers tenuous chicken neck shaped corridor in the state of West Bengal, popularly known as the Siliguri corridor.
is both convenient and comprehensive. Different optimality criteria for different networks have been developed and studied. In the case of road networks within a region, an “optimal” network is synonymous to the notion of shortest routes between any two nodes in the network (Aldous and Shun, 2010).

To measure the efficiency of any road network, this study has identified the following approach. The Conventional roadway planning evaluates roadway efficiency based primarily on motor vehicle travel speeds which requires increasing roadway capacity and design speeds. This supports roadway expansions. Secondly, the Traffic network planning evaluates roadway efficiency based on automobile access, and so recognizes the reduced travel distances that result from more connected road networks. This approach stressed on increase in the degree of road network connectivity. Thirdly, the Accessibility-based transport planning the access to services and activities such as education, employment, shopping and recreation. This approach also based on road network connectivity, support efficient modes, and encourage more accessible land use. This justifies integrated planning that increases transport network connectivity and supports more accessible and multi-modal community development. Fourthly, the Economic efficiency refers to present status of the road network against its expected standards. Finally, the Planning efficiency refers to the degree that planning activities are comprehensive and integrated. This is functional way to develop more accessible and economically efficient roadway systems. From this perspective transport systems are most efficient if planned, designed and managed to support strategic objectives (Bell, 1983).

Hence, to assess an integrated road network, a proper evaluation of road network structure is otherwise essential. This helps to identify the relative importance and performance of each node into a network context. It is a useful initial process to prioritize sections of the network for future works, and therefore, optimize the allocation of limited funds to maximize benefits to the region as a whole. Network planning assists in the development of a broad vision of how the road network could be improved to enhance performance in the future. This also helps to identify relative deficiencies on the road network and justify the assumptions often reached by
intuition and dialogue alone. This type of analysis is at the highest level producing results that tend to be broad and indicative. It serves as a means of gaining an understanding of the whole regional road network and how different parts are performing in comparison with each other (Bianco, 1987). Network measures provide a means of comparing performance both spatially and temporally, and can form a basis for developing strategies to move towards more desirable levels of performance. An important issue in formulation of transport policy is the trade-off between maximizing the socioeconomic efficiency and developing regional equity (Nijikamp, 1986)

1.3 Objectives of the Study

The primary objective of this study is to develop a practical analytical method to support sound investment and policy decisions for the planners at different levels to build an efficient road network system in Tripura. Accordingly, the area of research which is proposed here is basically an attempt to explore the possibilities of a viable road network which can respond to (1) the demand for communication by people of Tripura, (2) the demand of Tripura’s projected economy, and (3) efficiency in Tripura’s road transport network.

The objectives of this thesis are as follows:

1. To investigate the nature and trend of regional disparity and convergence of availability of national highway across the states with special reference to Tripura.

2. To examine the economic viability of an alternative internal road network in Tripura.

3. To examine the economic viability of an external road network for Tripura as a complementary to its internal road network.
1.4 Related Studies

Corresponding to the first category of research, the present road network system in India, particularly NH network across the states has been reviewed. In India, NH network plays an important role in the sustained economic growth of the country. At present, the NH network consists of only 1.7 percent of the total road network in India, carries more than 40 percent of total traffic. In December, 1943 Nagpur plan was formulated which emphasized on a well balanced road system, particularly NH network, for India which can carry the projected quantum of traffic and the developmental needs of the country. After independence in 1947, Indian planner has adopted a mixed economy structure where government is committed to provide equal opportunity to every segment of the society and every region of the country an equal opportunity to grow in terms of availability of infrastructure (Hirschman, 1958). Accordingly, investments in developing NH network, in particular, are often given high priority because they appear to be unique instruments for fostering economic growth and social progress which is supported by Kuznets (1960). On the other hand, the balanced regional growth is one of the principal objectives of the developing world, the major precondition for attaining such goal, however, is the availability and flow of required quantum of infrastructure in the economy. The systematic and spatial interaction approach to the study of transportation was first developed by Ullman (1958) who has attempted to measure the significance of complementarities through the application of gravity and potential notions since the expansion of the transportation network is a critical factor in the economic growth of any developing country. Starting from 1947, the government took the basic responsibility of building infrastructure base for the whole country with its limited resources. Since, the need for economically efficient transport system in the course of economic development is self explanatory, over the Plan periods; government took special initiative to build this infrastructure base, particularly nationwide in a balanced way considering mainly two criteria- population and area of any region. Although, the literature on effect of highway investment is well documented, the issue of interstate disparity of availability of NH network in India has not been discussed yet.
Corresponding to the second category of research, this study first try to identify the appropriate shortest route algorithm and then try to evaluate alternative proposals of route to identify the efficient one among the available alternative proposals. Choosing an efficient route in real road network is a critical task in transportation network analysis. The existing literature on transportation network is mainly concerned with the identification of shortest path algorithm (Zhan and Noon, 1996) and computation of appropriate shortest path in real road network in terms of distance or cost (Jiallei Wang et al, 2007). In a recent study (Zhan, 1995); a set of three shortest path algorithms that run fastest on real road networks has been identified. These three algorithms are the graph growth algorithm implemented with two queues, the Dijkstra algorithm implemented with approximate buckets, and the Dijkstra (1959) algorithm implemented with double buckets. However, in the literature of Transport Economics, the Floyd-Warshall’s algorithm (1962) is an improvement over and above the Dijkstra algorithm in the sense that the former is considering the shortest distances between each and every nodes of a network under study where as the latter is concentrating on the shortest route between any two nodes of that network. In this sense, Floyd’s algorithm may be taken as a generalization of the Dijkstra algorithm (Rardin, 2003). The existing literature on shortest path algorithm was further modified in this study by considering the relative weights of each node under study by the corresponding vehicle movement. Accordingly, the alternative proposals have been evaluated in terms of a weighted Floyd’s shortest path algorithm in the real road network of Tripura.

Corresponding to the third category of research, this study attempts to review the issue of transshipment from Agartala to Kolkata port through external transportation link. For this the existing literature on transit transportation has been reviewed with utmost care. Though Article V of the General Agreement on Trade and Tariff (GATT), 1994, popularly known as ‘Freedom of Transit’ (UNCTAD, 2003) try to

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5 Floyd-Warshall’s Algorithm was developed independently from each other by Floyd (1962) and Warshall (1962). Instead of computing a path from a given start node to all other nodes (or a single destination node), all shortest paths for each node to all others, are computed within a single loop.
ensure optimal conditions for transit, there are indications that, on the ground, real freedom of transit is often absent or compromised (Arvis, 2005; Amjadi and Yeats, 1995; Bloom and Williamson, 1998; MacKellar et al, 2002). The World Bank (2004) stresses the need to address more systematically access issues, especially for those who are mobility impaired. This is particularly the case for most of the Land Locked\(^6\) countries which does not have any sea coast (UNCTAD, 2002; Ventor et al, 2003; Maunder et al, 2004). As a result, in order to trade with the rest of the world, these countries must depend on the neighboring one or more countries for transit to reach the sea. The basic reasons behind the disadvantageous position faced by the landlocked countries from their immediate neighbor(s) with a feasible gateway are either due to imposition of unnecessary costs for military or economic incentives force the former trapped into the vicious circle of lack of transport connectivity (Radelet and Sachs, 1998; Gallup, Sachs and Mellinger 1999; Limao and Venables, 2001: MacKellar et al, 2002). However, Article V of GATT, is mainly concerned with the transit facility for landlocked countries but the problem of economic landlocked region of any country is not considered in particular where any region being a part of the coastal country cannot be termed as landlocked in true sense but the feasible road distance from the nearest port in its own country is far away than that of through another country, ultimately makes that region economically landlocked (Sen, Gupta & Mukhopadhyay, 2013).

In that case, it is an economic imperative for that region, in particular to seek greater regional integration through transit and or transshipment facility to integrate economically with its own country through another country(s). The problem is acute when the pseudo landlocked region is left with only one feasible transshipment route to integrate itself economically with its own country, ultimately leads to monopoly tendency or to impose unnecessary costs by the transshipment providing country. It is a fact that the transshipment providing country treats this as economic resources and expects a high return from that. Taking this as granted, this study attempts to investigate the process of determination of equilibrium transshipment charges of that

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\(^6\) At present, there are 42 landlocked countries. Except for the few, the rest are all least developed countries (LDCs). In SAARC region, there are three landlocked LDCs: Afghanistan, Nepal and Bhutan.
economic resource. So, the debate on the possibility of a viable road network is relevant for economic progress of the state.

1.5 Data & Methodology

This study is basically an empirical research and the data has been collected mainly from Secondary sources. Corresponding to the first objective of this study, secondary data has been collected and this study has utilized the σ-convergence approach to find the trend of dispersion in availability of national highway across the regions in India over the plan periods. Then, the nature of interstate disparity is measured using Club convergence technique and lastly, the extent of regional disparity is decomposed with respect to area and population criteria using AGC index. Corresponding to the Second objective of this study, both secondary and primary data has been used. The broad objective is to find the best possible route considering the alternative proposals in the real road network of Tripura. Accordingly, this study has applied Floyd’s algorithm to find the shortest path within the road transportation network of Tripura. Corresponding to the third objective of this study, the data has been collected from secondary sources. The game theoretic approach here is primarily used to understand the regional political dynamics that influence the sustainability of transit route from Kolkata to north eastern states in general and for Tripura, in particular and it may also provide different courses of actions for India, to exploit, in order to ensure affordable transit route for its north eastern states.

1.6 Organization of the Thesis

Apart from this Introductory Chapter, the remaining part of this thesis is organized as follows:

Chapter 2 reviews the existing literature and identified the research gap in the existing literature. This helps us to formulate the objectives of this thesis. Chapter 3
looks at the methodology and data related with this thesis. Corresponding to the broad objectives of this thesis, methodological aspects are considered. **Chapter 4** investigates the nature of regional disparity and convergence of availability of NH network over the period 1951 to 2011 across the states with respect to population and area criteria. The relative position of Tripura with respect to the NER of India, in general and with respect to All India level is discussed. **Chapter 5** evaluates the economic viability of internally efficient road connectivity in Tripura in terms of an appropriate shortest path algorithm available in the existing literature. **Chapter 6** evaluates the viability of an efficient external route link for Tripura with its nearest sea port in India that is Kolkata through Bangladesh. This chapter, further, extended the model developed by Sen, Gupta and Mukhopadhyay (2013) to investigate the economic viability of an integrated road transport network in Tripura in terms of combining efficiency in internal and external road network for this state. The game theoretic approach, here, is primarily used to understand the regional political dynamics that influence the sustainability of transit route from Kolkata to north eastern states in general and for Tripura, in particular. Finally, **Chapter 7** presents the conclusion of the research. The limitations of this thesis and the future direction of research in this issue are also presented here.