Chapter 2
Review of Literature

2.1 Introduction

India’s north eastern region (NER) is among the most endowed states in terms of the natural resources and is at the door-step of the East Asia, the region with which India is increasing its economic ties. But despite these advantages, the NER has remained one of India’s economically laggard regions, which accounts for a mere 2 per cent of India’s Gross Domestic Product (GDP) in 2009-10. High transactions costs arising out of inadequate transport systems connecting the NER with the rest of India and the neighboring countries and the lack of other essential infrastructure have rendered the region economically in underdeveloped state (De, 2008). The distribution of population is also uneven across the states. Assam and Tripura are top two densely populated states in NER, sharing almost 96 of the total NER population as per last census report. During pre independence period, under the British Colonial rule, majority of the population in the valleys and plains used to bank on the vast river systems and small rivulets for livelihood. The railway system was developed between Dibrugarh to Chittagong to support the rapid spread of tea gardens starting from 1835 and the export of the first consignment of tea to London in 1838. The discovery of oil in Makum and establishment of a refinery in Digboi in 1890 laid the foundation for the development of the then undivided Assam. But after partition of India, the entire landscape of the region changed overnight. The NER was virtually disconnected from the entire country just leaving a 15 km Siliguri corridor as the only link. The natural sea route of NER through the port city of Chittagong was blocked. The access to the domestic market was also lost. The region shares 96 per cent of its boundary with the neighboring countries of Bangladesh, Nepal, China and Myanmar. The geo-political distancing of the region from its main port of Kolkata combined with economic
insulation has caused immense structural damage to the NER economy (Ganguli, 1969).

The NER shares about 96 per cent of this region’s borders with the China in the north, Bangladesh in the southwest, Bhutan in the northwest, and Myanmar in the east. NER’s locational advantage provides a backdrop to its development as a base for cooperation not only with the Association of Southeast Asian Nations (ASEAN) but also with neighboring countries such as Bangladesh, Bhutan, and Nepal. It is a fact that this region is an industrial desert and all most every consumable are imported from outside this region, geographically, it is the focal point of trade within a vast area in general and for Bangladesh and Myanmar, in particular.

Formal trade links between India and its two neighbors, Bangladesh and Myanmar, have remained at a very low level. While the share of Bangladesh in India’s total trade was about 0.6 per cent in 2009-10, Myanmar had an even smaller share of about 0.3 per cent. It should be pointed out that the level of two-way trade between the two dipped slightly in 2009-10 from the record level of US$ 3.2 billion registered in the immediately preceding year. In the same period, India’s two-way trade with Myanmar grew almost three-fold between 2005-06 and 2009-10 to reach US$ 1.5 billion (Bhattacharya and De, 2006).

As mentioned in the Chapter 1, the primary objective of this research 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. The first category of research involves investigation of regional disparity of availability NH network across the states and examining the position of Tripura in terms of such availability. This body of research focuses on an evaluation of government’s policy of expansion of NH network during the plan periods across the states with reference to the north eastern India in general and with reference to Tripura in particular. The second category of research involves identification of available alternative road network in Tripura and the determination of the associated net benefits out of available alternative proposals. The final category of research involves the
determination of possibility of an external road link for Tripura through Bangladesh. It also examines the stability of such external road link through optimal pricing of the proposed transshipment route from Kolkata to Agartala through Bangladesh and or Myanmar.

Accordingly, this Chapter first introduces a general literature review on relation between Transport network and regional economic development with special emphasis on effect of highway investment on level of regional economic development. Then, the issue of availability of infrastructure in general and availability of NH at state level in particular is evaluated during the planning periods starting from 1951 to 2011. The research gap in the existing literature will help to understand the nature of disparity in availability of NH at state level as well as determining the present position of Tripura in terms of availability of such NH network in Tripura. To determine the efficient route in the existing road network of Tripura, the literature on shortest path algorithm and its application on real road network are considered. From the last twenty years, the state government of Tripura is continuously demanding for such an alternative route and proposes realignment of NH network in Tripura where as the central government of India is not ready to accept that proposal right now and offering for phase wise up gradation of the existing network. Hence, a proper evaluation of these proposals needs to be reviewed with utmost care. Lastly, the literature on development constraints of landlocked regions is evaluated to identify the issue of transshipment from Kolkata to Agartala for Tripura considering the routes of Bangladesh and or Myanmar. The efficiency of road transportation network solely depends on the routes offered by Bangladesh and or Myanmar; thereby a viability test of such routes is essential to integrate Tripura economically with the mainland India.

2.2 Transport Network and Economic Development

This research begins with the work of Banister (2002) who observed that the transportation system, particularly the highways, plays a crucial role in the development of any region.
Recently, Weisbrod (2008) explained this in terms of a business decision-making perspective and identify the mechanisms whereby transportation can affect supplier and buyer markets and costs, affecting the pattern and magnitude of economic growth among various industries and locations. The view expressed by Weisbrod (2008) regarding the interrelationship between transportation improvements and economic growth and development has a strong historical base. The ancient caravan routes such as the Silk Road, the Spice Route and the Gold and Salt Route were developed historically to promote inert industry trade between the European markets with the rest of the world. When these trade routes developed fully, they became formalized as distribution networks that effectively expanded jobs and income for various producers, traders and merchants. Over time, continued infrastructure investments improved travel times, reliability and capacity. The Romans emperor built over 50,000 miles of paved roads to support a trade network of national defense and interstate commerce routes. In the same line, Gaza and later Caesarea were developed as intermodal freight center for connecting the ship routes in the Mediterranean through land routes towards Arabia and Asia.

An early federal report of US focused on the benefit of the interstate highway system as increasing access by appearing to reduce effective distances between areas. Before that in 1964, a Presidential Commission reported that “economic growth in Appalachia would not be possible until the Region’s isolation had been overcome” and Congress reacted the next year by funding the Appalachian Development Highway System “to generate economic development in previously isolated areas.”

However, it is a fact that there are differences in the objectives of scholarly research and applied models that are important to recognize as part of any evaluation of predictive models. For instance, Isseman and Rephan (1994) advocated the relationship between highway presence and localized growth.

Nadiri and Mamuneas (1996) argued that there are lines of research that demonstrate a general relationship between transportation investment levels and economic growth.

Source: FHWA (1970)
rates whereas. From this analysis, it is evident that the transportation investment can make a difference in economic growth, it is not useful for transportation planning agencies that are considering alternative project proposals regarding how to spend a given transportation improvement budget.

Similarly, Taaffe, et al (1963) attempted to analyze the relationship between transportation and development. Their study showed that in the early stages of economic growth the introduction of modern transport makes a wide variety of new economic opportunities available and is therefore likely to promote economic growth.

Weisbrod (2008) showed that there is a need for evaluating the regional economic development impacts (as well as the travel efficiency and environmental impacts) of individual highway, rail, airport and marine port project proposals particularly for decision making purpose of the transportation agencies. It may be recalled that it has long been recognized that regional economic impacts can vary greatly depending on the form and locations of the proposed facilities, and the types of changes they can have on travel times, costs, accessibility, reliability and connectivity of travel routes and services.

In this connection, the view expressed by the World Bank is important. During the launch of its Group Transport Business Strategy for 2008-12 it argued that Transport is a necessary, though not sufficient, contributor to economic development. But its contribution cannot be taken for granted since

(1) In rural areas, nearly a billion of the world’s poorest people still do not even have adequate access to one all-weather road.

(2) In most of the cities that will soon contain half of the developing world’s population, public transport systems are struggling to cope.

(3) Many countries that have enjoyed strong trade growth in recent years are now facing capacity and quality constraints in transport and logistics.

Accordingly, the Bank Group’s transport business strategy articulates how transport and development goals come together. These are as following:
(1) Safe: acknowledges the prominence of health outcomes within the Millennium Development Goals; it implies safety for transport users, for transport workers, and for the wider community.

(2) Clean: reflects the contribution that transport can make to the environmental aims of the Millennium Development Goals, and the need to address its impact on climate change.

(3) Affordable: acknowledges that physical supply of infrastructure is not enough. Efficient freight infrastructure, translated through well-functioning markets into affordable transport and logistics services, is critical for trade. Similarly, efficient and affordable transport underpins personal accessibility and mobility in both urban and rural areas: and finally

(4) Transport for development: asserts that while transport can have many purposes, the World Bank primarily focus on its contribution to economic development.

Moreover, the World Bank (2004) also admits that significant technological changes have taken place in the transport sector during the past few decades. In parallel with these changes has been a growing interest in economic theory as a tool for investigating the role of spatial and geographical determinants of growth. However, while there is consensus that an adequate level of transport infrastructure is a necessary prerequisite for initiating growth, there is less agreement on the theoretical links between transport investment and growth and the contributions that the transport sector can make in enhancing growth with sustained poverty reduction. It is a fact that poverty reduction is the fundamental development objective of the World Bank. As the transport sector consumes a considerable part of the overall budget for infrastructure investments in developing countries as well as of the lending portfolio of the World Bank, there is a need to understand how these investments help with poverty reduction.

Most recently, Eberts (2000) has identified four factors for examining the impact of transportation on regional economic development. These are:
(1) Relevant type of transportation investment which again are of two kinds: Capital Expansion in terms of physical expansion of the present transportation system and/or Capital Enhancement in terms of incorporation of new technologies that can upgrade the efficiency of the existing transportation system.

(2) Data necessary to analyze the economic effect of the investment.

(3) Appropriate methodology to analyze the economic effect.

(4) The proper dissemination of the results and education of professionals as to the economic effects of transportation investment.

Again, Canning and Bennathan (2000) estimate social rates of return to electricity-generating capacity and paved roads, relative to the return on general capital, by examining the effect on aggregate output and comparing that effect with the costs of construction. They find that both types of infrastructure capital are highly complementary with other physical capital and human capital, but have rapidly diminishing returns if increased in isolation. The complementarities on the one hand, and diminishing returns on the other, point to the existence of an optimal mix of capital inputs, making it very easy for a country to have too much - or too little - infrastructure. For policy purposes, they compare the rate of return for investing in infrastructure with the estimated rate of return to capital.

Fan, Hazell and Thorat (2000) developed a model to estimate the different direct and indirect effects of government spending on rural poverty and productivity growth in India. They concluded that in order to reduce rural poverty, India government should give highest priority in additional investment in building rural roads, particularly in the economically backward regions.

In the context of China, Fan and Chan-Kang (2005) observed that low quality (mostly rural) roads have benefit/cost ratios for national GDP that are about four times larger than the benefit/cost ratios for high quality roads. Even in terms of urban GDP, the benefit/cost ratios for low quality roads are much greater than those for high quality
roads. Another significant finding of the study is the trade-off between growth and poverty reduction when investing in different parts of China. Road investments yield their highest economic returns in the eastern and central regions of China while their contributions to poverty reduction are greatest in western China (especially the southwest region). This implies different regional priorities depending on whether economic growth or poverty reductions are the most important goals for the country. These investments were a major force in China’s economic transformation during the 1980s and 1990s. However, as more and more investments are being poured into these projects, the marginal returns are beginning to decline, although they are still positive and economically sound. At the same time, low quality roads or rural roads have received less attention than high quality roads and as a result their marginal returns are much larger today than the returns to high quality roads.

Further, Mukherjee and Zhang (2007) compared the developmental pattern of India and China and argue that the observed patterns in the rural nonfarm development are the results of institutional differences between the two countries, especially in their political systems, ownership structure, and credit institutions. A review of the strengths and weaknesses of the rural nonfarm economy in China and India highlights the potentials and challenges of growth in the sector. They also recommended for huge expansion of rural roads in India.

From the above mentioned literature review, it is clear that a well-knit and coordinated system of transport plays an important role in the sustained economic growth of the country. The main objective of transport network planning has been to develop the transport infrastructure to carry the projected quantum of traffic and the developmental needs of the country. In this sense, the need for economically efficient transport system in the course of economic development is self-explanatory. As mentioned in Chapter 1, the NER in general and Tripura in particular, after partition, emerged as an isolated and economically landlocked region. Even after sixty five years of independence, the transportation infrastructure for this whole region is painful. Inter and intra regional connectivity in NER is yet not able to cater the needs
of the development. Hence, a proper planning of transportation network is essential for the developmental needs of this region as a whole.

2.2.1 Role of Highway Investment in Economic Development

This section of literature review attempts to look at the role of highway investment in economic development. The literature on the economic effects of highway investment is wide ranging. Most studies have underpinnings, at least implicitly, in a handful of economic theories. Because of the wide-ranging and multidisciplinary nature of the topic, an effort has been made to draw the material from a variety of academic disciplines, including transportation economics, planning, regional science, and geography.

Appalachia (1982) viewed investment in highway as an effective tool for strategic economic development, particularly for the underdeveloped and developing economy. Again, Forkenbrock et al (1990) viewed this as a tool to reduce the gap between the rural and metro areas including improved access to services and jobs for rural residents, better access to customers for businesses, and reduced transportation costs.

On the other hand, Lamb (1983) explained the development risk out of this investment in highways if that investment is carried out in such a way that the new investment diverts economic activity from an already existing road within the region. Some areas may also be harmed as highway development results in “sprawl” in some previously undeveloped rural areas. At the same time, Highway maintenance costs can also be a burden on localities that have too many roads and too few people to pay for their upkeep. For these reasons, effective highway investment usually requires good foresight and planning in terms of a proper Cost Benefit evaluation.

The task of the Regional development theory, derived from development economics, is to identify the most effective policy for economic development of any particular region. In the case of highway impact studies, the work of Allen (1994) argued that
investing scarce infrastructure resources will be more efficient in areas exhibiting some degree of prior urbanization.

Later Hansen (1971) also supported the same view. Twark et al (1980) used a forecasting model to identify factors thought to lead to economic development at highway interchanges in Pennsylvania.

At the same time, the Growth pole theory focuses on centers of economic activity, or growth poles, which are thought to attract investment due to their agglomerative powers. Stanley (1971) examines how the capacity and connectivity of a road network is an important factor in the national and regional development. He therefore, said that one of the important priorities of transport policy in developing countries should be the improvement of the rural road system with a view to linking the rural hinterlands with the urban areas which constitute growth poles or growth centers.

Later, Forkenbrock and Foster (1996) examined various State-level highway investment policies and concluded that maintenance and relatively minor improvements are likely to be more cost-effective economic development strategies than expensive highway construction projects.

According to the location theory proponents like Alonso (1964), reduced transportation costs are viewed as one of the key determinants of industrial site choice as highways have the potential to open up underdeveloped regions for economic development.

But, Rephann (1997) pointed out that highways can also lead to negative development effects; they may provide conduits for economic activity to leave underdeveloped regions. So, utmost care should be taken for a balanced regional development through investment in highway system that can cater the need of the economy by considering the present constraints as well as future direction of the economy. Starting from the works of Ricardo, trade theory attempts to explain international and interregional flows of labor and capital based on national and regional comparative advantages. In due course of time, several extensions of international trade theory have been made in the field of interregional analysis.
Siebert (1969) argued that sub national regions also tend to specialize in the production of goods in which they have comparative advantages over other regions. Kraft et al. (1971) went further by incorporating transportation costs and argued that regions tend to specialize in products that can be both produced and transported more cheaply than other products.

Hence, from the above analysis, it is clear that the determination of effects of investment on highway on economic development of any region is quite difficult. The foremost difficulty lies in ascertaining whether economic growth arising from the investment would have occurred even if the road had not been built. In this context, Fox and Murray (1990) questioned about the potential for highways to merely redistribute development without adding to overall economic activity.

However, several regional econometric models have been frequently used to assess the impact of transportation investment on regional economic activity. These models typically examine the effects of transportation investment on industry output and employment. In this field, the landmark study was done by Carlino and Mills (1987) who examined various factors, including different measures of employment which affects U.S. county population growth during the 1970s.

Another interesting study was carried out by Andersson et al. (2012) which analyzed relationships between infrastructure and regional productivity in Sweden and identified specific variables that contributed to regional productivity.

Again, some econometric models have been developed to deal explicitly with transportation effects. The Harvard Macroeconomic Transport Simulation Model propounded by Meyer (1971) focuses on the effect of transportation costs in developing countries.

The Pennsylvania Highway Corridor Model carried out by Sauerlender and Davinroy (1976) analyzes economic changes in small geographic areas located along highway corridors. The Multiregional, Multi-Industry Forecasting Model as developed by Harris (1980) assesses the effects of transportation costs and other locational factors on regional output.
But, all of these models suffer from, perhaps most importantly, issues relating to the quality of the data used as pointed out by Bolton (1985). For example, Rephann (1997) questioned about the sensitivity of the results to other specifications of the Multiregional, Multi-Industry Forecasting Model which uses transportation input data derived through linear programming techniques.

Another technique used to estimate the economic effects of highway investment is input-output modeling, which estimates direct and indirect effects of highway investments based on a disaggregated industrial framework. Liew and Liew (1984) use a multi-regional variable input-output model to estimate industrial output, personal income, and employment impacts resulting from a proposed transportation system in Alabama.

But, again, Rephann (1997) pointed out that input-output adapted for transportation analysis may be impracticable and require data that are inadequate or unavailable.

Harris (1980) argued that although highways may be an important factor in explaining rural development, distance to an urban area is often a much greater determinant of non-metro growth. This conclusion was also supported by the study of Rephann and Isserman (1994), found that isolated rural interstate counties and off-interstate counties benefit little from interstate highway investment since the urban areas already have an existing agglomeration potential, rural areas in close proximity to urban areas may also be able to take advantage of benefits that ensue from being adjacent to these growth poles. Hence, close proximity to built-up areas can be seen to lead to spread effects, in which rural areas can draw on the development effects of adjacent urban areas.

It is a fact that many studies find that transportation infrastructure is important in generating local economic development; other factors are often identified as necessary, as well. However, there is currently little consensus on which factors is most significant in determining growth. According to Henry and Johnson (1993), this absence of consensus stems largely from a lack of good regional data that would allow for objective testing of hypotheses from alternative models of growth.
From the earlier Section, it is clear that economic development of any society is a complex process, which depends on several interacting forces. Perhaps one of the most important of these forces is the provision of adequate transport infrastructures. This is particularly true in the largely subsistence economy of most Asian and African countries where transport constitutes the key to development especially at the early stages of economic advance.

The interaction between the level and pattern of transport resources and the standard of living of the population of any country is a critical factor affecting economic and social progress. This was evident from the study of Onokala (1995) who analyzed the case of West African countries in which the transport sector consumes a significant proportion of the capital investment, ranging between 20 and 40 percent of all public sector investment. Thus in most developing countries today, there is widespread concern for transport planning in the desire to promote rapid economic development. Later, it is also argued by Stone (2001) that the provision of transport facilities is therefore, an important factor in political interaction, co-operative and social interaction both at the micro and the macro level of the regional economies.

Winch (1963) wrote that transport facilitated economic advancement and transport improvement was indeed part of the economic advancement. A certain percentage of the economic activities arose directly because of new transport possibilities but for the most part, new transport facilities enabled the expansion of local activity and the integration of previously isolated market.

The study of Filani (1977) concluded that without roads and rails, produce will rot on the trees or in the field for lack of access to markets. Moreover, Filani further observed that the socio-economic development of any society depends on a large extent to the nature and structure of transportation network of the society. He also argued that transportation provides the arteries through which the economic life-stream of society flows—the people, information, raw materials and finished products which help to build and maintain the society. However, no society can exist above the subsistence level without a measure of improvement in its transport system.
2.2.2 Road Transportation and the Issues of Accessibility

Another critical issue in the provision of transport facilities in any area is the issue of accessibility of the services of such transport facilities to a greater majority of the residents of that area. Accessibility is a term often used in transport and land use planning and is generally understood to mean approximately “ease of reaching”. Accessibility is the ability to get from one place to another, the connectivity of a place with other places.

In the context of Nigeria, Atubi and Onokala (2004) argued that the extent of economic and social development in the rural areas is impeded by the absence of good road transportation in some parts of that country.

According to Aloba (1985), areas with under-developed transport infrastructures are more disadvantaged than areas with an improved transport system and. Further, Aloba in his study has identified the heart of transportation planning in any part of the world with the design of circulation systems, which maximize accessibility for essential movements between linked activities.

According to Jones (1981) accessibility also implies the opportunity that an individual or type of person at a given location possess to take part in a particular activity or set of activities whereas Hack (1976) defined this as a function of point's location in space to other points in any given system.

However, the most convenient approach to accessibility was made by Igram (1971) who defined this term as inherent characteristics of advantage of a place with respect to overcoming some spatially operating source of friction of, for example, time and/or distance.

As mentioned in earlier section, the transport sector of the World Bank plans an important part in reducing poverty by strengthening focus on accessibility environments and inclusive transport systems. World Bank (2004) stresses the importance of good guidelines for policy and planning decisions to increase and maintain accessible environments for all people including different disability groups.
In a review of Transport Strategy of the World Bank (1997); Ventor et al (2003) and Maunder et al (2004) recognize the need to address more systematically access issues, especially for those who are mobility impaired.

Last but not the least, Rephann and Isserman (1994) concluded regarding the potential impact of highway investments on rural economic development which are as following:

1. Rural counties in close proximity to metro areas, and those with some prior degree of urbanization, benefit economically, at least in the short term, by new highways, especially interstates.

2. Highway construction expenditures benefit rural employment in the manufacturing and retail sectors, with effects strongest in the short term.

3. Little consensus exists about how highways affect rural areas over the long term. Some studies argue that highways merely redistribute development potential from other areas.

4. Accurately measuring the economic effects of highway investment is difficult because of the problems of isolating highway effects from the larger processes associated with regional economic growth.

5. Current data sources are inadequate for measuring the economic effects of highway investment.

From the above mentioned survey of literature, it can be concluded that 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 where as better accessibility in the long run influences the pattern of growth, land use and the level of economic activities in positive direction. As mentioned in Chapter 1, after partition, this region had lost its traditional connectivity with its mainland and over night, became geographically sequester land. The presence of hilly terrain and mountainous landscape further created obstacle in the development of railways for this region. Hence, the transportation network is developed mainly as road transportation network and the
area of research which has been proposed here is basically an attempt to evaluate a long standing demand of the Government of Tripura as well as the people of this small state who are and has been severely suffering from communication bottleneck. It requires no mention that Tripura is geographically a sequester land located at the remotest corner of the Country where transportation is relatively a time consuming phenomenon. Hence, it may not be very simplistic to believe that if the above proposal is implemented, it may be a Big Push for a less developed state like Tripura.

**2.3 Regional Disparity of NH Network Expansion in India**

From the previous subsection, it is clear that a well-knit and coordinated system of transport, particularly NH is necessary but may not be sufficient sustained economic growth 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).

Medhi (1978) pointed out that India’s planned development process have been heavily biased in favor of industrial development led growth model before independence. There was a distinguished tendency of industries to get concentrated at only a few centers. The concentration was not the result of natural advantages but was imposed by historical forces. The study concluded that the backward state should start improving upon the efficiency in resource use, industrial, capital and labour shall start following in.

Kurion (1982) studied the industrial development of three southern states namely Andhra Pradesh, Karnataka and Tamil Nadu between 1952-65 and 1966-81. He found that Tamil Nadu, among the three states, grew very rapidly in the first two decades from 1950-70 and then slowed down. Karnataka grew rapidly during 1960-75. Between 1951 and 1961 taking all male workers in the manufacturing activity, Andhra Pradesh move from IX rank to VIII rank and Tamil Nadu remained at the fourth rank. He concluded that the potential for growth in the three states was dependent upon both central and state governments’ investment policy.
Joshi (1987) attempted to analyze the inter-state disparities in infrastructure and economic development in India between 1961 and 1981 by using per capita state domestic product, per capita consumption of power in agriculture, irrigation coverage, value added by manufacture per industrial worker, number of registered factories per lakh of population and per capita consumption of power in industry. He found that there had been a marked increase in disparities in infrastructure development at the state level. The eight states like Punjab, Tamil Nadu, Kerala, West Bengal, Maharashtra, Gujarat, Karnataka, and Haryana were relatively developed states with a higher level of infrastructure facility. The extent of interstate disparities in infrastructure had significantly declined between 1960-61 and 1980-81.

Rao (1987) critically examined to what extent economic planning in India has been used as an instrument for bringing about balanced regional development and to suggest the measures to make it more effective. Finally, it concludes that during the plan periods, the cumulative result of plan outlays and central assistance has been more in favor of relatively developed and backwards states.

Sastry (1988) in his study proposed to suggest some tentative explanation for such variations. His analysis showed that a change in per capita income and population explained nearly half of the variation in the change in net output of industry. From the analysis, he concluded that the influence of cost of electric power did not appear to be strong, but the other factors namely per capita income and the size of urban population did seem to provide reasonable explanation for inter-state variation in industry in India.

Ziauddin (1988) in his article stated that the disparities exist not just in terms of absolute levels of population, economic activity and related social indices such as unemployment, activity rate, income per head and rate of employment growth. This was due to the divergent process of development. He opined that the regional disparities in development, especially in industrial development, could not be removed unless the government intervenes in distribution of industrial activities by influencing location of industries.
Jha (2001) found that as a result of economic reforms, the flow of both domestic and foreign investment was directed more towards better performing regions. The low performing regions received only a small fraction of commercial bank credit and credit from all-India financial instructions. These indicate the likelihood of growing inter-regional disparities in future.

Jha (2002) examined the interstate disparities by using fixed capital, employment, output and value added as indicators. He found that there was a positive relationship per capita income of state and proportion of working force both in industrial and service sectors of the state. The difference between the highest and lowest per capita of the state had increased from Rs. 194 in 1960-61 to Rs. 668 in 1970-71 and further to Rs. 933 in 1980-81. There has been a considerable increase in inter-state disparities in the manufacturing sector. Maharashtra, West Bengal, Tamil Nadu and Gujarat had occupied the first four places. He concluded that the three and half decades of planned development in India had not been able to reduce inter-state disparities in industrialization.

But, Kaushal (2001) rejected the growing disparities hypothesis; saw the possibility of both intra-state and inter-state disparities reducing in future as a result of poor infrastructure, inefficient administration, power, transport and communication.

Baruah (2001) found the statistical evidence to the widening of industrial disparities in India both during the pre and post reforms periods. He found that the North-Eastern states were placed at the bottom of the ranking in the composite index of industrial development despite that these states being relatively rich in natural resources. The study concluded that the center should come forward in a big way in providing infrastructural facilities to enable the North-Eastern states reap the benefit of economic reforms.

Sharma (2001) examine the effect of resource flow to the states and regional disparities and found fiscal transfer from the central government, mostly, favoring the poorer and special category states. According to the study, financial institutions and market oriented investment has favored the relatively advanced states. He suggested
an enhancement of the equity-oriented fiscal transfer to enable the less developed states increase the level and quality of infrastructure. He added that the transfer of fund to the less developed states would not ensure a quicker pace of development of these states.

Again, Rao (2001) argued that the present practice of resource transfer through the planning commission and the finance commission in particular with positive discrimination for less developed states had the unintended effect of providing them an incentive for not moving up the economic ladder. Finally, the study concluded “economic autonomy, responsibility and accountability at the state level can produce India’s own Indonesia, Korea and Taiwan”.

Analyzing regional inequality in India with special reference to Assam, Neogi (2001) observed that reduction of government intervention is not a sufficient condition for better governance but for the success of market. The government has significant role in promoting market efficiency and growth, expanding public investment in infrastructure and social expenditure, reducing poverty and illiteracy and improving equity besides producing public goods. In addition, government intervention is also necessary to take counteractive measures to neutralize the gravitational and centrifugal forces associated with market in centralization of activities, thereby reducing spatial disparities. The study suggested, “The development is the best remedy to reduce regional inequality”.

Hazarika (2001) dealt with the imbalance caused in the Northeast because of migration on a large scale from present Bangladesh during the post independence period.

Bhattacharyay and De (2006) analyzed the different infrastructure development from Indian states during the past quarter century. The study considered the infrastructure facilities as physical, social and financial. The study has derived physical infrastructure development index (PIDI), social infrastructure development index (SIDI) and financial infrastructure development index (FIDI), weight and measurements for identifying disparity. The study has concluded that the inter-state
disparity in per capita net state domestic product among Indian states has been risky significantly over the last quarter century. The inter-state disparities in physical, social and financial infrastructure facilities have remained at alarmingly high level over the same period.

Sivaram (2004) in his study analyzed the regional disparities in Andhra Pradesh and pointed out that in a vast country like India, regional disparities are bound to exist with varying natural regions. The study pointed out that, the inflation of population changes the economic development. In Andhra Pradesh, the coastal Andhra is the most thickly populated region followed Telungana region. Rayalaseema region on the other hand is a sparsely populated region. The study concluded that the need of the hour for the planners is to take into cognizance the regional disparities and adopt regional planning to reduce these disparities.

Kaur and Saran (2004) studied the impact of infrastructural facilities on regional development. They have applied canonical correlation analysis for the Punjab state and each district of the state concerned as region and the two sets of data, one the development aspects and the other the availability of infrastructural facilities were considered. Rosen (2008) examines the spatial disparities in infrastructural facilities across 16 major states of India and in turn analyses its impact on regional economic growth. Further, an attempt has been made to examine the effect of the former on the latter at an aggregate level considering state as a unit of analysis, using a simple multivariate method to compute a composite Infrastructure Development Index (IDI) by combining various infrastructural services available at the state level and finds a positive relationship between Infrastructure Development Index & Per Capita Net State Domestic Product and negative relationship between Infrastructure Development Index & Poverty.

In Indian context Sen, Guha and Chakraborty (2013) attempted to examine the regional disparity in devolution of RIDF across the states during 1996 to 2010 using AGC index as reformulated by Spiezia (2002). The empirical findings support a relatively high degree of inter and intra regional disparity. Hence, this study strongly recommended the removal of normative criteria of disbursement of fund for rural
infrastructure development across the states and sanction of more funds for the less developed states of the NER particularly in the areas of rural transportation for achieving the goal of balanced regional development.

Further, Sen (2014) studied the regional disparity and convergence of availability of national highway network across the states during 1951-2011. The government’s policy of expansion of national highway network is primarily based on two criteria - area and population of the respective state or the region. During this period, government’s policy is successful in combating the problem of regional disparity. The trend of σ convergence value clearly exhibits convergence characteristics. But Theil index reveals that interstate disparity among the states is still a major problem. The major reason behind such interstate disparity is that the expansion of national highway was mainly area centric thereby depriving the states with higher density of population as they got relatively smaller area share. Based on the findings, the paper suggested state specific policies, particularly for those state(s) which are smaller in size but having high population density.

The study of Lele (1989) analyses the variation in infrastructure – induced pattern of socio–economic development among some selected rural settlements in Niger state of Nigeria. To achieve this aim, twenty-two rural settlements were randomly selected and their scores on selected infrastructure were used to ascertain the pattern of socio–economic development. The relative strength of the factors was determined by factors analysis. The results revealed variation in infrastructure – induced pattern of development.

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. Road investments 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.

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.

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. It is a fact that the degree of development of the transportation network is a determining factor for socio-political-economic progress of any particular region at different stages of national and regional development planning. However, these studies mainly concentrated on the interface between transportation investment and economic development; but this interface has broad ramifications that go beyond transportation’s basic purpose of moving goods and people from one place to another. Starting from the invention of wheel through the industrial revolution to current times, economic growth of any particular region has always been accompanied by the growth in the transportation sector. That is the effect of transportation investment on economic development comes from the role of transportation facilities in enabling movement and interchange of activities between different locations. In India, the NH network account for only 2 percent of the total road network but carries more than 40 percent of freight and passenger traffic. The planners chose two parameters namely area and population for expansion of NH network in India but no such significant work has been found in the existing literature which assessing the position of the state in terms of availability of such network.

Another critical issue is to choose appropriate methodology to assess such disparity in availability of NH network across the states. Geographic concentration indicates the extent to which a small area of the national territory accounts for a large proportion of
a certain economic phenomenon. While this definition is straightforward in theory, in practice the choice of an adequate statistical measure of geographic concentration is more problematic. Although an increasing body of empirical literature has investigated this issue, there seems to be still little agreement on which statistics are most appropriate to measure geographic concentration.

Conventionally, geographic concentration has been measured in three different ways. The first measure is the *Concentration Ratio*, *i.e.* the ratio between the economic weight of a region and its geographic weight. Taking availability of NH as an example, the concentration ratio is calculated by ranking regions and or states by their availability of N and dividing the share in NH network of the first “n” regions with their share in national territory, *i.e.* their area as a percentage of the total area of the country. The larger this ratio higher is the geographic concentration.

The second method of measuring geographic concentration is the so-called *Locational Gini Coefficient* (Krugman, 1991). This is simply a modification of the Gini inequality index where individuals are replaced by regions and weights are given by the regional shares in total population or employment.

Despite the popularity of this measure, several authors (Arbia, 1989; Wolfson, 1997) have pointed out that the Gini coefficient confuses inequality and concentration whereas these are two distinct concepts.\(^8\)

The neoclassical economists Solow (1956) and Swan (1956) separately proposed that due to diminishing marginal productivity of labor, the level of economic growth across the region would tend to a steady state level, popularly known as convergence of growth rate. The \(\sigma\)-convergence corresponds to the decline trend of dispersion in the variable under analysis. In economic literature, several measures have been used to analyze dispersion for example Carlino and Mills (1996) have used standard deviation where as the coefficient of variation approach has been used by Bernard and Jones (1996). In order to find \(\sigma\)-convergence there is a necessary but not sufficient

\(^8\) The confusion probably arises from the fact that the Gini coefficient is based on the Lorenz or so-called “concentration” curve.
condition: to find $\beta$-convergence. For which, Sala-i-Martin (1996) proposed complementing the convergence analysis using both methods. Adopting from income distribution studies, Koksi and Majumdar (2000) introduced two fundamental types of convergence into telecommunication industry literature. Sigma converges or catch-up process, meaning those countries which were erstwhile less efficient are becoming efficient as erstwhile efficient countries.

However, the analysis of the cross-section dispersion may be non-conclusive. Quah (1996) shown that a constant standard deviation can be consistent with very different dynamics. Consequently, it is not fully clear that a decreasing dispersion measurement is the definitive prove of the existence of convergence. For this, several other measures are used for example the Gini index, the Mehran index, the Piesch index, the Kakwani index, and the Theil index, being the latter one of the more popular ones. The Theil index is particularly appropriate when looking at inequality measurements because it has the property of mathematical fractals: it can be decomposed additively between groups, with the total Theil index being equal to sum of the Theil index between groups and the weighted average of the Theil indices within each group (Royuela and Vargas, 2009).

However, the method of $\sigma$-convergence and club convergence throw light on the trend of disparity across the region and trend of disparity across the states and region, respectively but the relative contribution of factors like area and population on extent of such To overcome the limitations of the three indexes above considered, this study considers a new measure of concentration, the Adjusted Geographic Concentration index (AGC) as reformulated by Spiezia (2002). The methodology underlying the construction of this index is portrayed in detailed in the Chapter 3 but, in its essential term, the AGC index is constructed by transforming the Herfindahl index as to take into account within-and between-country differences in the size of regions. Although concentration and inequality are two distinct concepts, territorial disparity does have an impact on geographic concentration. But, the spatial disparity of availability of NH across the state level in India remains unexplored in the existing literature. Hope, this study shall caveat that gap in the existing literature.
2.4 Computation of Shortest Path in Real Road Network

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, 1996); 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. Apart from that, as all to all shortest pair method, the Floyd-Warshall’s algorithm (1962) was popular. In fact, around 1960, Dijkstra, Floyd and Warshall published papers on algorithms for solving single source and all-sources shortest path problems, respectively. These algorithms, nowadays named after their inventors, are well known and well established.

Talib et al (2006) develop a system that capable to determine the vehicle route by implementing the traditional method, Floyd Warshall. This system focuses on area of a city in Penang and considers 46 locations as the case study. This system was capable to give travel distance, and determine the sequence of location for goods delivery with the shortest path. The system has been tested for a currier company in Malaysia.

Sokas (2009) analyzes problems of determining the shortest way and optimal route among given towns. The model of the problem is presented as non-directional graph, where nodes are towns and crossings outside towns, and edges are roads among towns and crossings. Each node has some information attached to it: name and size of the town, maintenance organizations, and mark of the crossing. All towns are connected

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9 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.
by roads. These roads are shown as graph edges. Each edge also has information sketched in: type of road, length of road, allowable speed on the road and other useful information. Retrieval of an optimal route is executed in two stages: finding shortest way between two towns and optimizing route to visit some towns. Algorithms to both exercises’ solutions are presented. Floyd-Warshall algorithm is selected for finding shortest way from one graph node to another selected node.

Kesswani and Gopalani (2011) observed that the advancement of Geographic Information System (GIS) technology and the availability of high quality road network data, it is possible to conduct transportation analysis concerning large geographic regions within a GIS environment. Sometimes, this type of analysis has to be completed in real time. As a consequence, these analysis tasks demand high performance shortest path algorithms that run fastest on real road networks.

Fu et al (2006) presents a survey review of various heuristic shortest path algorithms that have been developed in the past. The goal is to identify the main features of different heuristic strategies, develop a unifying classification framework, and summarize relevant computational experience.

Sadavare and Kulkarni (2012) analysis different shortest path algorithms like Dijkstra’s Algorithm, Bellman ford Algorithm and Warshall’s Algorithm by considering network base systems such as Cable network (T.V. cabling, Telephone cabling, Electricity power supply network) and water supply system network.

Hemalatha (2012) identified the optimal power flow path using Floyd Warshall Algorithm (FWA) with additional constraints. This algorithm is selected in the shortest path algorithms because in single execution, it finds the shortest path between all pairs of vertices. Software has been created in order to identify the restoration path in a sample 5 bus system and obtained the results for a practical Chennai 230kV network.

Roopa et al (2013) considered three shortest path algorithms viz. Dijkstra’s Algorithm (one to all pairs of nodes), Floyd Warshall’s Algorithm (all to all pairs of nodes) and Linear Programming Problems (LPP). These algorithms are also solved using Matlab.
software, which gives quick results for larger nodes. This paper also deals with the methodology to find shortest distance using the dual of Linear Programming Problems. In addition, Complementary Slackness Theorem is discussed to solve the primal problem from the solution of dual problem and determine the shortest distance as well as shortest routes.

However, in the literature of Transport Economics, the Floyd-Warshall’s algorithm 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).

In this context, Sen, Gupta and Mukhopadhyay (2013) evaluated the economic viability of the demand by the people of Tripura for an alternative road network. After partition in 1947, this state had lost its traditional connectivity with mainland India and overnight became a geographically sequester land. The presence of hilly terrain and mountainous landscape further created obstacle in the development of railways for this region. Hence, the transportation network is developed mainly as road transportation and the area of the research in the paper is basically an attempt to evaluate a long standing demand of the Government of Tripura as well as the people of this small state who have been suffering from communication bottleneck. This study has utilized the Floyd's algorithm of shortest path method in real road network of Tripura to test its feasibility in terms of cost-benefit analysis taking into consideration the regional demand and its possible benefits arising out of such a study.

The area of research which is proposed here is basically an attempt to explore the possibilities of a viable road network in Tripura, a proper evaluation of the existing road network in Tripura is otherwise essential. This aspect has not been covered in the existing literature. Hope, this study shall attempt pts to fill up the caveat in the existing literature.
2.5 Transports for Landlocked Region & the Issue of Transit

Arvis et al (2007) has pointed out that at present, about one out of five countries in the world is landlocked. The problem mostly affects the poorest countries: 20 out of 54 low-income economies are landlocked, with a majority of them in Sub-Saharan Africa; while only three high-income economies out of 35 are landlocked. Arvis et al further pointed out that nine of the twelve countries ranked lowest on the 2002 Human Development Index are landlocked.

Although landlocked developing countries represent 12.5 per cent of the world's land area and 4 per cent of the global population, their combined gross domestic product accounts for only 0.3 per cent of the total. Without direct access to the oceans, these countries must pay an average of 15 per cent of export earnings on transport; for some African countries it is as high as 50 per cent, other developing countries spend only 7 percent on such services and developed countries 4 per cent. The case of landlocked developing countries has naturally received special attention, including a specific set of development priorities which was reflected in the Almaty Conference (2003).

Variants of the new economic geography, new trade theory, neoclassical and endogenous growth theories have been applied to highlight the nexus between geographic location, trade and economic growth. Amjadi and Yeats (1995) point out that the incidence of transport costs fall heavily on the landlocked African countries since they have to adjust their selling price to world prices.

Bloom and Williamson (1997) highlighted that the landlocked countries are always experienced a weaker growth as compared to the other maritime developing countries. According to their estimates, sometimes it is reduced by 1.5% points as compared to the later which again supported by the study of MacKellar et al (2002).

Therefore, landlockedness can be thought as raising import prices and reducing export revenues. It is one reason why Radelet and Sachs (1998) advocate the idea that a re-export model is extremely difficult to achieve in landlocked developing countries due to higher cost of intermediate products.
Gallup, Sachs and Mellinger (1999) identified two reasons behind the disadvantaged position of landlocked countries which may be stated as:

1. Coastal countries may have military or economic incentives to impose costs on landlocked countries.

2. Infrastructure development across national borders is more difficult to arrange than similar investments within a country.

Limao and Venables (2001) estimate that the landlocked countries trade on average 30% less than coastal countries. In this context, MacKellar et al. (2002) explain the negative relationship between landlockedness and growth using a neoclassical theory. They highlight that crossing a border implies higher transaction costs due to customs and handling costs.

Dependence over the transit state necessarily implies high transaction costs (notably transportation costs). Again, high transaction costs are perceived as the result of:

1. “Transit charges” like port charges, road tolls, forwarding fees, customs bonds or transport quota restrictions identified by UNCTAD (2002);

2. The difficulties to benefit from regional adequate infrastructure.

The impact of being landlocked is based on the idea of dependence over the transit state. It has produced two main corollaries:

1. Dependence necessarily implies high transaction costs,

2. Mitigating measures for landlocked countries result of two set of actions:
   a. Adopting transit rules recognized by the international law,
   b. Developing regional transport infrastructure.

While there is a consensus on the problems of landlocked countries, the analysis so far has mainly focused on their transport cost disadvantage. Transport costs however account for only part of the real cost of being landlocked as they do not account for
the transit delays and unpredictability which are critical in international trade. In the literature, macro-data are usually used to estimate the transportation costs burden.

Radelet and Sachs (1998) find these costs to be about 50% higher for landlocked countries. Stone (2001) using the ratio of ‘freight payments as percent of total imports’ shows that landlocked developing countries, especially in Africa, bear exorbitant transport costs: out of 15 landlocked African countries, 13 had a ratio higher than 10% and for 7 the ratio was even higher at 20% as compared with 4.7% for industrial countries and 2.2% for the US.

However, Arvis (2007) questioned about the notion that costs of transportation supported by developing countries are intrinsically high. Neither the distance covered, nor the unit cost of transportation services, are necessarily much higher in landlocked developing countries than in the wealthiest countries. Yet there are significant variations; for instance, Central and East Africa have higher unit costs than the EU but this is not the case of South and East Asia or other sub-regions in Africa. Furthermore, transportation costs only explain one part of the real impact of being landlocked. Delays and even more importantly low degree of reliability and predictability of services create massive disincentives to invest and higher total logistics costs.

Moreover, Arvis et al demonstrated in that study that the gap between landlocked countries and gateway countries may not be very high – if transport cost is the only parameter taken into account. Shippers in most African gateway countries already face high logistics costs when adding maritime transport, port charges (which can be ten times higher in some African ports as compared to ports in developed countries), and domestic transport (especially to/from remote areas, as is the case for several export crops). In Africa, many shippers in landlocked developing countries have the same charges to move goods from/to ports as shippers in the gateway country.

In order to remove the disparity of transportation facility among the member countries, particularly for the landlocked developing countries, Article V of the GATT 1994 (Freedom of Transit) provides for the freedom of transit of goods, vessels
and other means of transport across the territory of WTO Members via the routes most convenient for international transit, without distinguishing between flag of vessel, origin, departure, entry, exit, destination, or ownership of the goods, vessels or other means of transport involved. In order to understand the full scope and the implications of transit, it is important to note that the term “transit” refers in fact to two related concepts with, however, rather distinct features.

(1) In the WTO trade facilitation context, transit traffic refers to the procedure whereby goods are actually moved through a territory with the beginning and the end of the transit operation being outside this territory, i.e. “through transit” or “international transit”.

(2) In the context of Customs procedures, i.e. “Customs transit”, transit is the procedure under which goods, under temporary suspension for the payment of taxes and duties, are transported under Customs control from one Customs office to another including outbound transit, through transit, inbound transit and even inland transit.

Freedom of transit and a viable Customs transit regime for international transit are both particularly important for landlocked developing countries, many of which are among the poorest of the developing countries with the weakest growth rates, and typically dependent on commodity exports or imports of intermediate goods.

In this context, the Almaty Conference in August 2003 drew attention to the problem of transit for these countries and devised an action programme. Customs transit regimes usually tend to suffer from the same shortcomings as other Customs transactions. These include the lack of simplified and standardized Customs procedures, documents and data processing, publication of fees and charges, cooperation among national Customs authorities, adequate security measures to combat fraud and smuggling, risk management techniques, computerization and electronic messaging. Inadequate transport infrastructure, logistics, vehicle standards and container seals add to these problems.
Transit countries and their landlocked developing and least developed neighbors stand to benefit both from unhampered transit traffic based on fast and simple trade facilitation measures and Customs transit procedures. However, so far their similarly weak economies, resource constraints, inadequate transport infrastructure, Customs and administrative systems have prevented them from reaping the gains of a functioning transit scheme. In addition, parallel, overlapping and often contradictory international or regional agreements and their lack of enforcement have often given rise to uncoordinated transit practices. National interests and their protective nature such as the protection of national transport operators from international competition perpetuate inefficient and inadequate transport services and have costly implications for both, the landlocked and the transit countries.

While the basic obligations in Article V aim at ensuring optimal conditions for transit, there are indications that, on the ground, real freedom of transit is often absent or compromised. The conditions of international trade and the requirements for transit have changed since Article V was originally formulated in the late 1940s, and comments from business, international organizations and WTO members, in particular developing ones, have suggested a number of obstacles and shortcomings in relation to transit.

As mentioned earlier, the NER in general and Tripura in particular are not landlocked in true sense but the extreme remoteness of this region from its immediate sea port within the country makes this region economically landlocked. This region lost its tradition sea route due to partition in 1947.

### 2.6 Concluding Remarks

From the above mentioned literature review, it may be concluded that though transportation alone is neither a result nor a prerequisite for economic development, it is important in the development process of any society, particularly for the region which are either landlocked or partially landlocked from its main part. Transportation
may not lead to development on its own. Rather, there has to be an integration of other forces along with transportation to bring about development of any region.