A STUDY ON THE PERFORMANCES AND IMPACT OF RURAL INFRASTRUCTURAL DEVELOPMENT ON AGRICULTURAL PRODUCTIVITY OF ASSAM: A DISTRICT LEVEL ANALYSIS

A Dissertation Submitted for the Degree of Master of Philosophy in Economics in the Faculty of Arts of Gauhati University

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CERTIFICATE

This is to certify that Miss Jayashree Bordoloi has prepared the dissertation entitled "A study on the Performances and Impact of Rural Infrastructural Development on Agricultural Productivity of Assam: A district level analysis" under my guidance and supervision. She has fulfilled all requirements under the M.Phil regulation of Gauhati University for the submission of her dissertation, which is a product of original research done by her. The dissertation or any part thereof has not been submitted anywhere for any degree or diploma.

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DECLARATION

I, Jayashree Bordoloi, hereby declare that the research work entitled "A STUDY ON THE PERFORMANCES AND IMPACT OF RURAL INFRASTRUCTURAL DEVELOPMENT ON AGRICULTURAL PRODUCTIVITY OF ASSAM – A DISTRICT LEVEL ANALYSIS" submitted by me for the degree of Master of Philosophy in the Faculty of Arts, Gauhati University, is original and it has not been submitted for the award of any research degree or diploma of any university.

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ACKNOWLEDGEMENT

I take this opportunity to acknowledge my sincere gratitude to all the individuals who assisted me in this work. First and foremost thanks to my guide Dr Gayatri Goswami, Associate Professor in Economics, Gauhati University for her constant guidance and invaluable help in doing my work. Besides, I owe a special sense of gratitude to other faculty members of the Department of Economics, Gauhati University for providing constant inspiration and invaluable suggestions towards completion of this work.

I am extremely thankful to the faculties of Directorate of Economics and Statistics for providing me the secondary data for the proposed topic. Special thanks are due to K. K. Handique Library of Gauhati University for extending me their library facilities in the course of the study.

Last but nct the least my greatest debt lies with my family members especially my parents Bhakta Ram Bordoloi and Padma Kra Bordoloi for their constant support, moral encouragement and understanding.

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ABSTRACT

Adequate infrastructural support is an essential requirement or condition for accelerated economic development of a country. In a developing country like India, infrastructural facilities are generally weak and inadequate. Many people, especially the rural poor areas are not accessed with the sufficient infrastructural facilities. In simple terms, infrastructure is an umbrella for many activities referred to as 'social overhead capital' by such development Economists like Paul Rosenstein Rodan, Ragnar Nurkse, and Albert Hirschman. Rural infrastructure is a powerful tool in strengthening the foundation of agriculture which is a pace setter for the economic growth. Thus, infrastructure is composed of all those activities and facilities which helps to sustain the growth in production as well as income generation in the economy. The major items of infrastructure as included in the planning process include irrigation, power, transport, communication, education, health etc. Within these major heads, there are sub-items of rural infrastructure which have direct impact on agricultural development.

Poor physical infrastructure in Assam has acted as roadblocks imbalancing the socio-economic development thus increasing the sense of insanity that has led to the other social and economic issues. Inclusive growth or development is one of the key factor that every state or a country desires. But even after decades of Govt intervention in form of development planning, Assam still has gaps not only in physical infrastructure but also in creating adequate social infrastructure. In the present study, an investigation has been made to analyse the level of development of various agriculture infrastructural indicators in Assam to understand the disparity and compare the percentage gap of the availability of rural infrastructures with that of the other states in order to know the Assam's position. Assam bestowed with enough of pleasant natural resources and good climatic conditions still seems to have low productivity in the agricultural sector. The study therefore approaches to assess the development of various infrastructural facilities and measure the impact of the infrastructures on agricultural land productivity. Thus, the study reaches to the conclusion that support of greater investment in infrastructure in rural areas is much needed and important steps are to be taken to enlarge and maximise the utilisation of the resources.

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CHAPTER 1

INTRODUCTION

1.1 Introduction:

The term ‘infrastructure’ as the word innates is a broader concept. Rural infrastructure is the cornerstone for an economy to function because the development of a country depends on the availability of infrastructure facilities. Generally the term infrastructure can be defined as the physical components providing commodities and services that is necessary for an economy or a society to enable, sustain or enhance societal living conditions. Thus, infrastructure is the fundamental facilities serving a country to function properly and efficiently. Infrastructural facilities involves various economic and social overhead viz, Energy (Coal, oil, Electricity), irrigation, transportation and communication, banking, finance and insurance, science and technology and other social overheads like education, health and hygiene (P.K.Dhar, *Indian Economy –its growing dimensions*.p-615). Thus the overall development of an economy consists of the classification of the three types of infrastructure – economic or physical infrastructure, social infrastructure and institutional infrastructure. The desired level of development cannot be achieved without the proper functioning of the infrastructural facilities. Availability of infrastructure acts as an important criterion in ushering the agricultural productivity as well as it has an effective relationship between the agricultural production and infrastructure. In fact, infrastructure acts as push factor towards agricultural development. World Development Report (1994) entitled ‘Infrastructure for Development’ examines the linkage between the infrastructure and development and leads a way in which the developing countries can improve the quality standards of infrastructure facilities. The report also mentions that “the adequacy of infrastructure helps determine one country’s success and another failure in diversifying production, expanding trade, coping with population growth, reducing poverty or improving environmental conditions.” In this respect, infrastructure is thus required for the socio-economic growth in promoting the efficiency and quality of life both in the rural and urban areas. Apart from all, agricultural sector is the dominant sector in generating employment and poverty reduction in the developing countries especially in the rural areas. Hence, a well-functioning of the infrastructure facilities is utmost necessary. In

this context, Dr. V.K.R.V.Rao observed, "The link between infrastructure and development is not a once for all affair. It is a continuous process and progress in development that has to preceeded, accompanied and followed by progress in infrastructure, if we are to fulfil our declared objectives of a self-accelerating process of economic development." (P.K.Dhar, p -615).On account of this, the govt both in the centre and state have been providing several infrastructure facilities and spending huge amounts on the development of the infrastructure facilities which are directly or indirectly associated with the development of a region.

1.2 Background of the study:

Agricultural sector alone contributes a large amount of share to GDP in a country which provides a way in strengthening the agricultural system of an economy. As most of the economies in the world are either developing or under developed countries whose primary occupation is the agriculture but these economies experiences low productivity in agricultural sector either due to the lack of sufficient rural infrastructure or lack of capital formation which keeps an economy way behind from enjoying the agricultural productivity. As a result, investment in capital also acts as basic criteria for capital formation because capital formation is the outcome of investment that helps to increase the stock of infrastructure. Hence infrastructure is the most vital input required for agriculture, agro based industries or manufacturing sector and overall development of the rural areas thus providing basic amenities in improving the quality of life as well as the environment. One important fact to be noted is that the vicious circle of poverty that is the global problem in developing or underdeveloped countries can be broken through investment in infrastructure which provides a way to capital formation. It leads to increase in national income and employment as well as to solve the problems of inflation in the economy.

Infrastructure acts as an umbrella for several activities referred to as social overhead capital by development economists such as Arthur Lewis, Rosenstein Rodan, Ragner Nurkse and Albert Hirschman (Satish, 2007). It can be seen that the rural Infrastructure has a direct relationship with farmer's access to institutional finance and markets pushing towards agricultural growth. Rural infrastructure as a tool has the power to transform the existing traditional agriculture into a modern and

commercial farming system in India. Being realising the importance of the agricultural infrastructure the Govt of India as well as the State Govt has made a strategic move in investment especially for the agricultural infrastructure from the First Five-Year Plan onwards. The major focus has been on irrigation, transportation, power, markets etc which not only contributed to the agricultural growth but also helped to find the wide differences between different regions in terms of agricultural growth (Venkatachalam.L, 2003).

According to the theory of unbalanced growth by Hirschman no LDC has a sufficient endowment of resources as to enable it to invest simultaneously in all sectors of the economy in order to achieve balanced growth. Hirschman maintains that investment in strategically selected industries will lead to new investment opportunities and so pave the way for further economic development (Srinivasu and Rao, 2013).

Though the availability of rural infrastructure in developing countries is an integral part of development, adequate attention from researchers or policy makers has not received yet. Since agriculture is the backbone of rural economies, effective links need to be established through proper investments in both hard and soft rural infrastructure. Good roads, highways, bridges, railway lines, airports, seaports, tele-communications etc are no longer luxury items, but a basic necessity in today's world. Hence, infrastructure is required for social and economic growth for promoting the quality of life both in urban and rural areas. As agricultural sector plays a dominant role in alleviating poverty the components such as growth of agricultural employment, income, output etc depend largely on the level of investment made in infrastructure. Here our major aim is to analyse the role of infrastructure in promoting agricultural productivity and regional development and also to identify the backward regions based on the level of infrastructure as well as to suggest policy measures to improve the performance of the regional economy.

1.3 Statement of the problem:

Assam blessed with amidst of natural resources, fertile soil and abundant rainfall, dense forests and good climatic conditions but still presents a poor picture of backwardness in the domain of agricultural sector, employment sector as well as in tourism sector. This situation has inclined to generalise the performance of

infrastructure facilities in Assam as agricultural production is disappointing mainly due to the lack of adequate infrastructure or investment in infrastructural development which stands as a constraint for generating employment opportunities as well as low contribution of GDP to the country. Inspite of this, the district has also not developed to its full potential because as we go on analysing different indicators of infrastructure development, we find an inadequate infrastructure development in the areas. Since the growth of infrastructural sector is inter related to the agricultural productivity, it is therefore required to make a crucial study of the availability of infrastructure in Assam that stands as a constraint in the path of development and to make an appropriate suggestion for the upliftment of the state in the study. If due importance is not given towards building good infrastructure the objective for a sustainable and inclusive growth cannot be achieved for the region.

1.4 Significance of the study:

The study of the rural infrastructure is considered to be of important in Assam because the development of rural infrastructure helps to enlarge markets, expand trading system with greater access to factors of production. Development of economic, social and institutional infrastructure has been considered as the inner pillar for the diversification and achievement of the overall development that enhances improvement in the quality of life as well as the life style of population. The poor growth of the economy results in scarcity of new jobs with rising educated unemployment. In the 21st century, there exists a 'development gap' not only between nations but also among districts as well. The major cause for this development cause is the inadequate development of infrastructure. Improved infrastructure not only leads to expansion of markets, economies of scale but also makes an improvement in factor market operations. It also leads to a conversion of latent demand into effective commercial demand. These effects of infrastructure accentuate the process of commercialisation in agriculture and rural sector (Jaffee and Morton 1995). Adequate infrastructure helps to decrease transportation costs and reduces poverty. Thus, infrastructure regulation plays an important role in poverty reduction in developing countries. Hence the topic entitled, "A Study on the Performances and Impact of Rural Infrastructural development on Agricultural Productivity of Assam: A district level Analysis" has assumed its significance.

1.5 Objectives of the study:

1. To study the major components of infrastructure development in the country and compare the gap in the availability of such infrastructures with that of the country in order to understands Assam's position.

2. To analyse the development of various infrastructure – physical, social and institutional facilities across different districts of Assam to know the performances and understand the discrepancy in infrastructural development in each district.

3. To study the impact of rural infrastructure development on agricultural land productivity of Assam.

1.6 Research Questions:

On the basis of the above third objective the study aims to answer the following research questions:

1. Is there any possibility of rural infrastructure influencing the agricultural productivity significantly?

2. If yes, which type of infrastructure influences and at what level of significance does infrastructure impacted on productivity?

1.7 Source of data:

The study undertakes a cross section data mainly collected through secondary method both for the state level as well as district level. Most of the data on infrastructural development indicators for the different states were collected from RBI Data, Economic survey of India, Directorate of Economics and Statistics and Agricultural report at a glance. Data on agricultural development indicators for the districts were collected from various sources such as Statistical Handbook of Assam, population census, Department of Agriculture and Cooperation, economic survey of Assam, NEDFI report. The state level data is compiled mainly for the two time period taking (2005 and 2015) in order to compare the ten years percentage gap in the availability

of the concerned infrastructures with respect to the country whereas to study the current performances of the infrastructural facilities in the districts of Assam the data is compiled for the period 2016 and rank the districts on the basis of its performances. Out of 33 districts only 26 districts are taken into the study due to the unavailability of reliable data. Published literature in the form of books, booklets and articles on infrastructure development were used to provide a general background of the study.

1.8 Methodology:

An attempt has been made to prepare a methodology of the present study with the availability of important infrastructure variables to understand the main factors behind the impact on agricultural land productivity in Assam, a north-eastern state. The present study is based on the secondary data collected from various sources. The seven infrastructure parameters and two other agricultural indicators were taken in the study i.e., irrigation, road, villages electrified, financial system, primary schools, primary health centres, regulated market, fertiliser consumption and percentage of area under HYV to analyse the whole infrastructural study . The study examines the performances of the rural infrastructures in various districts of Assam followed by the impact of analysis of infrastructure.

In order to attain the **first objective,** the study undertakes the major states of the country regarding infrastructural development and major infrastructural indicators for the two time-periods i.e. 2005 and 2015 and a relative infrastructure index is constructed to compare the relative changes in the availability of infrastructures of Assam in relation to India in the two periods. The relative index is formulated as:

$$\frac{|X_n - X_i|}{X_i} \times 100$$

Where X_n stands for indicator value of Assam and

X_i stands for indicator value of India.

In order to attain **the 2nd objective**, the infrastructure development in different districts of Assam is analysed with the help of set indicators. Simple statistical tool like percentages and ratio is used to analyse the data for the purpose of finding out the disparities in the development of infrastructure among various districts of Assam to

study the performances of infrastructures and then rank the districts in terms of their performances. The information collected from various sources is tabulated and presented in the form of tables.

Thirdly to examine the impact of infrastructural development on agricultural productivity an empirical investigation has been examined and for this a regression model has been constructed using a simple OLS method in the application of SPSS Software for finding out the impact of different infrastructure variables on the agricultural land productivity, taking land productivity as the dependent variable. A sample of 26 districts of Assam has been drawn and the variables were measured based on geographical location or population. In order to investigate the impact of infrastructure on productivity, the dependent variable i.e., the agricultural land productivity is used as a function of infrastructural indicators.

1.9 Limitation of the study:

The present study is subject to the following limitations:

1. Only a few states of the country are undertaken to study the trend and composition of infrastructures in the country to compare and assess the relative growth of Assam.

2. As Assam covers more than 26 districts, assessment of infrastructural facilities in all the districts were not made due to the lack of adequate and reliable information at the district level.

3. Published data regarding infrastructures were not comprehensive and even the available information is not fully reliable.

4. The infrastructures as a whole is not undertaken in the study because there are many infrastructural variables that may have a significant impact on productivity which is absent in the present study due to lack of availability of data.

1.10 Chapter Scheme:

The present dissertation is divided into six chapters. The contents of the following chapters are outlined below:

Chapter 1- Introduction:

This chapter consists of the main thematic part of the study dealing with the introduction, background of the study, significance of the study, statement of the problem, objectives, research questions, source of data, methodology and limitations of the study.

Chapter II – Review of Literature

In chapter II the review of literature and gap in literature is presented.

Chapter III – Components and Availability of Infrastructural Indicators in India to understand Assam's position:

The chapter gives a clear picture on the availability and development of infrastructures in India to understand the relative position of the Assam state as compared to the other states of the country.

Chapter IV – Performances of infrastructural indicators in Assam:

In the present chapter a detailed study has been made to analyse the level of development of various infrastructural indicators across different districts of Assam to understand the disparity and performances in infrastructural development.

Chapter V – Impact of Rural infrastructures on agricultural land productivity of Assam:

This chapter provides a comprehensive study on the role and how different types of infrastructural indicators have impacted the agricultural land productivity across the districts of Assam.

Chapter VI – Conclusions:

This chapter includes the major findings of the study and the suggestive measures initiated as per the requirement of the study.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Introduction:

Numerous studies have been undertaken over the years in the field of infrastructure over agricultural productivity. An increase in the development of rural infrastructure not only contributes to increase the agricultural productivity but also generates employment as well as eradicates poverty in the rural areas. As a result, rural infrastructure acts as the main pillar in shaping the economic growth of a country.

In this section an attempt is made to review the literature available pertaining to the development of rural infrastructures impacting the agricultural productivity in the economy. The main objective of this review is to find out the area of different studies done so far and to find out the gap in this field of research.

The background of literature available on infrastructures is divided into two categories:

2.1.A. Theoretical background on rural infrastructure for agricultural development:

Poor infrastructures are the main roadblocks disturbing the socio-economic condition of a country limiting the traders to travel and communicate with remote farming areas, thereby eliminating competition for their products. Rural infrastructure thus paves a way leading to agricultural expansion by increasing output, farmer's access to markets and availability of institutional finance to the needy farmers. Construction of rural roads promote connectivity to the farmers that increases agricultural production and productivity by bringing in new land into cultivation and helps the rural farmers to take advantage of expanded market opportunities (IFAD, 1995). Binswanger et al. (1993), in a study of thirteen states in Republic of India, found that investments in rural infrastructure lowered down transportation costs, expanded farmers access to markets and led a way to substantial agricultural expansion. Overall, rural

infrastructure is not only an important driving force for total factor productivity (TFP) growth but also contributes to a substantial reduction in rural poverty.

2.1.B. Investment and Agricultural growth:

As most of the people in a developing country like India, largely depends on the agricultural sector, crucial measures are to be taken for the development of the agricultural sector. Capital resource thus plays the major role for a significant increase in production which by and large implies the substantial increase on the rate of investment and capital formation. Investment and agricultural growth are interrelated as investment in agriculture sector generates capital in the form of infrastructure that improves the quality of natural resources and helps to create productive assets. Investment funds are an effective tool for agricultural development and Capital investment accounts for the drastic improvement in agricultural output over time and it makes the difference in performance of economies across countries (FAO, 1999). Thus, the use of modern techniques of agriculture acts as a pre-requisite condition for the continuous and significant growth in the capital investment per unit of land, man and livestock for the proper upliftment of the economy.

2.2 Empirical findings:

1. Majumdar (2002), on the basis of regression analysis of the State-level cross-section data for the years 1971-1995 indicated that among various physical infrastructures, it was the transport infrastructure that significantly affected the agricultural output level and agricultural development index. Physical and social infrastructure also had a significant positive impact on the dependent variables.
2. According to Nadeem et.al (2011), in the paper entitled, 'Impact of Social and Physical Infrastructure on Agricultural Productivity in Punjab, Pakistan – A Production Function Approach,' public investment acts as an important factor of rural infrastructure that helps to increase agriculture on one hand and reduces poverty on the other. Based on secondary data the study measured the impact of public infrastructure taking social and physical infrastructure investment on total factor productivity (TFP) using TFP as the dependent variable in Punjab, Pakistan using the methodology of multivariate Cobb

Douglas Production function for the period 1970-2005. As per the results the study concludes that the public investment on physical infrastructure such as rural roads, village electrification and irrigation and social infrastructure involving rural education and rural health have contributed a positive significant impact to TFP. The study also ends with the suggestive comment that more resources should be contributed towards the development of physical and social infrastructure that will increase the agricultural productivity and reduce the rural poverty as well.

3. A study on the 'Impact of Road Infrastructure on Agricultural Development and Rural Road Infrastructure development programmes in India' by Lokesha and Mahesha (2016), based on descriptive research found that rural roads are the major source of connectivity, assets of a nation , a tool for social inclusion , economic development and environmental sustainability. Improving rural roads reduces transportation cost and encourages marketing which results in increased production and productivity, crop diversification and increased profitability (Lokesha and Mahesha, 2016).
4. Chandrachud and Gajalakshmi (2015), in their study have investigated that economic infrastructure and social infrastructure can be achieved through developing various sectors like Energy, Power, telecommunication, transport, irrigation etc as well as Education infrastructure development and Health infrastructure development. The paper has provided a linkage between the infrastructure development and Agricultural sector through the transition of tradition agriculture sector into commercialised agriculture sector and found that the agriculture sector had low production due to a number of factors such as illiteracy, insufficient finance and inadequate marketing of agricultural products. The relationship between them is supported by undertaking the current status of economic infrastructure, social infrastructure, and role of infrastructure development in agricultural growth.
5. Baba et.al (2015), using the regression model have analysed the growth and impact of rural infrastructure on agricultural land and labour productivity in Jammu & Kashmir employing secondary data. The study mainly examined undertaking five infrastructure variables namely road, irrigation, village electrification, institutions and cooperatives. The result indicated that the

estimates of agricultural land and labour productivity model have significantly contributed to the growth of agricultural productivity. Based on major findings, the study suggests that the progress of growth in development of the rural areas as well as the agricultural economy has to be accompanied by consistent growth in rural infrastructure to maintain a stationary balance growth in the economy.

6. Singh and Kaur, (2014) in their paper entitled 'Role of Infrastructure in the Growth of Agriculture in Punjab' investigated the relationship between institutional Agri-infrastructure and volume of agriculture production through coefficient of correlation analysis. Based on the secondary data the study undertook the time period from 1990-91 to 2011-12 and reveals that the financial institutions both the formal and informal institutions have played a dominating role in increasing the volume of agriculture followed by number of regulated markets and total storage capacity with Govt agencies accreditation. The study also established a strong relationship between institutional Agri-infrastructure and volume of agriculture production.
7. Sidhu, Vatta and Kaur (2008), in their paper have contributed the dynamics of Institutional credit to agricultural growth in the state of Punjab. In their study, a simultaneous (four) equation model has been used to estimate the demand supply situation under different scenarios towards the use of production inputs, private investments and agricultural growth. The results showed that the relationship between use of variable inputs and production credit disbursement has been highly significant. The study also found that supply of production credit doubled and that of investment credit inflated by about 80 percent throughout the period 2001-02 to 2003-04. A similar relationship within the study between non-public capital formation and investment credit has resulted a major significant and positive impact on productivity with elasticity of 1.02.
8. Bhattacharya (2017) in his article 'Role of Institutional credit in Indian Agricultural Production: A detailed Time series analysis' looks at the relationship between institutional credit and agricultural production through time series analysis undertaking four variables namely – food grains production in India, major commercial crops production in India, total

agricultural production & institutional credit to the agricultural sector for the years 1970-2008. The study found that there is no co integration of institutional credit with production of food grains but cointegration exists with production of commercial crops and total agricultural production. According to the study, credit plays an important role and agriculture can improve a lot if sufficient amount of credit is issued to the agriculture sector.

9. According to Shah et al. (2008), finance is considered as the basic ingredient for each and every economic activity including agriculture. For this purpose a study was undertaken in a backward district Chitral of Northern Pakistan to find out the impact of credit on farm productivity and income of the sample farmers. However, as per the findings, the empirical results have shown a positive relationship between farm productivity and agricultural credit.
10. Barnes and Binswanger, (1986) in their article 'Impact of Rural Electrification and Infrastructure on Agricultural Changes, 1966-1980,' have empirically examined whether or not the tremendous capital investments in rural electrification had desired impact on the rural areas where the author selected three states and 108 villages to get the desired result. However, the study examined had found that rural electrification has had a direct impact on agricultural productivity through private investment in electric pumps. Also the farmers have made substantial investments in diesel pumps although at a slower rate but the study found that there has been no explosive growth as was anticipated by many of the early planners.
11. Bhalla, S. (1977) in the article 'Agricultural Growth: Role of Institutional and Infrastructural Factors' mainly focussed on the performances of the institutional and infrastructural factors that play a great role on the improvement of the agricultural growth. The study found that investment in infrastructure is not likely to be sufficient in the traditional rice growing areas because major institutional problems of land distribution, tenancy and unrestricted private property rights in land still stand in the way of increasing agricultural production. The major findings that the study has found is that there is an urgency of making a very substantial increase in the rate of investment in non-agricultural sectors as well in addition to more direct investment in agriculture itself.

12. Ghosh and De, 1998 in the paper entitled, 'Role of Infrastructure in Regional Development- A study over the Plan Period', analysed the role of physical infrastructural facilities and planning in regional income determination in Indian states since independence. The paper mainly focussed on the level of income differentials rather than growth. For this purpose, the study used the OLS regression model and a physical infrastructure development indicator is formulated with the help of principal component analysis. With numerous unavoidable information barriers, the results found are considerably positive and also the regional inequality has been rising within the recent period, and the regional imbalance in physical infrastructure has been found to be responsible for increasing income inequality across the states.
13. Desai and Namboodiri, 1997, a research paper named, 'Determinants of Total Factor Productivity in Indian Agriculture', develops a comprehensive framework that growth in total factor productivity in agriculture is a necessary and sufficient condition for development. The paper shows that technical change along with the infrastructure is also a major driving force to increase the productivity. And the technical change in agriculture according to traditional method is determined by non-price factors like govt expenditure on R and D and infrastructure but the recent reforms considers that relative farm practices provides incentives for technical change. After a detailed analysis the study finds that the technical change is a superior strategy that increases production at reduced unit-costs/prices in real terms which benefits the poors most. In accordance with, fragmentation of land also stands as an eligible factor for explaining technical change and new farm inputs such as seeds, fertilisers, pesticides, irrigation, farm implements, machinery and electricity helps to determine total factor productivity in agriculture.
14. According to Bhatia, 1999, in the paper entitled , 'Rural Infrastructure and Growth in Agriculture,' attempts to build a composite index of rural infrastructure state wise using mainly two approaches time series or cross section data to examine the relationship between infrastructure development and levels of production and growth in agriculture. The study revealed that index of infrastructure significantly influences the per hectare yield of food grains and value of output from agriculture in the states. The study also

established a strong relationship between rural infrastructural development and level of per hectare yield of food grains as value of output from agriculture. Again, the study finds that the development of infrastructure in the states requires large-scale step up in investment in those sectors which remained constraint because of financial resources. Thus the priority allocation of financial resources in infrastructure may affect development which in return may yield higher rate of economic growth.

15. In the paper entitled, 'Rural Infrastructure and Agricultural Development in Southern Africa: a centre- periphery perspective', Wanmali.S. and Islam.Y. (1997) mainly discusses the provision of rural infrastructure in Southern Africa by drawing on two case studies from Zimbabwe and Zambia. It mainly observed that the imbalances in rural infrastructure provision between different regions are a function of colonial modes of production, agro-ecological endowments and levels of agriculture development. The study finds strong similarities between the two countries. The findings of the study mainly underlines the importance of comprehensive rather than piecemeal, planning by the Govt, in order to provide a complete array of services required, including agricultural research and extension, input and output marketing, transport, credit and communications. All of these help in establishing a firm basis for regional growth and development.

2.3 Gap in Literature:

In a summary, a concluding remark can be appealed from the perspective of the above literature is that the infrastructure dealing with the economic, institutional or social infrastructure acts as a role model in various fields of the economy. It not only helps in promoting the agricultural growth of a particular region but also in other regions of the economy as infrastructure generates long term as well as extensive benefits which helps a firm to become more productive and encourage the workers to be engaged in different purposes accelerating the growth of an economy.

Moreover, it is being noticed there has been very limited research on the infrastructural development of agricultural sector in a less developed state like Assam. And whatever researches has been undertaken are mostly conducted on a

particular infrastructure sector like road transportation, irrigation, agricultural credit etc and mainly confined to the national and state level. Infrastructure development at different levels, particularly district levels has been least studied. In many of the studies, a particular district has been undertaken related to the economic, social or institutional infrastructure for finding out the interlinkage between the infrastructure and agricultural production but the performances of all the three types of infrastructure and impact for enhancing the agricultural development has been least studied in Assam. Further, elaborative review of literature in the study brought to light that studies in relation to all the three combinations of rural infrastructures impacting the agricultural land productivity and ranking of different districts of Assam based upon their performance is generally not found to be studied yet. Therefore, the proposed research is an attribute to fill these gaps; thereby undertaking the different types of the availability of rural and agricultural infrastructure in order to know the discrepancy across different districts of Assam. In view of this, a topic entitled "A study on the performances and Impact of rural infrastructural development on agricultural productivity of Assam – A district level analysis" has been undertaken in the study which is expected to fill up the gap in this regard.

CHAPTER 3
COMPONENTS AND AVAILABILITY OF RURAL INFRASTRUCTUE IN INDIA TO UNDERSTAND ASSAMS POSITION

3.1 Introduction:

Good infrastructural support and efficiency of an infrastructure acts as an essential condition for a good economic environment of a country. In a developing country like India, infrastructural facilities are generally weak and inadequate. Many people, especially the rural areas are not accessed with the sufficient infrastructural facilities. Rural infrastructure is a powerful tool in strengthening the platform of agricultural sector which leads a way in commercialising the agricultural sector as well as the rural areas. There are many infrastructures consisting of both the hard and soft infrastructures. Among them, the major items of infrastructure as included in the planning include irrigation, power, transport, communication, education, health etc. There are also sub-items of rural infrastructure which have direct impact on agricultural development. The major sub-items of infrastructure includes percentage of villages electrified, percentage of irrigated area, density of rural roads, traffic intensity of vehicles, flow of rural credit to the agricultural sector, number of wholesale markets, storage facilities etc. Thus, power, irrigation, transport, communication, education, health etc falls under the major items of infrastructure that are mostly important for the formation of rural areas into developed areas. All these facilities and services is an essential pre-condition for increasing agricultural production, income and employment generation in any area of the country.

3.2 State wise development of infrastructure indicators in India:

In the present chapter, the infrastructure development in India in relation to the agricultural sector of different infrastructure indicators is studied. The state wise

analysis of the infrastructural indicators is undertaken to study the relative performance of Assam as compared to the other states of the country. Therefore, an attempt has been made to find out the relative position of Assam state with the help of secondary data. The three types of infrastructure are mainly considered in the study – economic, social and institutional infrastructures. Each infrastructure indicator is measured by geographical area, by population or percentages. In the study, focus is made mainly on the trend in the growth of various kinds of rural infrastructure indicators in major states of the country, especially between two time-periods 2005 and 2015. The researcher has undertaken a ten years gap to find out the percentage gap of Assam in relation to other countries. In the study 2005 has been taken as a base year to compare the availability of infrastructure facilities because the Bharat Nirman Programme was launched on 16th Dec, 2005 by the Govt of India for creating and augmenting basic rural infrastructure. Its main objective was to develop rural infrastructure including six components on irrigation, roads (Pradhan Mantri Gram Sadak Yojana), housing (Indira Awaas Yojana), water supply (National Rural Drinking Water Programme), electrification (Rajeev Gandhi Grameen Vidyutikaran Yojana) and Telecommunication connectivity.

Considering the importance of the programme three main components of infrastructure – irrigation, roads, electricity are selected as they are the major component in transforming an agrarian economy into a modernised economy and alonwith the other infrastructure indicators like social and institutional infrastructure have been undertaken to see the changes in the last ten years. As the infrastructure facilities are large in number it is difficult to study all the components due to the unavailability of data. Therefore following facilities are selected for the assessment in the present study:

3.3 Types of infrastructural indicators undertaken in the present study:

Types	Indicators	
Economic infrastructure	Irrigation	% of net irrigated areas to total cropped areas.
	Road Transport	% of surfaced roads.
	Power	% of villages electrified.
Social Infrastructure	Education	No of schools per thousand populations.
	Health	No of PHC's per thousand hectare of geographical area.
Institutional Infrastructure	Markets	No of regulated markets per thousand hectare of geographical area.
	Agricultural Credit	No of PACS per thousand hectare of geographical area

Source: Researchers own

The researcher, thus have chosen the above variables to see the position of Assam in relation to India with a general overview of the Bharat Nirman Programme where the six components of infrastructure was taken under the programme. Also as per the literature review the above economic infrastructure are the main core areas for the rural development in any region. The indicators of the social infrastructure and the institutional infrastructure are being taken based on the literature review which is directly or indirectly related to agricultural productivity and thus proves to show significant impact on the productivity.

3.3.1 Irrigation:

Irrigation as one of the main source of occupation for fighting famine falls under the major item of infrastructure. It is a very essential method to sustain life and an important input in socio-economic development of the country. Massive scale irrigation dams, canals, bridges etc have been the key areas that attracted massive share of infrastructural investment. All these developments are reflected in terms of net irrigated area to the total cross cropped area in the country. The following table reflects the changes in the percentage of irrigated area to the total cross cropped area in various states of the country:

TABLE 3.1: Percentage of net irrigated area to the total cropped areas in major states of India as per 2005 and 2015 data (areas in hectare):

States	**% of net irrigated area to total cropped area**	
Years	**2005**	**2015**
Punjab	51.80	52.41
Tamil Nadu	49.44	45.47
Uttar Pradesh	52.38	55.03
Andhra Pradesh	34.75	38.06
Haryana	46.76	45.50
West Bengal	32.54	32.01
Gujarat	35.89	33.14
Kerala	13.43	15.77
Karnataka	23.68	29.30
Maharashtra	14.47	13.81
Bihar	44.85	38.92
Himachal Pradesh	11.01	12.30
Orissa	22.89	24.33
Madhya Pradesh	31.64	40.25
Rajasthan	3.72	7.24
Assam	32.61	34.47
India	51.80	54.41

Source: RBI data, 2017

In the above table 3.1, we can see that in the year 2005, only the sate Punjab and Uttar Pradesh, the irrigation facility measured in terms of the irrigated area to the total cropped areas is well above the country's figure with 51.80 and 52.38. But in the year 2015, except for the state Uttar Pradesh, the irrigation facility in the other states is well below the country's average. As on 2015, about 34.47 percent of the irrigated areas have access to irrigation in Assam which seems to have a little favourable increase in the last 10 years. In the same period of time there is an improvement in this facility at the all India level.

3.3.2 Road Transport:

Road network is another vital tool for sustained and inclusive growth of the economy. It helps to facilitate the movement of passengers as well as the farmers for easy access to the market system across the country. It promotes potency within the economy by minimising total transportation prices or costs in terms of economies of production, distribution and consumption. The road network of the country consists of National highways (NH), State Highways (SH), Other Public Works Department (OPWD) Roads, Rural Roads, Urban Roads and Project Roads. Developing of an efficient road network helps in linking the villages to the markets in the state and outside the state as well. The table 3.2 below shows the development of Road infrastructure in the state using the indicators such as percentage of surfaced roads and road density per sq. km.

TABLE 3.2: Percentage of surfaced roads across major states of India as per 2005 and 2015 data:

	2005			2015		
States	**Total length (in kms)**	**% of surfaced roads**	**Road density (per 100 sq. km)**	**Total length (in kms)**	**% of surfaced roads**	**Road density (per 100 sq. km)**
Punjab	46490	83.58	92.31	105368	89.04	209.22
Tamil Nadu	176209	78.73	135.48	261100	80.45	200.75
Uttar Pradesh	256683	54.04	106.53	415383	85.86	172.40
Andhra Pradesh	329407	55.08	202.12	179022	68.28	109.85
Haryana	28657	93.41	64.81	46287	90.50	104.69
West Bengal	195679	20.04	220.47	295997	37.32	333.51
Gujarat	143419	90.44	73.16	182287	89.50	92.99
Kerela	169516	53.89	436.18	194854	69.36	501.38
Karnataka	210415	62.73	109.71	321808	67.34	167.79
Maharashtra	220937	79.36	71.79	608140	77.49	197.63
Bihar	119958	48.18	127.39	206010	52.54	218.78
Himachal Pradesh	23452	83.06	42.12	55593	71.95	99.856
Orissa	215141	14.09	138.17	283692	87.07	182.19
Madhya Pradesh	163920	48.32	53.17	288931	80.65	93.73
Rajasthan	149753	67.25	43.75	248156	78.47	72.50
Assam	208788	11.67	266.18	326512	18.29	416.26
India	2962463	53.88	90.12	4508827	68.96	137.16

Source: 1. Census of India 2001 and 2011

2. Transport of Research wing, Ministry of Road Transport and Highways.

The above Table 3.2 shows the development of the road infrastructure in Assam during the two periods 2005 and 2015. To measure the development of road infrastructure in Assam, we have used indicators such as the percentage of surfaced roads and road density per sq. km. As seen from the above table, the availability of road infrastructure in Assam is generally a moderate one as compared to other states in the country. Road density to geographical area per 100 sq. km ranges from 502 in Kerala to 72 in Rajasthan in 2015. Again, the percentage of surfaced roads ranges from 90 in Haryana to 18 in Assam in the same period. It is to be noted that Assam has the lowest percentage of surfaced roads as compared to the other states. While the availability of road per square kilometres has increased in the last two periods i.e. (2005 and 2015) the state of Assam's average of 416 kms of road per square kilometres in 2015 is greater than the all India's average of 137 kms. Thus, the availability of road infrastructure in Assam has been increasing from 266.18 kms of road per 100 sq. km in 2005 to 416.26 kms of road per sq. km in 2015. But the percentage of surfaced roads seemed to be lower as compared to other states of India.

3.3.3 Power:

Power is one of the most prime mover of agricultural development. It always considers to be the core infrastructure as it facilitates development across various sectors of the Indian Economy such as manufacturing, agriculture, commercial enterprises and railways etc. Keeping this into account, Govt of India right from the inception of the first five year plan period has given special importance for its development. There always exists a direct relationship in the growth of consumption of power and that of the economy. The following table 3.3 shows the availability of power among the major states of the country:

TABLE 3.3: State wise availability of Power:

(Millions Units net)

States	**2005**	**2015**
Punjab	30383	48144
Tamil Nadu	47570	92750
Uttar Pradesh	41565	87062
Andhra Pradesh	50061	56313
Haryana	20562	46432
West Bengal	22789	46827
Gujarat	52724	96211
Kerela	12540	22127
Karnataka	33687	59926
Maharashtra	81541	133078
Bihar	6476	18759
Himachal Pradesh	3917	8728
Orissa	13875	26052
Madhya Pradesh	30097	53082
Rajasthan	28974	65310
Assam	**3582**	**5696**
India	**548115**	**1030785**

Source: Reserve Bank of India, 2017.

The state wise availability of power in the above table 3.3 shows that the availability of power in the state of Assam is increasing to a favourable rate from the year 2005 to 2015 alonwith the nations at the same period of time. On account of this, the number of villages electrified in Assam along with the other parts of the states has been notified below in the following table:

Table 3.4: Percentage of Villages electrified across major states of India as per 2001 and 2011 census:

States	Total no of inhabited villages (2001census)	No of villages electrified (2005)	Percentage	Total no of inhabited villages (2011 census)	No of villages electrified (2015)	percentage
Punjab	12,278	12,278	100	12,168	12,168	100
Tamil Nadu	15,400	15,400	100	15,049	15,049	100
Uttar Pradesh	97,942	57,042	58.24	97,813	97,589	99.77
Andhra Pradesh	26,613	26565	99.81	16158	16158	100
Haryana	6764	6759	99.92	6642	6642	100
West Bengal	37,945	31705	83.55	37,463	37,449	99.96
Gujarat	18,066	17940	99.30	17,843	17,843	100
Kerela	1,364	1,364	100	1017	1017	100
Karnataka	27,481	26771	97.41	27,397	27,358	99.85
Maharashtra	41,095	40351	98.18	40956	40956	100
Bihar	39,015	19251	49.34	39073	38080	97.45
Himachal Pradesh	17,495	16891	96.54	17882	17848	99.80
Orissa	47,529	37663	79.24	47677	45452	95.33
Madhya Pradesh	52,117	50,864	97.59	51929	51674	99.50
Rajasthan	39,753	38,786	97.56	43264	42944	99.26
Assam	25,124	24,156	96.14	25372	23422	92.31
India	593732	560993	94.48	597464	586065	98.09

Sources: 1.Census of 2001 and 2011
2. Village Electrification data from Central Electricity Authority (CEA) website.

The above table 3.4 shows the number of villages electrified in Assam as well as in the other states as per 2001 and 2011 census data. Surprisingly it can be seen that the number of inhabited villages in Assam according to 2001 census is 25,124 whereas the number of inhabited villages according to 2011 census is 25,372 with a slight increase in the inhabited villages. But, the number of villages electrified in 2015 is 23422 which is less than the number of villages electrified in 2005 with 24,156.

Accordingly, the percentage of electrified villages is decreasing from 96.14 to 92.31 whereas the nation's percentage increased from 94.48 to 98.09 at the same period of time.

3.3.4 Education:

Educational infrastructure is one of the strongest tool for the upliftment of the society as well as the agricultural productivity. Availability of educational infrastructure in the rural areas enables the farmers to read and understand the procedures and applications of inputs for the use of chemical fertilisers and pesticides on accelerating the agricultural productivity. Thus, education influences agricultural productivity either directly or indirectly. So, education is one of the key factors among all the infrastructure that affect agricultural productivity. The following table shows the number of schools including only the Primary and upper primary schools below:

Table 3.5: Number of schools per ten thousand populations across major states in India (including only primary and upper primary schools) 2005-06 and 2015-16.

	2005	2015
States	**No of schools per thousand population**	**No of schools per thousand population**
Punjab	6.47	6.21
Tamil Nadu	6.76	6.22
Uttar Pradesh	10.49	10.97
Andhra Pradesh	10.42	9.83
Haryana	6.77	6.35
West Bengal	6.38	9.21
Gujarat	7.70	6.83
Kerela	3.09	3.73
Karnataka	10.31	9.40
Maharashtra	7.08	7.28
Bihar	6.08	7.29
Himachal Pradesh	22.56	20.86
Orissa	17.22	14.11
Madhya Pradesh	21.54	18.74
Rajasthan	15.13	11.69
Assam	15.08	19.80
India	10.31	10.50

Source: 1. Handbook of Indian States 2016
2 Ministry of Statistics and Programme Implementation Govt of India;
Education – Statistical year book of India 2016.

Table 3.5 shows the number of schools as per state wise including the primary and upper primary schools in India taking two time periods 2005 and 2015. The educational infrastructure is being measured by the number of schools as per thousand populations. It can be seen from the table that the number of schools in 2005 ranges from 22.56 in Himachal Pradesh to 3.09 in Kerala. Again in 2015 the number of schools per thousand populations ranges from 20.86 in Himachal Pradesh to 3.73 in 2015. Interestingly, it is seen that in Assam the number of schools per thousand populations is increasing from 15.08 in 2005 to 19.80 in 2015. In the same period of time, there is also a slight improvement in this facility at the all India level.

3.3.5 Health:

Agricultural sector is directly or indirectly dependent on the health infrastructure as it acts as an inner pillar to improve the agricultural productivity of a country. Agriculture and health are linked in many ways because agriculture is essential for good health and it produces the world's food, fibre and materials for shelter. Again, health also affects agriculture as people's health status influences the demand for agricultural outputs and in agricultural communities, poor health reduces work performance, reduces income and productivity. It is therefore considered that health in an agricultural context is important because agriculture provides opportunities for improving health. The availability of health infrastructures in various states of India including only the Primary health centres is been laid below:

Table 3.6: Number of Primary Health centres per thousand hectare of geographical area across major states of India (2005-06 and 2015-16):

	2005		2015	
States	**PHCs**	**Number of PHCs per thousand hectare of geographical area**	**PHCs**	**Number of PHCs per thousand hectare of geographical area**
Punjab	484	9.61	427	8.47
Tamil Nadu	1380	10.61	1372	10.54
Uttar Pradesh	3660	15.19	3497	14.51
Andhra Pradesh	1570	5.70	1069	3.88
Haryana	408	9.22	461	10.42
West Bengal	1173	13.21	909	10.24
Gujarat	1070	5.45	1247	6.36
Kerela	911	23.44	827	21.27
Karnataka	1681	8.76	2352	12.26
Maharashtra	1780	5.78	1811	5.88
Bihar	1648	17.50	1883	19.99
Himachal Pradesh	439	7.88	500	8.98
Orissa	1282	8.23	1305	8.38
Madhya Pradesh	1192	3.86	1171	3.79
Rajasthan	1713	5.01	2083	6.08
Assam	610	7.77	1014	12.92
India	23236	7.06	25308	7.69

Source: Ministry of Health and Family Welfare Statistics Division, 2005-06 and 2015-16, Govt of India

3.3.6 Markets:

Regulated market nowadays acts as an important instrument in augmenting the productivity of agricultural economy as it plays a crucial role in improving the conditions of marketing the platform of agricultural products. It also builds a good bonding between the consumers and producers through reduction of marketing charges. The following table presents the number of regulated markets in Assam during the period 2005 and 2011. The data for regulated market is taken for the period 2005 and 2011 due to the lack of data availing for the study.

Table 3.7: Number of Regulated Markets per thousand hectare of geographical area operating in India as on 2005 and 2011:

	2005		2011	
States	**Regulated Markets**	**Number of regulated markets per thousand hectare of geographical area**	**Regulated Markets**	**Number of regulated markets per thousand hectare of geographical area**
Punjab	437	8.67	488	9.68
Tamil Nadu	288	2.21	292	2.24
Uttar Pradesh	584	2.40	605	2.48
Andhra Pradesh	889	5.45	905	5.55
Haryana	284	6.42	284	6.42
West Bengal	684	7.70	687	7.74
Gujarat	405	2.06	414	2.11
Kerela	NA	NA	NA	NA
Karnataka	492	2.56	504	2.62
Maharashtra	871	2.83	880	2.85
Bihar	NA	NA	NA	NA
Himachal Pradesh	38	0.68	48	0.86
Orissa	314	2.01	314	2.01
Madhya Pradesh	488	1.58	517	1.67
Rajasthan	416	1.21	431	1.25
Assam	224	2.85	226	2.90
India	7566	2.30	7249	2.20

NA: Not Available.

Source: Agriculture policy and reforms for higher and sustained farmers income prepared by ICAR National institute of agricultural economics and policy research new Delhi – 110012, India.

3.3.7 Agricultural credit:

Table 3.8: Number of (PACS) per thousand hectare of geographical area across major States of India as on (31-03-2005 and 31-03-2015).

	2005		2015	
States	**PACS**	**PACS per thousand hectare of geographical area**	**PACS**	**PACS per thousand hectare of geographical area**
Punjab	3985	79.12	1609	31.94
Tamil Nadu	4892	37.61	4436	34.10
Uttar Pradesh	8929	37.06	8929	37.06
Andhra Pradesh	4512	27.68	2050	12.57
Haryana	2433	55.03	711	16.08
West Bengal	18956	213.58	7402	83.40
Gujarat	9093	46.38	8804	44.91
Kerela	1796	46.21	1647	42.37
Karnataka	4051	21.12	5337	27.82
Maharashtra	20984	68.19	21094	68.55
Bihar	5936	63.03	8463	89.87
Himachal Pradesh	2089	37.52	2135	38.34
Orissa	4036	25.92	2701	17.34
Madhya Pradesh	4586	14.87	4457	14.45
Rajasthan	5651	16.51	6365	18.59
Assam	809	10.31	766	9.76
India	108779	33.09	93367	28.40

Source: National Federation of State Cooperative Banks Ltd, 2016

3.4 Relative Changes in Economic, Social and Institutional Infrastructure in Assam during the two periods:

A relative infrastructural index is constructed to measure the growth of infrastructural facilities in Assam in comparison to the India's position by selecting a few infrastructure variables. This index captures the change in the relative position of Assam with respect to India. The index tends to shows the percentage gap whether the availability of these selected infrastructure variables is widening (increasing) or narrowing (decreasing) with respect to the all India position.

The following formula is used to capture the relative changes of infrastructure variables in the two periods:

$$\frac{|X_n - X_i|}{X_i} \times 100$$

Where X_n stands for indicator value of infrastructure indicator of Assam and

X_i stands for indicator value of India.

The following table 3.9 presents the relative changes in the availability of the infrastructure indicators in Assam with respect to India.

Table 3.9: Relative Changes in the Availability of infrastructure in Assam with respect to India:

Infrastructural indicators	**Indicator value**			**Indicator value**		
	Year	**Assam**	**India**	**Year**	**Assam**	**India**
% of net irrigated area to total cropped areas	2005	32.61	51.80	2015	34.47	52.41
% of surfaced roads	2005	11.67	53.88	2015	18.29	68.96
% of villages electrified	2005	96.14	94.48	2015	92.31	98.09
No of PHCs per thousand hectare of geographical area	2005	7.77	7.06	2015	12.92	7.69
No of schools per thousand population	2005	15.08	10.31	2015	19.9	10.6
No of Regulated markets per thousand hectare of geographical area	2005	2.85	2.30	2011	2.90	2.20
No of PACs per thousand hectare of geographical area	2005	10.31	33.09	2015	9.76	28.40

Table 3.9 shows that during the two periods, Irrigation, Road, Health Centres, Literacy and Regulated Market infrastructures in the state of Assam have improved to some favourable extent. It has been seen that the percentage of net irrigated area to total cropped areas over the last ten years, has increased by 1.86 percentage points, whereas for all India it has increased by 0.61 percentage points. Thus, we see that the difference between the state of Assam and India is not a big one. During the same period of time, in case of the percentage of surfaced roads for Assam, it has gone up by 6.62 percentage points, whereas for the country as a whole it has increased by 15.08 percentage points. In the case of Health infrastructure the number of Primary Health Centres which is being measured by the number of PHCs per thousand hectare of geographical area, the number of PHCs in Assam has increased by 5.15 points, whereas for India, it has been increased by 0.63 points. Next in case of educational infrastructure being measured by the number of Schools (including only the Primary and Upper Primary School) per thousand populations, the number of schools in Assam is increased by 4.82 points but for the country as a whole, the number is increased by 0.29 points. Again, in case of the Regulated Markets measured by per thousand hectare of geographical area, the number of Regulated Markets in Assam is increased by 0.05 points which is not so favourable for the state of Assam whereas for India, as a whole the number of regulated markets is being decreased by 0.1 points.

However, in case of the availability of infrastructure regarding the power sector and Primary Agricultural credit Societies (PACS) being measured by the percentage of villages electrified, there has been a deterioration in the availability of the infrastructure in Assam, with the percentage of villages electrified being decreased by 3.83 percentage points and with the number of PACS per thousand hectare of geographical area being decreased by 0.55 points between 2005 and 2015.

Now in order to know the position of Assam with respect to India a Relative infrastructure index have been transformed to give a better picture of the growth of the infrastructural indicators in Assam which has been shown below:

Table 3.10: Relative Infrastructure index for the state of Assam with respect to India:

Infrastructural indicators	ASSAM	
	2005	**2015**
% of net irrigated area to total cropped areas	37	34
% of surfaced roads	78	73
% of villages electrified	1.75	5.89
No of PHCs per thousand hectare of geographical area	10.05	68.01
No of schools per thousand population	46	87
No of Regulated markets per thousand hectare of geographical area	24	31
No of PACs per thousand hectare of geographical area	68	65

Table 3.10 gives a detailed picture of the relative development of the seven infrastructural variables in Assam vis-à-vis the all India position during the period 2005 to 2015. Transformed values for the Assam state shows that the number of villages electrified, primary health centres, number of schools and number of regulated markets infrastructures indicators have improved in the ten years gap periods 2005 and 2015. It is to be noted that the percentage gap in the availability of these infrastructural facilities in Assam in relation to the availability of the same at the all India level has narrowed down i.e., the gap has reduced.

Individually, if the infrastructure is to be analysed we find that in case of the number of villages electrified, the transformed values has not only improved but the gap in the availability of these infrastructural facility has narrowed down but has also come up at par with the all India average. However, in case of the availability of the Primary health centres, number of primary schools and the number of regulated markets it is to be noted that not only the transformed values has improved but the

gap in the availability of these infrastructural facilities has narrowed down as well as it has surpassed the nations average.

On the other hand, the transformed values of Assam in case of the availability of the irrigation sector, has deteriorated that is progressively worse when compared to the all India situation, as well as with the index showing a widening of the gap in the availability of these infrastructure. Similarly, we find that in case of the road transportation and PACS (Primary Agricultural credit societies), the situation seems not to be better off because the transformed values has deteriorated as well as the gap in the availability of these infrastructures as compared to the all India position has widened during the two periods under study.

Thus, we can conclude that the position of Assam in the field of social, economic, institutional infrastructure gives a mixed picture in the study. However, the absolute position in respect of the availability of these infrastructures is still below the all India average. Since, infrastructure is inseparably related to the agricultural development, much effort are to be done for the availability of the infrastructures especially in case of the irrigational infrastructure in Assam so that it comes at least at par with the India's position.

CHAPTER 4
PERFORMANCES OF INFRASTRUCTURAL INDICATORS IN ASSAM

4.1 Introduction:

Assam blessed with plenty of natural resources and richly diversified in climatic conditions seems to perform low in agricultural productivity mainly due to the unavailability of infrastructural facilities in the region. That means poor physical as well as social and economic infrastructure in Assam acts as a major constraints imbalancing the socio-economic development of a state. Like other states, Assam also dreamt of an inclusive growth as the main objective in increasing the productivity of an economy. It has been widely recognised that the availability of basic infrastructure facilities and services are vital for boosting up the economic development of the country. Universal access to education, health and safe drinking water is a need for any society to progress. But even after decades of Govt intervention in form of development planning, Assam still has gaps not only in physical infrastructure but also in creating adequate social infrastructure. Inspite of various developmental plans, lack of infrastructural facilities seems to remain as a major drawback in progressing the economy of a country.

Assam a north-eastern states of India is one of the 28 states of the country with a geographical area of 78438 sq. km providing shelter to 2.57% population of the country. The population of India according to the census 2011, records 31.17 million. Again the literacy rate of Assam was 63.25% and 73.18% as against 64.80% and 74.04% for the country, according to the census 2001 and 2011 respectively. Also the sectoral composition of GSDP each at current and constant (2004-05) prices has undergone significant changes throughout the past few years. The annual average growth rate (AAGR) of gross State Domestic Product at constant (2011-12) prices during 2011-12 to 2016-17 of the state of Assam is estimated at 6.11%, which implies

a favourable status of the State Economy. Net State Domestic Product (NSDP) during the period 2011-12 to 2016-17 has shown an AAGR of 6.76% at constant price (base 2011-12) and 14.44% at current price.

In the present study, a detailed analysis on the development of various rural and agriculture infrastructure indicators is undertaken to find out the disparity in various districts of Assam. Based on the secondary data, an investigation has been undertaken to know the performance of the indicators at the district level and also to identify the infrastructure imbalances in the districts.

4.2 Development of various Infrastructure facilities in Different Districts of Assam:

Infrastructure is the basic component that serves a country or an area for an economy to function. As the infrastructural facilities are large in number it is quite difficult to study all the components. Therefore, keeping in view the most important type of rural and agriculture infrastructure that have a direct impact on agricultural productivity based on the literature review the following infrastructure facilities have been selected as per the availability of data for the assessment of the present analysis. This includes the Irrigation, Road transportation, power, Banks, Education, Health, Number of Tractors, Warehouses as the basic facilities along with the other facilities such as percentage of area under HYV, fertiliser consumption in kg per area and percentage of achievement under KCC scheme are taken as a substitute of the infrastructure indicators in the study.

As per the sources of many studies the gross cropped area of a region acts as a “push factor” towards infrastructural development as increasing gross cropped area helps in increasing agricultural production which in turn helps to increase infrastructure facilities for a better productivity of a region. Therefore, the percentage of gross cropped area in different districts of Assam from 2011 to 2016 is presented in the following table:

Table 4.1: **Percentage of gross cropped area in different districts of Assam - district wise (area in hectares):**

Districts	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Kokrajhar	8.59	3.66	5.54	7.34	5.85	5.86
Dhubri	0.42	0.16	0.32	0.27	0.11	0.10
Goalpara	1.35	1.64	1.51	1.53	0.99	0.71
Barpeta	2.88	1.10	1.67	1.81	4.09	2.39
Morigaon	0.70	0.57	0.80	0.57	0.42	0.35
Nagaon	15.48	18.58	17.66	9.83	12.37	10.74
Sonitpur	7.05	5.07	5.46	5.70	8.46	6.03
Lakhimpur	0.56	0.50	0.57	1.16	0.17	0.27
Dhemaji	0.33	0.22	0.01	1.12	0.26	0.04
Tinsukia	0.50	0.39	0.83	0.44	0.17	0.15
Dibrugarh	0.78	1.32	0.16	0.42	0.43	0.12
Sivasagar	0.62	0.18	0.17	0.43	0.21	0.58
Jorhat	0.58	0.64	1.14	1.32	0.50	0.16
Golaghat	0.18	0.08	0.41	0.62	0.75	0.43
Karbi Anglong	12.13	21.80	20.19	29.68	17.46	16.60
Dima Hasao	2.42	2.13	2.09	1.74	1.66	1.83
Cachar	1.96	3.35	4.68	3.67	1.67	0.33
Karimganj	0.15	0.75	0.19	1.24	1.73	0.06
Hailakandi	1.24	0.95	0.54	0.12	0.12	0.14
Bongaigaon	0.07	0.31	1.10	0.64	0.71	0.64
Chirang	5.36	3.86	7.24	7.03	7.86	6.61
Kamrup (R)	1.99	0.32	2.31	1.48	1.20	1.47
Nalbari	0.34	0.06	0.18	0.13	0.14	0.11
Baksa	11.74	7.48	6.59	6.54	7.69	4.93
Darrang	3.07	3.12	2.56	2.54	2.34	2.69
Udalguri	17.29	17.66	14.64	11.53	20.96	35.04
State Total	97.91	96.03	98.66	99.02	98.32	98.38

Source: 1. Statistical Handbook of Assam, 2011, 2012, 2013, 2014, 2015, 2016.
2. Percentage - Researchers own calculation.

The above Table 4.1 shows the percentage of gross cropped area from 2011-12 to 2016-17. The gross cropped area in the state has constantly increased from 2012-13 with 96 % to 99% in 2014-15 with a slight decline during 2015-16 with 98%. It is interesting to see that the district with largest area (10434 sq. km) of Karbi Anglong district, the percentage of gross cropped area is increased to a quite larger extent from 12.13% in 2011-12 to 16.60 % in 2016-17 in respective to the other districts. Following the Udalguri district, performs a very positive growth in the percentage of gross cropped areas increasing from 17.29 % in 2011-12 to 35.04% in 2016-17 though it shows a slight decline during 2014-15. In spite of the fact, only three districts i.e., Karbi Anglong, Chirang and Udalguri shows an increased gross cropped areas while the other districts seems to be decreased or remains the same may be due to the soil, climate, rainfall etc as it depends upon the geographical features as well as on the nature and availability of irrigation and infrastructural facilities in the respective districts.

One striking fact from the above table is noticed that the percentage of gross cropped area in 2016 has decreased except few of the districts. And that is the reason that justifies my study for taking 2016 as the benchmark year to study the performance and understand the disparity of different infrastructure facilities in different districts of Assam.

In the following section, various infrastructural facilities developed in different districts of the state are being analysed.

4.2.1 Irrigation:

Irrigation facilities are an essential input for agricultural sector. Irrigation plays a significant role in the efforts towards economic development of the state too. The development programmes for improvement of irrigation facility in Assam is taken up under two broad heads, viz. Minor Irrigation and Major & Medium Irrigation. While the Irrigation Schemes are classified as Major, Medium and Minor, they are categorised as Surface flow, surface lift (for major/ medium and minor) and ground water lift (for minor only).

The position of creation of irrigation potential under sectors is presented in the following table.

Table 4.2: Irrigation Potential Created (AIA) Upto March, 2017 (in hectares)

Department/ Agency	Major & Medium Irrigation Sector	Minor Irrigation Sector	Total
Irrigation Department	279423	524912	804335
ASMIDC Ltd (now merged with Irrigation, Deptt)	NIL	149205	149205

Source: Economic Survey of Assam, 2017-18.

Table 4.3: Intensity of irrigated cropping i.e., the ratio of gross irrigated area to net irrigated area in different districts of Assam (areas in hectares) 2016-17.

Sl no	Districts	Gross irrigated area	Net irrigated area	Intensity of irrigated cropping	Sl no	Districts	Gross irrigated area	Net irrigated area	Intensity of irrigated cropping
1.	Kokrajhar	13167	13069	100.74	**14.**	Golaghat	980	499	196.39
2.	Dhubri	242	197	122.84	**15.**	Karbi Anglong	37321	22140	168.56
3.	Goalpara	1602	1142	140.28	**16.**	Dima Hasao	4115	4115	100.00
4.	Barpeta	5385	4957	108.63	**17.**	Cachar	758	391	193.86
5.	Morigaon	805	620	129.83	**18.**	Karimganj	135	113	119.46
6.	Nagaon	24146	22689	106.42	**19.**	Hailakandi	317	172	184.30
7.	Sonitpur	13560	13444	100.86	**20.**	Bongaigaon	1458	731	199.45
8.	Lakhimpur	619	375	165.06	**21.**	Chirang	14375	12054	119.25
9.	Dhemaji	107	97	110.30	**22.**	Kamrup (R)	3386	2473	136.91
10.	Tinsukia	359	308	116.55	**23.**	Nalbari	248	168	147.61
11.	Dibrugarh	275	265	103.77	**24.**	Baksa	11100	9871	112.45
12.	Sivasagar	1305	1289	101.24	**25.**	Darrang	6064	5382	112.67
13.	Jorhat	366	227	161.23	**26.**	Udalguri	78777	61903	127.25
						Assam	224777	181355	123.94

Source: 1. Statistical Handbook of Assam, 2017.
2. Intensity of irrigated cropping- Researchers own calculation.

In Table 4.3 district wise different areas related to cultivation and intensity of irrigated cropping of Assam has been shown. As per the data of 2016-17, intensity of irrigated cropping is seems to be highest in Bongaigaon district (199.45%) followed by Golaghat (196.39%) and Cachar (193.86%). However, there are only three districts with 100% of cropping intensity as per the agricultural data. The intensity of irrigated cropping for the state as a whole was 123.94% which indicates a very low level of irrigation in the state.

4.2.2 Road Transport:

Road transport is considered to be one of the most vital infrastructures to economic development. With poor road connectivity farmers get lower price for their products while urban consumers pay a higher price thus disturbing the whole economic process in fulfilling the objective of inclusive growth. Keeping in view the crucial role of roads in the rapid development of the country, concerned efforts have been made to develop various types of roads in the districts. A number of measures have been taken by the Government to facilitate the rapid growth of network system. Among them were the National Rural Employment Guarantee Programme (NREP), Rural Landless Employment Guarantee Programme (RLEGP), Jawahar Rozgar Yojana (JRY) etc. but despite these measures many villages in the district suffer from improper road connectivity.

Table 4.4: District wise different types of Roads under P.W.D. in Assam

(in kms as on 31-03-2016)

Sl no	Districts	Total Road (SH+MDR+RR+UR	Total road length per100 sq km of geo area	Sl no	Districts	Total Road (SH+MDR+RR+UR	Total road length per100 sq km of geo area
1.	Kokrajhar	1802	54.67	**14**	Golaghat	2481	70.85
2	Dhubri	1153	52.99	**15**	Karbi Anglong	4200	40.25
3	Goalpara	1549	84.92	**16**	Dima Hasao	1719	35.17
4	Barpeta	1985	86.99	**17**	Cachar	1162	30.69
5	Morigaon	1142	73.63	**18**	Karimganj	935	51.69
6	Nagaon	3083	77.60	**19**	Hailakandi	473	35.64
7	Sonitpur	2649	50.90	**20**	Bongaigaon	805	73.65
8	Lakhimpur	1090	47.87	**21**	Chirang	626	32.55
9	Dhemaji	1341	41.43	**22**	Kamrup (R)	3198	69.53
10	Tinsukia	1743	45.99	**23**	Nalbari	1013	96.29
11	Dibrugarh	1692	50.04	**24**	Baksa	1073	43.67
12	Sivasagar	2875	107.76	**25**	Darrang	1067	67.32
13	Jorhat	2205	77.34	**26**	Udalguri	1829	90.90
					Assam	45554	58.08

Source: Statistical Handbook of Assam, 2016-17.
SH – State Highway, MDR – Major District Road, RR – Rural Road, UR – Urban Road

The above table 4.4 shows the road length in Assam in different districts in various categories. Among all the districts of Assam Hailakandi (473 km), Chirang (626 km) and Bongaigaon (805) have the weak road length. The highest road length is available in Karbi Anglong with (4200 km) followed by Kamrup and Nagaon district.

4.2.3 Electricity:

Electricity is one of the important infrastructural tool or an instrument in the process of agricultural development. There is a direct relationship between the degree of economic growth and per capita consumption of electricity. Assam, among the North-Eastern States has a capacity to produce 680 MW of hydro power. Since electricity is an essential input of all productive economic activity in both the rural-urban areas, the process of economic development depends invariably on the level of electricity

consumed. The following table shows the number of villages electrified in Assam district wise.

Table 4.5: Percentages of villages electrified in different districts of Assam in the year 2016-17.

Sl no	Districts	Number of inhabitant villages (as per 2011 census)	No of villages electrified	% of villages electrified	Sl no	Districts	Number of inhabitant villages (as per 2011 census)	No of villages electrified	% of villages electrified
1.	Kokrajhar	1068	890	83.33	14.	Golaghat	1125	1107	98.40
2.	Dhubri	1091	1088	99.72	15.	Karbi Anglong	2921	2907	99.52
3.	Goalpara	829	769	92.76	16	Dima Hasao	695	652	93.81
4.	Barpeta	835	827	99.04	17.	Cachar	1040	922	88.65
5.	Morigaon	632	513	81.17	18.	Karimganj	936	840	89.74
6.	Nagaon	1412	1369	96.95	19.	Hailakandi	331	327	98.79
7.	Sonitpur	1876	1622	86.46	20.	Bongaigaon	563	906	160.92
8.	Lakhimpur	1184	1172	98.98	21.	Chirang	508	472	92.91
9.	Dhemaji	1319	1316	99.77	22.	Kamrup (R)	1068	1267	118.63
10.	Tinsukia	1168	1102	94.34	23.	Nalbari	456	877	192.32
11.	Dibrugarh	1348	1118	82.93	24.	Baksa	690	682	98.82
12.	Sivasagar	875	773	88.34	25.	Darrang	561	1343	238.50
13.	Jorhat	848	805	94.92	26.	Udalguri	800	762	95.25
						Assam	26395	24512	92.86

Source: Statistical Handbook of Assam, 2017

4.2.4 Banking Sector:

The financial system of a country is of immense use and plays a vital role in shaping the economic development of the state. Banks also plays an important role in sustaining economic development by mobilising deposits and credits. The bank network has been increased by opening new branches in the state. As a result, the number of reporting Bank Offices of all Scheduled Commercial Banks in Assam is recorded to 2177 as on March 2016. The performance of Commercial and Regional Rural Banks in Assam shows that this sector has contributed a lot for the

development of this region. The following table shows the progress of the Commercial and Regional Rural Banks in the Assam district wise.

Table 4.6 District wise numbers of Bank Branches per 100 sq km of geographical area in Assam (2016-17):

Sl no	Districts	(Commercial Banks) and (Regional RuralBanks)	No of bank branches per 100 sq km of geographical area	Sl no	Districts	(Commercial Banks) and (Regional RuralBanks)	No of bank branches per 100 sq km of geographical area
1.	Kokrajhar	46	1.39	14.	Golaghat	109	3.11
2.	Dhubri	78	3.58	15.	Karbi Anglong	106	1.01
3.	Goalpara	60	3.28	16.	Dima Hasao	30	0.61
4.	Barpeta	103	4.51	17.	Cachar	143	3.77
5.	Morigaon	60	3.86	18.	Karimganj	79	4.36
6.	Nagaon	180	4.53	19.	Hailakandi	42	3.16
7.	Sonitpur	164	3.15	20.	Bongaigaon	55	5.03
8.	Lakhimpur	88	3.86	21.	Chirang	30	1.56
9.	Dhemaji	34	1.05	22.	Kamrup (R)	365	38.21
10.	Tinsukia	132	3.48	23.	Nalbari	74	7.03
11.	Dibrugarh	160	4.73	24.	Baksa	49	1.99
12.	Sivasagar	113	4.23	25.	Darrang	63	3.97
13.	Jorhat	120	4.20	26.	Udalguri	53	2.63
					Assam	2642	3.36

Source: Statistical Handbook of Assam, 2017

4.2.5 Education:

Education is an important instrument of social change and is an important component of social infrastructure. It strengthens the arena of rural development, economic, social, technical, environmental and scientific areas in the state. Education not only removes ignorance, it also helps in boosting the moral values of individuals by enhancing their skills, efficiency, productivity and overall quality of life. Education is very important and has been accepted as one of the most crucial inputs required for nation building.

Table 4.7: Literacy Rates in Assam:

State	1991	2001	2011
Assam	52.89	63.25	72.19

Source: Economic Survey of Assam

The literacy rates of Assam increased from 52.89 % in 1991, 63.25 % in 2001 census and 72.19 % in 2011 census.

Table 4.8: District wise number of Primary Schools per hundred sq km of geographical area in Assam as per 31-03-2016:

Sl no	Districts	No of Schools	No of primary schools per 100 sq km of geo area	Sl no	Districts	No of Schools	No of primary schools per 100 sq km of geo area
1.	Kokrajhar	1511	45.84	14.	Golaghat	1332	38.03
2.	Dhubri	2176	100	15.	Karbi Anglong	1798	17.23
3.	Goalpara	1499	82.18	16.	Dima Hasao	750	15.34
4.	Barpeta	1951	85.49	17.	Cachar	2059	54.38
5.	Morigaon	1236	79.69	18.	Karimganj	1635	90.38
6.	Nagaon	2648	66.64	19.	Hailakandi	1236	93.14
7.	Sonitpur	1940	37.27	20.	Bongaigaon	847	77.49
8.	Lakhimpur	1825	80.14	21.	Chirang	839	43.62
9.	Dhemaji	1288	39.78	22.	Kamrup (R)	2427	254.13
10.	Tinsukia	1132	29.86	23.	Nalbari	998	94.86
11.	Dibrugarh	1460	43.18	24.	Baksa	1456	59.25
12.	Sivasagar	1925	72.15	25.	Darrang	1096	69.14
13.	Jorhat	1754	61.52	26.	Udalguri	1168	58.05
					Assam	39986	50.97

Source: Statistical Handbook of Assam, 2017

4.2.6 Health:

Health is the basic requirement that is much essential need for improvement of the quality of life and enhancement of productive efficiency. Health infrastructure plays an important role in the development of any region. To quote World Development

Report 1993 “improved health contributes to economic growth in four ways- it reduces production losses caused by workers illness, it permits the use of natural resources that had been totally or nearly inaccessible because of diseases, it increases the enrolment of children in school and makes them better able to learn and it frees for alternative uses of resources that would otherwise have to be spent on treating illness.”

Table 4.9 Number of Health Care Centres per 100 sq km of geographical area in Assam district wise as on 31-03-2016:

Sl no	Districts	Total centres = (PHC+CHC+CH)	Number of Health Centres per 100 sq km of geographical area	Sl no	Districts	Total centres = (PHC+CHC+CH)	Number of Health Centres per 100 sq km of geographical area
1.	Kokrajhar	50	1.51	14.	Golaghat	45	1.28
2.	Dhubri	53	2.43	15.	Karbi Anglong	52	0.49
3.	Goalpara	47	2.57	16.	Dima Hasao	14	0.28
4.	Barpeta	58	2.54	17.	Cachar	39	1.03
5.	Morigaon	42	2.70	18.	Karimganj	35	1.93
6.	Nagaon	96	2.41	19.	Hailakandi	17	1.28
7.	Sonitpur	66	1.26	20.	Bongaigaon	34	3.11
8.	Lakhimpur	39	1.71	21.	Chirang	29	1.50
9.	Dhemaji	27	0.83	22.	Kamrup (R)	29	3.03
10.	Tinsukia	30	0.79	23.	Nalbari	57	5.41
11.	Dibrugarh	37	1.09	24.	Baksa	47	1.91
12.	Sivasagar	50	1.87	25.	Darrang	37	2.33
13.	Jorhat	49	1.71	26.	Udalguri	28	1.39
					Assam	1190	1.51

Source: Statistical Handbook of Assam, Directorate of Health Service Govt of Assam, 2017

PHC- Primary Health Centre, CHC – Community Health Centre, CH – Civil Hospital.

The above table presents the number of health infrastructure facilities across the districts of Assam.

4.2.7 Tractors and Warehouses infrastructure:

Tractors and warehousing facilities are very crucial infrastructure for strengthening the field of an agricultural productivity. The following table presents the number of tractors and warehousing available in different districts of the state.

Table 4.10 Number of Tractors and Warehouses registered in Assam upto 2016-17:

Sl no	Districts	No of Tractors	Warehousing Centres	Sl no	Districts	No of Tractors	Warehousing Centres
1.	Kokrajhar	1130	1	14.	Golaghat	415	2
2.	Dhubri	1424	0	15.	Karbi Anglong	212	2
3.	Goalpara	674	3	16.	Dima Hasao	31	0
4.	Barpeta	2249	1	17.	Cachar	1147	1
5.	Morigaon	1104	0	18.	Karimganj	104	1
6.	Nagaon	3872	3	19.	Hailakandi	211	0
7.	Sonitpur	4598	1	20.	Bongaigaon	2716	1
8.	Lakhimpur	3047	1	21.	Chirang	1146	0
9.	Dhemaji	360	5	22.	Kamrup (R)	3504	4
10.	Tinsukia	1408	2	23.	Nalbari	3677	0
11.	Dibrugarh	2764	1	24.	Baksa	818	0
12.	Sivasagar	1082	1	25.	Darrang	1279	2
13.	Jorhat	5089	0	26.	Udalguri	744	2
					Assam	47322	42

Source: Statistical Handbook of Assam, 2017

4.3 Data Analyse:

After being assessing the level of development of infrastructural facilities in different districts of the State, an attempt is being taken to measure the inter- district disparity by ranking the districts on the basis of its performances. Many of the studies uses the statistical tools like standard deviation , co-relation, factor loading, composite index for finding out the disparities among various districts or talukas but for this study, the researcher used the methodology adopted by (Venkatachalam.L, 2003) to study the performances of the districts on the basis of the state average; i.e., the researcher here takes the state average value as a reference to compare the level of that particular infrastructure in a particular district because it helps in summarising a large amount of data into a single value and eliminates the random errors in an experiment.

Selected Infrastructure Indicators in Assam:

Thus, for analysing the disparities of the infrastructural facilities, eight important infrastructure indicators have been selected to investigate the result below:

1. Ratio of gross irrigated area to net irrigated area i.e., the irrigation intensity (V_1).
2. Total road length per 100 sq. km of geographical area (V_2).
3. Percentages of villages electrified (V_3).
4. Number of bank branches per 100 sq. km of geographical area (V_4).
5. Number of primary schools per 100 sq. km of geographical area (V_5)
6. Number of Health Centres per 100 sq. km of geographical area (V_6).
7. Number of tractors registered per geographical area of the district (V_7).
8. Number of warehouse centres available in each of the district (V_8).
9. Percentage of area under HYV to net sown area (V_9).
10. Fertiliser consumption in kg per hectare of total cropped area (V_{10}).
11. Percentage of achievement under KCC scheme (V_{11}).

Table 4.11 Value of Rural and Agricultural infrastructure indicators in various districts of Assam (year 2016):

Districts	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}	V_{11}
Kokrajhar	100.75	54.67	83.33	1.39	45.84	1.51	1130	1	96.72	53.16	44.03
Dhubri	122.84	52.99	99.72	3.58	100	2.43	1424	0	87.19	53.16	56.27
Goalpara	140.28	84.92	92.76	3.28	82.18	2.57	674	3	102.12	76.32	49.5
Barpeta	108.63	86.99	99.04	4.51	85.49	2.54	2249	1	48.26	72.96	51.2
Morigaon	129.83	73.63	81.17	3.86	79.69	2.70	1104	0	70.98	92.58	46.15
Nagaon	106.42	77.60	96.95	4.53	66.64	2.41	3872	3	101.74	83.91	52.35
Sonitpur	100.86	50.90	86.46	3.15	37.27	1.26	4598	1	72.07	40.28	46.75
Lakhimpur	165.07	47.87	98.98	3.86	80.14	1.71	3047	1	79.92	39.48	57.94
Dhemaji	110.31	41.43	99.77	1.05	39.78	0.83	360	5	83.35	42.79	50.6
Tinsukia	116.56	45.99	94.34	3.48	29.86	0.79	1408	2	33.11	46.38	55.45
Dibrugarh	103.77	50.04	82.93	4.73	43.18	1.09	2764	1	33.01	71.42	80.98
Sivasagar	101.24	107.76	88.34	4.23	72.15	1.87	1082	1	32.68	72.61	41.3
Jorhat	161.23	77.34	94.92	4.20	61.52	1.71	5089	0	45.36	35.94	41
Golaghat	196.39	70.85	98.40	3.11	38.03	1.28	415	2	67.68	50.77	48.78
Karbi Anglong	168.57	40.25	99.52	1.01	17.23	0.49	212	2	79.43	33.45	33.36
Dima Hasao	100.00	35.17	93.81	0.61	15.34	0.28	31	0	21.54	23.42	26.42
Cachar	193.86	30.69	88.65	3.77	54.38	1.03	1147	1	63.72	98.7	37.8
Karimganj	119.47	51.69	89.74	4.36	90.38	1.93	104	1	73.05	59.85	35.83
Hailakandi	184.30	35.64	98.79	3.16	93.14	1.28	211	0	78.97	84.69	48.97
Bongaigaon	199.45	73.65	160.92	5.03	77.49	3.11	2716	1	60.34	116.07	67.1
Chirang	119.26	32.55	92.91	1.56	43.62	1.50	1146	0	52.09	94.78	29.59
Kamrup(R)	136.92	69.53	118.63	38.21	254.13	3.03	3504	4	64.69	53.28	50.81
Nalbari	147.62	96.29	192.32	7.03	94.86	5.41	3677	0	61.09	49.01	57.13
Baksa	112.45	43.67	98.82	1.99	59.25	1.91	818	0	91.55	42.31	35.5
Darrang	112.67	67.32	238.50	3.97	69.14	2.33	1279	0	112.29	48.76	46.78
Udalguri	127.26	90.90	95.25	2.63	58.05	1.39	744	2	57.44	64.23	36.58
State Average	134.07	61.16	106.34	4.70	68.79	1.86	1723.27	1.23	68.09	61.55	47.23

Source: Researchers own calculation.

The infrastructural indicators depicted above in the table 4.11 are used to know the performances of the infrastructural facilities at the district level. The state average is calculated by the summation of all the districts value divided by the total no of districts undertaken in the study. i.e,

$$\frac{\sum_{i=1}^{26} D_i}{26}$$

If the value of infrastructure is greater than the state average, then it is taken that district performs better off in terms of rural infrastructure.

Table 4.12 Performance of the districts in terms of infrastructure Availability:

	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}	V_{11}
No of Districts with Above state performance	10	12	4	4	12	12	9	8	13	11	13
No of districts with Below state Performance	16	14	22	22	14	14	17	18	13	15	13

Researchers own calculation

From the above assessment it can be seen that in case of gross irrigation area to net irrigated area (V_1), ten districts shows the ratio of irrigated area to net sown area above the state average and in the remaining 16 districts is found to be lower than the states average performance. As far as the road length (V_2), the number of primary schools (V_5) and number of Primary Health Centres (V_6) are concerned, it is seen that all the three indicators performs the same level of performance with 12 districts above the state average and the remaining 14 districts are below the state average. Again, two infrastructural indicators namely, number of villages electrified (V_3) and the number of availability of bank branches per 100 sq. km of geographical area (V_4) performs better only in 4 districts and the rest of the districts performs poor in 22 districts. Next coming to the number of tractors registered (V_7) 9 districts are above the states average and 17 districts are below the states average whereas in case of Number of warehousing centres availability (V_8) 0nly 8 districts above and 18 districts below the states average. As far as the rural credit is concerned, the percentage of achievement under the KCC Scheme (V_{11}) and percentage of area under HYV (V_9) we see that the performance is in balance with above 13 and below the states average with 13 districts. Again in case of the consumption of fertilisers in kg/hectare of total cropped area (V_{10}) only 11 districts are above the states average with the remaining 15 districts below the states average which are yet to be provided with this particular facility. It is quite interesting to see that the availability of the above infrastructures is not so satisfactory. Therefore in this regard, the Government should take a necessary measure in increasing the performance of the infrastructural

facilities specially the districts that performs below the states average because it helps in increasing productivity as well as growth and development of an economy.

The above analysis shows only the number of districts performing above or below the state average in terms of a particular infrastructural indicator. The following table shows that if a district has relatively more number of indicators performing above the state average then that district is being assumed to perform better in terms of agricultural growth. The following table shows the number of districts having number of infrastructural indicators that performs above and below the state level.

Table 4.13 Performance of infrastructural indicators in Different districts of the state:

Sl no	Districts	Indicators above State Average	Indicators below State Average
1	Kokrajhar	V_9	$V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_8, V_{10}, V_{11}$
2	Dhubri	V_5, V_6, V_9, V_{11}	$V_1, V_2, V_3, V_4, V_7, V_8, V_{10}$
3	Goalpara	$V_1, V_2, V_5, V_6, V_8, V_9, V_{10}, V_{11}$	V_3, V_4, V_7
4	Barpeta	$V_2, V_5, V_6, V_7, V_{10}, V_{11}$	V_1, V_3, V_4, V_8, V_9
5	Morigaon	$V_2, V_5, V_6, V_9, V_{10}$	$V_1, V_3, V_4, V_7, V_8, V_{11}$
6	Nagaon	$V_2, , V_6, V_7, V_8, V_9, V_{10}, V_{11}$	V_1, V_3, V_4, V_5
7	Sonitpur	V_7, V_9	$V_1, V_2, V_3, V_4, V_5, V_6 V_8, , V_{10}, V_{11}$
8	Lakhimpur	$V_1, V_5, V_6, V_7, V_9, V_{11}$	$V_2, V_3, V_4, V_6, V_8, V_{10}, V_{11}$
9	Dhemaji	V_8, V_9, V_{11}	$V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_{10},$
10	Tinsukia	V_8, V_{11}	$V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_9, V_{10}$
11	Dibrugarh	V_4, V_7, V_{10}, V_{11}	$V_1, V_2, V_3, V_5, V_6, V_8, V_9$
12	Sivasagar	V_2, V_5, V_6, V_{10}	$V_1, V_3, V_4, V_7, V_8, V_9, V_{11}$
13	Jorhat	$V_1, V_2, , V_7$	$V_3, V_4, V_5, V_6 V_8, V_9, V_{10}, V_{11}$
14	Golaghat	V_1, V_2, V_8, V_{11}	$V_3, V_4, V_5 V_6, V_7, V_9 V_{10}$
15	Karbi Anglong	V_1, V_8, V_9	$V_2, V_3, V_4, V_5, V_6, V_7, V_{10}, V_{11}$
16	Dima Hasao	0	$V_1, V_2, V_3, V_4, V_5, V_6, V_7 V_8, V_9 V_{10}, V_{11}$
17	Cachar	V_1, V_{10}	$V_2, V_3, V_4, V_5, V_6, V_7 V_8, V_9, V_{11}$
18	Karimganj	V_5, V_6, V_9	$V_1, V_2, V_3, V_4 V_7, V_8, V_{10}, V_{11}$
19	Hailakandi	$V_1, V_5, V_9, V_{10}, V_{11}$	$V_2, V_3, V_4 V_6, V_7, V_8$
20	Bongaigaon	$V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_{10}, V_{11}$	V_8, V_9
21	Chirang	V_{10}	$V_1, V_2, V_3, V_4, V_5, V_6, V_7 V_8, V_9, V_{11}$
22	Kamrup (R)	$V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_8, V_{11}$	V_9, V_{10}
23	Nalbari	$V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_{11}$	V_8, V_9, V_{10}
24	Baksa	V_6, V_9	$V_1, V_2, V_3, V_4, V_5, V_7, V_8, V_{10}, V_{11}$
25	Darrang	V_2, V_3, V_5, V_6, V_9	$V_1, V_4 V_7, V_8 V_{10}, V_{11}$
26	Udalguri	V_2, V_6, V_8, V_{10}	$V_1 V_3, V_4, V_5, V_6 V_7, V_9, V_{11}$

Source: Researchers Own calculation.

The above table 4.13 shows the number of districts having number of infrastructural indicators that performs both above and below the state average. The above table reveals that 15 districts are having at least four variables performing above the state average whereas the remaining 11 districts have got less than four indicators performing below the state level. The condition is better in Kamrup and Bongaigaon district with nine indicators above the state level, followed by Goalpara and Nalbari with eight indicators, Nagaon with seven indicators, Barpeta and Lakhimpur with six indicators, Morigaon, Hailakandi and Darrang with five indicators, Udalguri, Dibrugarh, Dhubri, Sivasagar and Golaghat with four indicators. The performance of infrastructure is not good in case of districts Karimganj, Dhemaji, Jorhat and Karbi Anglong which shows only three indicators above the state level, whereas Kokrajhar, Tinsukia, Sonitpur, Cachar, Chirang, Baksa with only two and one indicators. But the situation seems to be worst in Dima Hasao district where no any infrastructural indicator performs above the state level. In this regard, the Govt must take a necessary action for the development of the district.

Ranking of Districts:

Based on the above performances, the districts are ranked in terms of the number of infrastructural facilities available. That is the district with the best performance is ranked first and vice-versa. Again, after ranking of the districts, the districts are classified into three major categories – the districts having six or more than six types of infrastructure indicator are classified as category 1 – developed districts, the districts with three or more than three indicators (but less than six) are classified as category 2 – developing districts and the districts with two or less than two types of infrastructure are classified as category 3- under developed districts.

Table 4.14 Ranking of the districts as per its performance:

Sl no	District	Rank of the district
1	Kokrajhar	24
2	Dhubri	11
3	Goalpara	3
4	Barpeta	6
5	Morigaon	8
6	Nagaon	5
7	Sonitpur	20
8	Lakhimpur	7
9	Dhemaji	16
10	Tinsukia	21
11	Dibrugarh	12
12	Sivasagar	13
13	Jorhat	17
14	Golaghat	14
15	Karbi Anglong	18
16	Dima Hasao	26
17	Cachar	22
18	Karimganj	19
19	Hailakandi	9
20	Bongaigaon	1
21	Chirang	25
22	Kamrup (R)	2
23	Nalbari	4
24	Baksa	23
25	Darrang	10
26	Udalguri	15

Thus, from the above classifications, we find that Kamrup (R), Goalpara, Nagaon, Nalbari, Barpeta, Lakhimpur and Bongaigaon comes under Category 1 i.e, the

developed districts, Morigaon, Hailakandi, Darrang, Dhubri, Sivasagar, Jorhat, Golaghat, Udalguri, Dibrugarh, Karimganj, Dhemaji and Karbi Anglong comes under Category 2 i.e the developing districts. It is noticed that the Category 3 districts namely- Sonitpur, Tinsukia, Cachar, Chirang, Baksa, Kokrajhar and Dima Hasao are the districts that require immediate attention in the area of agricultural infrastructural facilities falls under the under-developed districts. The worst situation is in case of Dima Hasao district with zero infrastructures above the state average. Therefore, focussing on the infrastructural development in these districts is urgently needed for.

4.4 Conclusions:

Though Assam's performance is able to achieve a little impressive growth rate in the overall infrastructural development as compared to some other states in the country, the infrastructural development is still much backward within many of the districts in Assam. The empirical investigation provided an idea to understand the discrepancies as well as the backward districts of Assam that should be worth taken immediate care for the provision of the availability of agricultural infrastructure on a priority basis. As a result, many of the districts lag far behind the states average in respect of most of the items of infrastructural facilities. In the following chapter, various infrastructural indicators is regressed in order to measure the impact of infrastructural indicators on agricultural productivity and which type of infrastructure does has the significant impact on the agricultural productivity of Assam.

CHAPTER 5
IMPACT OF RURAL INFRASTRUCTURES ON AGRICULTURAL LAND PRODUCTIVITY

5.1 Introduction:

Assam a North Eastern state of India is covered with a geographical area of 78438 sq. km i.e., about 2.4% of the country's total geographical area. The performance of infrastructure reflects the performance of an economy. Development of infrastructure is very much necessary especially in the rural areas as they are the driving force of productivity increment and reduction in poverty. Agriculture sector which holds primary importance in rural areas, has been performing relatively poorer compared to the other sectors. Efficiency and competitiveness in the agricultural sector is the main strategy to attain a liberalised economic environment. Infrastructure is particularly crucial and relevant to the small farmers in the developing countries where the size holdings are small and traditional crops with low productivity are not capable of providing sufficient income and employment to the population dependent on agriculture sector.

The state of Assam presents to be a good case for measuring the impact of infrastructure on agricultural productivity as the percentage of gross cropped area in the state has constantly increased from 2012-13 with 96.03 % to 99.02 % in 2014-15 with a slight decline during 2015-16 with 98.32 %. In spite of the fact, it is noticed that only three districts i.e., Karbi Anglong, Chirang and Udalguri shows an increased percentage of gross cropped areas while in case of the other districts the percentage of gross cropped area decreased or remains the same may be due to the nature and unavailability of irrigation and infrastructural facilities in the respective districts.

The notable fact of Assam's economic development is that it is falling behind the rest of the major states of the country. Assam's economy is fundamentally based on agriculture. Over 75% of the state's population depends on agriculture for their livelihood. Total land under cultivation was 2.83 million hectares in 2014-15 which almost covers 36 % of total geographical land area of the state. The average size of land holdings was only 1.10 hectares during the year 2014-15 and more than 85% of

farmer families are either small or marginal farmers with average land holding of only 0.63 hectare. However, as agriculture supports more than 75% of its population, either directly or indirectly, it provides employment and support to more than 50% of its total workforce.

Assam has a rich soil conditions, very conducive for agricultural productivity. But due to the unavailability of infrastructure and unpredictable weather conditions, along with erratic rainfall and the presence of various constraints like floods, soil erosion etc, agricultural productivity has been suffering. The development of agriculture sector in hill districts of the state, namely East Karbi-Anglong, west Karbi-Anglong and Dima-Hasao are suffering due to presence of various weaknesses of low infrastructural facilities. Therefore development of agriculture facilities in these hilly areas needs attention for infrastructural development and access to markets.

The present study analyses the impact of infrastructural indicators on agricultural productivity across the districts of Assam. The study attempts to analyse how different types of infrastructural indicators have impacted the agricultural productivity taking (2016-17) time period across different districts in Assam. Along with infrastructure, other inputs like HYV, consumption of fertilisers and the achievement of KCC scheme variables are also been taken as the independent variable which act as the driving force of agricultural development in the study.

. 5.2 Data:

A cross section data have been undertaken to study the impact of infrastructures on agricultural land productivity of Assam. Most of the data on infrastructural development indicators for the different states were collected from RBI Data, Economic survey of India, Directorate of Economics and Statistics and Agricultural report at a glance. Data on agricultural development indicators for the districts were collected from various sources such as Statistical Handbook of Assam, population census, Department of Agriculture and Cooperation, economic survey of Assam, NEDFI report. As the study is based on a cross section data the district level data is compiled mainly for the period 2016 in order to know the performances of the infrastructural development in different districts investigating the phenomenon behind the impact of various infrastructural indicators on agricultural productivity for the 26

districts of Assam. Out of 33 districts only 26 districts are taken into the study due to the unavailability of reliable data. Published literature in the form of books, booklets and articles on infrastructure development were used to provide a general background of the study.

5.3 Methodology:

An attempt has been made to prepare a methodology of the present study with the availability of important infrastructure variables to study the impact of rural infrastructural variables on agricultural land productivity in Assam, a north-eastern state. The study adopted a linear regression model using a simple OLS method to specify the significant impact of infrastructure variables on land productivity. Linear regression model is used to attempt the relationship between the variables by fitting a linear equation model to observe the data consisting of the endogenous variable and exogenous variables. Many studies have used the regression model to study the impact of rural infrastructures (Ghosh and De, 1998; Majumdar, 2002; Baba et al. 2015; Barnes and Binswanger, 1986) and found that it is the availability of physical, social as well as institutional infrastructure that affects the agricultural output level and agricultural development index significantly. Therefore, the present study is confined to use the linear regression model on measuring the impact of rural infrastructures on agricultural productivity.

Again, on estimating the endogenous variable, the agricultural land productivity is being used as the dependent variable in fitting the linear model. Many studies uses the Total Factor Productivity (TFP) on capturing the dependent variable but the TFP is not measured by input factors but the combination of technical progress and technical efficiency with which factors are used to produce output (Fan,1991) (Ashok and Balasubramanian, 2006). Also TFP does not indicate a good sign to capture the dependent variable because TFP mainly uses the attributes of the workforce or technical efficiency rather than the output of major rural infrastructure. Therefore, the agricultural land productivity is proposed to use as the dependent variable on the present study. The agricultural land productivity is calculated as-

(Value of output / agricultural land) in Rs per hectare of net sown area.

Since Rice is the main cultivation of Assam, the study undertakes only the paddy crop (autumn, winter, summer) for the measurement of productivity. The prices of the output for the reference year 2016-17 have been taken for this purpose.

A district level cross section data is carried and out of 33 districts a sample of 26 districts of Assam is undertaken in the study as per the availability of data. The nine infrastructure parameters were taken in the study i.e., irrigation, road, villages electrified, financial system, agricultural credit, primary schools, primary health centres, fertiliser consumption and HYV seeds as per the availability of the data. The study examined the performances of the rural infrastructures in various districts of Assam in chapter four followed by the impact of infrastructure.

The present study also aims at answering the research questions such as-

(1) Is there any possibility of rural infrastructure influencing the agricultural productivity significantly?

(2) If yes, which type of infrastructure influences and at what level of significance does infrastructure impacted on productivity?

5.4 Selection of various infrastructural indicators:

Three classifications of infrastructures being undertaken in the study- the economic or physical, institutional, and social infrastructures. Each type of infrastructure indicator is measured by the area, by population or by percentages. The researcher have chosen the following variables on the basis of the components of the Bharat Nirman Programme as already mentioned in chapter three whose main objective was to provide basic amenities to the rural life. Also as per the literature review (Nadeem et al. 2011; Majumdar 2002) the economic infrastructure like irrigation, roads, electricity are the main core areas for the rural development in any region and contributes significant impact on productivity. The indicators of the social infrastructure and the institutional infrastructure are being taken based on the literature review (Sidhu et al. 2008; Singh and Kaur 2014) which is directly or indirectly related to agricultural productivity and thus proves to show significant impact on the productivity.

In the present study, the variables used in the analysis to capture the infrastructural indicators of agricultural and infrastructural development is described as follows-

In order to measure the physical or economic indicator, the ratio of gross irrigated area to net irrigated area is being used to capture the irrigation intensity. A percentage of villages electrified are used to measure the electricity infrastructure. The road transportation is being measured by the total road length per 100 sq km of geographical area.

In case of social infrastructural indicator, availability of the number of primary schools and number of Health Centres per 100 sq km of geographical area is being taken into the study.

Institutional infrastructure also plays an important impact which cannot be ignored in the study and has been measured with the availability of the number of banks per 100 sq km of geographical area and the credit from agricultural cooperatives is also taken into the study captured by the percentage of achievement under the KCC scheme which is a very important tool of the agricultural productivity in the rural areas at present. The study takes into account two other variables acting as a substitute of agricultural infrastructure that is, fertiliser consumption in kg per hectare of total cropped area and percentage of area under HYV to net sown area.

Table:5.1 Variables undertaken to measure the impact of land productivity.

Sl no	**Variables undertaken**	
1.	Irrigation	Ratio of gross irrigated area to net irrigated area
2.	Electricity	Percentages of villages electrified.
3.	Road Transport	Total road length per 100 sq. km of geographical area
4.	Education	Number of primary schools per 100 sq. km of geographical area
5.	Health	Number of health centres per 100 sq. km of geographical area
6.	Banks	Number of banks branches per 100 sq. km of geographical area
7.	Agricultural credit	Percentage of achievement under KCC scheme

Source: Researchers classification.

5.5 Model specification:

The following structural form of the regression model has been constructed to measure the impact of rural infrastructures on land productivity.

Y = F (IRR, ROD, ECT, EDN, HLT, BNK, ACR, FRT, HYV)

i.e., Y is assumed to be dependent on the values of IRR, ROD, ECT, EDN, HLT, BNK, ACR, FRT, HYV

Thus, the linear formulation of the function can be written as

$$Y_i = \alpha + \beta_1 (IRRI)_i + \beta_2 (ROD)_i + \beta_3 (ECT)_i + \beta_4 (EDN)_i + \beta_5 (HLT)_i + \beta_6 (BNK)_i + \beta_7 (ACR)_i + \beta_8 (FRT)_i + \beta_9 (HYV)_i \quad (1)$$

We get our linear regression model as ……

$$Y_i = \alpha + \beta_1 (IRRI)_i + \beta_2 (ROD)_i + \beta_3 (ECT)_i + \beta_4 (EDN) + \beta_5 (HLT)_i + \beta_6 (BNK)_i + \beta_7 (ACR)_i + \beta_8 (FRT)_i + \beta_9 (HYV)_i + U_i \quad (2)$$

Now, if we log transform the above model (2) we obtain:

$$Ln (Y_i) = \alpha + \beta_1 \ln (IRRI)_i + \beta_2 \ln (ROD)_i + \beta_3 \ln (ECT)_i + \beta_4 \ln (EDN)_i + \beta_5 \ln (HLT)i + \beta_6 \ln (BNK)_i + \beta_7 \ln (ACR)_i + \beta_8 \ln (FRT)_i + \beta_9 \ln (HYV)_i + U_i \quad (3)$$

In the above log linear model, Y is the agricultural land productivity taken as the dependent variable and the coefficients of the model $\beta_1, \beta_2, \ldots\ldots\ldots\ldots, \beta_9$ implies the marginal impact of the independent variables (IRRI, ROD, ECT, EDN, HLT, BNK, ACR, FRT, HYV) on agricultural land productivity i.e., Y.

U_i is the Random disturbance term which takes smaller value with higher probability and

"i" stands for the subscripts taken for various districts that means (1,2,……26).

Here, it has been assumed that productivity provides a better analytical and empirical framework for studying the impact of the rural infrastructure in the agricultural sector and therefore agricultural land productivity has been specified as endogenous variable in the above linear equation (2). The model was estimated in log linear form with a research question that every selected infrastructure variable has a positive influence

on agricultural productivity and which type of infrastructure has the highest significant on the agricultural land productivity.

Empirical Investigation:

The table 5.2 below presents the summary statistics of the development indicators of agricultural variables used in the study i.e., the mean, maximum, minimum and the standard deviation.

Table 5.2: Description of variables and Expected sign of Coefficients:

Variable name	Variable Description	Descriptive Statistics				Expected sign of coefficient
		Mean	Min[m]	Max[m]	SD	
IRRI	Ratio of gross irrigated area to net irrigated area	4.87	4.60	5.29	0.22	+
ROD	Total road length per 100 sq. km of geographical area	4.05	3.42	4.67	0.35	+
ECT	Number of villages electrified per thousand hectare of geographical area	4.62	4.39	5.47	0.25	+
EDN	Number of primary schools per 100 sq. km of geographical area	4.01	2.73	4.60	0.48	+
HLT	Number of primary health centres per 100 sq. km of geographical area	0.28	-1.49	1.85	0.65	+
BNK	Number of bank branches per 100 sq. km of geographical area	1.18	-0.48	3.64	0.76	+
ACR	Percentage of achievement under KCC scheme	3.82	3.27	4.39	0.24	+
Other variables						
FRT	Fertiliser consumption in kg per hectare of total cropped area	4.05	3.15	4.75	0.38	+
HYV	Percentage of area under HYV to net sown area	4.15	3.07	4.72	0.40	+

5.6 Results and Discussions:

The result of the Regression analysis is presented in the following table:

Table 5.3: Results of the Regression Analysis:

Sl no	Variables	coefficients	Std.error	t- value	p value
1	Constant	-1.207	8.507	-0,142	0.889
2	IRR	1.102	0.916	1.202	0.247
3	ROD	1.538	0782	1.967	0.067*
4	ECT	-0.338	0.956	-0.353	0.729
5	EDN	-0.138	0.775	-0.178	0.861
6	HLT	-0.575	0.806	-0.714	0.486
7	BNK	0.905	0.398	2.273	0.037**
8	ACR	-0.914	0.931	-0.982	0.341
9	FRT	-0.018	0.638	-0.029	0.978
10	HYV	1.048	0.577	1.816	0.088*
	R^2	0.531			
	F	2.016			0.102*

Note: (**) indicate significant at 5% level.

(*) indicate significant at 10 % level.

The study mainly attempted to measure the impact of rural infrastructure taking into account the economic, social and institutional infrastructure on agricultural land productivity in 26 different districts of Assam using a simple OLS regression model for the period 2016. Summary statistics of the model representing Mean, Standard Deviation, Minimum and Maximum is presented in table 5.2. The above model 2 is estimated in linear logarithm form and results are presented in table 5.3. The sign of estimated coefficients are accorded to prior expectations of the model.

As per the results shown in the above table 5.3, it has been found that among the seven infrastructure indicators along with two other variables only three indicators shows a positive and significant impact on agricultural land productivity namely the

road infrastructure, banking and HYV. The results indicates that the estimate coefficient of the availability of road infrastructure is statistically significant at 10% level, for the 'p' value is 0.0627 ($0.05<p\leq 0.10$) and the't' value is 1.967 thus accepting the alternative hypothesis $H_1:\beta_2 \neq 0$. The interpretation is that the ROD elasticity is (1.538) suggesting that, holding other variables constant, a 1 unit increase in the availability of ROD infrastructure in rural areas is associated with an increase of around 1.538 units in agricultural land productivity depicting a positive relationship between the road infrastructure and the land productivity. The institutional infrastructure representing the number of bank branches per 100 sq km of geographical area is positive and statistically significant at 5% level. Again, HYV area (%) being used as other variable is an important indicator of agricultural infrastructure shows a positive sign and is statistically significant at 10% level of significance. The other variables like irrigation, electricity, education, health, agricultural credit and fertiliser consumption are not significant in the model.

To determine the overall fit of the model, it is found that R^2 is (0.531) which is not so good fit for the model. The overall R^2 of 53 % shows that the model is moderate and 53 % of variations on the actual land productivity is captured by the estimated model.

Similarly, the regression output of the overall significance of the parameters here found that the F statistics is (2.016) and is significant at 10 % level i.e.

Let H_O : all estimated coefficients are equal to zero.

H_1: all estimated coefficients are not equal to zero

F statistics is (2.016) and is significant at 10% level so we have to accept the alternative hypothesis. The level of significance is 0.102

5.7 Conclusions:

Agricultural sector being the most prominent source of livelihood in Assam's economy, the present study emphasised the importance of the infrastructural development across the different districts of Assam. After a detailed analysis of the impact of rural infrastructures on agricultural land productivity we can conclude that the estimations of the OLS model showed the importance of the rural infrastructures

in boosting the agricultural productivity. Among the various number of rural infrastructures that has been undertaken in the study, the road transportation i.e, the total road length per 100 sq km of geographical area turned out to be significant at 10 % level respectively. Also, the number of banks under the institutional infrastructure proved to be significant and positive at 5 % level. Among the other variables, HYV turned out to be significant at 10% level.

Thus, the foregoing analysis of the study reaches the validity of the research question that the rural infrastructure development influences the agricultural productivity significantly and among all the various type of infrastructures only the road, bank and HYV proved to have the significant impact on agricultural productivity. Along with the infrastructures, the other use of traditional inputs such as fertiliser application rainfall and climatic conditions are also responsible for significant results in land productivity across the district which has not been undertaken in the study. Thus, rural infrastructure significantly impacts the land productivity directly or indirectly through improvements in infrastructure facilities. Also, the study provides evidence in support of greater investment in infrastructure in rural areas and also at the same time important steps are to be taken to enlarge and maximise the utilisation of the resources in the respective state.

CHAPTER 6
FINDINGS AND CONCLUSIONS:

The present research undertakes the study of the development of rural infrastructural facilities for the upliftment of the agricultural productivity in different districts of Assam. After the detailed analysis of the different infrastructural sectors some of the major findings can be drawn related to various components of infrastructure and disparities present in Assam a well as in different districts of Assam.

6.1 FINDINGS:

The major findings of the study can be summarised as follows:

1 Lack of availability of infrastructural facilities is one of the major problems in Assam as well as in many districts of Assam due to which the agricultural productivity is still a way behind as compared to other states of the country. Firstly, the position of Assam with respect to India in the field of social, economic and institutional infrastructure presents a mixed picture in the study that is; the absolute position in respect of the availability of these infrastructures is below the all India average.

2 As per the sources of the report of the 2005 and 2015 data the availability of infrastructures like the irrigation, Road, Health centres, Literacy and the Regulated Market infrastructures have improved to some favourable extent. But there has been deterioration in case of the availability of power sector and PACS during the two periods. Again from the relative index of the infrastructure variables in Assam vis-à-vis the all India position it is found that the number of villages electrified, primary health centres, number of schools and number of regulated market infrastructures indicators have improved in the ten years gap periods of 2005 and 2015 that is, the percentage gap in the availability of these infrastructural facilities in Assam in relation to the availability at the all India level has narrowed down.

3 On the other hand, the infrastructural variables like the availability of the irrigation sector, Road transportation and PACS (Primary Agricultural credit

Societies) has deteriorated as compared to the all India level, with the index showing a widening of the percentage gap in the two periods under the study.

4 The status of gross cropped area in Assam i.e., from (2011-12 to 2016-17) shows a constant increase from 96% in 2012-13 to 99% in 2014-15 with a slight decline during 2015-16 with 98%. Only three districts i.e., Karbi Anglong, Chirang and Udalguri shows an increased gross cropped area while the other district seems to be decreased. Though irrigation is an essential input of agriculture but the availability of agricultural infrastructure in Assam is not literally sound. As per the data of 2016-17, intensity of irrigated cropping is seems to be highest in Bongaigaon district (199.45%) followed by Golaghat (196.39%) and Cachar (193.86%) and so on.

5 In case of road transportation, among all the districts of Assam Hailakandi (473 km) , Chirang (626 km) and Bongaigaon (805) has the weak road length. The highest road length is available in Karbi Anglong with (4200 km) followed by Kamrup and Nagaon district.

6 The number of villages electrified per thousand hectare of geographical area in Assam is recorded to 106.34 in 2016-17. The highest number of villages electrified among all the district is Darrang, Nalbari, Bongaigaon and Kamrup. As per the report of 31-03-2016 data, Kamrup (metro) is the only district with large number of commercial banks followed by Dibrugarh, Nagaon, Sonitpur, Cachar, Tinsukia, Jorhat and so on

7 On the assessment of the performance of different infrastructural indicators in different districts of Assam, we find that 15 districts are having at least four variables performing above the state average whereas the remaining 11 districts have got less than four indicators performing below the state level. The condition is better in Kamrup and Bongaigaon district with nine indicators above the state level, followed by Goalpara and Nalbari with eight indicators, Nagaon with seven indicators, Barpeta and Lakhimpur with six indicators, Morigaon, Hailakandi and Darrang with five indicators, Udalguri, Dibrugarh, Dhubri, Sivasagar and Golaghat with four indicators. The performance of infrastructure is not good in case of districts Karimganj, Dhemaji, Jorhat and Karbi Anglong which shows only three indicators above the state level, whereas Kokrajhar, Tinsukia, Sonitpur, Cachar, Chirang,

Baksa with only two and one indicators. But the situation seems to be worst in Dima Hasao district where no any infrastructural indicator performs above the state level.

8 On the basis of ranking, we find that Kamrup (R), Goalpara, Nagaon, Nalbari, Barpeta, Lakhimpur and Bongaigaon comes under the developed districts (Category 1) , Morigaon, Hailakandi, Darrang, Dhubri, Sivasagar, Jorhat, Golaghat, Udalguri, Dibrugarh, Karimganj, Dhemaji and Karbi Anglong comes under the developing districts (Category 2) . It is noticed that the Category 3 districts namely- Sonitpur, Tinsukia, Cachar, Chirang, Baksa, Kokrajhar and Dima Hasao are the districts that require immediate attention in the area of agricultural infrastructural facilities falls under the under-developed districts. However, the situation is worst in case of Dima Hasao district as none of the infrastructure performed below the state average.

9 On measuring the impact of the rural infrastructures on agricultural land productivity, the road infrastructure turns to be positive and significant at 10 % level respectively. The availability of banks under the institutional infrastructure also turns to be significant at 5% level. Along with the availability of infrastructures, the use of modern inputs such as fertiliser and HYV that has been used as the other variable to understand the impact on productivity, HYV proved to have the significant impact on agricultural land productivity at 10% level. Thus, several indicators impacted the agricultural land productivity directly or indirectly through improvements in infrastructures.

6.2: CONCLUSIONS:

Rural infrastructure acts as an important tool for the development of agricultural productivity in Assam as many of the people in Assam are still dependent on agriculture and it directly contributes to poverty alleviation as it gives access to safe water and basic sanitation, education etc. Increase in agricultural land productivity depends on good rural infrastructure, well-functioning of the domestic markets, appropriate institutions and access to appropriate technology. The prominent truth of

Assam's economic development is that it is falling behind the rest of the country. Assam has to come up and catch up with the rest of the states. It can be concluded that agricultural growth cannot be achieved in isolation without the development of rural infrastructure. The study has shown a deep concern about the development of rural infrastructures in Assam and the estimates of agricultural land productivity models revealed that rural infrastructure variables have significantly impacted as well as contributed to the growth of agricultural productivity. Government has an important role to play in the development of Assam in the provision of social services, infrastructure and good governance.

6.3 SUGGESTIONS:

Following policy implications emerge on the basis of findings:

- It has been noted that the irrigation facilities is very poor in Assam and therefore the irrigation capacities should be expanded for the improvement of agricultural productivity. Proper irrigation facility should be provided in the proposed area to solve the problem of water and also existing irrigation structures should be made functional through regular maintenance.
- As we have seen that the pattern of development of the availability of infrastructures is not uniform in the respective districts the state needs to be given due importance regarding the proposed matter. The cooperative societies of the state should be more revitalized and proper skilled training programme should be undertaken in the cooperative organisations.
- Assam is lacking far behind in case of agricultural infrastructure like cold storage facilities, warehousing facilities, regulated market etc. so proper care should be taken for the development of the proposed infrastructures in the respective districts to augment agricultural development.
- As Assam is blessed with much potentiality of natural resources as well as different types of flora and fauna it calls for an improvement of tourism development. Therefore, tourism infrastructure should be properly developed to develop the tourism sector in the state.

- In order to improve the performance of the agricultural sector, the role of the private sector should also be recognised as it plays a major role in providing various kinds of infrastructural facilities in the era of globalisation.

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