YANGON INSTITUTE OF ECONOMICS

Ph.D. PROGRAMME

TRANSPORT NETWORK AND CHANGES OF SETTLEMENT PATTERN IN AYEYARWADY REGION

KHIN THIDA NYEIN

MARCH, 2014

TRANSPORT NETWORK AND CHANGES OF SETTLEMENT PATTERN IN AYEYARWADY REGION

A dissertation submitted in partial fulfillment of the requirements for the degree of Ph.D.

at the Department of Economics

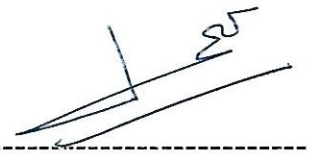
Yangon Institute of Economics

Khin Thida Nyein

Ph.D. Ba 2

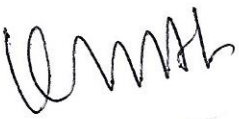
March, 2014

Board of Examiners



Prof. Dr. Khin Naing Oo
(Chairman)
Rector
Yangon Institute of Economics

Prof. U Aung Myint
(Referee)
Rector
Monywa Institute of Economics



Prof. U Kyaw Min Htun
(Member)
Pro-Rector (Retired)
Yangon Institute of Economics

Prof. Dr. San Kyi
(External Examiner)
Professor (Retired)
Department of Statistics
Yangon Institute of Economics

Prof. Daw Sintheingie
(Internal Examiner)
Professor/Head of Department (Retired)
Department of Economics
Yangon Institute of Economics

Prof. Daw Nyunt Nyunt Swe
(Internal Examiner)
Professor/Head of Department (Retired)
Department of Applied Economics
Yangon Institute of Economics

Prof. Dr. Thidar Kyu
(Member)
Professor/Head of Department
Department of Economics
Yangon Institute of Economics

Prof. Daw Phyu Phyu Ei
(Member)
Professor/Head of Department
Department of Applied Economics
Yangon Institute of Economics

Prof. Dr. Cho Cho Thein
(Member)
Professor
Department of Economics
Meikhtilar Institute of Economics

Prof. Dr. Yi Aye
(Supervisor)
Professor/Head of Department
Department of Economics
Sagaing Cooperative University

CERTIFICATION

I hereby certify that the contents of this dissertation is wholly my own work unless otherwise referenced or acknowledged information from sources is referenced with original comments and ideas from the writer him/herself.

Khin Thida Nyein

Ph.D. Ba 2

March, 2014

To My Parents

Abstract

This study analyzes the development of road network and the growth of settlements in the Ayeyarwady region from 1987/88 to 2010/11. Employing panel data on real GDP, population, geographical situation and road condition, the thesis examines which variables influence the settlements in the Ayeyarwady region. It is observed that the robust economic condition of the settlements substantially influences that area. Next, the empirical result suggests that an increase in population size has strongly effect on the settlements in the Ayeyarwady region, other conditions being equal. Based on the regression results, it is evidently stated that favorable geographical situation has a considerable effect on the settlements of the Ayeyarwady region. In addition, the regression result has shown how important the quality of road is. It is observed that the effect of tarred road construction in the settlements of the Ayeyarwady region is really strong. In this dissertation, the pattern of 24 settlements of the Ayeyarwady region has been analyzed by using the urban area of each settlement, the number of houses in each settlement and the distance between one house and another, for each of two time periods - before and after 1989. Based on the findings of the study, it is observed that the patterns of settlements in the Ayeyarwady region after 1989 vary from those of settlements in the region before 1989.

Acknowledgements

First and Foremost, I would like to extend my gratitude to Dr. Kan Zaw (Union Minister of Ministry of National Planning and Economic Development) who encouraged me to write this title. I also would like to make a special reference to Dr. Khin San Yee (Union Minister of Ministry of Education), Dr. San Lwin (Union Deputy Minister of Ministry of National Planning and Economic Development), and Dr. Khin Naing Oo (Rector, Yangon Institute of Economics) who gave me very valuable advice during my dissertation.

I am greatly indebted to my supervisor Professor Dr. Yi Aye for her infinite and valuable suggestions throughout my dissertation. I also would like to heartily express my deepest gratitude for the immeasurable and invaluable guidelines and kind attention of Associate Professor (Retired) Daw Khin Chaw Myint who took care of me like a supervisor during the period of writing my dissertation. Without their kind and patient guidance, I would not be able to accomplish this dissertation successfully.

I am also grateful to Dr. Lay Kyi (Pro-rector), U Kyaw Min Htun (Pro-rector, Retired), Dr. Hla Maung (Economist), Professor Daw Tin Hla Kyi (Retired), Professor Daw Nyunt Nyunt Swe (Retired), Professor Daw Sintheingi (Retired), Professor Daw Aye Aye Myint (Retired), Professor Dr. Daw San Kyi (Retired), Dr. Thidar Kyu (Professor and Head of Department of Economics), and Dr. Nilar Myint Htoo (Professor from Department of Economics), Daw Phyu Phyu Ei (Professor and Head of Department of Applied Economics) and Dr. Thida Htoo (Associate Professor of Department of Applied Economics) for their helpful comments and suggestions throughout my dissertation.

I would like to give special thanks to Professor U Aung Myint (Rector, Monywa Institute of Economics) and Dr. Cho Cho Thein (Professor of Department of Economics, Meikhtila Institute of Economics) for their valuable suggestions.

Then, I must thank all my teachers from Yangon Institute of Economics for teaching me with great goodwill to achieve a Ph.D. degree. My sincere thanks would also be extended to U Thein Aung (Prime Minister of the Ayeyarwady Region), U Aye Myint Maung (Union Deputy Minister of Ministry of Environmental Conservation and Forestry), and the authorities from respective departments of the Ayeyarwady Region, U

Htun Kyaw Kyaw (Director from General Administration Department of the Ayeyarwady Region) and U Zaw Lin Htet (Staff Officer from General Administration Department of the Ayeyarwady Region) who facilitated my study with indispensable facts and figures.

I am also indebted to Dr. Sokchea Lim, Visiting Assistant Professor at John Carroll University, Ohio (United States) for his tremendous support, help, guidance, comments and suggestions.

Special thanks also go to Professor Daw Sintheingie (Retired) for helping me out with my English usage.

I am also grateful to my colleagues from the Department of Economics, Yangon Institute of Economics for their wonderful support and help.

Last but not least, I have not forgotten my entire family who are always ready to encourage and support me with all their love, kindness and goodwill at any time.

Table of Contents

List of Tables

List of Figures

List of Charts

List of Abbreviations

GDP	Gross Domestic Product
GRP	Gross Regional Product
SLORC	State Law and Order Restoration Council
SPDC	State Peace and Development Council
NOH	Number of Houses
RGDP	Real GDP
POP	Population
Geog	Geographical Situation
ROADCon	Road Condition
Rn	Nearest Neighbor Ratio

Chapter (1)

Introduction

Transport industry is essential for the society. Transportation means the moving of people and goods from one place to another within a given time; in other words, the journey of people and goods. Transportation is performed by various modes such as water, road, rail and air. Transport industry generates the usefulness of time and place. Every day, people move from one location to another for either economic or social purpose. It is required to transport a variety of goods for people from one region to another because people could not obtain all their necessities from one place. Therefore, transport industry becomes important for the whole society. From ancient time to modern era, people make use of vehicles such as carts, bicycles, motor cycles, automobiles, buses, trucks, helicopters and aircraft.

Transportation plays an important role in the production process because it brings factors of production such as labour and raw material to the right place at the right time. Accordingly, the importance of transportation becomes significant as economic and social matters demand transportation in the globalization age. Due to transportation, people can consume a variety of goods from different locations, and thus transportation favours specialization. Better transport makes more trade and greater spread of people, and thereby affects the settlement pattern of a region.

There are a number of important factors that affect settlement pattern, namely economics, transportation system, geography, population size and density, technological innovations, and social concerns. Amongst these factors, transportation is the major factor in the development of settlements in a region (Henry, 1981). It not only provides primary economic importance in moving goods and customers to markets but also offers avenue for social interaction. The transportation system consists of the modes of transport such as foot, horseback, wagon, railroad, shipping, and transport network - the physical routes used for the movement of goods and people from one place to another. Changes in any part of the transport system lead to changes in the settlement pattern of a region (Henry, 1981). Many routes are built according to demand of the existing situation in a region. It is found that larger settlements are provided by major routes, and smaller settlements are connected by lesser routes.

A number of scholars assure that transport improvement facilitates the expansion of product markets, and generates the enlargement of labour markets, which in turn affects the productive sector, and settlement development within the region. Region is defined differently by various scholars and analysts.

By tradition, there are three different approaches in defining regions. The first approach emphasizes homogeneity regarding one or combination of physical economic, social or other characteristics; the second stresses nodality or polarization, so it is called nodal region. Nodal regions are the composition of heterogeneous units; for instance, cities, towns and villages according to a hierarchy of settlements. The third approach is concerned mainly with administrative coherence or identity between the areas and available political institutions for effectuating policy decisions. These three traditional definitions of region are not mutually exclusive (Meyer, 1963).

A region can be defined as a homogeneous area with physical and cultural characteristics distinct from those of neighboring areas (Vance, 1968). Region can be defined formally and functionally. Formally, the definition of region draws attention to the homogeneity of some rudiments within an area. Functionally, the definition of region gives emphasis to the systems of functional relations within an integrated territorial system. Regions are interconnected by networks or hierarchical arrangements with at least one central place (Smith, 1976).

Regarding the delineation of regional boundary, a number of scholars articulate that there is no common agreement, and that countries designate regions themselves within their territories based on their own accepted concepts on political and economic philosophy. According to various criteria which countries recognize, a region is a unit of size, or an administrative one, or a functional one, depending on its functions with reference to the implementation of development plan, and integration of different factors. It is said that countries determine the boundaries of their regions based on degree of uniformity, or their functions or their aims. It is generally recognized that developing countries designate their regions according to both administrative and economic purposes.

Types of regions are varied depending on different criteria. Therefore, regions may be geographical region, homogenous region, nodal region, political region, military

region, program region and administrative region. All subdivisions of a country's territory are designated as regions; a range of different settlements are included in such regions. (Truner and Junesch)

In Myanmar, it is divided into 14 states and regions according to administration, namely Kachin State, Kayah State, Kayin State, Chin State, Mon State, Rakhine State, Shan State, Sagaing region, Taninthayi region, Bago region, Magway region, Mandalay region, Yangon region, and Ayeyarwady region. The study area in this dissertation is the Ayeyarwady region (previously known as the Ayeyarwady Division). The Ayeyarwady region is a fraction of a country, and also an administrative region.

All 14 states and regions in Myanmar are administrative regions, so institutions, statistics and information are already set in each and every region according to administrative purposes. If geographical region was to be chosen for this dissertation, it would be needed to designate the region geographically; in addition, it is incredibly hard to collect necessary information and statistics for the region. This is the reason why an administrative region, Ayeyarwady has been chosen for this dissertation.

The Ayeyarwady region is the delta area of the Ayeyarwady River, and it is situated in the south-western part of Myanmar. The Ayeyarwady region shares borders with the Rakhine state in the northwest, the Bago region in the north and east, the Yangon region in the east, and the Bay of Bengal in the south and west. The total area of Ayeyarwady region is 13,567 sq.miles (35,138 sq.km), and the capital city of the Ayeyarwady region is Pathein. According to 2010 statistics, total population of the Ayeyarwady region is 8,041,000, and takes the second place after the Mandalay region. The Ayeyarwady region is composed of six districts; namely, Pathein district, Hinthada district, Myaungmya district, Maubin district, Pyapon district, and Laputta district. Amongst six districts, Laputta district is an area which was extended in August 2008, 3 months after the region was struck by Cyclone Nargis.

Amongst the 14 states and regions in Myanamar, the Ayeyarwady region is full of natural resources. It is imperative for growing rice which is staple food for Myanmar and other important crops such as groundnuts, peas and beans, and jute. The Ayeyarwady region is well known as the "rice bowl" of Myanmar because sown area of paddy in the region is one-third of that of the whole country. As the rice export of Burma (it is now

called Myanmar) was over three million tons in 1941, Burma was the largest exporter in the world at that time. As there are many rivers, creeks and lakes in this region, the production of fish, prawn, and meat industries, fish-paste, dried fish, dried prawn, and fish sauce are substantial. According to 2010 statistics, the gross regional product of the Ayeyarwady region is 250 thousand millions kyats, and the share of the Ayeyarwady region in the whole country's gross domestic product is 13.2 percent which takes the second place after Yangon region. Based on these factors, it can be said that the Ayeyarwady region is an important region for Myanmar.

These are the factors which have led to the choice of the Ayeyarwady region amongst 14 states and regions in Myanmar for the study.

The Ayeyarwady region has many rivers and creeks; however, prior to 1988 the region lacked bridges across the Ayeyarwady River. This factor showed that transportation in the region was not smooth; that is, there was no adequate road transportation, and was dependent on water ways. However after transforming from that of a centrally planned economic system to a market-oriented one, Myanmar has built several bridges such as Bo Myat Tun Bridge (Nyaungdon), Daydalu Bridge (Pyapon), Dedaye Bridge (Kungyangon Township in Yangon Region and Dedaye Township in the Ayeyawady Region), Gonnhindan Bridge, Khattiya Bridge (Maubin), Kyauk Chaung Gyi Bridge (Pathein), Kyungon Bridge, Labutta Bridge, Maubin Bridge (Maubin), Maung Bi Wa Bridge (Pathein), Mayan Ngu Bridge (Myaungmya), Myaungmya Bridge (Myaungmya), Natchaung Bridge (Bogalay), Nga Wun Bridge (Myokwin)(Ingapu), Ngathaingchaung Bridge, Pinlelay Bridge, Seikma Bridge (Bogalay), Shwelaung Bridge, Thegon Bridge (Kyaunggon Township and Kangyidaunk Township), Uto Bridge, and Wakema Bridge in the Ayeyarwady region.

Besides, the government has been undertaking the expansion of many routes to develop secure and smooth transportation in the Ayeyarwady region. As it is believed that transportation plays an important role in the socio-economic development of the whole country, the government has constructed many roads such as Yangon – Pathein, Yangon – Myaungmya, Yangon – Hinthada, Yangon – Kyaunggon, Pathein - Myaungmya roads. According to official data, it is found that many miles of roads have

been extended in the region. Consequently, it cannot be denied that regional transportation networks in the region have increased significantly since 1989.

However, the Ayeyarwady region was hit severely by the Cyclone Nargis in 2008. Due to the Cyclone Nargis, many people died, thousand acres of paddy fields, thousand acres of orchads, and many miles of embankment were devastated. Much State-owned and private-owned properties were lost. According to official data, the production of paddy declined to 15640 thousand baskets in 2009 from 264940 thousand baskets in 2008. The production of oilseed crops, pulses and beans declined enormously. The destruction of physical infrastructure, social infrastructure and human resources were enormous. As the Ayeyarwady region is a strategic region for "rice bowl" of Myanmar, the failure of the Ayeyarwady region means that the whole country was also hard hit. Therefore, the government and the people carried out the tasks of relief and reconstruction activities of the region.

In addition, the government has been undertaking the building of the following new roads after Nargis, aiming to make the transportation network in the region much easier and smoother.

(1) Maubin-Yaylegalay-Shwetaunghmaw-Kyaikpi-Mawlamyinekyun Road
(2) Mawlamyinekyun-Hlaingbone-Thitpote-Kwinpauk-Pyinsalu Road
(3) Laputta-Thingungyi-Pyinsalu Road
(4) Laputta-(Kyaukphyarlay)-Thonekhwa-Oaktwin-Htakesun Road
(5) Bogalay-Kyainchaung-Kadonekani Road
(6) Bogalay-Setsun-Htawpine-Ahmar Road
(7) Pyapon-Kyonekadun-Dawnyein-Ahmar Road
(8) Kyonekadun-Setsun Road
(9) Pathein-Thalatkhwar-Mawtinsun Road
(10) Bogalay-Mawlamyinekyun-Kyonemangay-Warkhema-Myaungmya Road
(11) Pathein-Ngaputaw Road

As explained above, there was no adequate road transport in most of the area, depending mostly on water ways prior to 1988. Only after 1988, the government has constructed many roads in the Ayeyarwady region. As the government has carried out road infrastructure projects since the last three decades, road improvements can be seen

significantly in the map of the Ayeyarwady region. Consequently, amongst the many variables which influenced the settlements, the effect of only road transport on settlements is focused in this dissertation.

Botric, V., Sisinacki, J., and Skuflic, L., (2006) observed the effect of improvements in road transport by considering mainly effects on regional development such as regional economic growth, increase in employment, and effects on trade, industry and tourism, as Nijkamp, P., Ubbels, B., and Verhoef, E., has analysed.

Socio-economic impacts of new motorways on different spatial levels such as local, regional and national level, at different temporal levels such as short, medium and long term, and on different sectors such as manufacturing and services were analyzed separately by the European Commission, in its paper "APAS – Methodologies for transport impact assessment". These factors were also recognized by Botric, V., Sisinacki, J., and Skuflic, L.

However, what has not been studied is how road transport can affect the settlements in a region.

This scenario becomes "problem statement" for this dissertation.

1.1 Problem Statement

According to Henry (1981), transportation is the most influential factor that affects the pattern of settlements in a region. In Myanmar, as the government has constructed many roads since the last three decades, it can be seen that road network has been improving significantly in the Ayeyarwady region during these decades. Road improvements lead to changes in the travelling pattern of people in the region. People can use not only waterways but also roads nowadays. Road construction may change the pattern of settlements in the region as the theory says.

Taking into account the improvement of road network in the Ayeyarwady region, a problem statement arises whether or not the pattern of settlements in the region changes after the expansion of road network. This study, therefore, analyzes how road network in the Ayeyarwady region has an effect on the settlement pattern of that region during the period between 1987/88 and 2010/11.

1.2 Objectives of the Study

According to a number of scholars, it is observed that transportation route development, settlements growth and settlements' pattern are interlinked. The development of road network in the Ayeyarwady region is firstly observed in this dissertation. Secondly, the growth of settlements in the Ayeyarwady region is explored. Then, it is investigated how road affects the settlements in the Ayeyarwady region, and which variables influence the settlements in the Ayeyarwady region. Finally, the changes of settlements' pattern in the Ayeyarwady region are examined.

1.3 Scope and Limitations of the Study

Although transportation is performed by various modes such as water, road, rail and air, only road network is examined in this study. Amongst the various modes, there are some reasons why only road network is examined in this dissertation. The Ayeyarwady region is a delta area, and rivers and creeks in this area are countless. However there was no obvious road network in this region until 1988, so people in the region depended only on water ways. Only after 1988, the government has been constructing many roads and bridges, aiming to ease travel from one place to another within and outside the region. Such improvement in road transport is noticeable in the map of the Ayeyarwady region, so this dissertation makes a decision to focus only on road network.

To pursue the objectives of the study, the road improvement in the Ayeyarwady region from the period 1987/88 to 2010/11has been explored. In this dissertation, the time period is limited from 1987/88 to 2010/11. There is a reason why such time frame is limited as the study period. Myanmar was under the leadership of Burma Socialist Programme Party from 1962 until late 1988. However, the Tatmadaw took the responsibility of the nation since late 1988 because of the demonstrations that occurred as a result of general dissatisfaction across the country. At present, the Civilian Government has been undertaking the responsibility of the nation since March 2011 after the Multi-

Party Democracy General Election was held on 7 November, 2010[1], aiming at moving towards Democracy. This dissertation, therefore, designates as the study time frame from one year preceding the SPDC era (1988/89 to 2010/11) to the end of its era, aiming at comparing the situation between one era and another. In order to compare the situation between one era and another, the term "before and after 1989" is used in this dissertation, where the time period "before 1989" means 1987/88, which is one year preceding an era, and time period "after 1989" means 2010/11, which is the end of its era.

Based on the variables such as business activities, social and communication services, real GDP, population size, geographical situation and road condition, this dissertation analyzes how road network influences the pattern of settlements in the Ayeyarwady region, and which variables influences the settlements of the Ayeyarwady region.

1.4 Method of Study

Literatures regarding transportation network and settlement development in a region are reviewed in this dissertation. Necessary data and indispensable literatures are obtained from various sources such as respective government departments of the Ayeyarwady region, library and Internet website. Descriptive analysis is employed to portray the progress of road network in the Ayeyarwady region, and to explore the growth of settlements, through size of population, situation of business enterprises, conditions of social and communication services. Gross regional product (GRP) of the settlements is also employed to measure the economic growth of settlements.

After that, econometric analysis is used for exploring how road influences the settlements in the Ayeyarwady region, and which variables influence settlements in the Ayeyarwady region. Finally, the changes in the pattern of settlements in the Ayeyarwady region are observed by using nearest neighbor ratio, which is a measure to explain the pattern of settlements.

---

[1] Chronicle of National Development Comparison between Period Preceding 1988 and After (Up to 31-12-2010), p - 10

1.5 Structure of the Study

The structure of the study is designed as follows. Chapter 1 is the introduction, including problem statement, objectives of the study, scope and limitations of the study, methods of study, conceptual framework of the study and structure of the study.

The literatures on the concept of transport network and settlement pattern, and settlement development of regions are reviewed in Chapter 2. Starting from the history of transportation over the world, effects of transportation on settlements, approaches to measure settlements, settlement patterns, types of settlements, and other factors affecting settlement development apart from transportation have been articulated in this chapter. In addition, empirical scenarios which a number of scholars have previously studied are considered and presented in this dissertation.

Chapter 3 emphasizes the background of the Ayeyarwady region, and provides its historical background and history of the capital city of the region. In addition, as the Ayeyarwady region consists of six districts, historical background of each district, namely Pathein district, Hinthada district, Myaungmya district, Maubin district, Pyapon district and Laputta district is presented in this chapter. This chapter also highlights geographical situations including location, topography and climate, population, and rivers and creeks in the region.

Development of road network and growth of settlements in the Ayeyarwady region is described in Chapter 4. Firstly, the progress of road network in the region is examined. With an improvement in roads, the changing situation of business activities, education, health and communication services are then presented for Pathein and other district towns in this chapter.

Analysis on road transport and settlements in the Ayeyarwady region is presented in Chapter 5. In this chapter, econometric analysis is used to investigate which variables among factors that Henry (1981) recommended have an effect on the settlements of the Ayeyarwady region. Then, the results of econometric models are also discussed in this chapter. In addition, this chapter presents the changes of each settlement's pattern in the region by employing nearest neighbor ratio.

Chapter 6 is the conclusion including a brief discussion about the results of the study, and suggestions and some comments which may be useful to the authorities of the region and to the nation as a whole.

Chapter (2)

Literature Review

Attempts have been made to review literatures on the concept of transport network and settlement pattern, and settlement development of regions. Starting from the history of transportation over the world, settlement patterns, types of settlements, how transportation affects settlement development, and other factors affecting settlement development apart from transportation have been articulated in this section. In addition, empirical scenarios which a number of scholars previously studied would be considered and presented in this dissertation.

2.1 The History of Transportation

In the early Paleolithic and Neolithic eras, people traveled by foot from one place to another. There were no means of transportation during those eras. In the later part of Neolithic era, people started to use beasts of burden to carry things from one place to another. As the very first step towards man-made transportation, people invented the wheel around 4000-3500 BC.

(i) Land Transport

In the late Neolithic era, people domesticated animals and used horses and other beasts of burden for carrying commodities and other things from one location to another. Due to the invention of the wheel around 4000 – 3500 BC, people and commodities could move faster from one place to another. Since then, the development of land transport followed step by step. The landmark inventions are shown in the following table.

Table 2.1

Chronology of Inventions for Land Transport

Period	Particular
3500 BC	Two-wheeled chariot – world's first form of wheeled transportation – invented in Sumaria. This eventually led to the invention of the four-wheeled chariot in due course.
1670 AD	Cart driven by a steam turbine, built by a Jesuit missionary in China
1790 AD	Modern bicycles invented
1801 AD	Richard Trevithick invented the first steam powered locomotive (for roads)
1814 AD	George Stephenson invented the first practical steam powered railroad locomotive
1826 AD	Jean Lenoir made a gasoline engine automobile
1860 AD	Invention of Internal Combustion Engine by a Frenchman named Jean Joseph Etienne Lenoir
1867	First motorcycle invented
1885	Karl Benz builds the world's first practical automobile to be powered by an internal combustion engine
1895 AD	First experiment of electric powered trains
1908 AD	Henry Ford improves the assembly line for automobile manufacturing

Source: Iloveindia.com, history of transportation[2]

The steam engine was replaced with the diesel engine during World War II.

[2] http://lifestyle.iloveindia.com/lounge/history-of-transportation-4121.html

(ii) Water Transport

In fact, people had developed waterways before they had domesticated horse. At first, the dugout canoe was invented for water transport. Later, people invented and used sail-propelled ships. Due to the introduction of automation in 19th century, water transport became modernized. Nowadays, people could move faster and easier, and commodities could be carried more smoothly. The following table shows the landmark innovations in water transport.

Table 2.2

Chronology of Inventions for Water Transport

Period	Particular
1620 AD	Cornelis Drebbel invented the first submarine
1783 AD	First practical steamboat demonstrated by Marquis Claude
1787 AD	Steamboat was invented
1912 AD	First diesel-powered ship
1956 AD	Hovercraft was invented
1958 AD	First nuclear powered ship launched

Source: Iloveindia.com, history of transportation[3]

(iii) Air Transport

The Wright brothers – Orville and Wilbur Wright – invented the first flying machine in December, 1903. They initiated a bicycle propelled device at first, and later developed jet-propelled aircraft; in other words, aeroplane. Due to their invention, people, nowadays, are able to travel easily to great distances during a short time. The following table illustrates the landmark inventions in air transport.

[3]Op - cit

Table 2.3

Chronology of Inventions for Air Transport

Period	Particular
1492 AD	Leonardo da Vinci – first to seriously theorize about flying machines – with one 100 drawings that illustrated his theories on flight
1783 AD	The Montgolfier brothers invent the first hot air balloons
1903 AD	The Wright Brothers invented and flew the first engine airplane
1907 AD	Very first helicopter

Source: Iloveindia.com, history of transportation[4]

(iv) Space Transport

In order to satisfy people's desire to gaze towards the night sky, and the stars, the United States pronounced the development of the Vanguard Satellite Program in 1955. Subsequently, a series of experiments in aerospace engineering were conducted. The landmark episodes in space transport are shown in this table.

[4]Op - cit

Table 2.4

Chronology of Inventions for Space Transport

Period	Particular
1957	USSR's Sputnik I – first earth – orbiting satellite
1961	USSR's Vostok I – first manned space-flight
1969	Man Lands on moon – American astronaut Neil Armstrong became the first man to set foot on the moon
1977	USA's Enterprise – first reusable space shuttle

Source: Iloveindia.com, history of transportation[5]

2.2 Importance of Transportation

Transportation means the physical movement of people and goods between locations. Transport industry links people and economic activities from one location to another, thereby provides the welfare of population, which in turn promotes the development of the economy. Therefore it is a crucial part of the economy. If transport systems are well-organized, economic and social opportunities and benefits such as better accessibility to markets, employment and additional investments will be definitely achieved. If the capacity of transport systems is poor, economic and social opportunities and benefits will be missed.

From a general perspective, people can achieve directly and indirectly the benefits from the improvement of transportation. If transportation provides larger markets and facilitates to save time and costs, it can be said that people achieve direct impacts from transportation. If transportation makes the price of goods and services to fall and the variety of goods and services increases, it can be said that people achieve indirect impacts from transportation.

[5]Op-cit

Better transportation makes mobility of people and commodities easy. One of the most essential characteristics of economic activity is "mobility". The economies or regions that enjoy greater mobility achieve better opportunities to develop their economies or regions. It is said that transport network is indispensable as greater mobility is a channel for the development of a region or country (Rodrigue, 2011).

Transport infrastructure is essential for the development of a region. Regions with smooth transport network will be more productive and competitive because transport network provides better access to locations of inputs and markets, and thus more successful than more remote and isolated regions (Schürmann, Spiekermann, and Wegener, 2002).

Transportation developments had taken place since the Industrial Revolution that began in England in the 17th century. Markets were special needs for Industrial development. The improvement of water transport and road transport expanded markets for goods which resulted from the Industrial Revolution. Although transport by itself is not a sufficient condition for development, the lack of transport infrastructures constrains development (Schürmann, Spiekermann, and Wegener, 2002).

Seaports were developed with the activities of the European expansion during the period of the 16th century and the 18th century. They facilitated the expansion of international trade throughout the colonial empire. In the late 18th century and early 19th century, canal systems became developed in Western Europe and North America, aiming to transport commodities. This encouraged the development of inland areas. Railways became developed in the 19th century, and this enabled a more flexible inland transportation system and facilitated the development of regions or countries. Road transportation systems and automobile manufacturing developed in the 20th century. This factor made commodities available to the masses. In the later part of the 20th century it is said that the role of airways in transportation development became significant. Accordingly, no one can deny that the progress of transport networks has certainly enabled the movement of people and goods, and development of regions or countries.

A number of scholars recognize that transportation is one of the factors of production of goods and services. The improvements of transport networks support in the implementing of economic processes. In general, goods and services are produced with

the most suitable combination of capital, labor and raw materials. For instance; if transport networks are adequate, people will produce goods and services in the area which has comparative advantage compared to other areas and distribute them, thereby promoting the economic productivity of that region. A well-organized transport system lowers cost, saves time and allows reliability advantages. This factor encourages mass production via economies of scale. There is no doubt that efficient transportation promotes that accessibility to markets. Thus, the better the transport networks, the more are the economic opportunities for the region. Improvement in transport networks expands economic activities and creates jobs in settlements along the routes, which in turn contributes to the development of regions or countries (Rodrigue, 2011).

Accordingly, improvements in transportation are crucial for the growth of settlements. Improvements in the quality of roads make smooth travelling for people and commodities. Therefore, it is obvious that the type of roads need to be good enough. Amongst the types of roads such as earth road, rocky road and tarred road, tarred road has the highest degree in the evenness and smoothness of road. As the high quality of road such as tarred road significantly facilitates the flow of goods and services, and travelling of people, high quality road – tarred road is very important for the growth of settlements.

2.3 Effects of Transportation on Settlements

According to historical records of civil society, new settlements were established along transport routes due to realization of the opportunities for economic activities. Alternatively, existing settlements got better or worse depending on the changes in importance of its economic activities. The improvement of transport routes changes the functions of settlements, increases business activities, generates physical growth, and encourages the economy to be developed.

It is recognized that transportation expansion is essential in attempting to achieve economic development of a region or a country. Especially, it is said that high quality transport facilities are a necessary condition for realizing the full contribution of remote communities in building national development. Improvement in transportation reduces production costs, increases producer prices, and creates a focus for investment.

Improvements in infrastructure and support services are essential for investment decisions. Development in transport infrastructure increases access to institutional credits, and facilitates the allocation of credit from nonproductive to productive activities, which in turn increases investment in the region where there are production facilities.

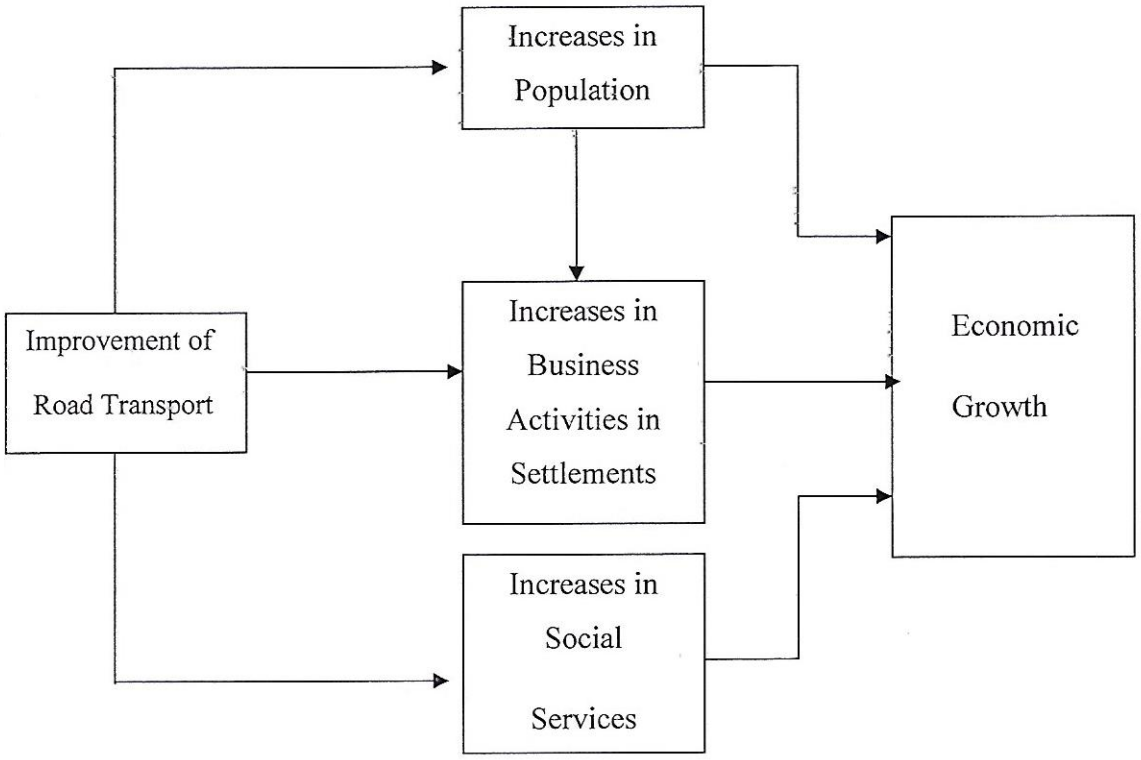
In addition, increases in investment opportunity due to good transportation encourage the enlargement of production, and also makes possible the upgrading of production technology. This in turn increases the economies of scale, causing further expansion in investment.

Higher investment in a settlement makes possible the expansion of labour forces to that settlement. This is true for both labour that is required on a temporary basis such as specialists, advisers and skilled labour required for permanent employment. Consequently, transportation improvements increase the population of the settlement.

It is observed that improvement of transportation networks increases not only the population of the settlement but also business activities such as hotels and a variety of shops. Moreover, social services such as education and health services were extended for their people in accordance with an increase in population. With an improvement of roads, increase in population, business activities and social services facilitate economic growth of the settlements. A number of theories and approaches assert that transportation improvement supports both physical growth and socio-economic development of the settlement. The effect of transportation on settlements is shown in Figure 2.1.

Figure 2.1

The Effect of Transportation on Settlements



Source: Author's Sketch based on Literature

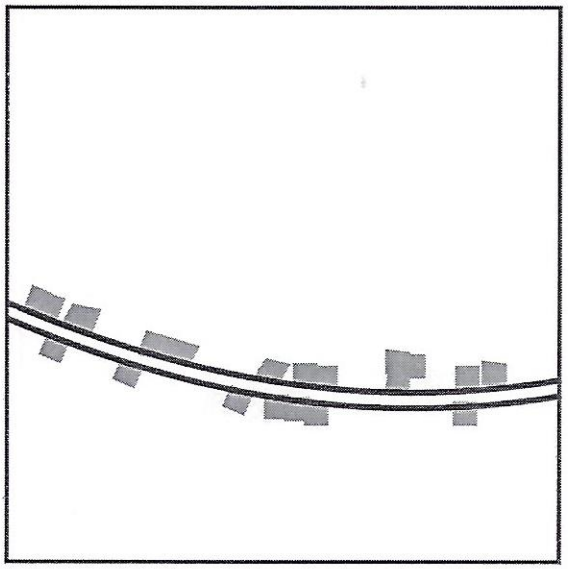
2.4 Settlement Development

A settlement is a place which supplies its own needs and the needs of its surrounding areas. It can be a village or a town or a city. According to the U.S. Census Bureau, if there are less than 2,500 people in an area, it is called **rural settlement**. If there are more than 50,000 people in an area, it is designated as **urban settlement**. Settlement patterns are different based on how a community has developed over time. If the buildings in a settlement are dispersed along the transport route such as road and water way, it is called a **linear settlement pattern**. Linear settlements become developed due to the convenience of proximity with a transport route. When the buildings are spread in the whole area, it is designated as **a dispersed settlement pattern**. The nature of **nucleated settlement pattern** articulates that the buildings are clustered around a central part of an area.[6]

The following figures[7] show the patterns of settlements.

Figure 2.2

Linear Settlement Pattern



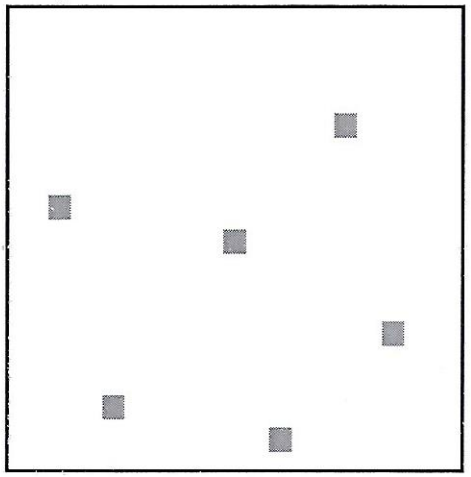
Source: Author's Sketch based on "portage and mainpress.com"

[6] http://www.ehow.com/facts_7460776_settlement-pattern_.html

[7] http://www.portageandmainpress.com/lesson_plans/plan_258_1.pdf

Figure 2.3

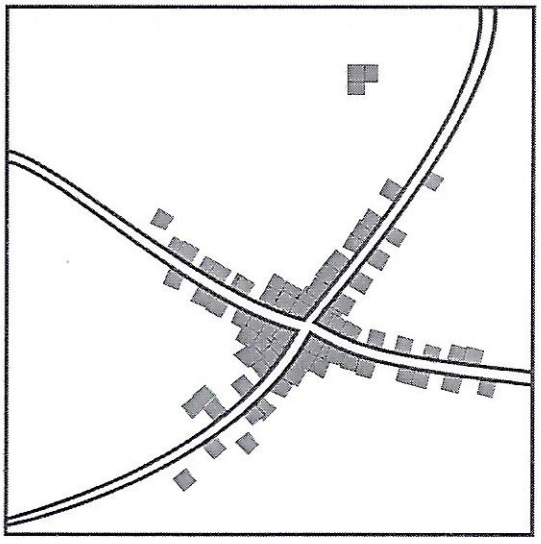
Dispersed Settlement Pattern



Source: Author's Sketch based on "portage and mainpress.com"

Figure 2.4

Nucleated Settlement Pattern



Source: Author's Sketch based on "portage and mainpress.com"

2.4.1 Approaches to Measure Settlements

A number of scholars have suggested some theories and tests in order to describe the relationship and comparison between settlements. The approaches applied to objectively measure the settlements in different parts of the world are "Nearest neighbor analysis: a measure used to explain the pattern of settlement, the Rank-size rule: a method used to find numerically relationship between the population size of settlements, Central place theory: an approach employed to describe the functional importance of places, and Gravity models: a mean utilized to find out the interaction between settlements".

(1) Nearest Neighbour Analysis

In general, dots on maps are employed to explain settlement patterns. However, it is recognized that dot distributions are frequently difficult to describe settlement patterns. Only when settlements are extremely nucleated or dispersed, the patterns could be said exactly. The patterns of settlements in the real world may be described as somewhat in between these two extreme patterns; so the settlement pattern which is described in practice may be subjective. A method which can be used to describe objectively, a pattern, is the nearest neighbor analysis. However, as it is only a "means", the implication is that, it cannot explain the patterns.

Nearest neighbor analysis was used by botanists in order to explain the patterns of plant distributions. Likewise, the patterns of settlements, shops and industries could be described by using this analysis whether the pattern is nucleation or dispersion or others. This analysis provides a technique used to measure whether the patterns of settlements are clustered or random or regular. In clustering pattern, all the dots are very close to the same point. When the exact pattern cannot be described, it is called random distribution. When each settlement is equal distant from another one, it is said that it is regular pattern which is perfectly uniform[8].

[8] http://www.geogonline.org.uk/nearest neighbour.ppt

Nearest neighbor ratio is the ratio of observed mean and expected mean of nearest neighbor distance. The formula employed in this analysis is:

$$Rn = \frac{Observed\ Mean}{Expected\ Mean}$$

where Rn = Nearest Neighbor Ratio

$$\text{Observed Mean} = \overline{D}(Obs) = \frac{\Sigma d_i}{n}$$

d_i = the distance between one house and another

n = the number of houses in the study area

$$\text{Expected Mean} = 0.5\sqrt{\frac{a}{n}}$$

where n = the number of houses in the study area

a = the area of each settlement

$$\therefore \quad Rn = \frac{\frac{\Sigma d_i}{n}}{0.5\sqrt{\frac{a}{n}}}$$

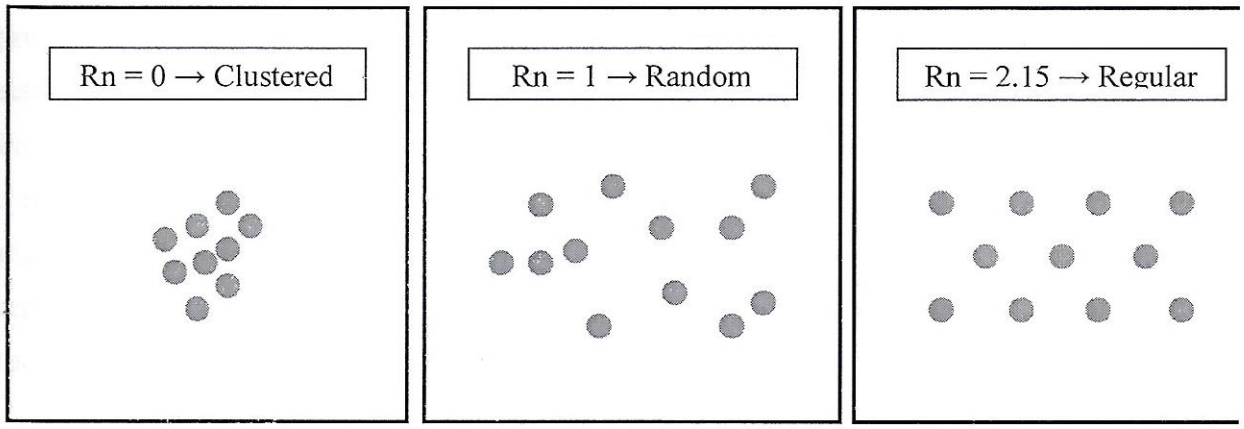
Based on theory, the result of the nearest neighbour analysis must lie between 0 and 2.15. If the value of the index "Rn" is equal to 0.00, the pattern of settlement is a totally clustered pattern. When "Rn" shows 1.00, the pattern will be random distribution. If the result gives 2.15, the settlement pattern will be a completely regularly spaced pattern.

The patterns of settlements based on nearest neighbor analysis are shown in the following figure[9].

[9] Op-cit

Figure 2.5

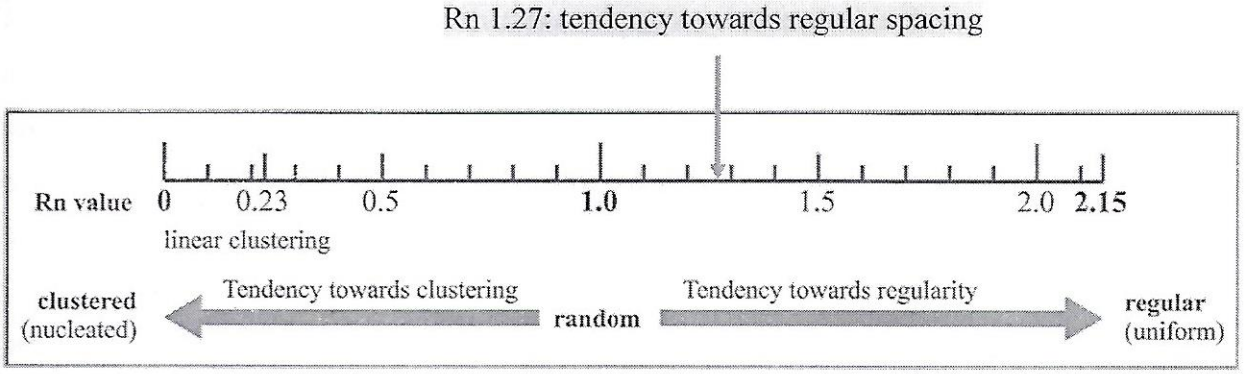
The Patterns of Settlements



Source: Author's Sketch based on "geogonline.org.uk/nearest neighbor"

Figure 2.6

Rn Value for the Pattern of Settlement



Source: Author's Sketch based on "geogonline.org.uk/nearest neighbor"

If the value of Rn is 1.27, it means that there is a fairly strong tendency towards a regular pattern of settlements. If the value of Rn approaches to "0", it implies that the pattern tends to linear clustering.

(2) The Rank–size Rule

The rank-size rule provides a measure to designate the rank between settlements. According to the rank-size rule, the population of a settlement will be inversely proportional to its rank in the hierarchy ($P_r = P_1/R$, where P_r is the population of settlement r, P_1 is the population of largest settlement, R is the rank size of settlement r). For instance, population of the second largest city is half of that of the first largest one in a region; population of the third largest city is one-third of that of the largest one in a region; population of the fourth largest city is one-fourth of that of the largest one in a region. According to the observation of Berry (1961), the rank-size distribution generally took place in mature, large scale, highly urbanized, stratified, or complex economies.

(3) Central Place Theory

A German geographer Walter Christaller introduced Central Place Theory in 1933, aiming to give an explanation of the spatial arrangement, size, and number of settlement. Christaller initially studied the settlement patterns in southern Germany, and conveyed how urban settlements develop. A central place is a place which makes available one or more services for its surrounding population. In his theory, Christaller mentioned high order place and low order place depending on how the settlement provides services. If the settlement provides simple basic services such as grocery stores, it is called low order settlement. If the settlement provides specialized services such as universities, it is called high order settlement.

Christaller introduced two basic concepts in his theory; "*threshold*" – the lowest population that is required to provide certain goods or services and "*range of goods or services* (transportation) – the highest space people will go to buy goods and services. Based on these two concepts, he explained how the central places are arranged in a region.

According to the central place theory, market centres will be located based on the competitive features of the market economy. Each seller will endeavor to saturate consumers' needs in order to control many consumers, so each has circular demand area. However, as several suppliers attempt to satisfy a region up to their minimum thresholds,

their areas will overlap. Consumers will choose the closest supplier with the lowest price. This consumer rationality will cut in half the circle areas of overlap, which leads to hexagonal market areas for each seller. Thus, Christaller asserts that the shape of market area is hexagonal grid. In arranging central places, the three principles: the marketing principle (K = 3 system); the transportation principle (K = 4 system) and the administrative principle (K = 7 system) are noted in theory. According to the marketing principle, the relationship of the market area between one lower order centre and higher level centres can be indicated by the value 3. It means that the higher level central place hierarchy is three times bigger than the lower one. For instance, if there are three cities, the number of towns, villages and hamlets would be 9, 27 and 81 respectively.

The transportation principle articulates that the lower order central places are located at the middle of each side of the hexagon, and it is indicated by the value of 4. It means that the market area in the central place hierarchy is four times larger than that in the next lowest order. For instance, if there are two cities, there would be 8 towns, 32 villages and 128 hamlets.

The administrative principle comes from a political or administrative viewpoint centres. This principle is indicated by K = 7.

Central place theory pronounces that urban centers are recognized as service centres for their nearby areas because they supply central goods and services such as retail services, commercial, banking and professional services, educational, leisure and cultural facilities. Based on the demand threshold and the range, these services can be categorized into higher order and lower order central places.

(4) Gravity Model

The concept of Gravity Model indicates that the potential use of services and the size of population in a particular place are positively related, and the potential use of services and the distance people have to go to reach these services are negatively related. Based on the Gravity model, the larger population living in a particular settlement generates the larger potential consumers for services, and if people are far from a particular service, the opportunities they can use those services are likely to be low. In other words, settlements that have large population size and are very near are more likely

to interrelate. Conversely, settlements that have small population size and are very far are less likely to interrelate. If the calculated result of the model is huge, the gravity model asserts that the interaction between settlements is strong.

In general, the formula used to measure the interaction between settlements is as follows;

$$I_{ij} = \frac{P_i P_j}{d_{ij}}$$

Where I_{ij} = expected degree of interaction between settlement "i" and settlement "j"

P_i = population of settlement "i"

P_j = population of settlement "j"

d_{ij} = a measure of distance between settlement "i" and settlement "j"

2.4.2 Types of Settlements

It is said that the most hierarchical typology of settlements within a region is presented based on economic factors (Henry, 1981). However this scheme does not consider other factors that affect settlement development. Thus, a number of scholars articulate that other factors such as relative size, settlement function, structural density, population size and the number of businesses have been applied to distinguish between the types of settlements (Keriel, 1970; Hoffecker, 1974; Henry, 1981). According to those scholars, there are five types of settlements, namely homestead, hamlet, village, town and city.

(i) Homestead

In distinguishing the types of settlements, the basic settlement unit is the homestead. The homestead contains the land, house and the farm.

(ii) Hamlet

A little group of homesteads is called a hamlet. The settlement pattern of hamlet is not systematic; that is, there is no evidence of planning. Initially, people in the hamlet

may be relatives; in other words, the homesteads of one family cluster. A few part time specialists such as blacksmith may have in this small area. In general, they generate goods and services for this small limited area.

(iii) Village

The area and population of the village is larger than that of the hamlet. Although the settlement pattern of some villages may not be systematic, that of some villages may be planned. In general, the settlement pattern of the village which grew from a hamlet may not be systematic. Based on the functions of the village, that village may be a small scale trading centre. The village may have a small business such as a store, a grocery, an inn and a blacksmith, and a government office such as a post office. In addition, there may have a school and a church which provide numerous important social functions in a village.

(iv) Town

The area and population of the town is larger than that of the village. The settlement pattern of the town is typically planned; that is, the town is laid out on a grid pattern. However, the settlement pattern of the town which grew from an unplanned village may display an irregularity. The settlement pattern of the town may change over time because of population growth and other factors. The town may be the focal point of economic and social activities. Accordingly, the town generally provides economic functions, and offers employment opportunities. The town may be a transshipment point of the sub-region. There are small scale manufacturing enterprises and greater specialization in production in the town. In addition, the town offers important social functions such as church activities, and provides "town hall" recreations such as travelling entertainment and school activities. The town may be the political and judicial administration centre of the sub-region.

The type of town which was important in the 17th and early 18th centuries is the "Frontier Town". The frontier town is the centre for all economic, political, social, and religious activities of the frontier, and connects the frontier and the homeland (Hoffecker, 1974). Primarily, the frontier town is a market centre. Raw materials and semi-processed

goods are brought to the homeland and processed goods are re-transported to the frontier town. The settlement pattern of the frontier town is organized by dispersed homesteads which are concentrated along the major transportation routes[10].

(v) City

The area and population of the city is larger than that of the town. In general, there is only one city in a region. The settlement pattern of the city is planned, and the city is expanded in accordance with the plans. The city is the core of a region for inter-regional economic, political, judicial and social activities. There are large scales manufacturing enterprises in the city. The settlement development of cities depends on population growth, the situation related to other towns and cities, and the availibility of raw materials. The two special types of city which were evident in the historical records are the "Mercantile City" and the "Industrial City". The Mercantile City was developed during the period of the mid 18th century and the early 19th century. The Industrial City was developed between 1830 and 1900.

(a) Mercantile City

The Mercantile City developed from the frontier town. It focuses on merchandising, shipping, and bulk processing. Locations along major transportation routes become important. Multi-use structures; for instance, businesses in the first floor and residence in the second floor, high class dwellings, and small scale handicraft businesses are situated along the main transportation routes. Low class accommodations, mass merchandise goods handling, small industries, and large scale handicraft businesses are situated on the suburbs. As the Mercantile City developed, people located in those areas acquired more opportunities to work. Workers live next to their working place.

(b) Industrial City

Based on innovations in technology such as steam power and improvement of transport networks such as railroads, an Industrial City developed from a Mercantile City.

---

[10] http://www. deldot.govarchaeologydraft_research_designpdfderies19_set_dev

Industrialization made goods and services more available, and provided more employment opportunities to the people located in the city and its neighboring areas. High class dwellings are situated on the suburbs. Low class accommodations, mass merchandise goods handling, small industries are situated in the centre of the city close to the railroad and heavy industries. Financial service industries and commercial service industries, and small scale handicraft businesses are situated in the core of the city. However, workers live somewhere else.

2.5 Factors Affecting Settlement Development

A number of scholars articulate that the improvement of transport networks and the development of settlements are interlinked. Transportation is a main foundation of the development of settlements within the region (Henry, 1981). There are numerous imperative factors that influenced settlement pattern, namely[11];

(1) Economics
(2) Transportation system
(3) Geography
(4) Population size
(5) Technological innovations
(6) Social concerns

All these underpinnings for the development of settlement are related to each other. In general, it is said that amongst these factors, economics and transport networks are the most prominent; the others are of secondary importance.

(1) Economics

The crucial factor for the development of settlements is the presence of greatly competitive power in the economy and the ability of a settlement to sustain its place within the competitive economic system. If economic competitors lived in a settlement such as town and village fail in their competition, the settlement will lose workers inhabited in that location and businesses established in that place. Consequently, the

[11] Op-cit

importance of that settlement will gradually decline, and then the development of that settlement will not be achieved. However, if the economic opportunities for people living in a settlement are good enough for them - the healthiness of the economy is strong enough, the settlement will sustain its position. Accordingly, the importance of that settlement will eventually increase, and then that settlement will certainly enlarge, which in turns the pattern of that settlement may change. (Kariel, 1970 and Henry, 1981)[12].

(2) Transportation System

Transport network is the most important reason for settlement development (Henry, 1981). Transportation is important for moving commodities and consumers to markets; moreover, it offers roads for social interaction. The transportation system comprises the modes of transport such as foot, horseback, wagon, railroad, and shipping, and the transport network; that is, the physical routes. Generally, if the transportation routes between two settlements are good enough, the amount of economic and social relations between them are bulky. If a settlement is located on a minor route, the economic and social relations between that settlement and others will not be smooth, thereby hinders the development of that settlement. However, if various economic, political, and social pressures enlarge the transport routes, the development of that settlement will positively be achieved. Various transport routes are built based on the existing demand of the settlement. The location of settlements may be changed in the future depending upon the building of transportation routes (Henry, 1981)[13].

(3) Geography

In general, the existence of energy, raw materials and natural resources primarily supports in the production of economic products. Conversely, the areas which lacked energy, raw materials and resources are not significant in terms of geographical situation. The abundance of such resources would usually expand the settlements although the lack of such resources would not necessarily affect the growth of settlements. Geographic characteristics such as rivers can be a transport route for travelling or it can be an obstacle

[12] Op-cit
[13] Ibid

for the smooth transportation. A region with steep slopes and marshes discourages the growth of settlements; however, an area with fertile coastal plains encourages the growth of settlements. Regions with abundant natural resources such as a rich coal seam would facilitate the growth of settlements (Johnston, 1966). Furthermore, regions with naturally aesthetic landscape could afford to grow the settlements (Henry, 1981).[14]

(4) Population Size

It is also one of the important factors which determine the development of settlements. If a settlement is an area which is economically strong, it will be fulfilled with employment opportunities and housing, thereby it can absorb its increasing population. Consequently, that settlement may expand its area and the density of that settlement will certainly increase, which in turn may change its pattern over time.

(5) Technological Innovation

Technical improvements in transportation and/ or manufacturing are imperative for the growth of settlements. Improvements in transportation make smooth travelling for commodities and people, and improvements in manufacturing products due to advanced technology make costs lower. These factors increase population size and density of a settlement, and then this consequence tends to change the settlement pattern and development. For instance; the construction of railroad to Wilmington in the U.S invigorated the city which had been facing severe economic downturn (Hoffecker, 1974).[15]

(6) Social Concerns

Social concerns such as religion, kinship ties, social status and ethnicity have an effect on settlement pattern. According to the observation of Hudson (1969), settlement patterns are distributed in terms of nationalities and religious denominations in southeastern Pennsylvania, indicating that settlements are built by their own cultural

[14] Op-cit
[15] Ibid

groups[16]. These factors became more obvious in arranging the internal patterns of a settlement. For instance; upper class neighborhoods and ethnic ghettos lived together in their respective groups.

2.6 Review on Empirical Studies

Hudson (1969) investigated the changes in settlement distribution over time for rural Iowa in the United States during the period of 1870 and 1960. He employed the spatial process similar to those used in analyzing plant ecology for rural Iowa settlement. In his analysis, the three phases that he asserted are colonization, spread, and competition. In the first stage of colonization, as the population of a settlement gets bigger, its occupied territory becomes large. However, population density is low. In the second stage of spread, the spatial process is short distance dispersal because of increased population density. In the final stage of competition, the settlement pattern leads to regularity because increases in population density generate competition for resources such as agricultural land and marketing areas. According to the results he investigated during a 90 year period, the farm settlement showed clustered pattern in the beginning, then randomness, and finally leads to regularity.

Wanmali, S (1992) articulated the analysis of the settlement system in the eastern part of North Arcot District, Tamil Nadu State, India. He carried out this analysis based on the framework of Walter Christaller's central place theory, which strived to give details of the distribution of services in a region. The hierarchy of services is consistent with what the theory said. Areas which have larger population have a greater variety of services than areas which have lower population. Furthermore, he investigated that in addition to population size, access to transport routes such as roads is a vital factor in establishing services such as education, health, communication, finance, cultivation inputs and implements, output marketing, and retail services by employing the data on the settlement populations and on distances to bus stop (road transport) located in the study region. The analysis has confirmed that population of a settlement and the

[16] Ibid

accessibility of services such as high school, primary health center, government hospital; post offices and so on are positively and significantly related. According to the results of his analysis, the effect of remoteness from road transport is suggested: if the nearest bus stop is located 1 kilometer farther away, the probability of a high school being located in a particular community would be 6 percent rather than 12 percent; the probability of a primary health center being located in a particular community would be 1 percent rather than 2 percent; the probability of a post office being located in a particular community would be 0 percent rather than 2 percent; the probability of a telegraph office being located in a particular community would be 23 percent rather than 25 percent; the probability of a lead bank being located in a particular community would be 1 percent rather than 2 percent; the probability of a fertilizer shop being located in a particular community would be 7 percent rather than 11 percent; the probability of a veterinary dispensary being located in a particular community would be 1 percent rather than 3 percent; and the probability of a groundnut market being located in a particular community would be 3 percent rather than 4 percent.

Bottic, V., Sisinacki, J., and Skuflic, L (2006) analyzed how road infrastructures affect the development of a region, using some evidence from Croatia. In their analysis, they discussed direct and indirect effects of transport infrastructure although transportation is positively related to the development of a region. According to them, the direct effects of improvement in transport network are accessibility of movements within the region, migration changes of households and business location, an increase in productivity of the regions, a decrease in travel times, an effectiveness of production, a reduction in commuting time, and an increase of economic activity. The following table shows the effect of road construction.

Table 2.5

The Effect of Improvement in Road Transport

Transport economics	**Effects on environment and landscape**	**Effects on regional development**
- increased travel safety - reduction in journey time - increased travel comfort - reduced operating costs - lower maintenance costs - user benefits	- noise - air pollution - water pollution - vibrations - change of landscape - conservation of nature - land development	- regional economic growth - employment increase - effects on trade, industry and tourism

Source: Nijkamp, P., Ubbels, B., and Verhoef, E., "Transport Investment Appraisal and the Environment",

Botric, V., Sisinacki, J., and Skuflic, L., "Road Infrastructure and Regional Development: Some Evidence from Croatia"

In addition, according to the study of the European Commission (1996) it was recognized that transportation has direct effect, induced effect and catalyst effect on the development of a region. presses the analysis of all three effects on different spatial levels, time framework and sectors as in the following tables.

Table 2.6

Socio-economic impacts of new motorway on different spatial levels

	Local level	**Regional level**	**National level**
Direct Effects	Increased Employment in Construction Sector	Wide service sector employment due to multiplier effect	
Induced Effects	Increased office rents close to new interchanges	Decentralization of households into areas with enhanced accessibility	Increased competitiveness of firms because of reduced travel costs
Catalyst Effects	Increased business employment due to enhanced perception of area		

Source: European Commission, "APAS - Methodologies for Transport Impact Assessment"

Botric, V., Sisinacki, J., and Skuflic, L., "Road Infrastructure and Regional Development: Some Evidence from Croatia"

Table 2.7

Socio-economic impacts of new motorway at different temporal levels

	Short term	**Medium term**	**Long term**
Direct Effects	Increased Employment in Construction Sector		
Induced Effects	Some anticipatory relocation of households into improved corridors	Some agglomeration of firms close to interchanges	Further movements of firms and households, away from area due to congestion and high rents
Catalyst Effects	Additional employment in landscaping projects		

Source: European Commission, "APAS - Methodologies for Transport Impact Assessment"

Botric, V., Sisinacki, J., and Skuflic, L., "Road Infrastructure and Regional Development: Some Evidence from Croatia"

Table 2.8

Socio-economic impacts of new motorway on different sectors

	Low income households	High income households	Manufacturing	Service
Direct Effects	Increased casual employment in the construction sector			Spin-off business for service sector due to increased local construction expenditure
Induced Effects		Reallocation into affected corridors by car owning households	Increased profits due to reduced transport costs	Reallocation to newly accessible nodes
Catalyst Effects	Some increased employment			Some relocation due to improved perception of area

Source: European Commission, "APAS - Methodologies for Transport Impact Assessment"

Botric, V., Sisinacki, J., and Skuflic, L., "Road Infrastructure and Regional Development: Some Evidence from Croatia"

Meshkini, A and Rahimi, H. (2011) investigated the changes of settlement pattern and population dynamics in Tehran province from 1966 to2006 by employing particular methods such as mehta index, entropy coefficient and urban development

model. They classified settlements based on the population amount of settlements in order to study the changes of settlement pattern. Among their three methods, mehta index concentrates on changes, and entropy coefficient and urban development model calculate deconcentrating process. "Mehta index" can be calculated as the following formula:

$$\text{Mehta index} = \frac{P_1}{P_1 + P_2 + P_3 + P_4}$$

Where P_1 is population of the primate city, P_2 is population of the second big city, P_3 is population of the third big city, and P_4 is population of the fourth big city in Tehran province. They employed the range Richardson suggested in order to determine primate city score. According to Richardson's range, the least primacy is between 0.41 and less, the figures shown the value between 0.41 and 0.54 are desirable primacy, high primacy is between 0.54 and 0.65, and if the number is between 0.65 and 1, it is extra primacy.

The second method they employed in their investigation is "entropy coefficient" which ranges from 0 to 1. The formula of entropy coefficient can be defined as follow.

$$E = -\sum_{i=1}^{n} P_i \cdot L_n P_i$$

$$P_i = \frac{\text{Population of or number of urban points in Class}_i}{\text{Total urban population or total number of urban points}}$$

where E is entropy coefficient,

L_n is natural logarithm of P_i,

Class_i is classification of cities according to population[17].

If the entropy coefficient is close to "0", the distribution pattern of settlements is more concentration. Conversely, the entropy coefficient is close to "1", the distribution pattern of settlements is more dispersion. This, in fact, is the concept which Hekmatnia et

[17] 900 – 10000 persons ---Urban – Rural village
10001 – 20000 persons ---Small city
20001 – 100000 persons ---Mid city
100001 – 500000 persons ---Big city
500001 and above ---Metropolis

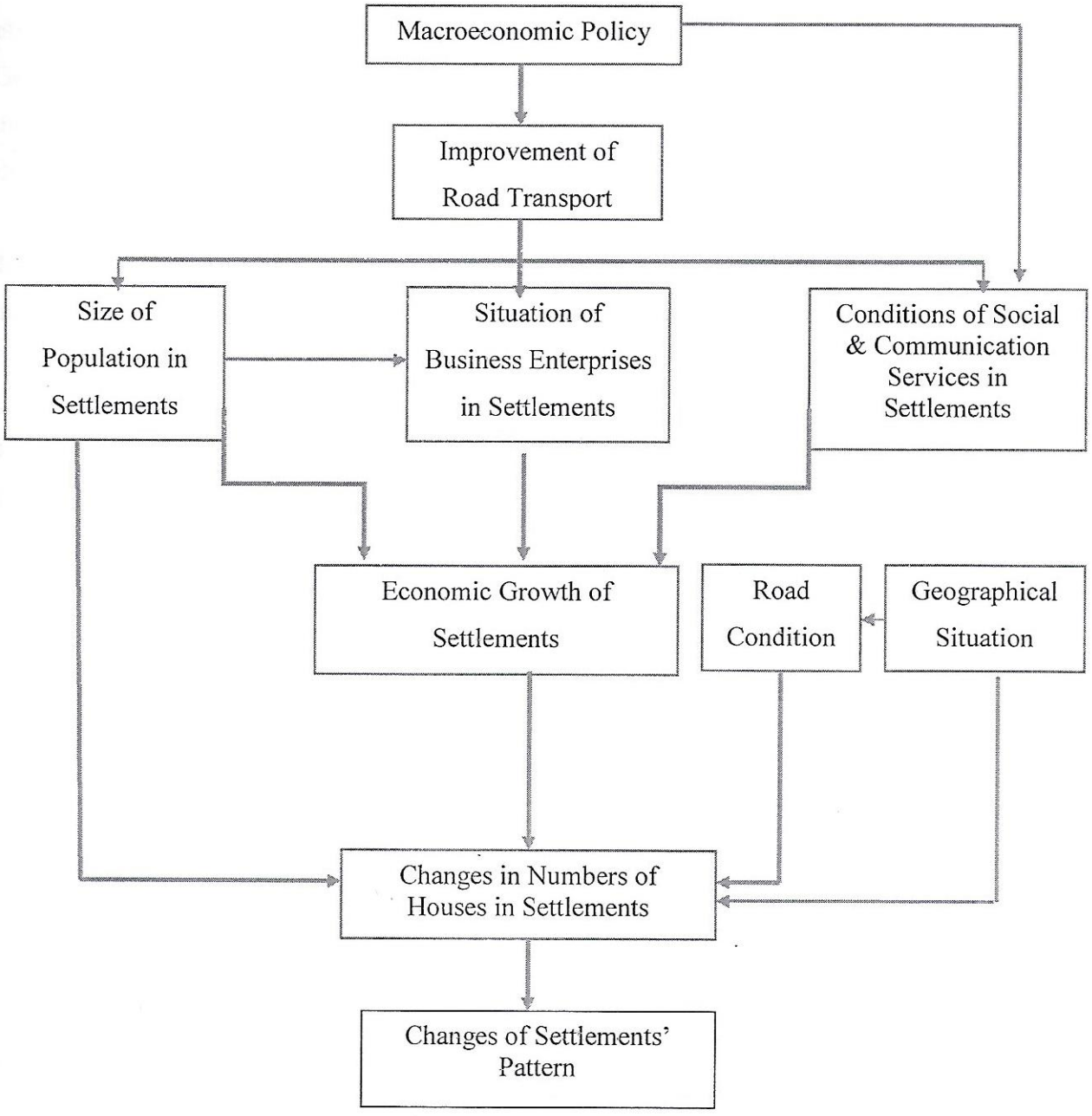
al.,(2006) articulated. In the real world, the entropy coefficient could not be exactly "0" or "1"; however, the result could not go outside this range.

The third method they employed in their investigation is "urban system development model". It depends on the variations in the direction and rate of population change between centre and periphery. If cities are studied in term of urban development model, the determination of daily urban system is the primary step. Daily urban system is defined as a set of cities having daily flows of population among themselves. It is measured by commuter bus system criterion based on data obtained from field survey. Based on the results, the fact that big cities grow in number and in population is the most significant change in urban system of Tehran province during the period of 1966 and 2006.

Macroeconomic policy is indispensable so as to achieve the development of a region. The improvement of road transport in an area as a macroeconomic policy increases the size of population in that region, which in turn generates the enlargement of business activities in that area. In addition, social services such as education and health services are certainly extended. These factors significantly facilitate economic growth of those settlements. Such factors as population size, economic growth, road condition and geographical situation change the numbers of houses in the settlements, which in turn the pattern of the settlements. In fact, the construction of road in a region can be based on geographical situation of that region; however, this part is not included in this study. In order to put on view the pattern of the study, the conceptual framework of the study is shown in the following figure.

Figure 2.7

Conceptual Framework of the Study



Source: Author's Sketch based on Literatures

Chapter (3)

Overview on The Ayeyarwady Region

The location of the Ayeyarwady region is in the south-western part of the central plains of Myanmar. The total area of the region is 13,567 sq. miles (35,138 sq.km). Geographically, the Ayeyarwady region shares borders with the Bago region in the north, the Bago region and the Yangon region in the east, the Andaman Sea and the Bay of Bengal in the south and in the west, and the Rakhine region in the northwest.

The Rakhine Yoma and coastal strip of land is in the west. As the region is a delta, there are many rivers and creeks, and its land surface is flat. Amongst there are many rivers branching out from the mighty Ayeyarwady, the Ngawan river, the Pathein river and the Toe river are famous.

3.1 Historical Background

3.1.1 The Ayeyarwady Region

The delta area of the Ayeyarwady Region was a part of territory which was governed by the Mon Kings in ancient times. In A.D 11, Myanmar and Rakhine governed this Region. After the Second English-Myanmar War, this region was under the colonial rule of the English empire prior to the British Annexation of Upper Myanmar.

According to the 1947 constitution, the Ayeyarwady Division was formed with five districts, namely Pathein District, Hinthada District, Myaungmya District, Maubin District and Pyapon District. In 1965, it was reformed with 26 townships under five districts. In 1972, the definitions of districts, sub-districts and townships no longer exited. Instead, they all were compiled under one name of "division". According to the 1974 constitution also, the Ayeyarwady Division stood as one of the state divisions

Districts were designated as "township tracts" under the State Law and Restoration Council (SLORC) in 1989. However, in 1992, the SLORC (later it was changed to the State Peace and Development Council (SPDC) in 1997) changed the name of "township tracts" to that of "Districts", aiming at giving clear name according to administrative perception. According to the notification of the Ministry of Home Affairs

in 1999, Ahphauk town and six "village tracts" in Zalun Township, Hinthada District was put under "Tikekyi District", Yangon Region. In 2008, Myaungmya District was divided into two districts, namely Myaungmya District and Laputta District based on the notification of the Ministry of Home Affairs. In 2010, the Ayeyarwady division was renamed as the Ayeyarwady Region.

Administrative territories were recognized in order to be consistent with the development of political, administrative, economic and social conditions of the Ayeyarwady Region over time. At the present time, the Ayeyarwady Region is organized administratively with 6 districts, 26 townships, 7 sub-townships, 34 towns, 249 wards, 1913 village tracts, and 11938 villages according to data published by the Ministry of Home Affair, Myanmar in 2011. Pathein is the capital city of the Ayeyarwady Region.

The evolution of administrative territories in the Ayeyarwady Region is shown as follows:

(a) Burma Socialist Program Party period (1974 – 18/9/1988)

(1) Townships	26
(2) Towns	28
(3) Wards	207
(4) Village tracts	1922
(5) Villages	11705

(b) State Law and Restoration Council (SLORC) period (18/9/1988 – 15/11/1997)

(1) Districts	5
(2) Townships	26
(3) Towns	29
(4) Wards	216
(5) Village tracts	1920
(6) Villages	11689

(c) State Peace and Development Council (SPDC) period (15/11/1997 – 31/3/2011)

(1) Districts	6
(2) Townships	26
(3) Sub-townships	7
(4) Towns	34
(5) Wards	249
(6) Village tracts	1913
(7) Villages	11938

3.1.2 Capital City of the Region

Pathein is the administrative city of the Ayeyarwady Region, and recognized by 7 names. In the olden days of Myanmar, there were Monti, Monsa and Monnya areas, and Monti was divided into Dagon and Dala, Monsa was divided into Thahton and Madama (Motetama), Monnya was divided into Pathein and Myaungmya. Pathein was included in Monnya area. Pathein was named as "Ahtitay thitzarnan Yanmartiti Ahtithitzar Nargayaw" in very ancient time, meaning good people lived in this area. Therefore, the original name of Pathein was "**Ahati Thitzar Nargaya**".

Under King "Yanmokekha", grandson of the Thirikhittayar King "Ngadapar", over 3000 monks moved from "Thiho Island" to "Pathein City" because "Dokebikandarya" epidemic occurred in Thiho Island. Accordingly, it was given the name of "the harbor to go to heaven – Kuthimayahta". Moreover, it was called "**Kuthein**" as ""the harbor to go to heaven" due to the migration of monks, religious persons, and the heritage of Buddha from Pathein area to Thiho and Myitzima areas, and vice versa.

In addition, it was called as "Myo Pathi" according to Mon language, and also called as "Wai Pathi" by "Taline Kayin". Thus, the third name of Pathein became "**Puthima-nagaya**" in that era.

In the very ancient time, Pathein was governed over a 9 - year period by King "War Thudathta" – son of Hinthawady King "Wimala" , a 10 - year period by King "Bala Dathta" – brother of Hinthawady King "Wimala", a 7 – year period by King "Mahar

Zayya", a 8 – year period by King "Sula Zayya", a 6 – year period by King "Thargaya", and a 7 – year period by King "Ganatehta". After that, it was governed by Kings "Pathi Kalar" – a 8 – year period by King "Pathi", a year period by King "Auglatail", and a 3 – year period by King "Agkaba" from religious year 536 to 583. Accordingly, the fourth name of Pathein became "**Pathi**" in that period.

After the princes of "Taline" – "the brothers of Gonnawa" killed "the prince of Kalar" in the religious year 595, it was governed a 8 – year period by the King "Guna Tharya", a 9 – year period by the King "Guna Tharyi", and a 13 – year period by the King "Thamuda Gawtha". It was fifthly given the name of "**Pathein**" at those periods. Under King "Thamuda Gawtha" and his queen "Ohmar Dandi", Pathein was a very prosperous economy because the King and his queen undertook the maintenance of pagodas and the building of new pagodas and monasteries. Therefore, the sixth name of Pathein became "**Nargaya Waiponla**". (Nargaya means "city" and Waiponla means "very prosperous")

It was found that according to Raiffitca's record, the seventh name of Pathein was "**Kawthamain**" by Mon language or "**COSMIN**" by Western countries' literature in 1586 or religious year 948.

According to "Naymatetaka", "Yarzamuttan", "Thayawdaya", "Thayawizzaydaya", and "Zawtidipikar" astrological theses, Ka and Tha (Kuthein) are opponents, in other words, enemies. Instead of Ka and Tha, as Pa and Tha (Pathein) were allied, the name of Pathein was recorded in religious year 536.

3.1.3 Pathein District

In very olden days, Pathein District was included in the Bago Division (now, the Bago Region). In 1811, Pathein District, Hinthada District, Thonekhwa District and Thayet District from the Bago Division were put into the Ayeyarwady Division. Originally, Pathein District included East Pathein Township, West Pathein Township, Tharpaung Township, Ngapudaw Township, Kyonepyaw Township, Yaykyi Township and Kyaungkone Township. In 1995, it was changed as Kangyidaunt Township by the combination of village- tracts including Kangyidaunt village-tract from East Pathein

Township, and in addition, original Kangyidaunt village was changed to Kangyidaunt town. In April 2004, Ngwe-saung sub-township and Shew-thaung-yan sub-township were established in Pathein District, Higyikyun sub-township and Ngayotekaung sub-township were established in Ngapudaw township, Ngathaichaung sub-township was established in Yaykyi township. According to 2011 statistics, Pathein District includes 7 townships, 4 sub-townships, 11 towns, 54 wards, 479 village-tracts and 2787 villages.

3.1.4 Hinthada District

Hinthada District was only a part of Tharyawaw District in AD 1853 when the British government occupied Bago. In AD 1861, as Bo Myat Htun from Hinthada and Bo Gaunggyyi from Tharyarwady fought against the British government, Hinthada and Tharyarwady regions were unstable. Therefore, Tharyawaw District was divided into Hinthada District and Tharyawady District. At that time, Myanaung was an administrative town of Hinthada District; however, Hinthada became an administrative town of Hinthada District in AD 1870. In AD 1890, Laymyathnar township from Pathein District was included in Hinthada District. When the British government occupied lower Myanmar, they governed Hinthada District including Hinthada township, Ingapu township, Myanaung township, Kyankhin township, Zalun township and Laymyathnar township. According to 2011 statistics, Hinthada District includes 6 townships, 7 towns, 48 wards, 371 village-tracts and 2991 villages.

The reasons for the name "Hinthada" were as follows:

(1) There were many forests, rivers and creeks in the place known as Hinthada in very ancient time. King "Mani Sithu" went around that place at that time. When he arrived at the place which was now called as "Hinthada Myo" he saw a **Hinsar bird** crying over the death of her mate. Based on this event, it was named as "Hinthada".

(2) Once upon a time, King "Naya Thihapatai" (Tayokepyay Min) escaped along Ayeyarwady River from the battle with the Chinese. When he arrived at the place which was known as Hinthada, he rested for a while, and had to take the only a little food due to encounter a difficulty to get enough food for a King. Thus the

King pined for his usual food. Therefore, it was named as "Hinn-lyar-ta" (wants to get enough and good curries). After a very long time, it became "Hinthada".

(3) There were many "Dadone" plants in the place which was known as "Hinthada" in very ancient time. According to "Taline" language, Dadone was called as "Hamzadar". Myanmar national called "Hinthadarr". Later it became known as "Hinthada".

3.1.5 Myaungmya District

In 1811, Pathein District, Hinthada District, Thonekhwa District and Thayet District from Bago Division was included in Ayeyarwady Division. As Thonekhwa District and Pathein District were very large, Myaungmya District was established as a new District in 1893. Pantanaw and Shwelong townships were included in Myaungmya District which was new at that time. At the same time, Thayet District was excluded from Ayeyarwady Division. At that time, population increased and agricultural sector improved in a great momemtum in Ayeyarwady delta. Accordingly, in December 1903, Pyarpon District was established as a new District as the administrators of Thonekhwa District and Myaungmya District found it very difficult to efficiently manage the tasks of the whole District. At the same time, Thonekhwa District was renamed as a new name – Maubin District, and then Pantanaw Township from Myaungmya District was included into Maubin District. According to 2011 statistics, Maungmya District includes 3 townships, 3 towns, 35 wards, 321 village tracts and 1592 villages.

Amongst there were 3 places of Mon – Monti, Monsa and Monnya, Myaungmya town from Myaungmya District was a territory of Monnya. Mon Myosargyi (administrator of Mon town) "Launphyar" established Myaungmya town over 600 years ago. Instead of the name of Myaungmya, "Min-ma-la"(Maungmalai) was called according to Mon language. As Min means "place", malai means "Myayar plant", it was also called Mya-yar-gone. In addition, as "Mya Thabate" (container used for monks to put rice and curries donated by people) was found in the creeks, it was also called "Myaungmya".

3.1.6 Maubin District

Before "Konebaung" era, the place which is now known as Maubin District was not a well-known place, and population in that place was very small. When the British government occupied Bago in 1852, it established Bago Division which included the whole area of lower Myanmar. Bago Division included 3 districts, namely Hantharwady District, Hanthada District and Pathein District. Maubin was included in Dala sub-township, Hantharwady District. At that time, the Mon Talines from Hinthada, the Myanmars from Upper Myanamr, and the Mon Talines from Bago and Yangon gradually moved to Maubin. Due to an increase in population, agriculture and fisheries improved.

In 1875, Thonekhwa District was established as a new district in Bago Division. Nyaung-done, Pyapon and Dedaye townships from Hanthawady District, and Danuphyu township from Hanthada District, Shwe-laung and Pantanaw townships from Pathein Districrt were included into Bago Division.

Maubin (which became Maubin town later) was only a very small village at that time. As there was a Mau plant in the entrance of that small village, it was named Maubin.

When Thonekhwa District was established in 1875, townships in Thonekhwa District, especially Danuphyu, Shwelaung and Pantanaw townships were very far from Thonekhwa town which was the administrative town of Thonekhwa District. This was the reason why Maubin was designated as an administrative town of Thonekhwa District. Therefore, Maubin became the administrative town of Thonekhwa District in 1876.
Since the area of Thonekhwa District and Pathein District were very large and wide, a new district - Myaungmya District was established as well in 1893. Then, Pantanaw and Shwelaung districts were included in Myaungmya District. At the same time, Thayet District was excluded from Ayeyarwady Division.

As long as the administrators of Thonekhwa and Myaungmya Districts took great responsibilities, as a new district – Pyarpon District was established on 1 st December, 1903. At the same time, Thonekhwa District was renamed as Maubin District. Maubin District consisted of Maubin, Nyaungdon, Danuphyu townships and Pantanaw township - which was a part of Myaungmya District before.

According to 2011 statistics, Maubin District includes 4 townships, 4 towns, 44 wards, 235 village-tracts and 1648 villages.

3.1.7 Pyapon District

Pyapon District includes Pyapon, Bogalay, Kyaiklatt, Daydaye townships and Ahmar sub-township. It is located in the Ayeyarwady region, and it shares borders with Maubin District in the north, Yangon Region in the east, Motetama Sea in the south, and Myaungmya in the west. Townships which are included in Pyapon District were previously included in Thonekhwa District in 1887. After Pyapon District was established according to the 1947 Constitution, it included Pyapon, Bogalay, Kyaiklatt, and Daydaye townships based on the Ministry of Home Affair's Notification No. (778) on 4 November 1965. According to 2011 statistics, Pyapon District consists of 4 townships, 1 sub-township, 5 towns, 42 wards, 300 village-tracts and 1598 villages.

In very ancient time, Pyapon was a part of the Mon province. The name of Pyapon came from Mon language "Pyarpone". Pyar means "Zay (market)", and "pone" means "Htamin (cooked rice)". Therefore, it is said that the meaning of "Pyarpone" is "Htamin Zay". As Pyapon is located in the junction of rivers and creeks, people use big boats to travel from place to place by water way. To travel to the area in Upper River, travelers have to wait in that place which is called "Pyarpone" till the tide rises enough to use boats. Therefore, that place became one where travelers ate and stayed while they were waiting. According to the Mon language, it was called "Pyarpone – Htamin Zay". As Pyapon was a part of the Mon province, village-tracts in Pyapon township were given Mon names.

3.1.8 Laputta District

According to the notification of the Ministry of Home Affair, Labutta District was extracted from Myaungmya District in 2008. "Laputta" is named according to the Mon Language. Based on Mon language, "Laput" means "Yaykyaw" – which is the connecting of two rivers, and "Tar" means "Htan – Palm tree" in Myanmar. Thus, the

meaning of "Laputta" is "Htanpin Yaykyaw". Under the control of Mr. J.S. Vernival who was the administrator of Myaungmya District, Laputta village was upgraded to Laputta town according to the notification of the Tax Department on 27 December 1918. On 23 October 1971, Laputta was extracted from Myaungmya township, and it was designated as "Laputta township". The original area of "Laputta town" was 10.9 miles, and it included 9 wards, 50 village tracts and 353 villages according to the notification of the Ministry of Home Affairs on 15 July 1972. On 31 December 2004, Pyinsalu sub-township was included into Laputta township. According to the notification of Ministry of Home Affair, Laputta township was upgraded to "Laputta District". According to 2011 statistics, Laputta District includes 2 townships, 2 sub-townships, 4 towns, 27 wards, 206 village-tracts and 1173 villages.

3.2 Geographical Situation

3.2.1 Location

The Ayeyarwady Region is located in the Southern part of the central plain of Myanmar. The total area of the region is 13,525.88 square miles. Geographically, it shares borders with the Bago Region in the north, Bago Region and Yangon Region in the east, Andaman Sea and the Bay of Bengal in the south and the west, and Rakhine in the northwest. The Ayeyarwady Region lies between north latitude 15 degrees 40 minutes and 18 degrees 30 minutes, and between east longitudes 94 degrees 15 minutes and 96 degrees 15 minutes. The most area of the region is delta.

Pathein District lies between north latitude 15 degrees 50 minutes and 17 degrees 30 minutes, and between east longitudes 94 degrees 10 minutes and 95 degrees 47 minutes. Hinthada District lies between north latitude 17 degrees 20 minutes and 18 degrees 31 minutes, and between east longitudes 94 degrees 48 minutes and 95 degrees 47 minutes. Myaungmya District lies between north latitude 15 degrees 45 minutes and 16 degrees 50 minutes, and between east longitudes 94 degrees 33 minutes and 95 degrees 30 minutes. Maubin District lies between north latitude 16 degrees 30 minutes and 17 degrees 25 minutes, and between east longitudes 95 degrees 18 minutes and 95 degrees 55 minutes. Pyapon District lies between north latitude 15 degrees 30 minutes

and 16 degrees 40 minutes, and between east longitudes 95 degrees 15 minutes and 96 degrees 05 minutes.

According to 2011 statistics, the total area of Pathein District is 3847.5 square miles, and Hinthada District has the total area of 2697.28 square miles. The total area of Myaungmya District and Laputta District are 1349.42 square miles and 1847.91 square miles respectively. Maubin District has the total area of 1651.48 square miles, and the total area of Pyapon District is 2132.22 square miles.

3.2.2 Topography and Climate

The Rakhine Yoma (Arakan Mountains) lies between the Ayeyarwady Region and the Rakhine State as a boundary. Except that area which is in the western part of the region, the other parts are plains. The height of the Rakhine Yoma is between 1500 feet and 3000 feet in the north, and between 500 feet and under 500 feet in the south. The Ayeyarwady River lies between the Bago Region and the Ayeyarwady Region as a boundary. The shape of the Ayeyarwady Region is triangular, and the region stretches about (180) miles from the top to the bottom coast and about (150) miles from east to west in the south.

The region has a tropical climate characterized by the monsoon seasons. The pre-monsoon period is from February to middle of May, and it is dry and hot in that period. The South West monsoon period is from middle of May to October, and it is rainy in that period. The North East monsoon period is from November to January, and it is cold in that period. April and May are the hottest months, and December and January are the coldest months. The average temperature range of the southern part of the region in April is 85° F (29.4° C), the northern part is hotter than the southern part. The average temperature range of the southern part of the region in January is 75° F (23.9° C), and the northern part is colder than the southern part. The annual rainfall of southern part is heavier than that of northern part. Pathein (located in the southern part) has an annual rainfall of about 120 inches, and Hinthada (located in the northern part) has an annual rainfall of about 95 inches.

The sea levels for dangerous condition are stated in the following table.

Table 3.1

The Sea Level for Dangerous Condition

S.R	Township	Name of River	The Sea Level for Dangerous Condition
1	Hinthada	Ayeyarwady	1342 cm
2	Ngathinechaung	Ngawan	1130 cm
3	Pathein	Ngawan	350 cm

Source: Ayeyarwady Divisional Gazetter, 2007

3.2.3 Population

Population of the Ayeyarwady Region in 2008 is estimated at 7.86 million, and the population density is 492 per square mile. Among the inhabitants, about 15 per cent of the population lives in the urban area and 85 per cent in rural area. The major ethnic groups are Bamars and Kayins. Rakhines are the minority, and lives in the western coastal region.

The following table shows the population by race living in the region according to 2010 statistics.

Table 3.2

Population by Race in the Ayeyarwady Region (2010)

S.R	Race	Population	% of Total Population
1	Bamar	5993365	76.27
2	Kayin	1595070	20.30
3	Rakhine	63917	0.81
4	Chin	12492	0.16
5	Shan	4587	0.06
6	Mon	5969	0.08
7	Kachin	803	0.01
8	Kayah	430	0.01
9	Foreigner	5427	0.07
10	Foreign Registered Citizen	5762	0.07
11	Citizen (by marriage)	926	0.01
12	Others	169529	2.16
	Total	7858230	100

Source: Regional facts, Ayeyarwady Region, 2010

The majority of the population is Buddhists, and make up over 90 per cent of the total population in the region. Around 7 per cent of total population is Christians, and the others are Muslims, Hindus, and others.

3.2.4 Rivers and Creeks

The Ayeyarwady River is the major river of the Ayeyarwady Region. The river starts to flow from Kyangin Township into the region in the north, and the Ayeyarwady River has many creeks starting from Maubin Township to the end of the south of the

region. The following table shows the rivers and creeks flowing within the Ayeyarwady Region.

Table 3.3

Creeks in the Ayeyarwady Region

S.R	Name of River/Creek	Length(mile)	Width(feet)	Average Water Flow Rate	Average Water Depth(meter)
1	Ngawan river	209	890	0.506	6.53
2	Paypin river	25	616	0.560	4.50
3	Thetkail stream	7	264	0.540	4.50
4	Panmawadi river	66	1584	0.850	8.80
5	Thetkailthaung river	20	4488	0.60	13.5
6	Myaungmya river	23	416	0.470	8.20
7	Yway river	63	33.44	0.780	14.0
8	Pyanmalau river	85	4752	0.810	18.0
9	Pyinsalu river	12	422	0.550	4.00
10	Thaungdu river	24	2323	0.560	8.00
11	Kakayan river	30	2217	0.650	7.50
12	Salone stream	7	528	0.60	4.00
13	Kyonepatote stream	18	914	0.660	12.0
14	Kyunpyathut river	67	2816	0.650	8.00
15	Thayettaw river	14	1232	0.590	6.00
16	Kanyinpin river	8	1583	0.55	5.00
17	Yarzudai river	50	2322	0.50	3.00
18	Sawke stream	6	520	0.81	9.20
19	Ayeyarwady river	162.5	2995	0.67	9.30
20	Kywechan - yaykyaw	6	528	0.56	7.00

Source: Regional facts, Ayeyarwady Region, 2007

Chapter (4)

Development of Road Network and Growth of Settlements in the Ayeyarwady Region

After Myanmar transformed its economy from a centrally planned economic system to a market-oriented economic one in late 1988, the government had undertaken many major economic reforms which are directly affecting the macro-economy, aiming at achieving the economic development of the country. As safe and smooth transportation is very important for the achievement of every sector, the government has been fulfilling transport requirements, and expanding and maintaining the transport infrastructure to be able to fully support increased production from other economic sectors and meet growing public and social demands, aiming to contribute towards the realization of an economically strong, modern and developed nation[18].

4.1 Development of Road Network

Transportation plays a very important role in the development of a region or a country. Improvement in trade and communications, development in agriculture and industry, improvement in education and health, and unity among national peoples depend heavily on transportation. According to many scholars, improvement in transportation enhances social and economic conditions of a region.

The Ayeyarwady region being a delta area is rich in plains and valleys. And also, there are many rivers and creeks in the region. Therefore, in the olden days the main mode of transport in Ayeyarwady region was by water way only. Water ways were used to move passengers or freight either from one place to another within the region or from the region to neighbouring regions – Yangon, Bago and Rakhine regions.

In fact, the Ayeyarwady region is an imperative one in the contribution to economic development of the country. Being a delta region, the quality of soil is very high and appropriate for crops cultivation. In addition, fish, prawn, fish paste, dried fish, dried prawn, and products from water resources are rich because of abundant rivers and creeks

[18] Ministry of Transport, Myanmar, 2007

in the region. However, residents in the Ayeyarwady region relied only on water ways either for trading products from the region to another or people travelling from one location to another before 1989 (i.e, in 1987/88). Actually, there were some roads in the region; however, road transport was unproductive. For instance; Kyonepyaw-Innma-Thonekhwa road was built in 1917. Pathein-Shwemyintin-Waryarchaung road, Pathein – Yangon road, Pathein-Shawpya-Chaungthar road, Laputta-Myaungmya-Eime-Kyaungkone-Kyonepyaw road, and Eime-Darka road were constructed in 1959/60, 1962/63, 1965, 1983/84, and 1984/85 respectively. However, they could not effectively perform for smooth transport.

Only after transforming into a market oriented economic system in late 1988, the government has been undertaking the building of new roads and the upgrading of existing roads, aiming to make the transportation network in the region much easier and smoother. The government built several roads to easily and smoothly move from one location to another within the region, and outside the region. A number of roads such as district to district roads, district to township roads, township to township roads, township to town roads, and town to town roads have been constructed. According to statistical data, the length of road became 1671 miles and 4 furlongs in 2010 although there were only 440 miles within the region before 1989. In addition, the government built a number of bridges to move easily and smoothly from one location to another at all times. Under the special project, the government has built many bridges; and bridges above 180 feet included the following.

(1) Khut-ti-ya Bridge
(2) Day-da-lu Bridge
(3) Seik-ma-chaung Bridge
(4) Nat-chaung Bridge
(5) Myaung-mya Bridge
(6) Ma-u-bin Bridge
(7) Bo Myat-htun Bridge
(8) Pin-le-lay Bridge
(9) Pan-ta-naw Bridge
(10) Gon-nyin-tan Bridge

(11) Shwe-laung Bridge

(12) War-khe-ma Bridge

(13) Day-da-ye Bridge

(14) Dar-ka Bridge

(15) Pathein Bridge

(16) Myin-ka-seik Bridge

(17) Pyapon Bridge

(18) Nga-won Bridge

(19) Kyun-kone Bridge

(20) Yar-zu-daing (1)

(21) Yar-zu-daing (2)

Besides the above bridges which were built under the special project, the number of bridges with a length above 180 feet increased from 11 in 1988 to 101 in 2010. The number of bridges with a length below 180feet was 87 in 1988, and increased to 399 in 2010 as a result of the efforts of the government.

In addition, the government has been implementing 11 road networks development plan after storm - Nargis in 2008. The 11 road networks are as follows;

(1) Maubin-Yaylegalay-Shwetaunghmaw-Kyaikpi-Mawlamyinekyun

(2) Mawlamyinekyun-Hlaingbone-Thitpote-Kwinpauk-Pyinsalu

(3) Laputta-Thingungyi-Pyinsalu

(4) Laputta-(Kyaukphyarlay)-Thonekhwa-Oaktwin-Htakesun

(5) Bogalay-Kyainchaung-Kadonekani

(6) Bogalay-Setsun-Htawpine-Ahmar

(7) Pyapon-Kyonekadun-Dawnyein-Ahmar

(8) Kyonekadun-Setsun

(9) Pathein-Thalatkhwar-Mawtinsun

(10) Bogalay-Mawlamyinekyun-Kyonemangay-Warkhema-Myaungmya

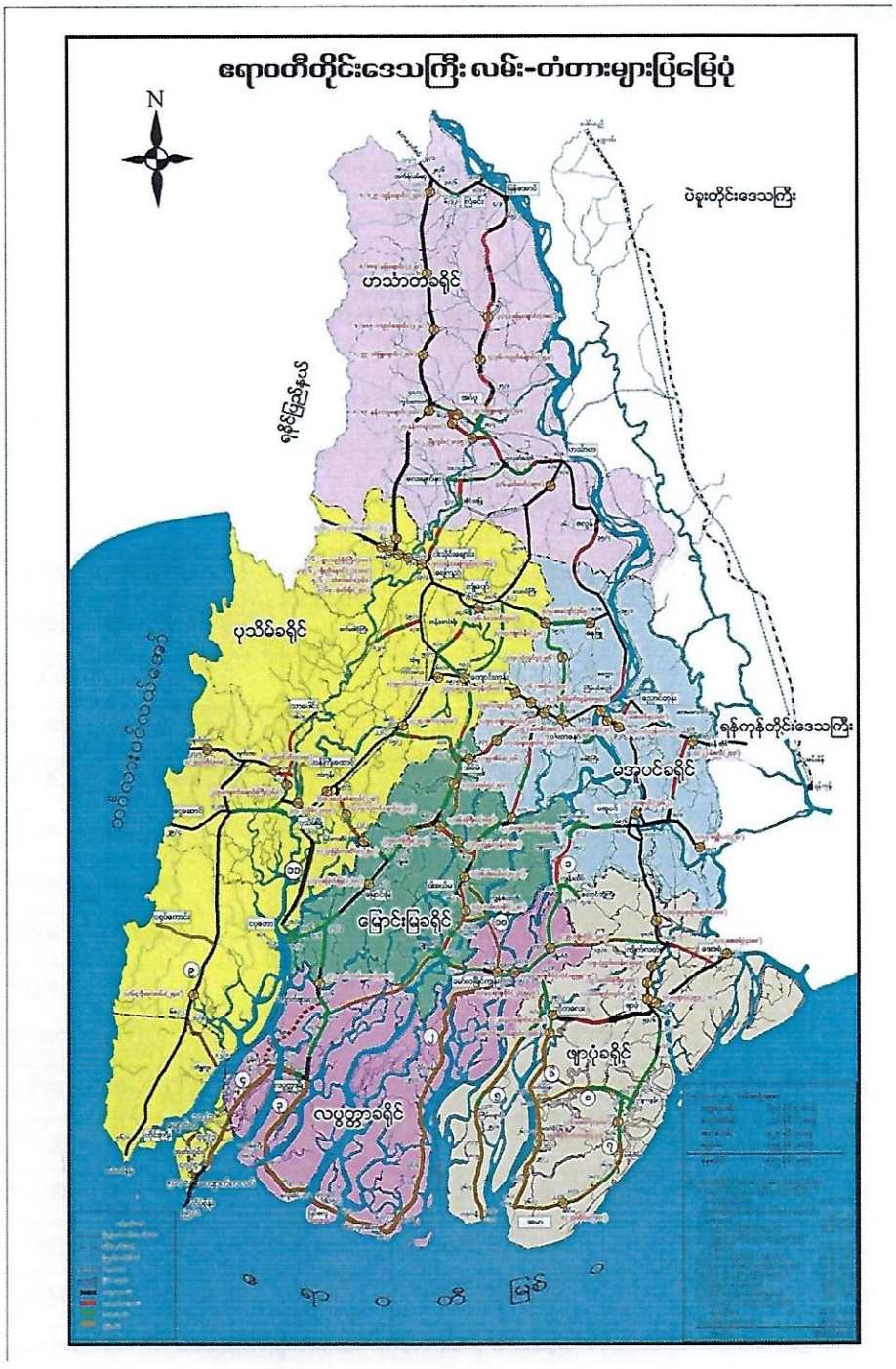
(11) Pathein-Ngaputaw

Amongst 11 road networks shown in the above figure, the construction work of 10 road networks was completed in 2009 and 2010. The last one - Laputta-(Kyaukphyarlay) -Thonekhwa-Oaktwin-Htakesun road was also finished in 2012.

As a consequence of the construction of several bridges and roads, people can move to almost all cities in the region within a short time. The road connection among cities in the region is shown in the following figure.

Figure 4.1

Roads connecting Cities in the Ayeyarwady region



Source: Public Works, Ayeyarwady Region

As can be seen in the above figure, people can travel to almost anywhere in the region at any period by road. Therefore, residents of the Ayeyarwady region no longer need to rely only on water ways as in the olden days. The following table shows that the time duration of travelling by road is less than that of by water ways.

Table 4.1

Distances and Duration by Road Transport Compared to Water Ways

Itinerary	Distance by Road (mile)	Duration by Road	Distance by water way (mile)	Duration by water way
Pathein-Kangyidaunt	17	45min	33	4 hr
Pathein-Tharpaung	27	1hr	27	3hr&30min
Pathein-Ngaputaw	21	1 hr	23	2hr&30min
Pathein-Kyaungkone	45	1hr &30min	60	7hr&30min
Pathein-Ngathinechaung	59	2 hr	77	10 hr
Hinthada -Zalun	16	45 min	17	2hr
Hinthada - Myanaung	65	2hr & 30min	58	7hr
Hinthada - Kyangin	70	2hr & 40min	66	8hr
Myaungmya -Einme	30	1hr & 20min	38	4hr&30min
Myaungmya - Laputta	47	1hr & 60min	48	6hr
Myaungmya - Warkhema	31	1hr & 30min	23	3hr
Myaungmya – Mawlamyinegyun	54	1hr & 45min	62	8hr
Maubin - Pantanaw	36	1hr & 30min	34	4hr
Maubin - Nyaungtone	23	55 min	42	5hr
Maubin - Danaphyu	30	1hr & 20min	60	7hr&30min
Pyapon - Bogalay	19	1 hr	45	5hr&40min
Pyapon - Kyaiklatt	12	45 min	16	2hr
Pyapon - Daydaye	18	45 min	32	4hr
Pathein - Hinthada	98	3hr	175	22hr

Pathein - Zalun	114	3hr & 30min	158	20hr
Pathein - Laymyethnar	160	5hr & 30min	108	13hr&30min
Pathein - Myaungaung	140	4hr & 50min	200	25hr
Pathein - Kyankhinn	27	1hr	208	26hr
Pathein - Eime	69	1hr & 30min	80	10hr
Pathein - Myaungmya	65	2hr	37	4hr&40min
Pathein - Pantanaw	62	1hr & 45min	109	13hr&30min
Pathein - Nyaungdone	73	3hr & 15min	117	14hr&40min
Pathein - Maubin	96	3hr & 55min	126	15 hr& 40min
Pathein - Danubyu	91	3hr	136	17hr
Pathein - Warkhema	47	2hr	60	7 hr & 30min
Pathein - Mawlamyinekyun	70	2hr & 55min	99	12hr & 30min
Pathein - Bogalay	81	3hr	112	12 hr
Pathein - Pyapon	100	3hr & 30min	157	20 hr
Pathein - Kyaiklatt	90	3hr	151	19 hr
Pathein - Daydaye	120	3hr & 50min	168	21hr
Pathein - Laputta	114	3hr & 30min	90	11hr &20 min
Hinthada -Eime	165	5hr & 30min	158	20 hr
Hinthada -Myaungmya	107	3hr & 30min	167	21hr
Yangon-Pathein	115	3hr & 30min	172	21hr & 30 min
Myaungmya-Ngaputaw	14	40 min	60	7 hr & 30 min
Warkhema-Eime	21	1 hr	43	5 hr & 30 min
Eime-Kyaungkone	15	30 min	17	2 hr
Mawlamyinekyun-Bogalay	11	30 min	13	1 hr & 30 min
Daydaye-Kyaiklatt	30	1 hr & 30min	16	2 hr
Daydaye-Bogalay	35	1 hr & 40min	77	9 hr & 40 min
Hinthada-Pyapon	120	4 hr	152	19 hr
Zalun-Danuphyu	16	40 min	26	3 hr
Danubyu-Nyaungdone	31	1 hr & 20min	18	2 hr 20 min

Source: Ministry of National Planning and Economic Development

As can be seen in the above table, distance by road is closer than that by water way. In addition, transport by road is time saving. Bottic, V., Sisinacki, J., and Skuflic, L (2006) articulated that the improvements in road transport decreases travel times. Therefore it can be said that the effect supports what the literature asserts. As people can go easily from one location to another within a short time because of the construction of several roads, it is found that there are no difficulties in carrying regional products such as rice, beans and pulses, dried fish, dried prawn and fish paste to other regions. Similarly, products from other regions can easily flow into the region.

The improvement in road construction within the Ayeyarwady region makes the distance between district towns and towns shorten compared with the distance by water way. The gravity model states that settlements which are very near are more likely to interrelate. In order to analyze the interactions between settlements, gravity model is employed in this study.

The formula employed to calculate the interaction between settlements is:

$$I_{ij} = \frac{P_i P_j}{d_{ij}}$$

Where I_{ij} = expected degree of interaction between settlement "i" and settlement "j"

P_i = population of settlement "i"

P_j = population of settlement "j"

d_{ij} = a measure of distance between settlement "i" and settlement "j"

Based on the theory, the interactions between settlements are strong if the result of gravity model is huge. Based on gravity model, the calculated I_{ij} values between settlements are stated in Table 4.2.

Table 4.2

The Interaction between Settlements

Itinerary	Iij (Water Way)	Iij (Road)
Pathein-Ngaputaw	59027500.52	66104871.62
Pathein-Kyaungkone	41469440	47171293.87
Hinthada - Zalun	336668892.4	511513480.9
Hinthada - Myanaung	113574908	144523896.3
Hinthada - Kyangin	62899042.5	87194585.51
Myaungmya - Einme	31596765.11	66393953.43
Myaungmya - Warkhema	76518103.13	147384480.9
Maubin - Pantanaw	10350302.53	24305496.67
Maubin - Nyaungdon	8946096.619	40621724.09
Maubin - Danabyu	5617743.3	27937451.8
Pyapon - Bogalay	29758104.6	125582411.8
Pyapon - Kyaiklatt	44590332.94	93455341.33
Pyapon - Daydaye	15545766.47	48134922.67

Source: Author's Calculation

As shown in the above table, it can be seen that the interactions between district towns and towns significantly increase. Since transportation becomes easy and smooth after 1989, people move from one place to another either for commercial reason or for recreation purpose. Thereby, business enterprises and employment opportunities for the people in the region has been enlarged. Therefore, it can be said that the improvement in transportation supports economic growth, commerce and social development of the region.

4.2 Growth of Settlements in the Ayeyarwady Region

Due to the achievement of safe and smooth road transport, the movement of people and commodities are easier and faster than that of olden times. This fact evolves settlements in the form of increases in social services such as education and health and enlargement of business activities, and thereby the settlements in the region gradually grow. The growth of each settlement is demonstrated as follows.

(a) Pathein

It is not only the capital city of the Ayeyarwady region since ancient times but also an administrative city of Pathein District under the Ayeyarwady region. As it is an administrative region, towns are designated as townships, sub-townships and towns according to administrative purposes.

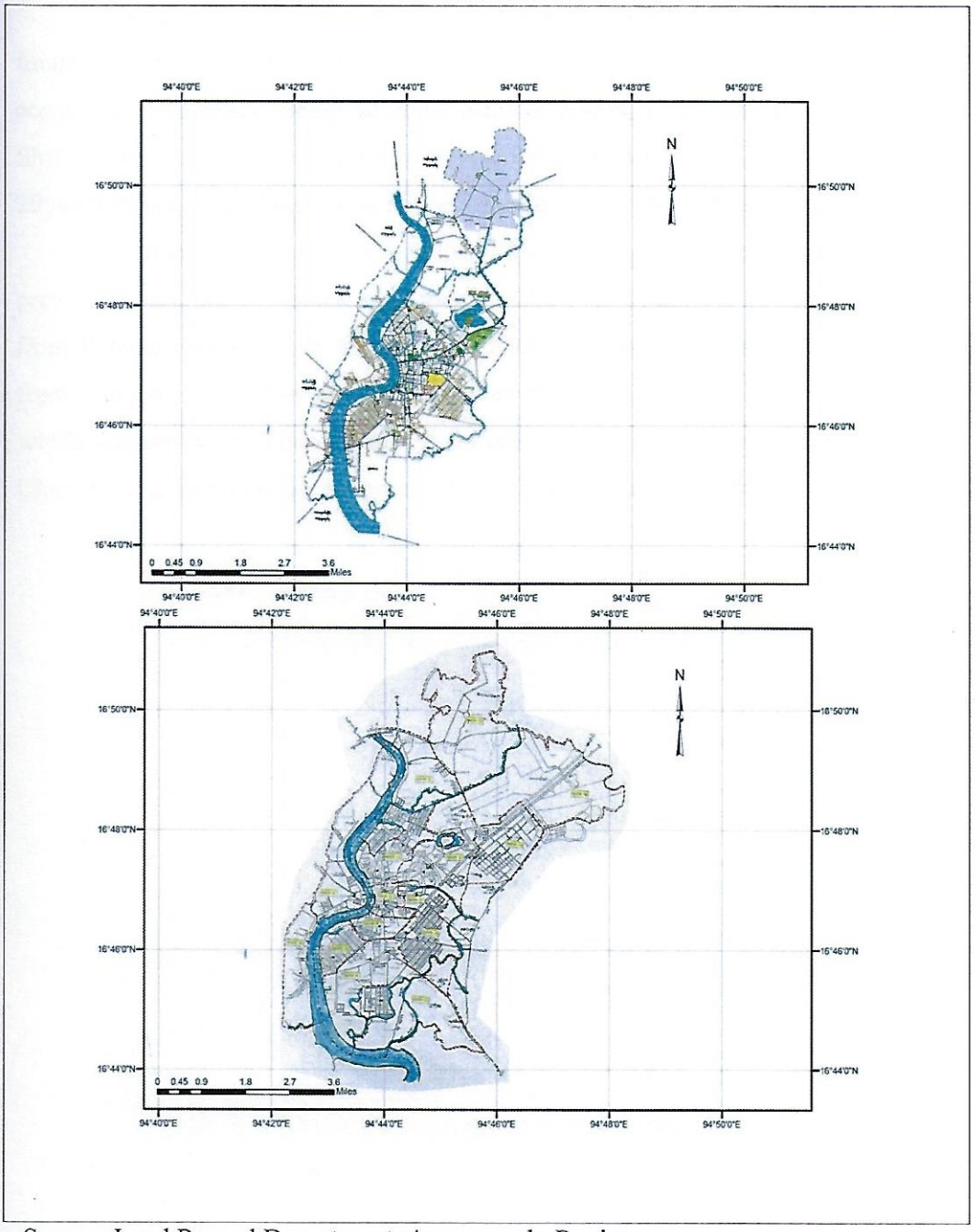
As township to township roads, Pathein-Thalattkhwa-Mawtinson road, Pathein-Chaungthar road, and Pathein-Ngwesaung road, Pathein-Kangyidaunt road, and Pathein-Tharpaung road have been constructed. Bridges such as Pathein bridge, Kyauk-chaung-gyi, Thapyu-chaung, Kwin-chaung, Maung-bi-wa, Myin-ka-seik and Nyaung-chaung have been constructed. The length of those bridges is above 180 feet. In addition, several bridges which have a length less than 180 feet, such as Ka-law-khone, Ka-tan-kuu, Kyein-chaung, and Ah-pin-hnit-se bridges have also been constructed.

With an improvement of roads, the numbers and types of businesses increase, social sector such as schools and hospitals develops, and communications services also develop in Pathein.

Before 1989, the urban area of Pathein was 16.2 square miles. After late 1988, State Law and Order Restoration Council (later renamed as the State Peace and Development Council later) of Ayeyarwady region extended the urban area, and thus the area increased to 23.5 square miles according to 2010/11 statistics. The urban structure of Pathein compared with the structure before 1989 is depicted by the following map.

Figure 4.2

The Urban Structure of Pathein Before and After 1989



Source: Land Record Department, Ayeyarwady Region

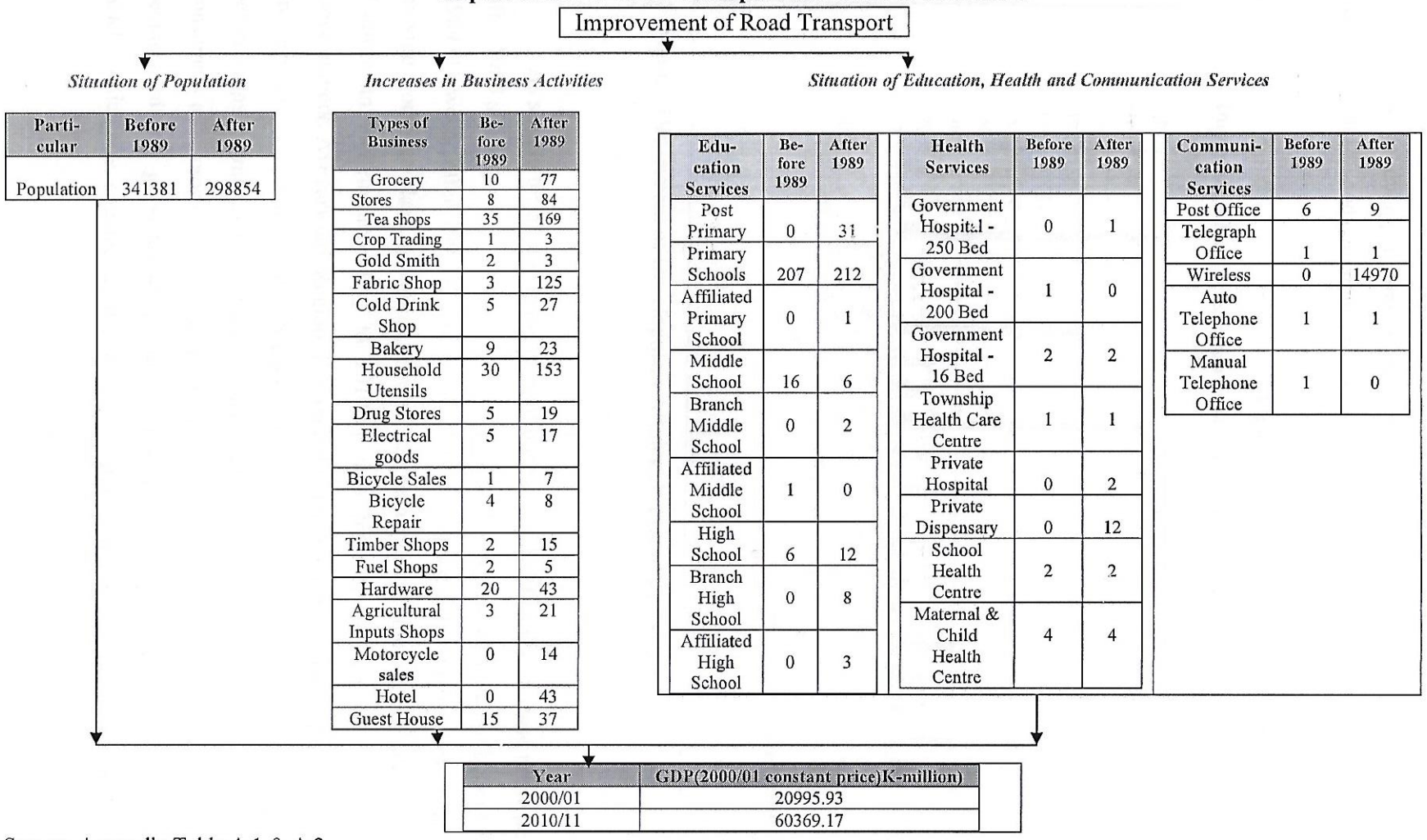
With an improvement in roads, the changing situation of business activities, education, health and communication services are presented for Pathein and other towns in the study, based on the investigation analyzed by Aksoy, E.and Gultekin, N. T.

Albeit an improvement in road transport in Pathein within over 20 years, it was found that the size of the population fell in 2010/11compared to the year 1987-88 according to statistics. Being an administrative region, Kangyidaunt, Ngwe Saung and Shwe Thaung Yan were separated from Pathein Township in 1994/95, 2000/01, and 2004/05 respectively. This is one reason why the size of the population decreased.

Another reason is that as road today from Yangon to Pathein is better than that of previous times, and communication today is also better than that of before, some people from Pathein usually move to Yangon. They can manage their businesses in Pathein from Yangon. When they need to go to their businesses in Pathein, they can reach there within 4 hours by car. These factors, therefore, reduce the size of population.

Chart 4.1 represents the improvement of road transport and growth of Pathein.

Chart 4.1
Improvement of Road Transport and Growth of Pathein



Parti-cular	Before 1989	After 1989
Population	341381	298854

Types of Business	Be-fore 1989	After 1989
Grocery	10	77
Stores	8	84
Tea shops	35	169
Crop Trading	1	3
Gold Smith	2	3
Fabric Shop	3	125
Cold Drink Shop	5	27
Bakery	9	23
Household Utensils	30	153
Drug Stores	5	19
Electrical goods	5	17
Bicycle Sales	1	7
Bicycle Repair	4	8
Timber Shops	2	15
Fuel Shops	2	5
Hardware	20	43
Agricultural Inputs Shops	3	21
Motorcycle sales	0	14
Hotel	0	43
Guest House	15	37

Edu-cation Services	Be-fore 1989	After 1989
Post Primary	0	31
Primary Schools	207	212
Affiliated Primary School	0	1
Middle School	16	6
Branch Middle School	0	2
Affiliated Middle School	1	0
High School	6	12
Branch High School	0	8
Affiliated High School	0	3

Health Services	Before 1989	After 1989
Government Hospital - 250 Bed	0	1
Government Hospital - 200 Bed	1	0
Government Hospital - 16 Bed	2	2
Township Health Care Centre	1	1
Private Hospital	0	2
Private Dispensary	0	12
School Health Centre	2	2
Maternal & Child Health Centre	4	4

Communi-cation Services	Before 1989	After 1989
Post Office	6	9
Telegraph Office	1	1
Wireless	0	14970
Auto Telephone Office	1	1
Manual Telephone Office	1	0

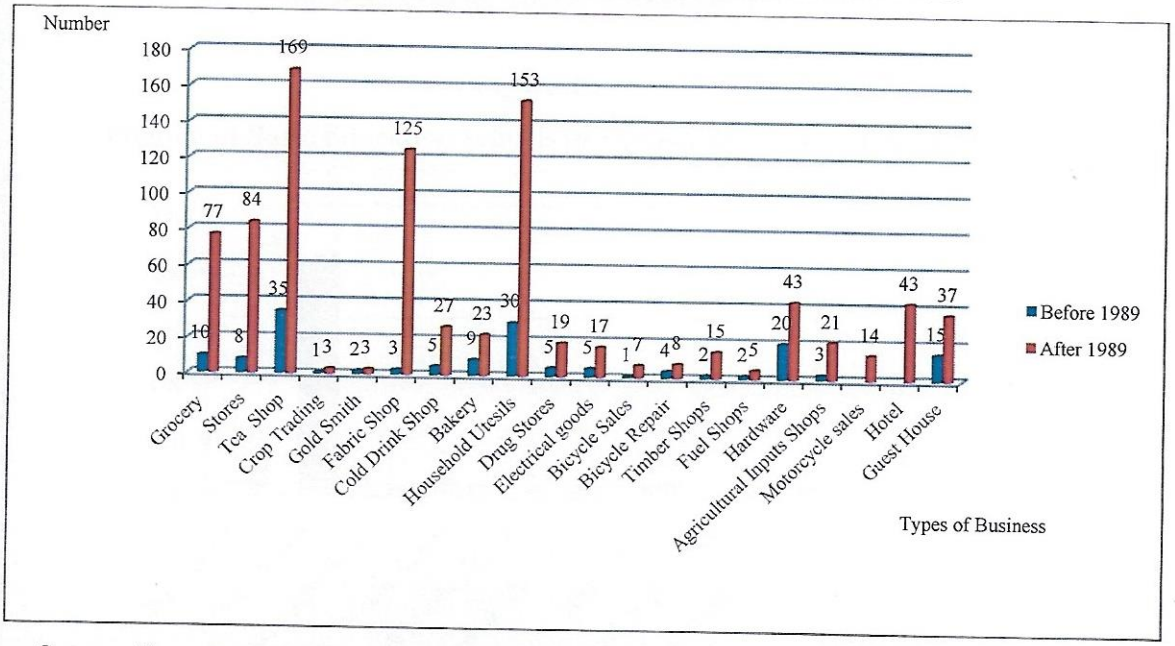
Year	GDP(2000/01 constant price)K-million)
2000/01	20995.93
2010/11	60369.17

Source: Appendix Table A.1 & A.2

The following figures support to observe easily the situation of business, education, health and communication services before and after 1989.

Figure 4.3

Increase in Business Enterprises in Pathein Before and After 1989



Source: Department of Development Affairs, Ayeyarwady Region

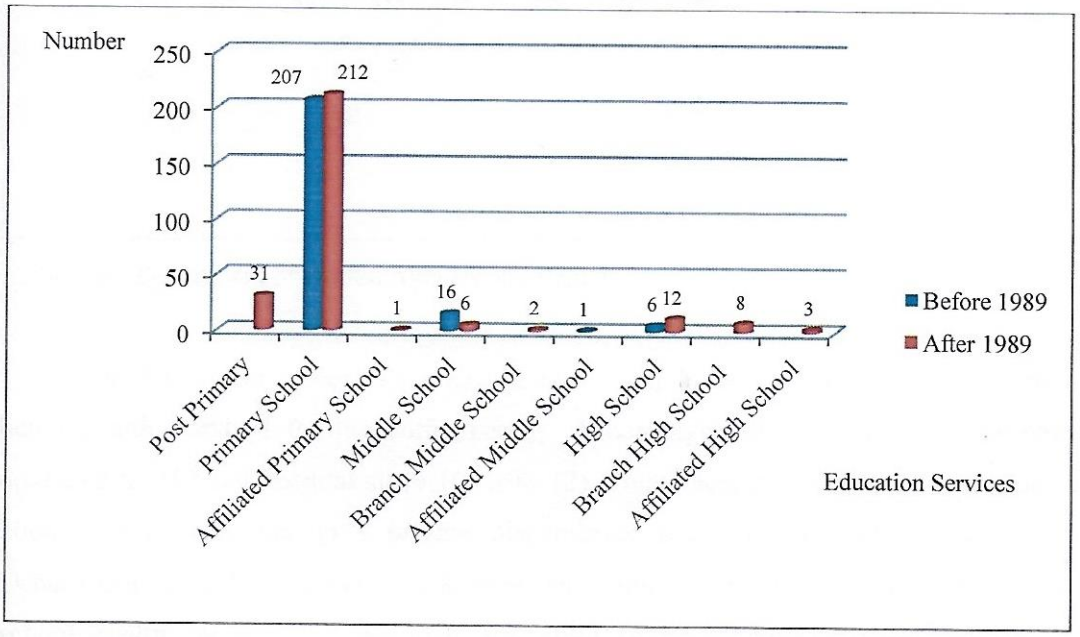
Department of Hotel and Tourism, Ayeyarwady Region

As seen in the above figure, most of businesses significantly increase in the period after 1989 as compared to the period before 1989. Motorcycle sales did not boom before 1989. However after 1996/97, motorcycle usage increased due to its convenience in moving from one place to another. Therefore, the number of motorcycle sales shops is fourteen in Pathein according to 2010/11 data from Department of Border Area Development, Ayeyarwady Region. It is seen that the number of crop trading businesses are very few in Pathein. This is because crop traders usually pay the money in advance before crops are matured, and they directly send to markets and Yangon to distribute to consumers after crops are harvested. There were no hotels in Pathein up to 1994/95; people used only guest houses to stay for a while. Chaungthar beach and Ngwesaung beach, which are situated at the west of Pathein, are very famous resorts in the

Ayeyarwady region and they are about 30 miles from Pathein. It takes only an hour drive from Pathein and 4 hours drive from Yangon. As Yangon – Pathein road transport is smooth and easy; many local and foreign tourists visit to Chaungthar and Ngwesaung beaches. Consequently, the number of hotels and guest houses are 16 and 30 respectively in Chaungthar beach, and 22 and 10 respectively in Ngwesaung beach.

Figure 4.4

Situation of Basic Education Schools in Pathein Before and After 1989

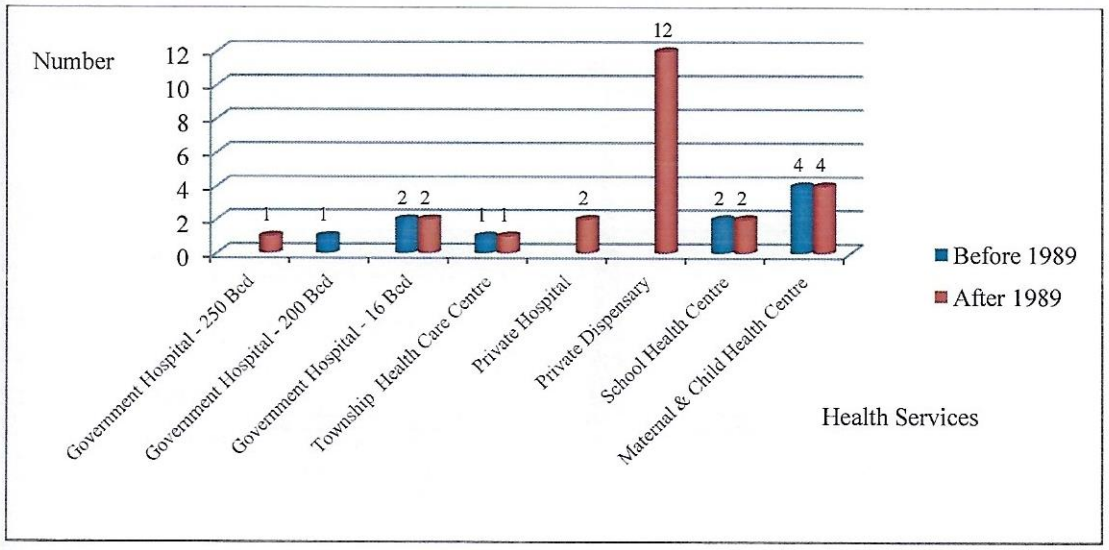


Sources: Department of Basic Education, Ayeyarwady Region

Regarding education services, Basic education schools have been extended to post primary schools since 2002/03, and affiliated primary schools since 2003/04 at primary level. The numbers of middle schools decreased to 6 after 1989 from 16 before 1989 because they were upgraded to branch high schools and affiliated high schools since 2004/05 at high school level.

Figure 4.5

Situation of Health Services in Pathein Before and After 1989

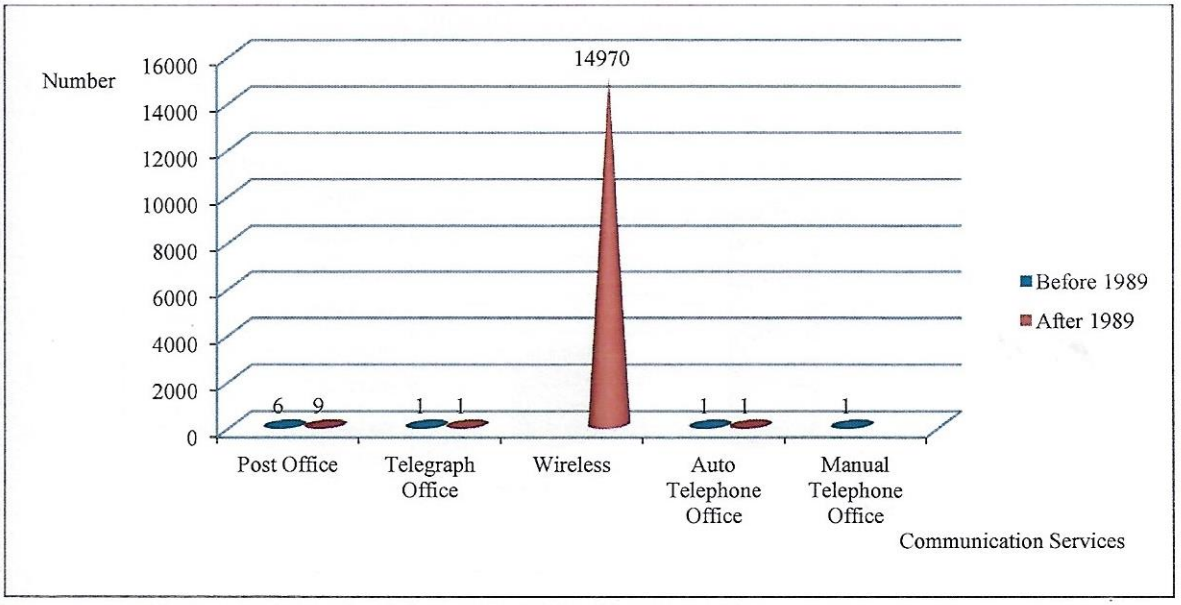


Source: Department of Health, Ayeyarwady Region

On the subject of health services, the government has put in efforts to achieve a better health standard for the entire people. Accordingly, 200-bed hospital has been upgraded to 250-bed hospital since 1991/92. (2) private hospitals started construction in 2006/07 and there are (12) private dispensaries according to statistics from the Department of Health, Ayeyarwady Region. The number of township health care centres, school health centres, and maternal and child health centres remained unchanged, compared to the numbers before 1989.

Figure 4.6

Situation of Communication Services in Pathein Before and After 1989



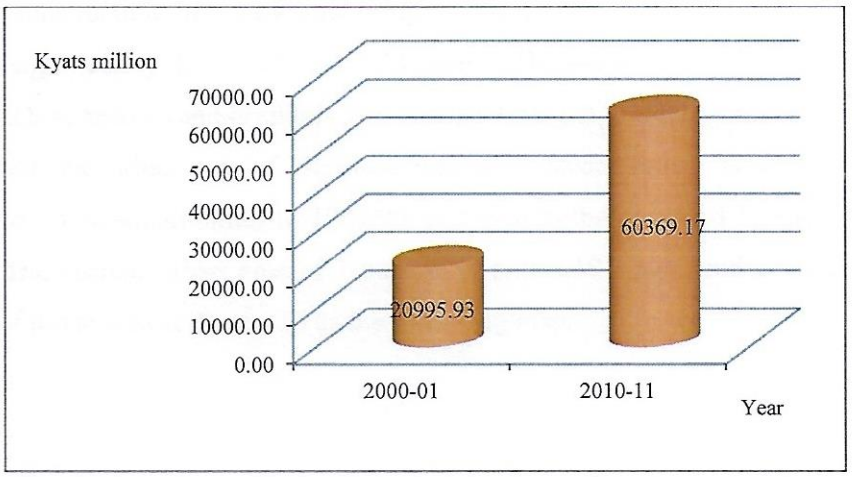
Source: Department of Posts and Telecommunication, Ayeyarwady Region

With regard to communications services, as can be seen in the above figure, people in Pathein began to use 490 wireless phones in 2004/05, and the usage of wireless phone extensively increased nowadays. The numbers of wireless phone are (14970) according to information from the Department of Posts and Telecommunication, Ayeyarwady Region. As there was no more use of manual phones beginning from 2008/09, the manual phone office was abolished in 2008/09.

With an increase in road transport, business activities, social services such as schools and hospitals, and communications services are also developed throughout the period from 1989 till now, as shown in the above table and figures. According to data availability, the growth of regional gross domestic product of Pathein from 2000/01 to 2010/11 is shown in the following figure. It can be seen that Gross Regional Product of Pathein increased almost three times over the periods of 10 years, as shown in Figure 4-7.

Figure 4.7

Growth of Gross Regional Product of Pathein in 2000/01 and 2010/11 (at 2000/01 constant price)



Source: Department of National Planning and Economic Development, Ayeyarwady Region

(b) Hinthada

It is an administrative city of Hinthada District. It lies between north latitude 17 degrees 15 minutes and 17 degrees 50 minutes, and between longitudes 95 degrees 10 minutes East and 95 degrees 35 minutes East. The area of Hinthada township is 378.70 square mile. It has hot and wet weather, the hottest month is March, the highest rainfall is in August, and the coldest month is December. The average temperature is 31.1˚C, the temperature of the hottest month is from 34.2˚C to 36.2˚C, and the temperature of the coldest month is from 12.6˚C to 14.5˚C. It has a rainfall of 77.19 inches per annum according to 2010 statistics. The major ethnic groups are Bamars and Kayins while Mons are the minority. The majority of the population are Buddhists and make up 90 per cent of total population in Hinthada. Around 5 per cent of total population are Muslims, and over 0.5 per cent are Hindus.

As town to town roads, Hinthada – Zalun road, Hinthada – Sonekone – Myanaung road, Kyankhin – Myanaung road, Talotehtaw – Laymyakhnar road, Laymyakhnar – Ithapyu – Ngathinechaung road were constructed in the Ayeyarwady Region. As for the

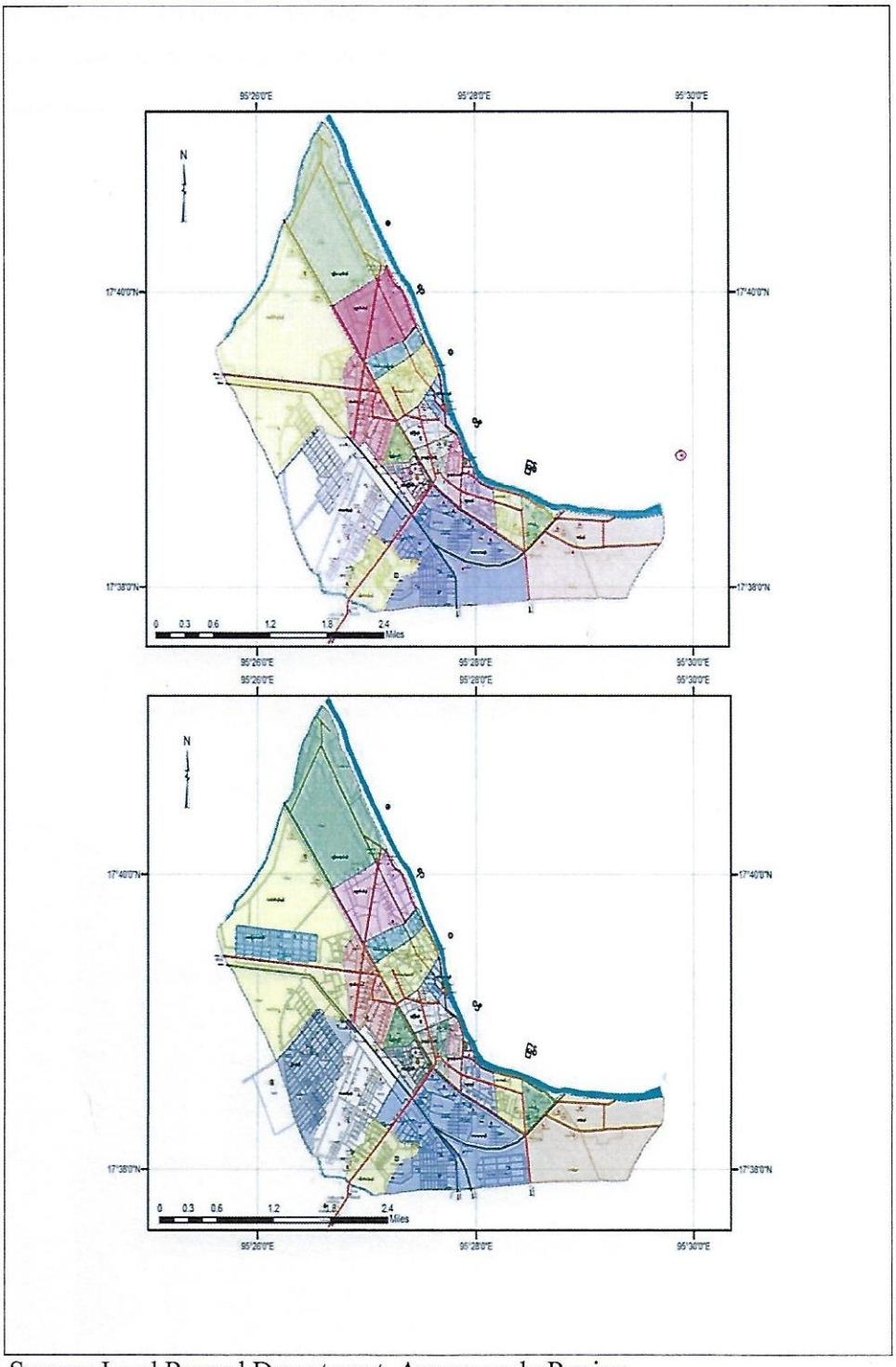
bridges with a length above 180 feet, Ka-nyin chaung bridge and Ma-mya chaung bridge were constructed. In addition, a number of bridges with a length less than 180 feet have been constructed within Hinthada township.

Accordingly, people can move easily and smoothly from one place to another. With the construction of roads and bridges, population and numbers of houses in Hinthada significantly increased over 20 years. The situation of businesses, social services such as schools and hospitals also change during the research time span.

Before 1989, the urban area of Hinthada was 3.77 square miles. Then, the area was extended to 4.10 square miles in 1989/90, and then to the area of 4.19 square miles in 1995/96. The current urban area of Hinthada is still 4.19 square miles. The changing structure of urban area is illustrated as the following map.

Figure 4.8

Structure of Hinthada Before and After 1989

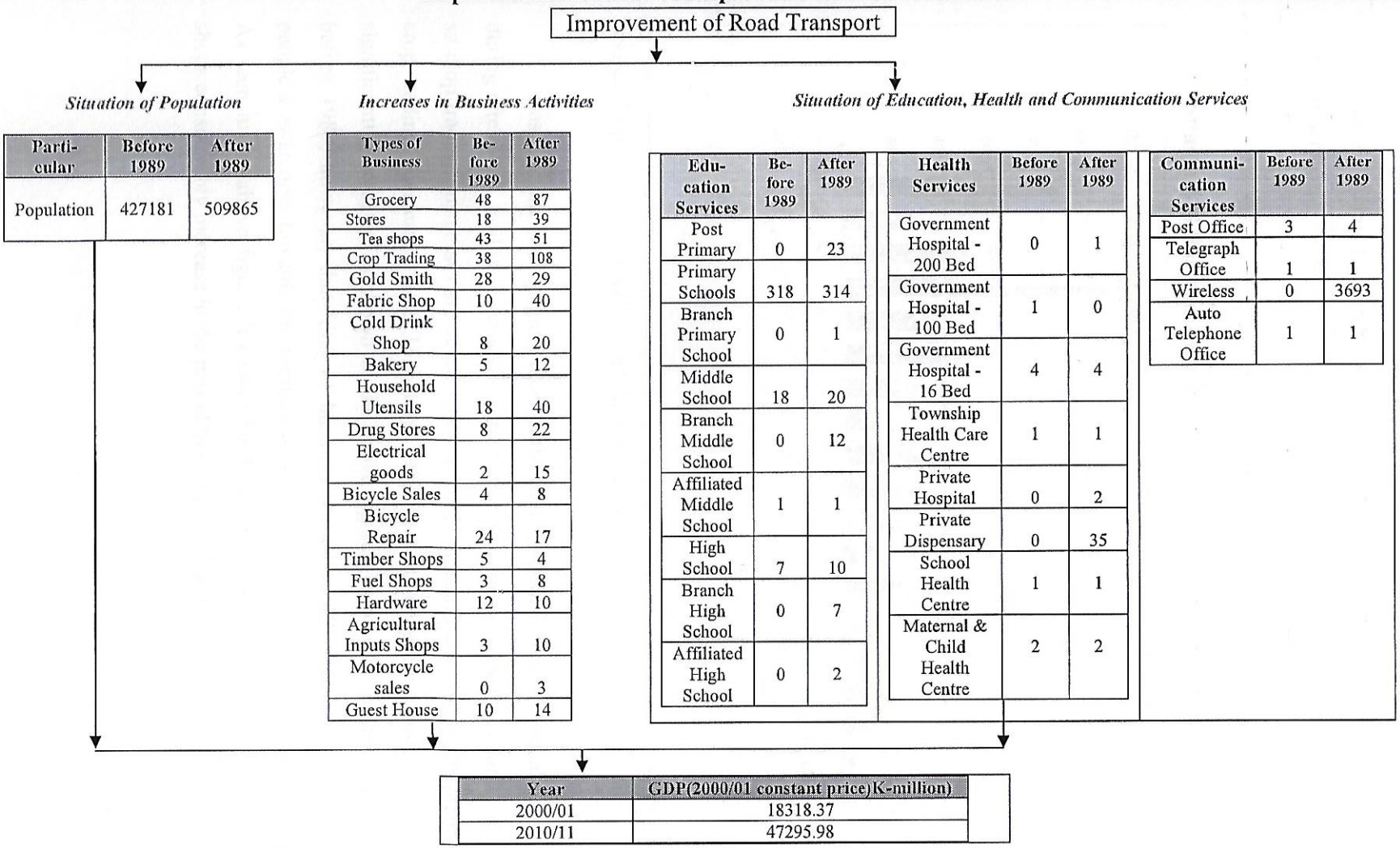


Source: Land Record Department, Ayeyarwady Region

The changing structure of Hinthada can be seen in the above figure. Increasing population enlarged accommodations, enhanced number of businesses, social services such as education and health, and improved communication services. As road transport in Hinthada township improved, the changing situation of business enterprises, education and health services, and communication services is illustrated in the following chart.

Chart 4.2

Improvement of Road Transport and Growth of Hinthada



Parti-cular	Before 1989	After 1989
Population	427181	509865

Types of Business	Be-fore 1989	After 1989
Grocery	48	87
Stores	18	39
Tea shops	43	51
Crop Trading	38	108
Gold Smith	28	29
Fabric Shop	10	40
Cold Drink Shop	8	20
Bakery	5	12
Household Utensils	18	40
Drug Stores	8	22
Electrical goods	2	15
Bicycle Sales	4	8
Bicycle Repair	24	17
Timber Shops	5	4
Fuel Shops	3	8
Hardware	12	10
Agricultural Inputs Shops	3	10
Motorcycle sales	0	3
Guest House	10	14

Edu-cation Services	Be-fore 1989	After 1989
Post Primary	0	23
Primary Schools	318	314
Branch Primary School	0	1
Middle School	18	20
Branch Middle School	0	12
Affiliated Middle School	1	1
High School	7	10
Branch High School	0	7
Affiliated High School	0	2

Health Services	Before 1989	After 1989
Government Hospital - 200 Bed	0	1
Government Hospital - 100 Bed	1	0
Government Hospital - 16 Bed	4	4
Township Health Care Centre	1	1
Private Hospital	0	2
Private Dispensary	0	35
School Health Centre	1	1
Maternal & Child Health Centre	2	2

Communi-cation Services	Before 1989	After 1989
Post Office	3	4
Telegraph Office	1	1
Wireless	0	3693
Auto Telephone Office	1	1

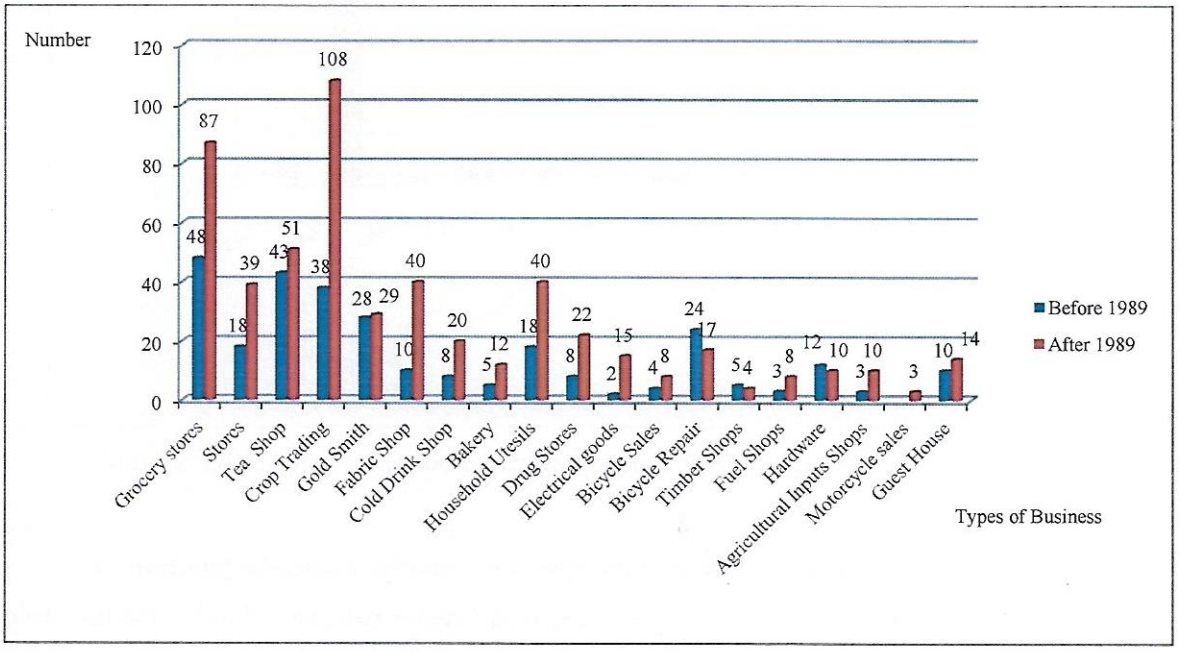
Year	GDP(2000/01 constant price)K-million)
2000/01	18318.37
2010/11	47295.98

Source: Appendix Table B.1 & B.2

The following figure shows how much change in businesses enterprises after 1989 is described.

Figure 4.9

Situation of Business Enterprises in Hinthada Before and After 1989

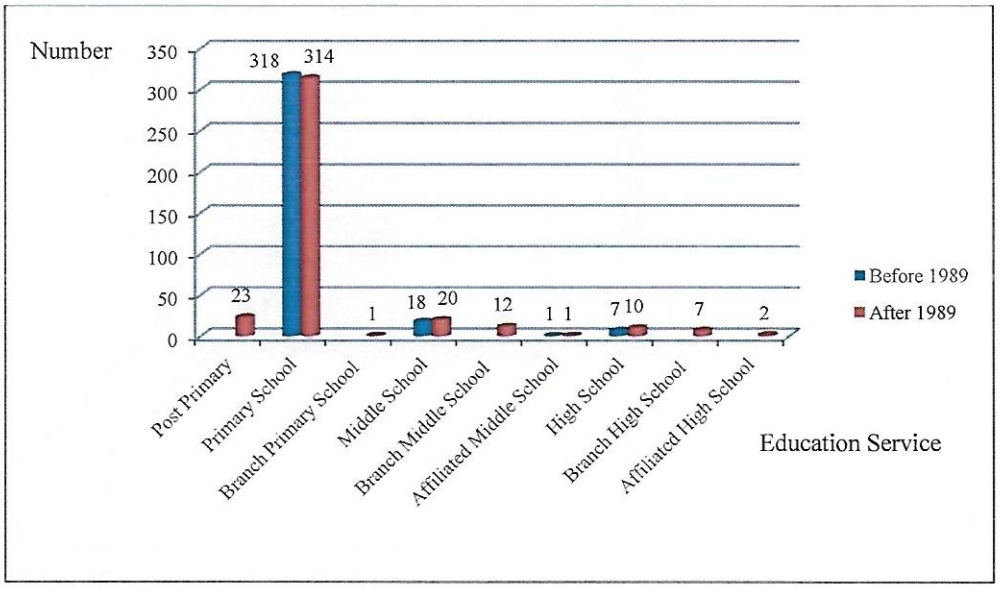


Source: Department of Development Affairs, Ayeyarwady Region

Based on the above figure, most of the businesses in Hinthada gradually increased during after 1989. Soil in Hinthada is very appropriate for growing many kinds of crops, so crop trading businesses are successful ones in Hinthada. Accordingly, the number of crop trading businesses were 38 before 1989, and at the present time the numbers significantly increased as shown in the above figure. There were no motorcycle sales before 1989; however, that kind of business started in 1995/96 in Hinthada due to people's awareness towards the usefulness of motorcycle after the road improvements. As seen in the above figure, it cannot be denied that the numbers of electrical goods shops considerably increase in the period from 1989 till now.

Figure 4.10

Situation of Education Services in Hinthada Before and After 1989

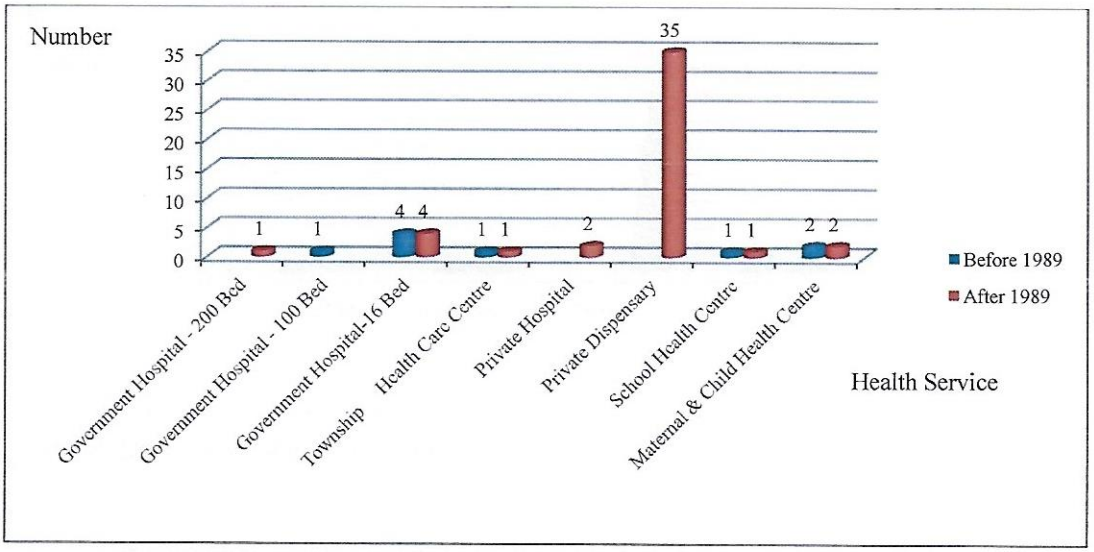


Sources: Department of Basic Education, Ayeyarwady Region

Concerning education services, not only some primary schools were promoted to post primary schools, but also several post primary schools were extended at primary level in order to provide primary education for the increased population after 1989. Branch middle schools, branch high schools and affiliated high schools were also established, aiming at achieving the middle and high school level education.

Figure 4.11

Situation of Health Services in Hinthada Before and After 1989

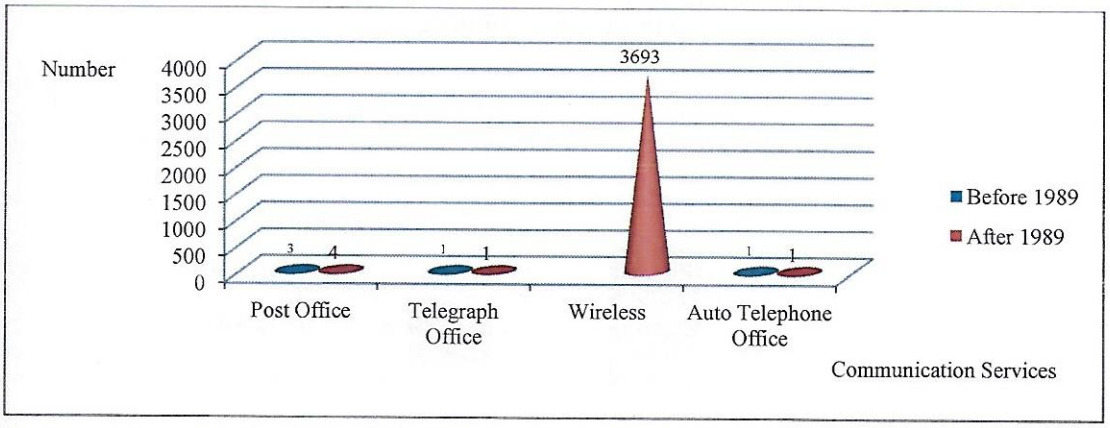


Source: Department of Health, Ayeyarwady Region

Regarding health services, 100-bed hospital was upgraded to 200-bed hospital in 1997/98 for the attainment of better health standard of the entire people in Hinthada. In addition, (2) private hospitals and (35) private dispensaries were established in 2010/11. However, the number of township health care centres, school health centres, and maternal and child health centres remained unchanged.

Figure 4.12

Situation of Communication Services in Hinthada Before and After 1989



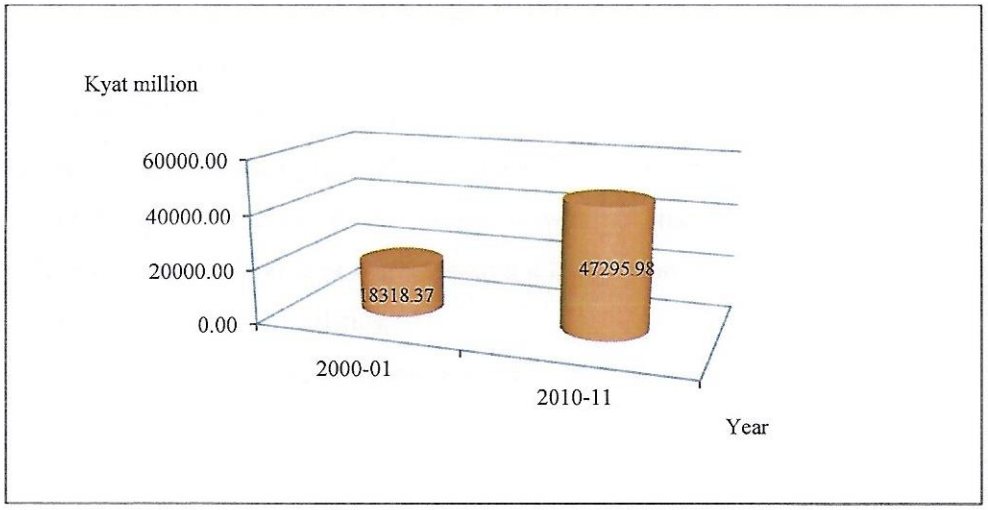
Source: Department of Posts and Telecommunications, Ayeyarwady Region

For communications services, wireless phones were installed starting in 2008/09. The numbers of wireless phones were 1717 in 2008/09, and at the present time, it increased over two times if compared with that of 2008/09. Regarding manual telephones, as wireless phones become more convenient nowadays, manual telephones are no longer used in the region.

With an improvement of road transport in Hinthada, the situation of business enterprises, education and health services, and communication services have improved. Accordingly, the gross domestic product of Hinthada has also risen about two and half times during the period 2000/01 to 2010/11, as shown in Figure 4.13.

Figure 4.13

Growth of Gross Regional Product of Hinthada from 2000/01 to 2010/11 (at 2000/01 constant price)



Source: Department of National Planning and Economic Development, Ayeyarwady Region

(c) Myaungmya

It is an administrative city of Myaungmya District under Ayeyarwady region. It lies between north latitude 16 degrees 12 minutes 30 seconds and 16 degrees 44 minutes, and between longitudes 94 degrees 40 minutes 50 seconds East and 95 degrees 15 minutes 30 seconds East. The area of Myaungmya is 397.566 square miles. For weather conditions, the highest temperature is 100.5˚F, and the lowest is 40.2˚F. The total rainfall of Myaungmya is 49.17 inches and the lowest rainfall recorded is 0.14 inches. The major ethnic groups are Bamars and Kayins while Shans are the minority. The majority of the population are Buddhists, and the others are Christians, Muslims, Hindus, and others.

In Myaungmya, Laputta - Myaungmya – Eime – Kyaungkone – Kyonepyaw road, Pathein – Myaungmya road, and Myaungmya – Ngaputaw road have been constructed as town to town roads. Pinlelay bridge, Myaungmya bridge, Kangyi bridge, Myinkaseik bridge, each with a length of above 180 feet, were constructed during the period 1989 to 2011. Bridges with a length less than 180 feet such as Sittapin,

Thaminchan, Thapyaychaung, Ngarponchaung, and Pyinmachaung bridges were also constructed from 1989 to 2011.

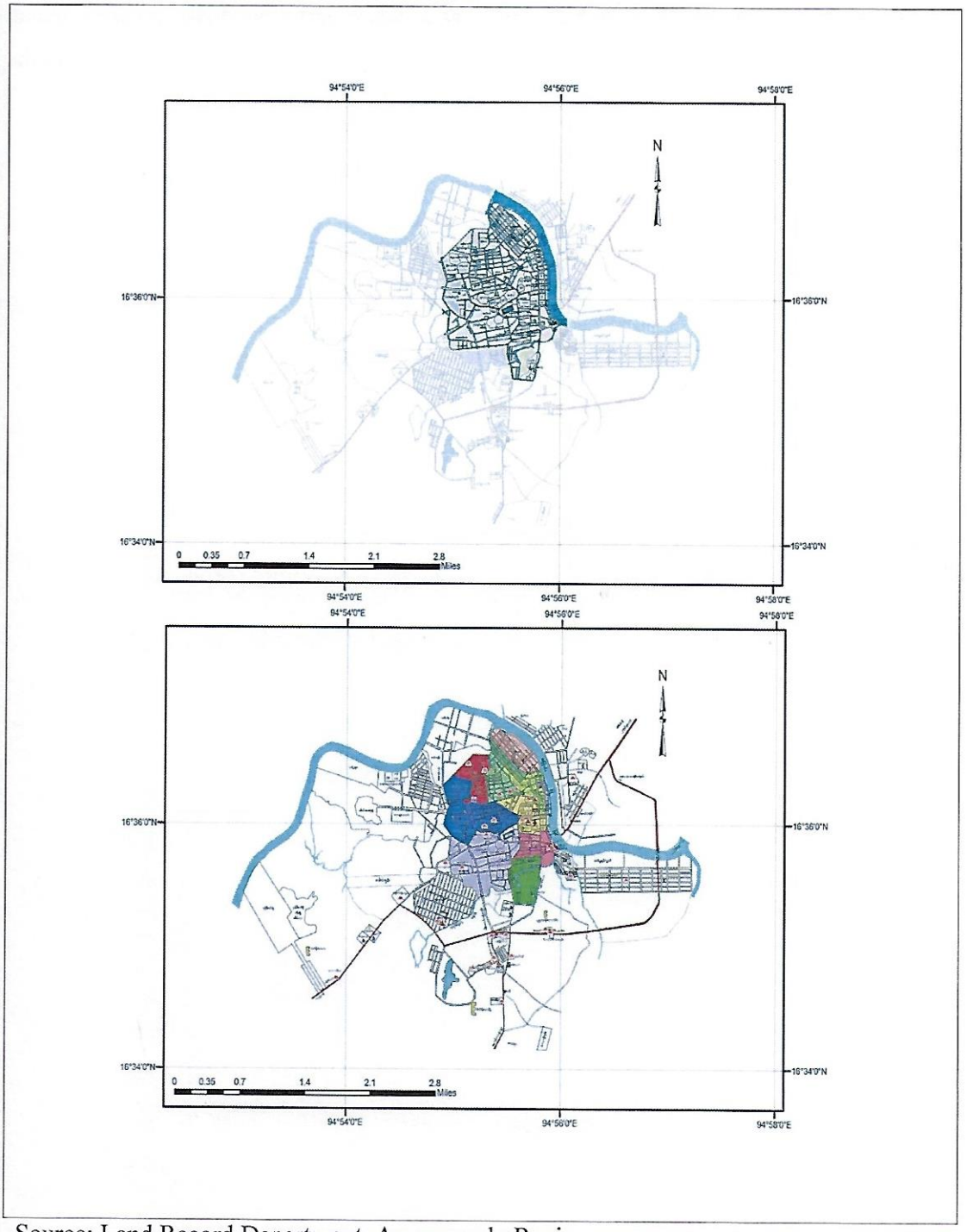
With an improvement of road transport, growth of population led to an increase in the number of businesses, schools, hospitals, health centers, telephone services and so on over the 20 years period.

Before 1989, the area of Myaungmya was 1.14 square miles. With an increase in population, the government gradually extended the urban area of Myaungmya starting from 1989/90 up to 1992/93. After that, there was no change in the land area up to 2009/10. However, the land area was extended a little again; its land area is 1.62 square miles according to 2010/11 statistics.

The changing structure of Myaungmya is depicted as follows.

Figure 4.14

Structure of Myaungmya Before and After 1989



Source: Land Record Department, Ayeyarwady Region

The different structure of Myaungmya before and after 1989 can be seen in the above figure. Growth of population increased the numbers of business, schools, hospitals, health centers, telephone services and so on. This situation is illustrated by the following chart.

Chart 4.3

Improvement of Road Transport and Growth of Myaungmya

Improvement of Road Transport

Situation of Population

Parti-cular	Before 1989	After 1989
Population	298828	392773

Increases in Business Activities

Types of Business	Be-fore 1989	After 1989
Grocery	3	78
Stores	0	17
Tea shops	50	65
Gold Smith	11	14
Fabric Shop	0	9
Cold Drink Shop	15	14
Bakery	10	25
Household Utensils	4	7
Drug Stores	5	21
Electrical goods	0	8
Bicycle Sales	1	7
Bicycle Repair	0	5
Timber Shops	15	13
Fuel Shops	8	2
Hardware	8	21
Agricultural Inputs Shops	1	11
Motorcycle sales	0	2
Guest House	3	11

Situation of Education, Health and Communication Services

Edu-cation Services	Be-fore 1989	After 1989
Post Primary	0	40
Primary Schools	215	186
Branch Primary School	0	25
Affiliated Primary School	34	14
Middle School	5	15
Branch Middle School	0	12
Affiliated Middle School	7	8
High School	4	7
Branch High School	0	8
Affiliated High School	3	0

Health Services	Before 1989	After 1989
Government Hospital - 100 Bed	1	1
Government Hospital - 16 Bed	2	2
Township Health Care Centre	1	1
Private Hospital	0	1
Private Dispensary	0	19
School Health Centre	2	2
Maternal & Child Health Centre	2	2

Communi-cation Services	Before 1989	After 1989
Post Office	1	3
Telegraph Office	1	1
Wireless	0	3219
Auto Telephone Office	0	1
Manual Telephone Office	1	0

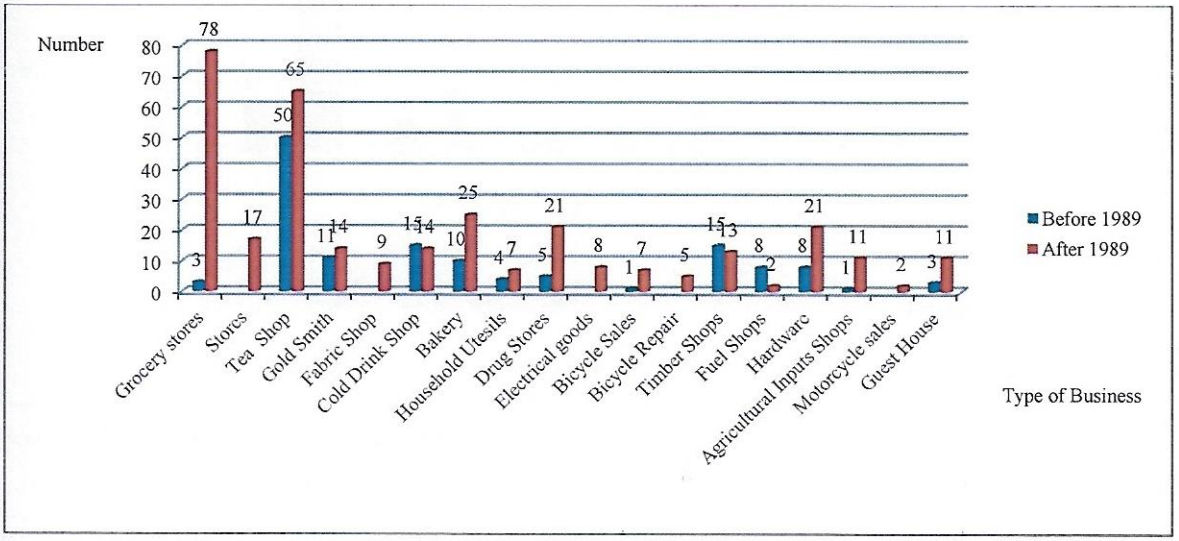
Year	GDP(2000/01 constant price)K-million)
2000/01	24836.55
2010/11	51769.00

Source: Appendix Table C.1 & C.2

Regarding business activities, most of the businesses significantly increase in Myaungmya after 1989. This figure shows the increase in business enterprises after 1989 compared to the situation before 1989.

Figure 4.15

Increases in Business Enterprises in Myaungmya Before and After 1989

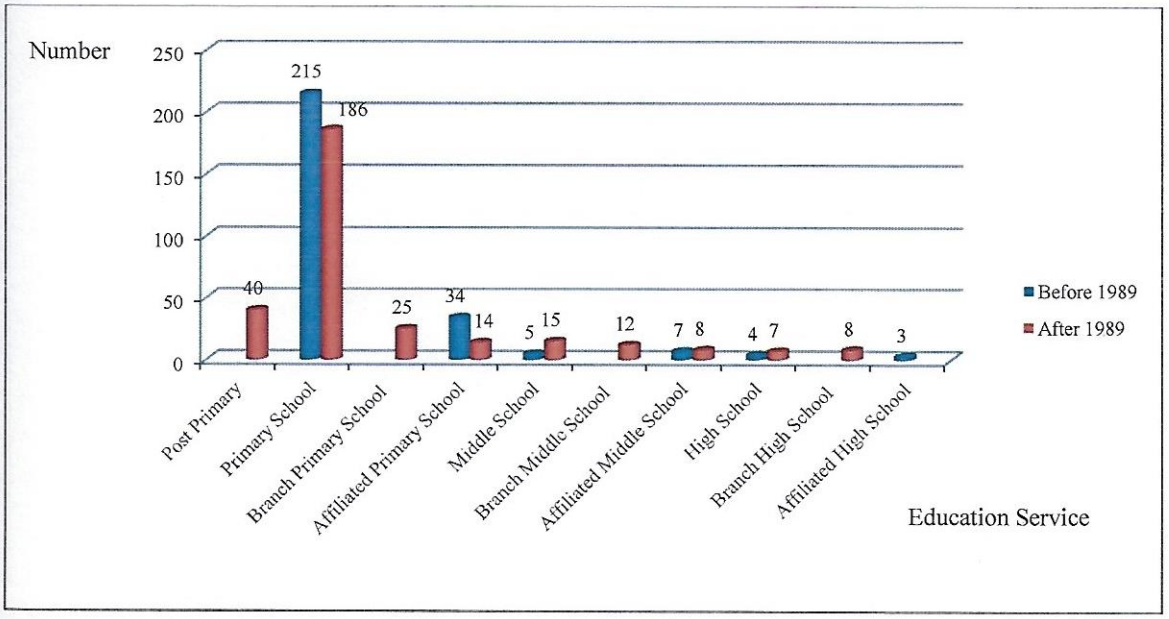


Source: Department of Development Affairs, Ayeyarwady Region

As seen in the above figure, most of the businesses increased after 1989. With an increase in population, grocery shops significantly increase to 78 after 1989 from 3 before 1989. Motorcycle sales started in 2001/02 onwards due the improvement of road and people's awareness of the usefulness of motorcycle. As a result of road improvement, people can move from one place to another by road besides water way. Accordingly, it can be said that the number of guest houses considerably increase over the 20 years. In other words, it is found that with an increase in population, various business activities have been increased during the research time span.

Figure 4.16

Situation of Education Services in Myaungmya Before and After 1989

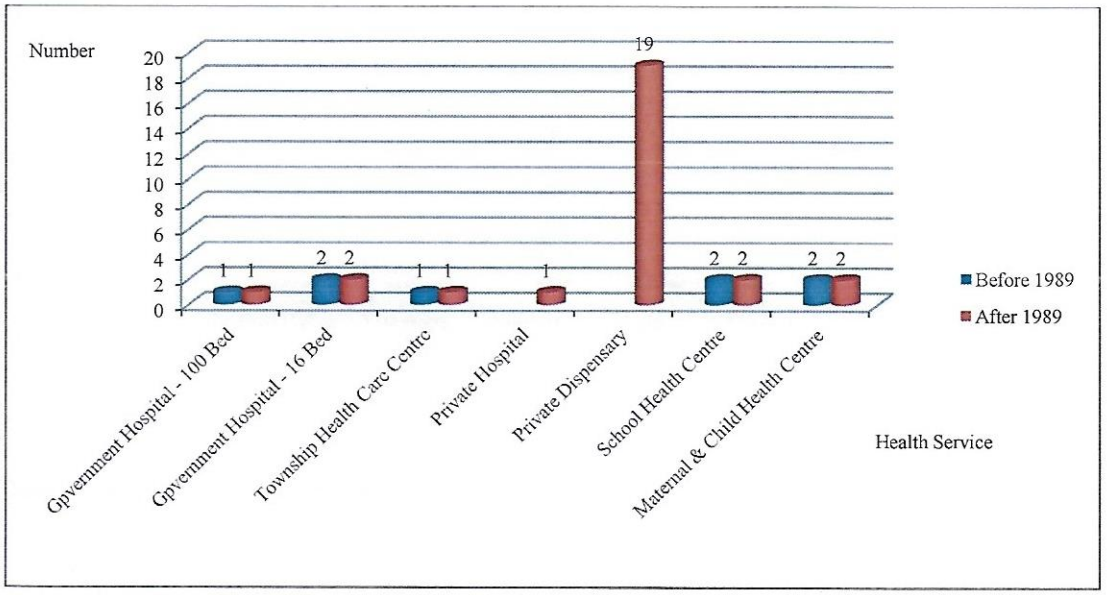


Sources: Department of Basic Education, Ayeyarwady Region

Regarding education, some primary schools and affiliated primary schools were reduced; instead several post primary schools and branch primary schools were extended at primary level due to increasing population after 1989. In addition, middle schools, branch middle schools and affiliated middle schools were established at middle school level. Affiliated high schools were upgraded to high schools, and branch high schools are also set up at high school level, aiming at providing necessary education for the increasing population.

Figure 4.17

Situation of Health Services in Myaungmya Before and After 1989

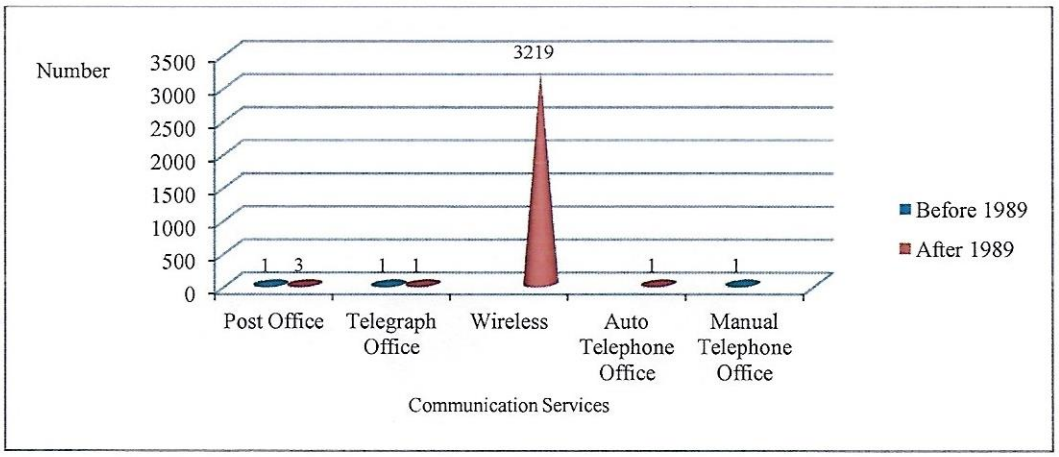


Source: Department of Health, Ayeyarwady Region

Concerning health services, there were two 16-bed hospitals before 1989. One of them was upgraded to 25-bed hospital in 1989/90 and 1990/91, aiming at achieving better health for the increasing population. However, due to inadequancy of facilities, it was redesignated as a 16 bed hospital in 1991/92. Then, one private hospital and 19 private dispensaries were established in 2010/11.

Figure 4.18

Situation of Communication Services in Myaungmya Before and After 1989



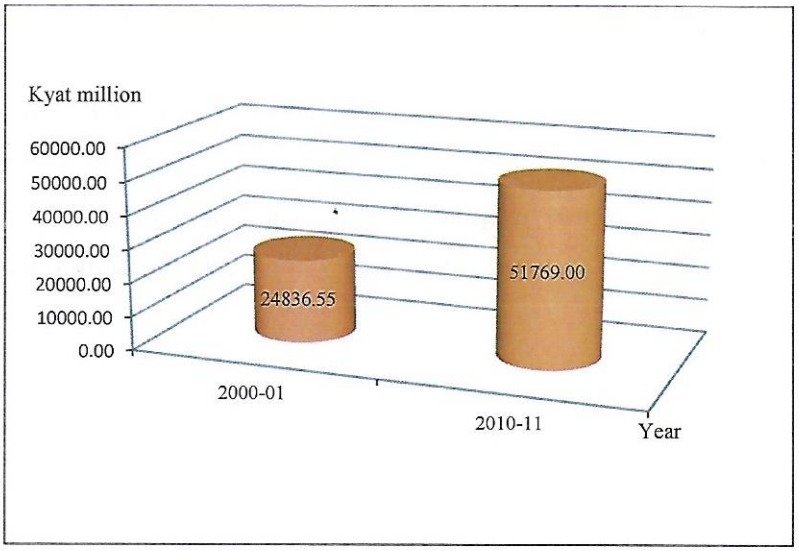
Source: Department of Posts and Telecommunication, Ayeyarwady Region

For communications services, an auto telephone office was established in 1999/2000 to improve communications. Wireless telephones were also installed beginning from 2008/09, aiming at achieving easy and smooth communication. The number of wireless telephones in starting year was 1422, and became over two times at the present time. Regarding the use of manual phone, it was seen that the manual phone office was abolished in 1997/98 as there was no more use of manual phone.

Once the road transport improves within the region, business enterprises, schools and hospitals, and communication services noticeably increased. Based on the statistics, it can be seen that the Gross Regional Product of Myaungmya doubled during the 10 years period, as shown in Figure 4.19.

Figure 4.19

Growth of Gross Regional Product of Myaungmya from 2000/01 to 2010/11 (at 2000/01 constant price)



Source: Department of National Planning and Economic Development, Ayeyarwady Region

(d) Maubin

Maubin lies between north latitude 16 degrees 30 minutes and 16 degrees 57 minutes, and between longitudes 95 degrees 24 minutes east and 95 degrees 52 minutes east. Its neighbours are Tontay and Nyaungdone to the east; Warkhema to the west; Kyaiklatt to the south; and Pantanaw to the north. The area of Maubin township is 515.38 square miles. The lowest temperature in summer is 68˚F, and the highest is 102.2˚F. The lowest temperature in the cold season is 42.8˚F, and the highest is 95˚F. The annual average rainfall is 105 inches, the lowest rainfall of maubin is 81.96 inches and the highest is 124.51 inches. The major ethnic groups are Bamars and Kayins while Kayahs is the minority. The majority of the population are Buddhists, and is about 96 per cent of the total population in Maubin. Around 3 per cent of total population are Christians, and over 0.5 per cent of total population are Muslims.

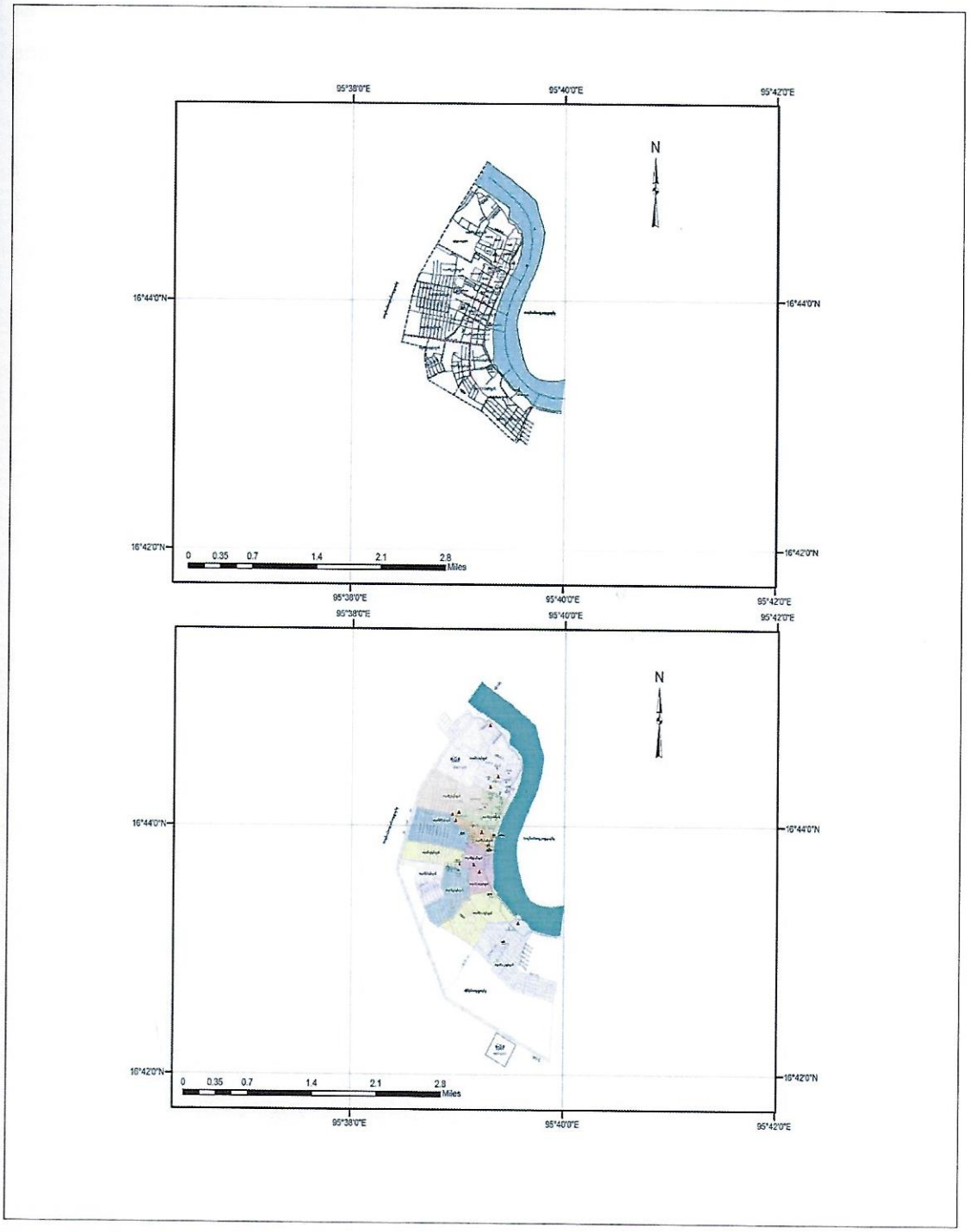
Several roads and bridges have also been undertaken in Maubin in order to attain easy and smooth transportation. As township to township roads, Maubin – Kyaiklatt road,

Maubin – Tontay road, and Maubin – Sarmalauk road have been constructed during the period between 1989 and 2011. Maubin, Khut-ti-ya, Thone-khwa-chaung and Than-lwin-ngu bridges were constructed in Maubin. The length of those bridges is above 180 feet. In addition, Ma-let-to bridge, with a length less than 180 feet, was also constructed in 1993. With an improvement in road transport, the business, social services and communication services significantly increased in Maubin from the period of 1989 to 2011.

According to statistics, it was found that population in Maubin gradually increased over 20 years time period. The changing structure of the urban area is illustrated in the following map.

Figure 4.20

Comparative Structure of Maubin Before and After 1989



Source: Land Records Department, Ayeyarwady Region

With an increase in population, the numbers of business, schools, hospitals, and communication services such as wireless phone noticeably increased over 20 years. Such an increase in population, houses, business enterprises, and education, health and communication services is demonstrated by this chart.

Improvement of Road Transport and Growth of Maubin

Improvement of Road Transport

Situation of Population

Parti-cular	Before 1989	After 1989
Population	186866	294668

Increases in Business Activities

Types of Business	Be-fore 1989	After 1989
Grocery	2	12
Stores	0	20
Tea shops	5	83
Crop Trading	0	1
Gold Smith	0	2
Fabric Shop	0	1
Cold Drink Shop	2	20
Bakery	2	6
Household Utensils	3	20
Drug Stores	1	4
Electrical goods	1	6
Bicycle Sales	0	3
Bicycle Repair	0	5
Timber Shops	2	9
Fuel Shops	2	2
Hardware	0	7
Agricultural Inputs Shops	1	2
Motorcycle sales	0	2
Guest House	1	7

Situation of Education, Health and Communication Services

Edu-cation Services	Be-fore 1989	After 1989
Post Primary	0	29
Primary Schools	272	233
Branch Primary School	0	10
Affiliated Primary School	0	1
Middle School	10	7
Branch Middle School	2	12
Affiliated Middle School	3	0
High School	5	7
Branch High School	1	8

Health Services	Before 1989	After 1989
Government Hospital - 200 Bed	0	1
Government Hospital - 100 Bed	1	0
Government Hospital - 16 Bed	2	2
Township Health Care Centre	1	1
Private Dispensary	0	10
School Health Centre	1	1
Maternal & Child Health Centre	2	2

Communi-cation Services	Before 1989	After 1989
Post Office	3	4
Telegraph Office	1	1
Wireless	0	3535
Auto Telephone Office	0	1
Manual Telephone Office	1	0

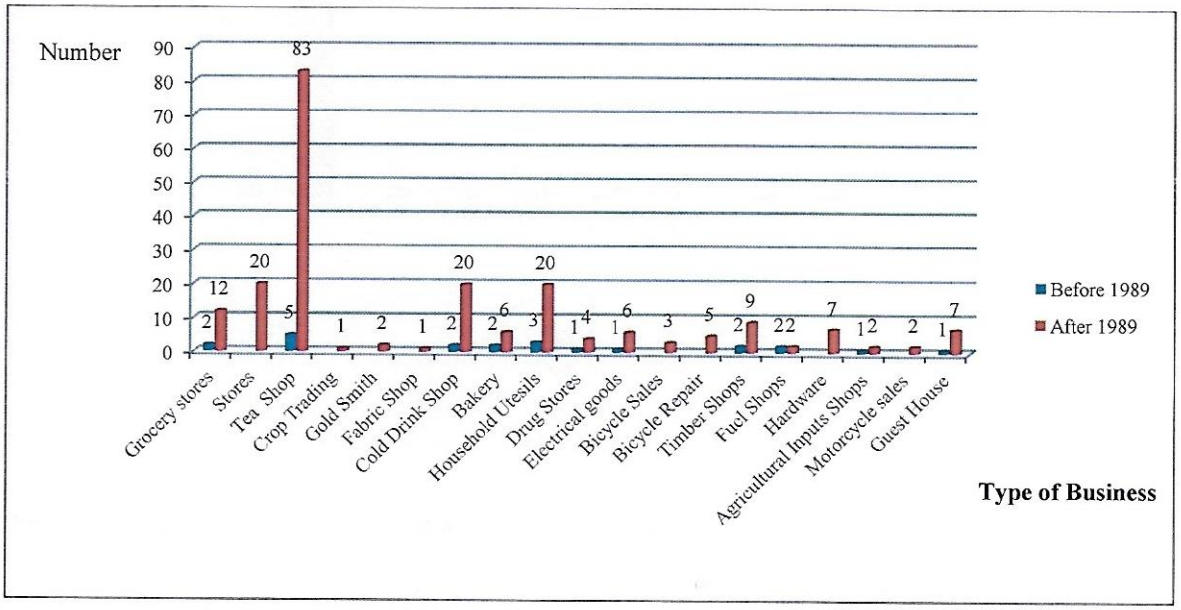
Year	GDP(2000/01 constant price)K-million)
2000/01	23004.70
2010/11	60301.42

Source: Appendix Table D.1 & D.2

The following figure supports to view how much increases in businesses in Maubin after 1989.

Figure 4.21

Increases in Business Enterprises in Maubin Before and After 1989

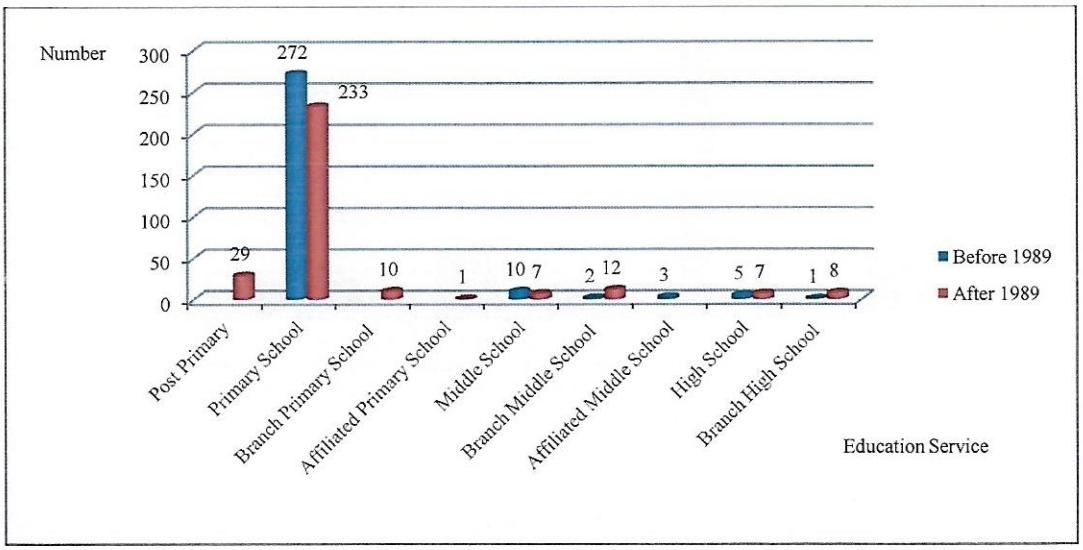


Source: Department of Development Affairs, Ayeyarwady Region

According to official statistics, the numbers of businesses notably increase after 1989, as seen in the above figure. The numbers of stores, tea shop, cold drink shops, and household utensils shops significantly increased after 1989. Maubin is not far from Yangon. So crops are sent directly from Maubin to Yangon without storing at warehouses after harvesting. This is the fact that crop trading business does not boom much in Maubin.

Figure 4.22

The Situation of Education Services in Maubin Before and After 1989

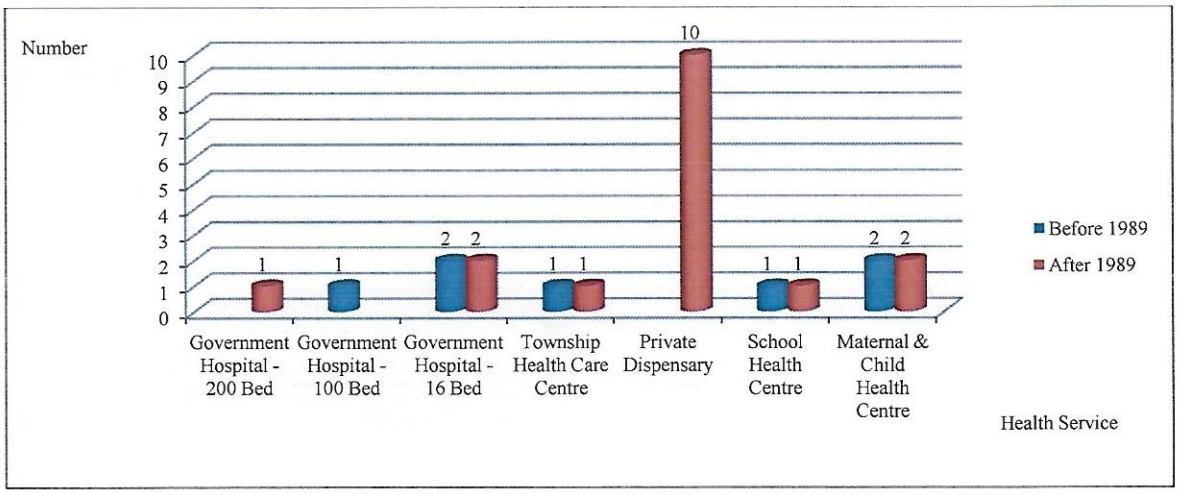


Sources: Department of Basic Education, Ayeyarwady Region

Regarding education services, in order to fulfill the education requirements for increasing population, some primary schools are upgraded to post primary schools and affiliated primary schools at primary level after 1989. Branch middle schools and branch high schools are also extended at middle school level and high school level education.

Figure 4.23

The Situation of Health Services in Maubin Before and After 1989

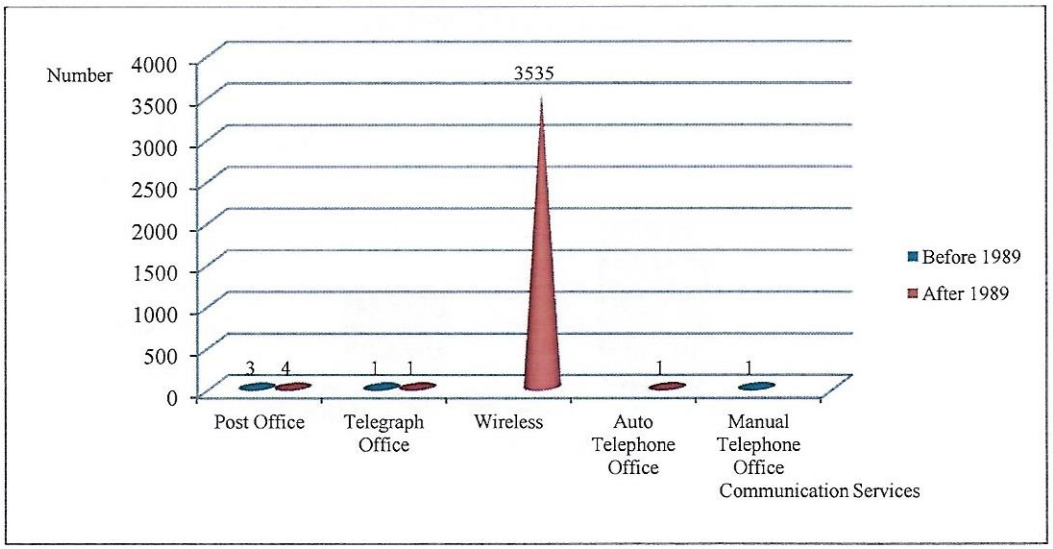


Source: Department of Health, Ayeyarwady Region

On the subject of health services, 200-bed hospital was established by combining a 100-bed hospital and two 16-bed hospitals together in 1997/98. In 2003/04, two 16-bed hospitals were additionally extended to fulfill the health requirements for increasing population. In 2010/11, private dispensaries were come out with an increase in population.

Figure 4.24

The Situation of Communication Services in Maubin Before and After 1989



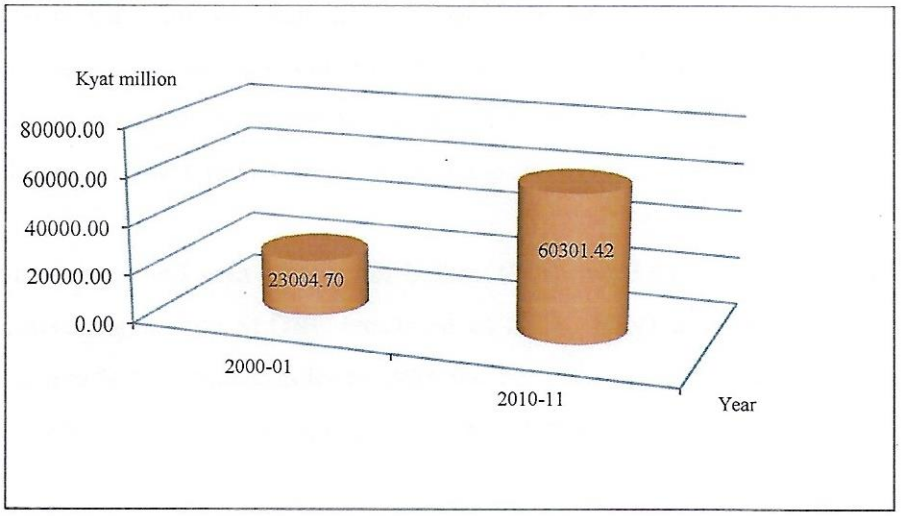
Source: Department of Posts and Telecommunication, Ayeyarwady Region

On the topic of communication services, in line with a market-oriented economic system adopted in late 1988, the use of wireless phone started in 2008/09. Manual telephone office was abolished in 2004/05. However, post office was extended in that year for the achievement of an opportunity for convenient connection among people.

As a result of the improvement of business activities, social services and communication services within the region, Gross Regional Product of Maubin has been boosted 2.6 times over the period of 10 years, as shown in Figure 4.25.

Figure 4.25

Growth of Gross Regional Product of Maubin from 2000/01 to 2010/11 (at 2000/01 constant price)



Source: Department of National Planning and Economic Development, Ayeyarwady Region

(e) Pyapon

Pyapon lies between north latitude 15 degrees 30 minutes and 16 degrees 25 minutes, and between longitudes 90 degrees 30 minutes East and 95 degrees 45 minutes East. Its neighbours are Daydaye to the east; Bogalay to the west; Bay of Motetama to the south; and Kyaiklatt and Bogalay to the north. The area of Pyapon township is 267.70 square mile. It has hot and wet weather, the hottest month is April and the coldest month is January. The average temperature of the hottest month is 96˚F, and the average temperature of the coldest month is 63˚F. It has annual average rainfall of 144.04 inches. The major ethnic groups are Bamar and Kayin, Mon is the minority. The majority of the population is Buddhists, and then Christians, Hindu and Muslims follow.

After 1988, in Pyapon city under the administration of Ayeyarwady region, several roads and bridges were established in order to achieve smooth transportation. As town to town roads, Pyapon - Daydaye road, Kyonekadun – Ahmar road, Pyapon – Kyaiklatt road, and Pyapon – Bogalay road have been constructed. Gon-nyin-tan bridge, Tha-lake-kyi bridge, Chaung-dwin bridge, Pyapon bridge, Seik-ma bridge and War-

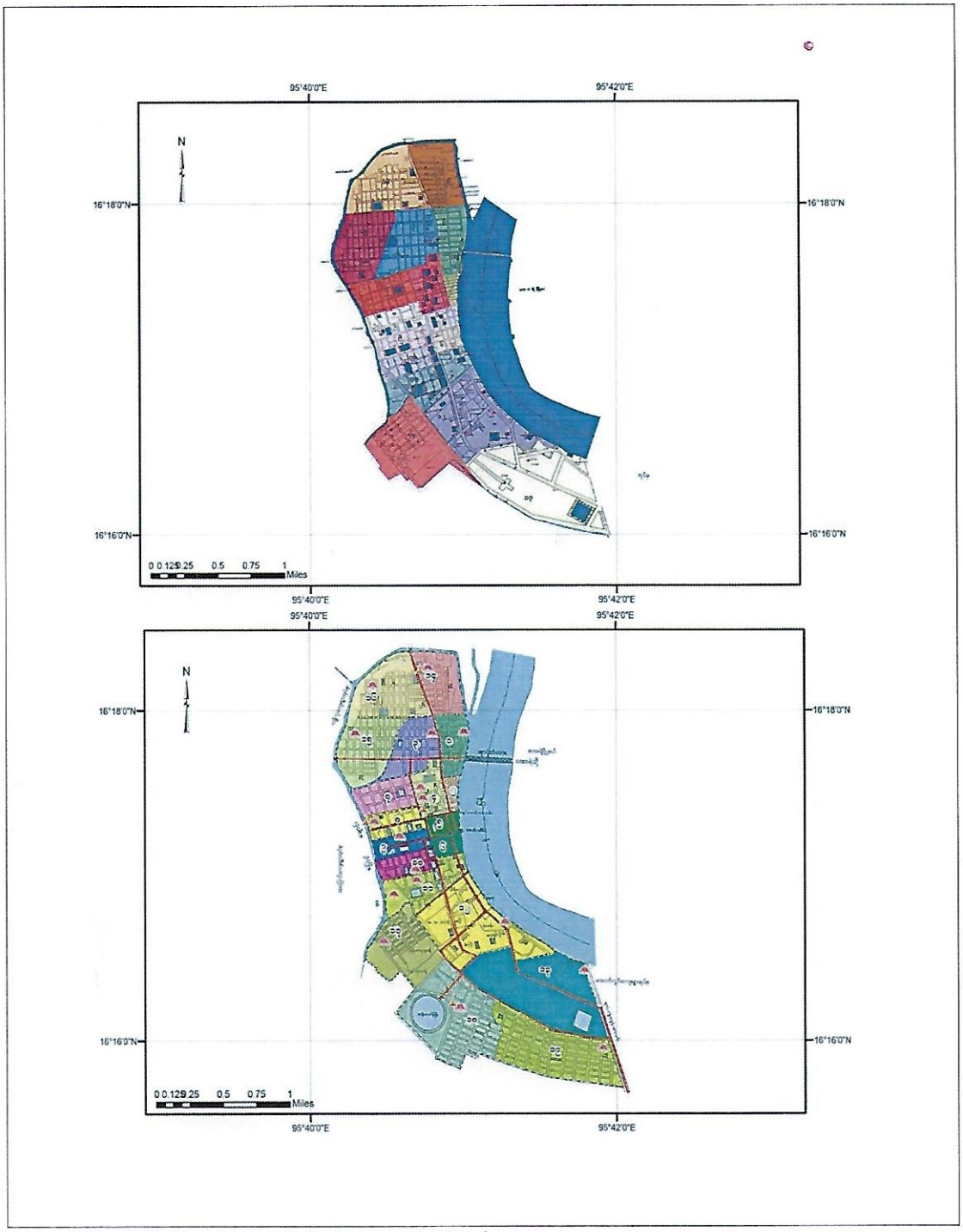
chaung bridge, with a length above 180 feet, were constructed during the period of 1989 and 2011. The numbers of bridges with a length less than 180 feet are 31 in Pyapon township.

The construction of roads and bridges made the moving of people and freight from one place to another safe and smooth inside and outside the region. Consequently, the numbers and types of business, social services such as schools and hospitals, communication services such as wireless phone gradually grow during the period of 1989 and 2011.

The urban land area of Pyapon before 1989 was 3.61 square miles. Being an administrative region, the SLORC (renamed as SPDC later) government extended the urban land area to 4.15 square miles in 1989-90. The current urban land area of Pyapon is still 4.15 square miles. The changing structure of urban area is shown as the following map.

Figure 4.26

Comparative Structure of Pyapon Before and After 1989



Source: Land Record Department, Ayeyarwady Region

Within over 20 years, it is found that the size of population decreased although road transport improved. The storm "Nargis" occurred in 2008 caused many indigenous people to die. This fact is one reason why the size of population considerably decreases in Pyapon. Another reason is that Ahmar was separated from Pyapon Township starting from 2004/05. Chart 4.5 represents the improvement of road transport and growth of Pyapon.

Chart 4.5

Improvement of Road Transport and Growth of Pyapon

Improvement of Road Transport

Situation of Population

Particular	Before 1989	After 1989
Population	221199	190846

Increases in Business Activities

Types of Business	Before 1989	After 1989
Grocery	3	13
Stores	10	26
Tea shops	50	71
Gold Smith	7	20
Fabric Shop	1	2
Cold Drink Shop	3	18
Bakery	1	2
Household Utensils	1	2
Drug Stores	1	6
Electrical goods	2	8
Bicycle Sales	1	2
Bicycle Repair	1	2
Timber Shops	6	16
Fuel Shops	3	4
Hardware	2	13
Agricultural Inputs Shops	1	5
Motorcycle sales	0	1
Guest House	4	11

Situation of Education, Health and Communication Services

Education Services	Before 1989	After 1989
Post Primary	0	22
Primary Schools	170	116
Branch Primary School	0	1
Middle School	6	2
Branch Middle School	0	9
Affiliated Middle School	4	2
High School	4	6
Branch High School	0	3
Affiliated High School	1	3

Health Services	Before 1989	After 1989
Government Hospital - 200 Bed	0	1
Government Hospital - 100 Bed	1	0
Government Hospital - 16 Bed	1	0
Township Health Care Centre	1	1
Private Hospital	0	2
Private Dispensary	0	26
School Health Centre	1	1
Maternal & Child Health Centre	1	1

Communication Services	Before 1989	After 1989
Post Office	3	2
Telegraph Office	1	1
Wireless	0	4236
Auto Telephone Office	0	1
Manual Telephone Office	1	0

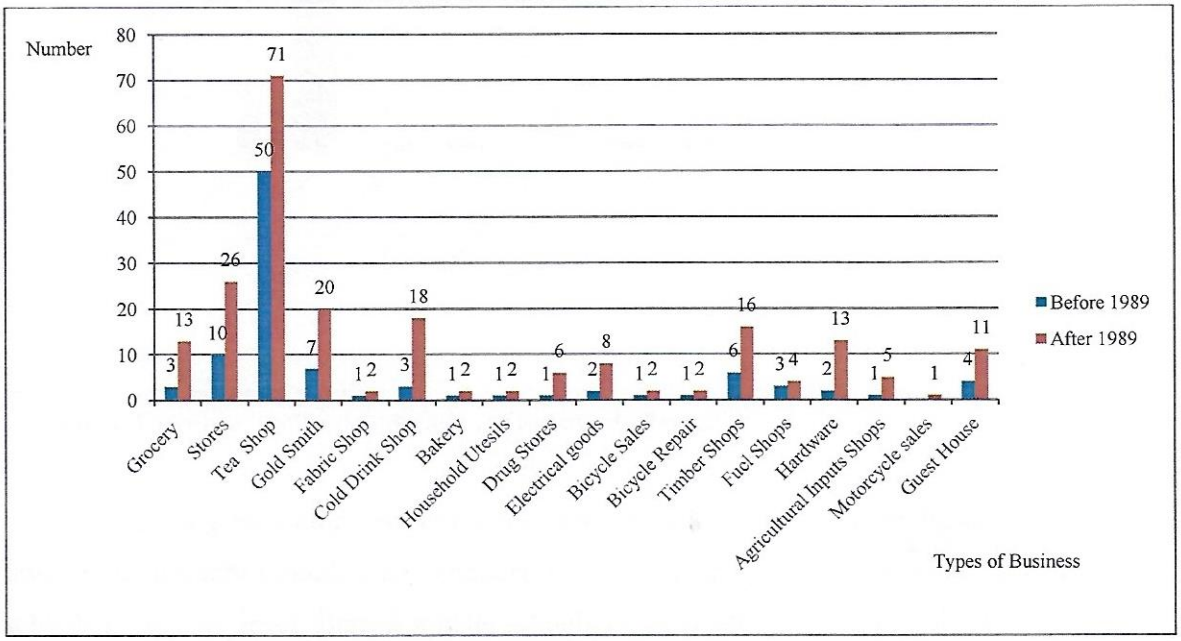
Year	GDP(2000/01 constant price)K-million)
2000/01	21530.19
2010/11	62345.82

Source: Appendix Table E.1 & E. 2

The following figures explain the changing situation of businesses, education, health, and communication services.

Figure 4.27

Changes of Business Enterprises in Pyapon Before and After 1989

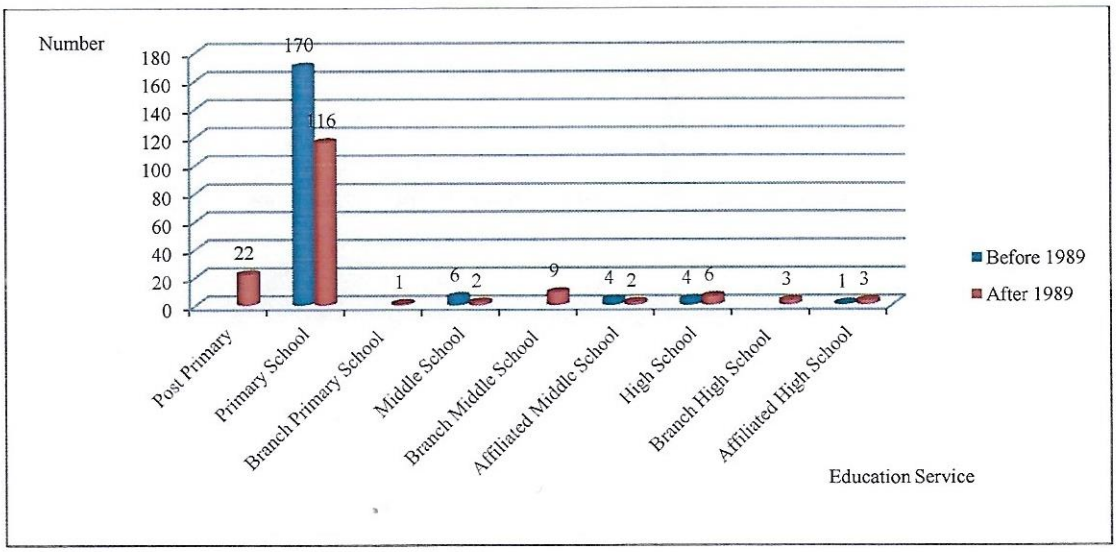


Source: Department of Development Affairs, Ayeyarwady Region

The changing situation of business enterprises during the research time span can be seen as shown in the above figure. People whose businesses are tea shop, hard ware shop and cold drink shop significantly increased in Pyapon.

Figure 4.28

The Situation of Education Services Before and After 1989

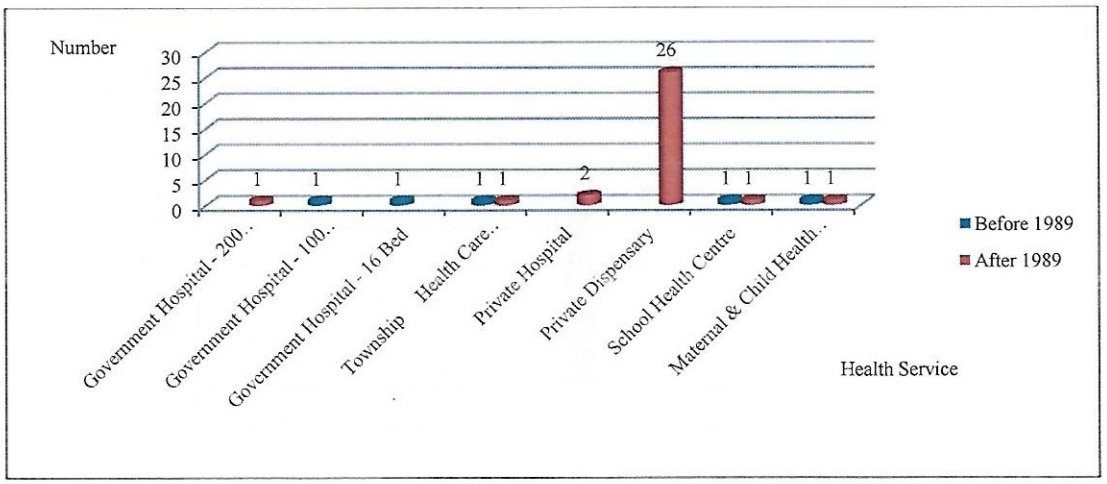


Sources: Department of Basic Education, Ayeyarwady Region

Regarding education services, necessary education services were fulfilled over time. Some primary schools were upgraded to post primary schools and branch primary schools at primary level. Branch middle schools and affiliated middle schools at middle school level, and branch high schools and affiliated high schools at high school level are established after 1989.

Figure 4.29

The Situation of Health Services Before and After 1989

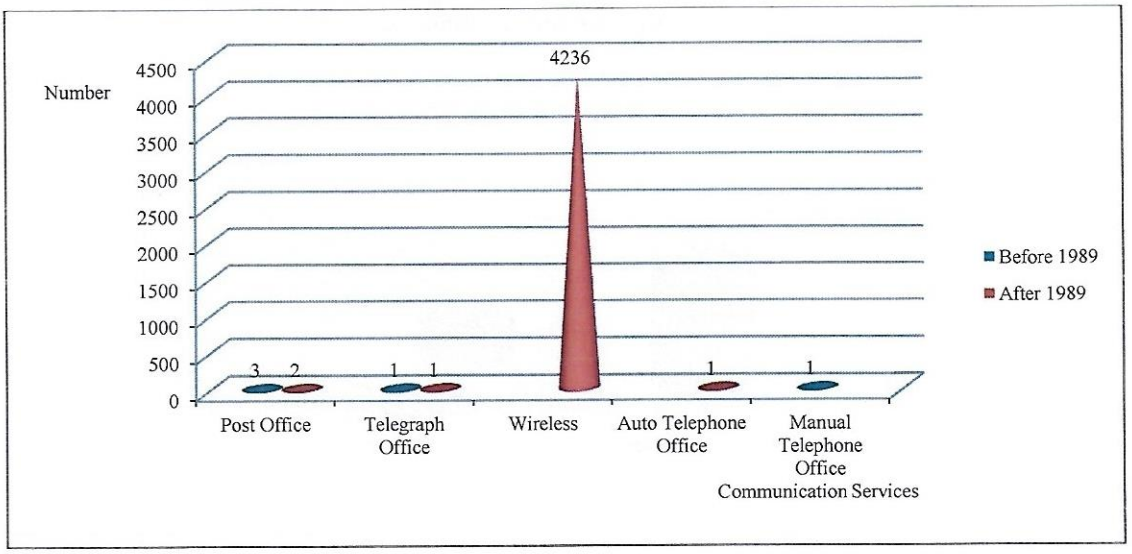


Source: Department of Health, Ayeyarwady Region

On the topic of health services, the government has made an effort to fulfill the health requirements for increasing population. In Pyapon, 200-bed hospital was established by combining a 100-bed hospital and a 16-bed hospital together after 1989. Two private hospitals and 26 private dispensaries have also been established in accordance with a market-oriented economic system since 2010/11.

Figure 4.30

The Situation of Communication Services Before and After 1989



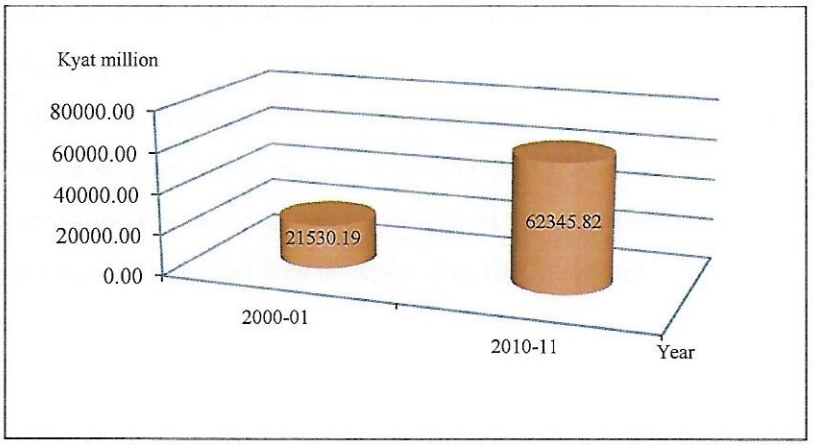
Source: Department of Posts and Telecommunication, Ayeyarwady Region

On the subject of communication services, an auto telephone office was launched for the achievement of convenient communication services in 2002/03. In 2008/09, the use of wireless phone began in Pyapon, in accordance with the changing economic system. Manual phone office was abolished in 2004/05 as manual phone was not used since then.

As the road transport generates people to move safe and smooth from one place to another, business enterprises, social services such as education and health, and communication services also develop over 10 years. The growth of Gross Regional Product in Pyapon compared to the situation of 2000/01 is almost 3 times, as shown in Figure 4.31.

Figure 4.31

Growth of Gross Regional Product of Pyapon from 2000/01 to 2010/11 (at 2000/01 constant price)



Source: Department of National Planning and Economic Development, Ayeyarwady Region

(f) Laputta

It is an administrative city of Laputta District under Ayeyarwady region. It lies between north latitude 25 degrees 44 minutes 30 seconds and 16 degrees 23 minutes, and between longitudes 94 degrees 33 minutes East and 95 degrees 9 minutes East. Its neighbours are Pyapon District to the east; Bay of Bangle and Pathein District to the west; Myaungmya District to the north; and Bay of Bangle to the south. The area of Laputta township is 905.79 square miles. The highest temperature of Laputta is 102˚F, and the lowest temperature is 78˚F. It has annual average rainfall of 103.84 inches. The major ethnic groups are Bamar and Kayin, Shan and Chin are the minority. The majority of the population is Buddhists, and then Christians, Hindu, Muslims and others follow.

Several roads and bridges have been constructed for safe and smooth road transport in Ayeyarwady region. In Laputta township, Laputta – Myaungmya road, Laputta – Pyinsalu road and Pyinsalu – Mawkyun road have been constructing during the period of 1989 and 2011 as town to town roads. Many bridges, with a length more than

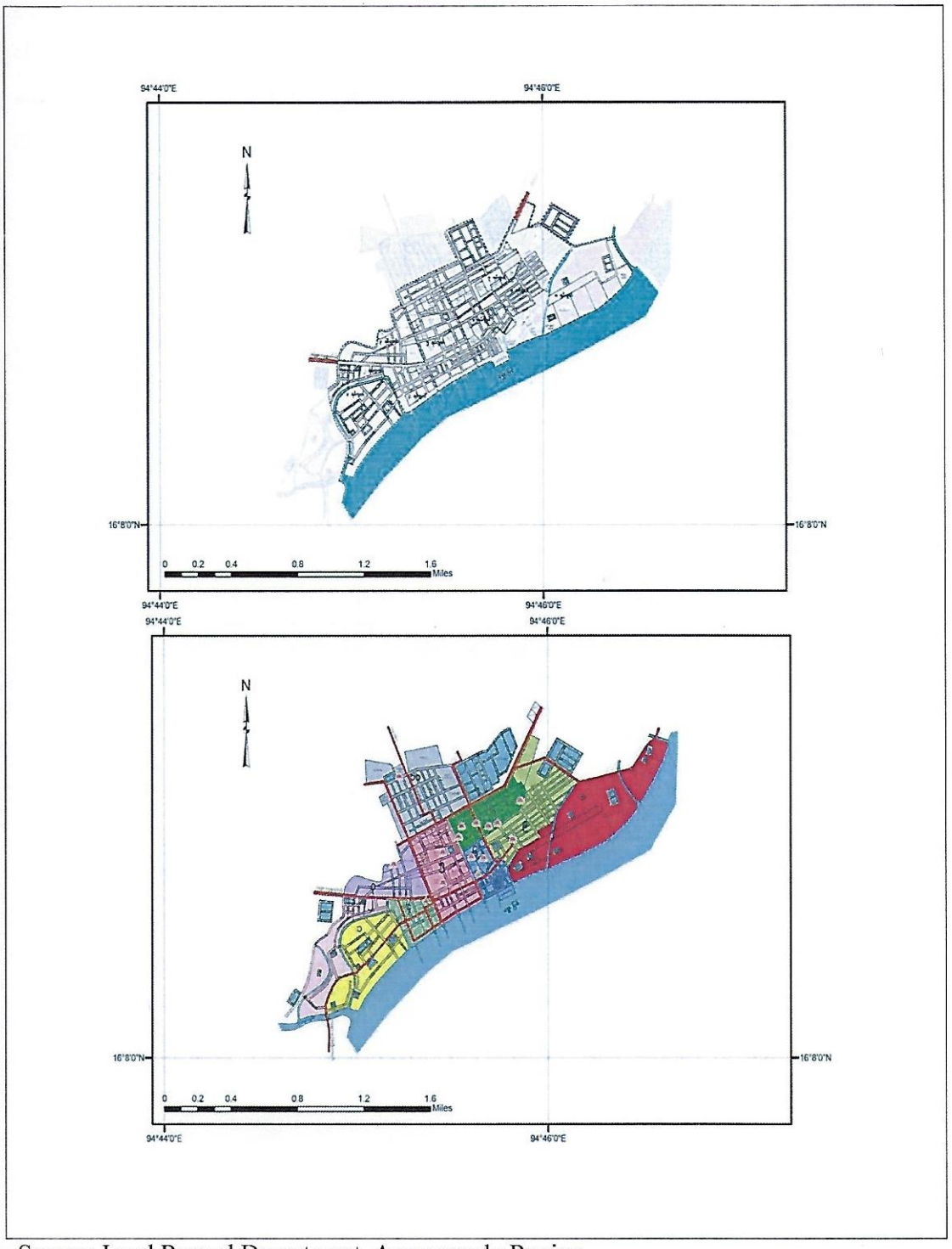
180 feet, were constructed, and many bridges, with a length less than 180 feet, were also constructed during that period.

Accordingly, the situation of business, social services such as schools and hospitals, and communication services changed throughout the research time span.

The urban land area of Laputta was 0.85 square miles before 1989. The area was extended to 0.91 square miles starting from 1989-90. Again, the area was extended to 2.27 square miles in 2009/10. The population of Laputta was 285121 in 2008/09. However, the size of population decreased to 283138 in 2010/11 because many people died and their properties were severely destroyed by Cyclone Nargis in 2008. The changing structure of urban land area is depicted as the following map.

Figure 4.32

Comparative Structure of Laputta Before and After 1989

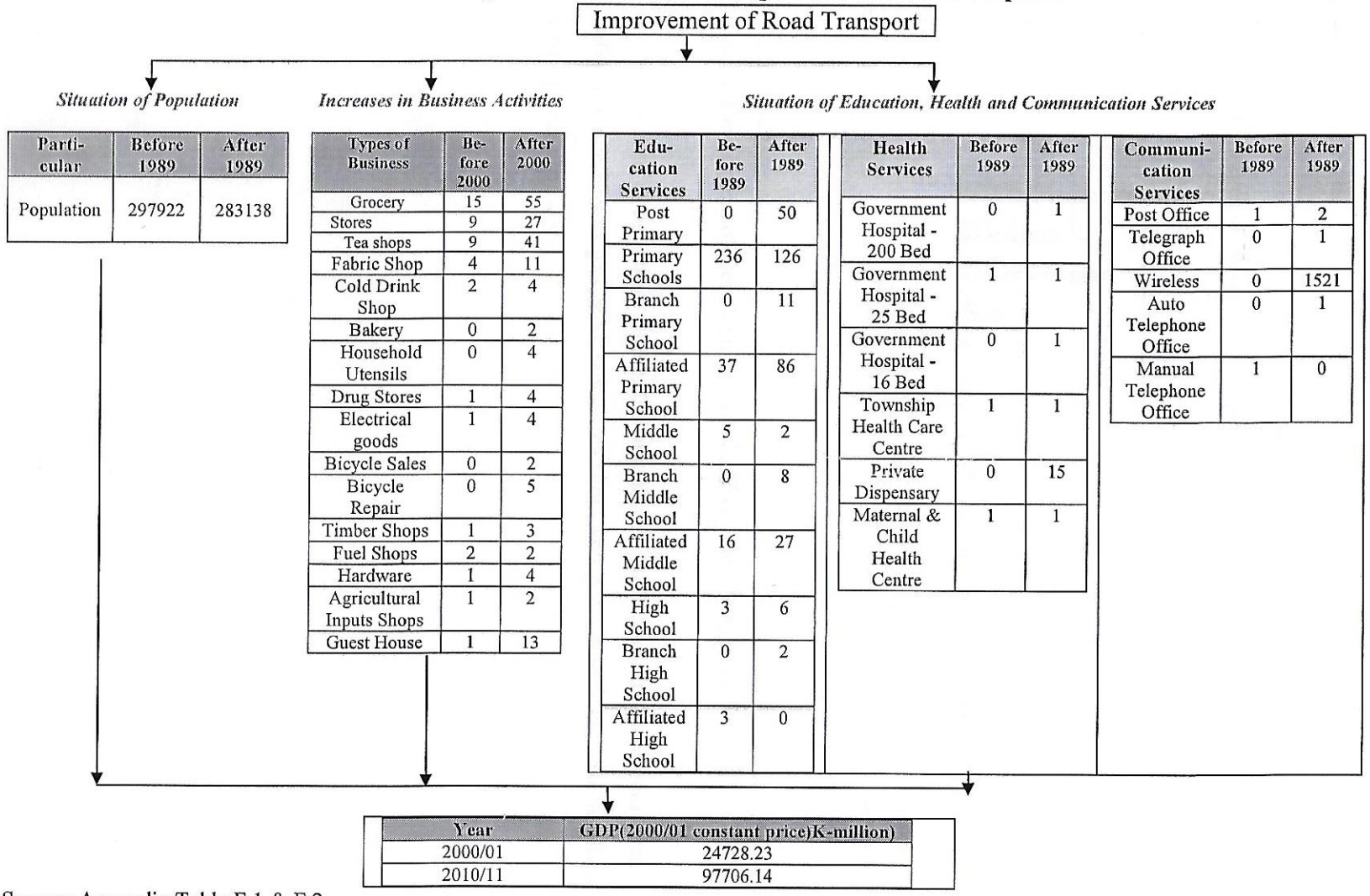


Source: Land Record Department, Ayeyarwady Region

The changing structure of Laputta is shown in the above figure. With an enlargement of urban land area, the number of business, education services such as schools and hospitals, and communication services such as wireless phone gradually changed over time. As statistical data for businesses could not get before 1989, the situation of business enterprises is shown only before and after 2000. Chart 4.6 represents the improvement of road transport and growth of Laputta.

Chart 4.6

Improvement of Road Transport and Growth of Laputta



Parti-cular	Before 1989	After 1989
Population	297922	283138

Types of Business	Be-fore 2000	After 2000
Grocery	15	55
Stores	9	27
Tea shops	9	41
Fabric Shop	4	11
Cold Drink Shop	2	4
Bakery	0	2
Household Utensils	0	4
Drug Stores	1	4
Electrical goods	1	4
Bicycle Sales	0	2
Bicycle Repair	0	5
Timber Shops	1	3
Fuel Shops	2	2
Hardware	1	4
Agricultural Inputs Shops	1	2
Guest House	1	13

Edu-cation Services	Be-fore 1989	After 1989
Post Primary	0	50
Primary Schools	236	126
Branch Primary School	0	11
Affiliated Primary School	37	86
Middle School	5	2
Branch Middle School	0	8
Affiliated Middle School	16	27
High School	3	6
Branch High School	0	2
Affiliated High School	3	0

Health Services	Before 1989	After 1989
Government Hospital - 200 Bed	0	1
Government Hospital - 25 Bed	1	1
Government Hospital - 16 Bed	0	1
Township Health Care Centre	1	1
Private Dispensary	0	15
Maternal & Child Health Centre	1	1

Communi-cation Services	Before 1989	After 1989
Post Office	1	2
Telegraph Office	0	1
Wireless	0	1521
Auto Telephone Office	0	1
Manual Telephone Office	1	0

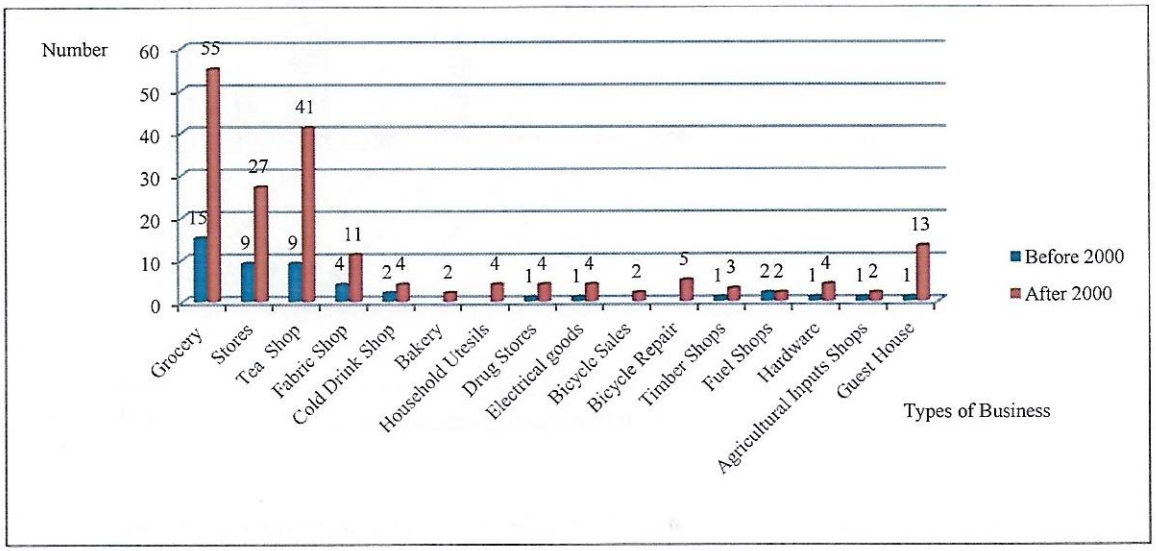
Year	GDP(2000/01 constant price)K-million)
2000/01	24728.23
2010/11	97706.14

Source: Appendix Table F.1 & F.2

The following figure certainly explains the increases in business enterprises over 10 years.

Figure 4.33

Changes of Business Enterprises in Laputta Before and After 2000

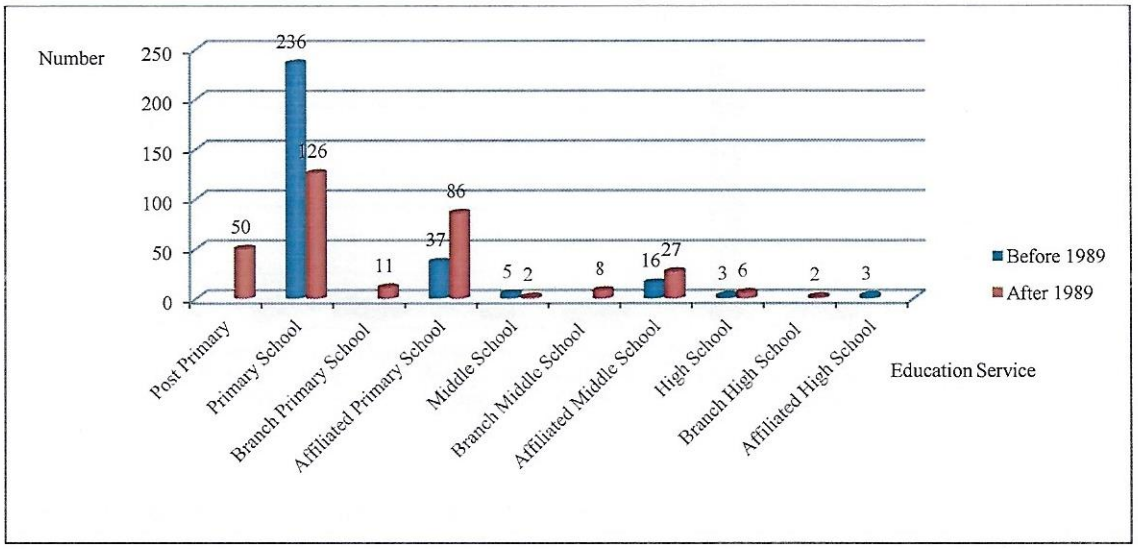


Source: Department of Development Affairs, Ayeyarwady Region

As seen in the above figure, the numbers of businesses gradually increased after 2000. The numbers of groceries, stores, tea shops and guest houses increase significantly year by year after 2000.

Figure 4.34

The Situation of Education Services in Laputta Before and After 1989

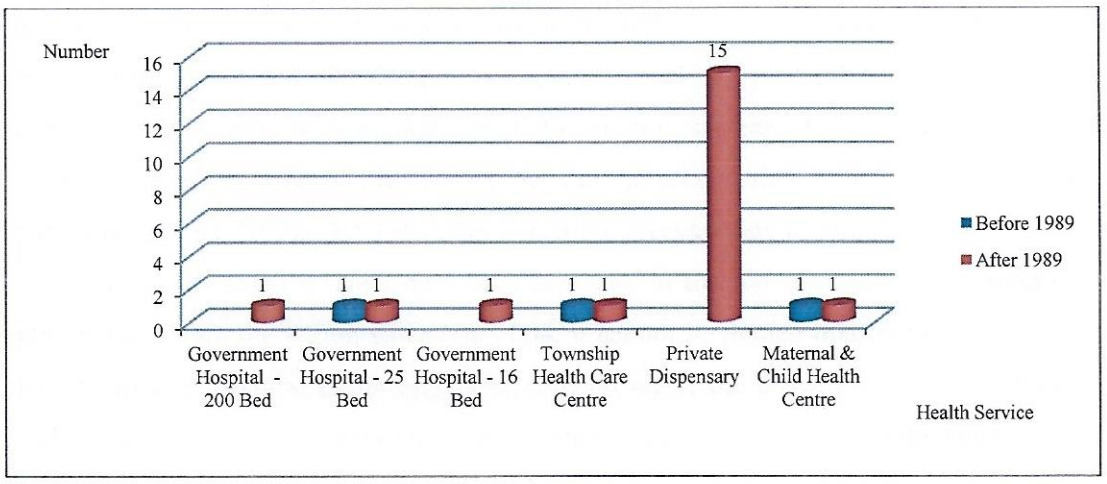


Sources: Department of Basic Education, Ayeyarwady Region

Concerning education services, post primary schools, branch primary schools and affiliated primary schools have been extended at primary level, in place of some primary schools. Branch middle schools and affiliated middle schools at middle school level and branch high schools at high school level have also been upgraded to fulfill the education requirement.

Figure 4.35

The Situation of Health Services in Laputta Before and After 1989

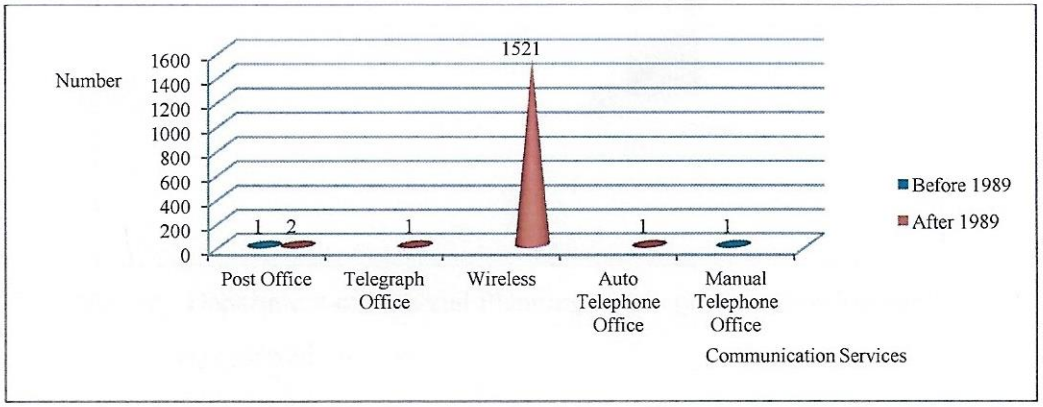


Source: Department of Health, Ayeyarwady Region

Regarding health services, a 16-bed hospital was established in 1991/92, and in 2010/11, a 200-bed hospital was also extended, aiming at achieving the better health standard for the entire population in Laputta. With a market-oriented economic system adopted after 1988, (15) private dispensaries were opened in 2010/11.

Figure 4.36

The Situation of Communication Services in Laputta Before and After 1989



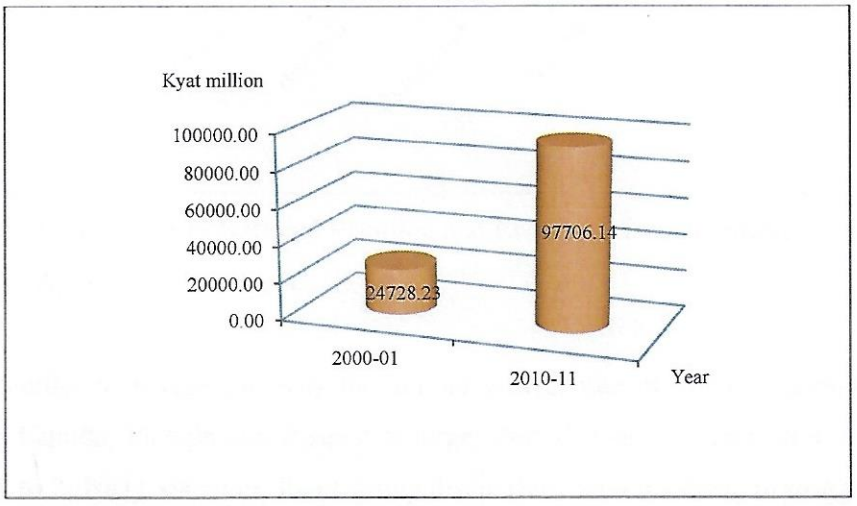
Source: Department of Posts and Telecommunication, Ayeyarwady Region

On the subject of communication services, Auto telephone office was established starting from 2006/07. There was only manual phone office in Laputta prior to that year. However, manual phone office was abolished in 2008/09 as there was no use of manual phone starting from 2008/09. People in Laputta started to use (574) wireless phone in 2008/09 in accordance with market-oriented economic system adopted after 1988, and then the numbers of wireless phone are (1521) at the present time based on the statistics from Department of Posts and Telecommunication, Ayeyarwady Region.

People in Laputta relied only on water way in the old days. After constructing many roads within the region since late 2008, it cannot be denied that moving from one place to another become easier and faster. Accordingly, the growth of Gross Regional Product of Laputta significantly increases by almost 4 times, compared to the situation of 2000-01, as shown in Figure 4.37.

Figure 4.37

Growth of Gross Regional Product of Laputta from 2000/01 to 2010/11 (at 2000/01 constant price)



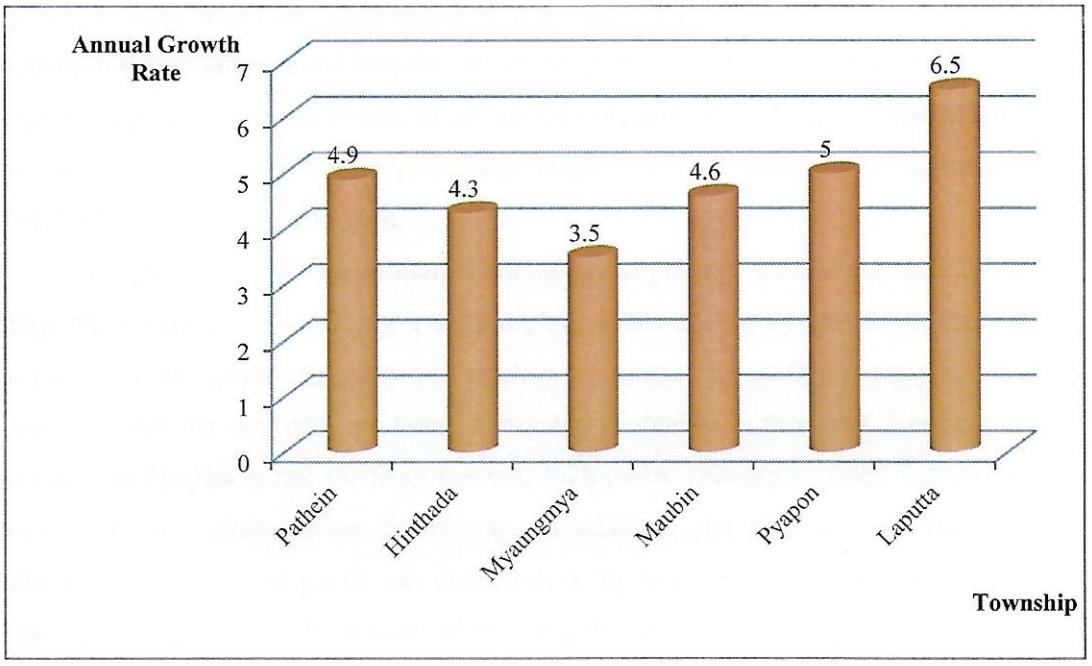
Source: Department of National Planning and Economic Development, Ayeyarwady Region

According to statistics, it is found that Gross Regional Product of Pathein, Hinthada, Myaungmya, Maubin, Pyapon and Laputta significantly increase over 10 years,

accounts for 4.9%, 4.3%, 3.5%, 4.6%, 5% and 6.5% respectively. The following figure shows annual growth rate of Gross Regional Product of Settlements in the Ayeyarwady region during the period of 2000/01 and 2010/11.

Figure 4.38

Annual Growth Rate of Gross Regional Product of Settlements during the period of 2000/01 and 2010/11



Source: Department of National Planning and Economic Development, Ayeyarwady Region

In order to investigate why the annual growth rate of Gross Regional Product (GRP) of Laputta, Pathein and Pyapon is larger than that of the other three settlements according to 2010/11 statistics, focus group discussions with residents from Ayeyarwady region, and respective personnel from Administrative Department, Ayeyarwady Region are made.

Being a delta region, paddy, sesame, groundnut, sunflower, matpe, pedesein and pesinngon are being cultivated in these areas. In addition, marine fisheries, culture fisheries and inland fisheries are being developed due to the prosperity of rivers and

creeks. Fish-paste, fish-sauce, dried fish and dried prawn industries are also being carried out in these areas.

Amongst these townships, it is found that the annual growth rate of GRP of Laputta is the highest one. Being good soil in Laputta, it does't need to say that crop cultivation is successful. In addition, as Laputta is located near the entrance of ocean, marine fisheries, culture fisheries and inland fisheries are very developing. Accordingly, Fish-paste, fish-sauce, dried fish, dried prawn and salt industries are effectively operating. In addition, the construction of road supports the flow of goods and movement of people within the region.These factors certainly drive the GRP of Laputta to reach the highest stage among these towns, based on the outcome of focus group discussion with residents from Ayeyarwady region, and respective personnel from Administrative Department, Ayeyarwady Region.

Pyapon is a settlement which its annual growth rate of GRP is the second highest stage among these towns. Being a delta region, fertile soil in Pyapon is productive for growing paddy, groundnut, sesame, sunflower, matpe. In addition, pepper, banana, coconut, betel nut and dani are being cultivated profitably in this area. Besides, as the location of Pyapon is not far from the sea, Fish-paste, fish-sauce, dried fish and dried prawn trading businesses are flourishing. In addition, the map of road construction affirms that the flow of goods can also be done by not only water ways but also road. Consequently, these are the reasons of reaching the second place among these six towns according to the answers of focus group discussion.

Based on 2010/11 statistics, the annual growth rate of GRP of Pathein is the third place among the six district towns. Paddy, sesame, groundnut, sunflower, matpe, pesinngon, pepper, jute, tapioca, betel leaf and nut, banana and coconut are fruitfully grown in Pathein due to fertile soil. It is affirmed that fishing industries are also successful owing to the proximity of the sea. Ii is also found that as Chaungthar and Ngwesaung beach are very attractive for tourists, tourism industries are successfully running. According to road condition, people easily reach to Yangon from Pathein. The ability to use road also support to easily flow of products from Pathein to outside. All these factors force Pathein to reach the third place in the annual growth rate of GRP of

settlements, as said by residents from Ayeyarwady region, and respective personnel from Administrative Department, Ayeyarwady Region.

Being a delta region, there is no need to say that crop cultivation is booming. However, Myaungmya, Maubin and Hinthada townships are located far from the sea if compared to the location of Laputta, Pyapon and Pathein townships. Accordingly, marine fisheries could not be expanded although inland fisheries in these three townships are developing. The result of focus group discussion with residents and respective personnel from Ayeyarwady region supports that the above factors indicate a reason why the GRP of these three townships are smaller than that of Laputta, Pyapon and Pathein.

In a nutshell, it is observed that a number of roads connecting from one district to another, from district to township, from one township to another, from township to town, and from one town to another have been constructed after transforming into a market oriented economic system in late 1988. It is also asserted that distance by road is closer than that by water way, and transport by road is time saving. Accordingly, it is also observed that the interactions between district towns and towns significantly increased. From the point of view of the growth of settlements, enlargement of business activities, increases in social services and communication services are considerably seen during the period of 20 years. In addition, it is found that gross regional products of settlements actually increase in 2011, compared to the situation of 2001.

Chapter (5)

Analysis on Road Transport and Settlements in Ayeyarwady Region

This chapter attempts to provide the factors which might influence the settlements of the Ayeyarwady region. By using linear regression analysis, these factors were chosen from the list of factors recommended by Henry (1981). Then, it is examined how these factors influence the settlements of the Ayeyarwady region. After that, the changes of each settlement's pattern in the Ayeyarwady region are identified.

5.1 Econometric Analysis on the Effect of Road Transport on Settlements

5.1.1 Model Specification

The literature states that the improvement in road transport could substantially be beneficial to the settlements of a region. Henry (1981) articulates that there are numerous imperative factors such as economic conditions, transportation system, geography, population size, technological innovations and social concerns, which influence settlements. This study will examine the relationship between these factors and the settlements of the Ayeyarwady region. For the settlements in the Ayeyarwady region, transportation system and social concerns could not be employed in the model due to the limitation of data available. The other variables, namely real GDP, population, geographical situation and road condition are considered in the econometric model. In addition, train station access variable is initially included in the model. It is equal to 1 if an area has train station, 0 otherwise.

Firstly, real GDP, population, train station access, abundance of rivers and creeks (represented for geographical situation), and road condition are considered as the determinants of settlements in the model.

NOH = f (RGDP, POP, Train station, Geog, ROADCon)

where,

NOH = number of houses in each area

RGDP = real GDP of each area (kyat million)

POP = population in each area

Train station = dummy for train station access of each area

= 1 if an area has train station

= 0 otherwise

Geog = dummy for geographical situation of each area

= 1 if an area has many rivers and creeks

= 0 otherwise

ROADCon = dummy for road condition in each area

= 1 if road condition is tarred road

= 0 otherwise

The result of the first regression is the following:

NOH = 1254.178 + 0 .140* RGDP + 0.129* POP + 5030.055* Train station
+ 5350.764* Geog -983.807 ROADCon

* stands for at 1% significance level respectively.

In the above equation, the constant term and the coefficient of road condition are not significant, and road condition variable shows a wrong sign. When the model is rerun without road condition variable, the resulting equation is as follows:

NOH = 1775.485 + 0.130*RGDP + 0.129*POP + 4925.239*Geog
+4536.469*Train station

* stands for at 1% significance level respectively.

According to the above equation, the constant term is not significant. Next, when the model is rerun without abundance of rivers and creeks variable, the resulting equation is:

NOH = 7134.696* + 0.171* RGDP + 0.120* POP +2192.639** Train station
+ 746.789 ROADCon

** and * stand for at 1% and 5% significance level respectively.

According to the above equation, the coefficient of road condition is not significant although the coefficients of other variables are positively significant. At this

point, the one important thing is that road condition is needed to be considered in this dissertation because this study is about road network and its effect on the settlements.

Accordingly, in an effort to identify which variables influence the settlements in the Ayeyarwady region, four variables are used in the model. The variables which are employed in this study are variables with panel data relating 24 settlements during the period from 2001 to 2011.

NOH = f (RGDP, POP, Geog, ROADCon)

The model is:

$NOH_{it} = \beta_0 + \beta_1 RGDP_{it} + \beta_2 POP_{it} + \delta_1 Geog_{it} + \delta_2 ROADCon_{it} + \varepsilon_{it}$

In this model, ε_t embodies the stochastic error term and the coefficient β_1 of explanatory variable and coefficient β_2 of control variable are known as slope coefficients (Gujarati, p – 205). In addition, i and t denote cross town unit (1,2,3,….24) and time (1,2,3,……11) respectively.

The regression result is:

NOH = 6765.246***+ 0.103***RGDP + 0.127***POP + 1906.322**Geo
+ 1453.043*ROADCon

***, ** and * stand for at 1% , 10% and 15% significance level.

According to the above regression result, it can be identified that the factors for the settlements of the Ayeyarwady region are real GDP, population, geographical situation and road condition.

After indentifying the factors affecting the settlements of the Ayeyarwady region, not only the separate effect of each variable on the settlements but also the effect of two or three variables on the settlements is also considered by the following equations:

NOH = f(RGDP)

$NOH_{it} = \beta_0 + \beta_1 RGDP_{it} + \varepsilon_{it}$ equation (1)

NOH = f (POP)

$NOH_{it} = \beta_0 + \beta_1 POP_{it} + \varepsilon_{it}$ equation (2)

$$NOH = f(RGDP, POP)$$

$$NOH_{it} = \beta_0 + \beta_1 RGDP_{it} + \beta_2 POP_{it} + \varepsilon_{it} \quad \text{equation (3)}$$

$$NOH = f(POP, Geog)$$

$$NOH_{it} = \beta_0 + \beta_1 POP_{it} + \delta_1 Geog_{it} + \varepsilon_{it} \quad \text{equation (4)}$$

$$NOH = f(POP, ROADCon)$$

$$NOH_{it} = \beta_0 + \beta_1 POP_{it} + \delta_1 ROADCon_{it} + \varepsilon_{it} \quad \text{equation (5)}$$

$$NOH = f(POP, Geog, ROADCon)$$

$$NOH_{it} = \beta_0 + \beta_1 POP_{it} + \delta_1 Geog_{it} + \delta_2 ROADCon_{it} + \varepsilon_{it} \quad \text{equation (6)}$$

$$NOH = f(RGDP, POP, Geog)$$

$$NOH_{it} = \beta_0 + \beta_1 RGDP_{it} + \beta_2 POP_{it} + \delta_1 Geog_{it} + \varepsilon_{it} \quad \text{equation (7)}$$

$$NOH = f(RGDP, POP, ROADCon)$$

$$NOH_{it} = \beta_0 + \beta_1 RGDP_{it} + \beta_2 POP_{it} + \delta_1 ROADCon_{it} + \varepsilon_{it} \quad \text{equation (8)}$$

The Variables

Explained Variable: Number of Houses

To measure which variables among factors that Henry (1981) recommended have an effect on the settlements of the region, number of houses in each area is employed as the dependent variable.

Explanatory Variables

i. Real GDP

Based on the observations of scholars, the presence of significantly competitive power in an economy and the ability to sustain its place are crucial factors for the growth of settlements. In other words, producers need to have a large spatial area for their goods and services; that is to say, they need to achieve many buyers who will pay money for their goods and services. Specifically, the healthiness of the economy of settlement is strong enough so as to achieve its growth. The theory said that real GDP is an indicator

which is employed to measure the healthiness of the economy. Therefore, real GDP of each settlement in the Ayeyarwady region is used as an explanatory variable in this dissertation, aiming at measuring the healthiness of the economy. It captures how the economic situation of a region influences the settlements.

Henry (1981), Shahumyan, Convery and Casey (2010) and Ducruet and Lugo (2011) have emphasized the healthiness of the economy as a crucial factor that influenced the settlements. A region with a healthier economy attracts more settlers, other conditions are held constant. The coefficient of this variable should be positive and significant.

ii. Population

Based on literature, population is an imperative factor determining the development of settlements. Hudson (1969), Henry (1981), Molar (2007), Shahumyan, Convery and Casey (2010), and Ducruet and Lugo (2011) have highlighted the effect of population on the settlements. A settlement which is economically and socially strong is capable of absorbing the enlargement of population, in terms of employment opportunity and housing. This in turn, generates the growth of settlements certainly. In this study, therefore, population of each settlement in the Ayeyarwady region is employed as a determinant variable. The coefficient of this variable is expected to be significantly positive.

iii. Geography

Generally, favorable geographic features such as fertile soil, environmental property, deposits of raw materials have an effect on the settlements. Hudson (1969), Henry (1981), and Shahumyan, Convery and Casey (2010) investigated how the geographical situations influence on the settlement. In this dissertation, a dummy variable is employed as a proxy for geography. Geographically, an area with a favorable geographic situation encourages the growth of settlements, thereby increases the numbers of settlers at that area. Being a delta region, every settlement in the Ayeyarwady region has fertile soil. Therefore crop cultivation is booming everywhere. However, fishing industries are fruitful only if that area has abundant rivers and creeks. Therefore, it is

considered that geography dummy variable is 1 if an area has abundant rivers and creeks, and 0 otherwise.

In the Ayeyarwady region, Hinthada district is located relatively far from the sea, and rivers and creeks are also scarce compared with other districts. The settlements within the other five districts apart from Hinthada district have many rivers and creeks. Accordingly, it is assumed that the geography dummy variable of settlements within the five districts, namely Pathein district, Myaungmya district, Maubin district, Pyapon district and Laputta district is 1, and the geography dummy variable of settlements within the Hinthada district is 0. The relationship between the geography dummy variable and the explained variable should be significantly positive.

iv. Road Condition

To see how the road condition affects the settlements of the Ayeyarwady region, tarred road access dummy variable is employed in these models. According to Hoffecker (1974), Henry (1981), Holl (2004), Mathew and Rao (2006), Shahumyan, Convery and Casey (2010), and Ducruet and Lugo (2011), improvements in transportation are crucial for the growth of settlements. Improvements in the quality of roads make smooth travelling for commodities and people. People settle more at an area with high-quality condition of roads. Based on the observation of a number of scholars, the evenness and smoothness is considered to measure the road condition in this study. Amongst the types of road, tarred road has the highest degree in the evenness and smoothness of road. For the model, therefore, the value is 1 if the settlement in the Ayeyarwady region has tarred road access, 0 otherwise. The expected sign of this tarred road access dummy variable should be positive if an area has high-quality condition of roads such as tarred road.

5.1.2. Source of Data

In this study, the data are taken from respective government offices. The data of real GDP comes from Department of National Planning and Economic Development, Ayeyarwady Region. The data for road condition is received from the Public Works, Ayeyarwady Region. The data relating population is obtained from the General Administration Department, Ayeyarwady Region. The data for business enterprises

comes from the Department of Development Affairs and the Department of Hotel and Tourism, Ayeyarwady Region. The data for education, health and communication services are taken from the Department of Basic Education, Ayeyarwady Region, the Department of Health, Ayeyarwady Region, and the Department of Posts and Telecommunication, Ayeyarwady Region, respectively.

5.1.3 Results and Discussions

In this study, the results are discussed by estimating pooled regressions in the above model and equations. The following table summarizes the estimated regression results of the above model and equations.

Table 5.1
Summary of Regression Results

Explained Variable is the number of houses in each area

Variable (Coefficient)	Model	Equation (1)	Equation (2)	Equation (3)	Equation (4)	Equation (5)	Equation (6)	Equation (7)	Equation (8)
Constant	6765.246**** (1492.731)	30136.742**** (1714.601)	10766.717**** (1190.869)	8519.453**** (1235.437)	6802.161**** (1523.774)	9955.772**** (1202.884)	6747.391**** (1513.177)	6803.254**** (1495.972)	8315.780**** (1236.923)
RGDP	0.103**** (0.036)	0.436**** (0.055)	-	0.149**** (0.031)	-	-	-	0.116**** (0.035)	0.132**** (0.033)
POP	0.127**** (0.005)	-	0.130**** (0.005)	0.121**** (0.005)	0.135**** (0.005)	0.130**** (0.005)	0.135**** (0.005)	0.126**** (0.005)	0.123**** (0.005)
Geog	1906.322** (1037.510)	-	-	-	3701.105**** (924.472)		3202.217**** (946.076)	2077.114*** (1033.512)	-
ROADCoc	1453.043* (978.090)	-	-	-	-	2891.006**** (954.420)	2100.383*** (964.568)	-	1652.184** (976.498)
R-squared	0.779	0.195	0.754	0.774	0.768	0.762	0.773	0.778	0.777
Adjusted R-squared	0.776	0.192	0.753	0.772	0.767	0.761	0.770	0.775	0.774
F-statistic	228.874****	63.482****	803.674****	447.307****	432.899****	418.963****	294.318****	303.023****	301.287****
Observation	264	264	264	264	264	264	264	264	264

Numbers in parenthesis are standard errors; ****, ***, ** and * stand for significance at 1%, 5%, 10%, and 15% respectively.

Discussion for the Result of the Model

With the intention of investigating whether the variables which Henry (1981) recommended actually have an effect on the settlements in the Ayeyarwady region, real GDP, population size, geographical situation and road condition are employed as the explanatory variables in this model.

The estimated coefficient of $RGDP_{it}$ is 0.103, and is statisticaly significant at 1 percent, indicating that the healthiness of the economy significantly influences the settlements of the Ayeyarwady region. It means that one unit increase in real GDP boosts the number of houses in the settlements of the Ayeyarwady region by 0.103 units, if other conditions are being equal. To make it more economically interpretable, if the real GDP increases by one thousand (kyat million), on average, the number of houses in the settlements of the Ayeyarwady region would rise by the quantity of 103, if the influence of population size, geographical situation and road condition are held constant.

The coefficient of POP_{it} is 0.127, and is strongly significant at 1 percent. It implies that population size considerably supports the settlements of the Ayeyarwady region. More precisely, if population increases by one thousand, the average number of houses in the settlements of the Ayeyarwady region would raise by the quantity of 127, if other conditions remain unchanged.

The estimated coefficient of the dummy variable for geographical situation " $Geog_{it}$" is 1906.322, and is significant at 10 percent, indicating that favorable geographical situation maintains the importance of the settlements in the Ayeyarwady region. Specifically, the regression result advocates that favorable geographical situation enhances the number of houses by 1906, if other conditions are being equal.

The regression articulates that the coefficient of $ROADCon_{it}$ is 1453.043, and is positively significant at 15 percent. It means that a high-quality condition of road supports the settlements of the Ayeyarwady region. More precisely, a high-quality condition of road such as tarred road increases the number of houses by 1453, if other things are the same.

The coefficient of the determination (R^2) for the model, indicates that the four variables explain approximately 78 percent of the growth of settlements in the Ayeyarwady region during the 2001 - 2011study period.

According to this model, it can be said that real GDP, population size, geographical situation and road condition influence the settlements in the Ayeyarwady region. Amongst these variables considering in this model, it is observed that the effect of real GDP on settlements of the Ayeyarwady region is significant. Moreover it can be straightforwardly perceived that population size definitely determines the settlements of the Ayeyarwady region. Besides, it can be said that favorable geographical situation supports the importance of the settlements in the Ayeyarwady region by a considerable amount. In addition, it is examined that the road condition is quite important for the settlements of the Ayeyarwady region.

(i) Discussion for Equation (1)

In order to investigate whether the healthiness of an economy influences the settlements in the Ayeyarwady region, $RGDP_t$ is employed as explanatory variable in equation (1). According to the regression result of equation (1), the coefficient of this explanatory variable $RGDP_{it}$ is 0.436 and is positive and significant at 1 percent, implying that the robustness in the economy of a region influences people's decision to settle in that area. The theoretical literature states that in general, a region with a better economy has the opportunity to settle more people if other conditions are held constant, thereby increasing the number of houses in that area. Based on this regression result, a one unit increase in the economic situation of the settlements in the Ayeyarwady region would increase people's living there by 0.436 units on average. Specifically, if real GDP goes up by one thousand (kyat million), on average, the number of houses in the settlements of the Ayeyarwady region goes up by the quantity of 436. (Gujarati, p-214)

The coefficient of the determination (R^2) for equation (1) is 0.195, indicating that the independent variable explains approximately 20% of the variation of the dependent variable of the equation.

(ii) Discussion for Equation (2)

There is no doubt that the improvement in economic situation influences the settlements in the Ayeyarwady region. Next, the size of population is included in the regression in order to investigate the effect of population size on the settlements in the Ayeyarwady region. According to the regression result of equation (2), the coefficient of the control variable POP_{it} is 0.130 and is significant at the 1 percent level, indicating that the effect of population size on the settlements of the Ayeyarwady region is significant.

If the size of population increases by 1 unit, the average number of houses in the settlements of the Ayeyarwady region certainly increases by 0.130 units. Specifically, if the population in the settlements of the Ayeyarwady region increases by 1000, on average, the number of houses in the region would increase by the quantity of 130.

The value of (R^2) for equation (1) is 0.754, indicating that the explanatory variables explain 75% of the variations of the dependent variable of the equation. Accordingly, it can be said that the empirical result totally fits with the existing literature.

(iii) Discussion for Equation (3)

In order to examine the effect of both real GDP and population size on the settlements of the Ayeyarwady region, $RGDP_{it}$ and POP_{it} are employed as explanatory variables in equation (3). According to the regression result of equation (3), the coefficient of the control variable $RGDP_{it}$ is 0.149 and is significant at the 1 percent level, indicating that an improvement in economic situation of an area has an effect on people's desire to settle in that area. Specifically, with the influence of population held constant, as real GDP increases by one unit, on average, the number of houses in the settlements of the Ayeyarwady region goes up by 0.149 units. To make it more economically interpretable, if real GDP goes up by one thousand (kyats million), on average, the number of houses in the settlements of the Ayeyarwady region goes up by the quantity of 149 if other conditions remain unchanged. Therefore it can be said that the result supports what the theory predicts.

Next, the estimated coefficient of the second explanatory variable POP_{it} is 0.121, and is statistically significant at 1 percent. This means that population has an effect on settlements. It can be interpreted that a one unit increase in population size of the settlements in the Ayeyarwady region would raise the number of houses in that area by 0.121 units. Specifically, if the number of population in the settlements in the Ayeyarwady region increases by 1000, the number of houses in the region would be enhanced by 121 on average if real GDP held constant. Accordingly, it can be said that the empirical result is consistent with the literature supposed.

The coefficient of determination for the equation is 0.774. It indicates that the two variables explain 77% of the variations of the dependent variable of the equation. Based on the above explanation of equation (3), it is obvious that both economic situation and population size of the settlements in the Ayeyarwady region have an effect on the settlements of the region.

(iv) Discussion for Equation (4)

Equation (4) considers whether population size and geographical situation influence the settlements in the Ayeyarwady region. The estimated coefficient of the explanatory variable POP_{it} is 0.135 and significant at the 1 percent level. This means that one unit increase in population size enlarges the average number of houses in the settlements of the Ayeyarwady region by 0.135 units if other things are being equal. Specifically, the number of population in the settlements of the Ayeyarwady region goes up by 1000, on average, the number of houses certainly increase by the quantity of 135 if the influence of geographical situation is held constant.

Then, the coefficient of the control variable $Geog_{it}$ is 3701.105, and is strongly significant at 1 percent, implying that favorable geographical situation absolutely influences the settlements of the Ayeyarwady region. If this interpretation is made more meaningful, a favorable geographical situation enhances the number of settlements in the Ayeyarwady region by the quantity of 3701, if other things are being equal.

The value of (R^2) for equation (4) is 0.768, implying that the control variables explain approximately 77% of the variations of the controlled variable of the equation. According to the above explanation of equation (4), it is clear that both population size and geographical situation of the settlements in the Ayeyarwady region have an effect on the settlements of the region.

(v) Discussion for Equation (5)

Equation (5) emphasizes how population size and road condition of a region have an effect on the settlements in the Ayeyarwady region. With the intention of considering whether these two variables influence the region, POP_{it} and $ROADCon_{it}$ are utilized as independent variables in this model. The estimated coefficient of the explanatory variable POP_{it} is 0.130, and is robustly significant at 1 percent. It indicates that with the influence of road condition being held constant, as population size increases by one unit, on average, the number of houses goes up by 0.130 units. Specifically, if the number of population increases by 1000, the average number of houses in the settlements of the Ayeyarwady region would raise by 130 if the other condition is being equal. Accordingly, it cannot be denied that population size has a significant effect on the settlements in the Ayeyarwady region.

In order to grasp the importance of road quality, tarred road access dummy variable is employed as a proxy of the measure for road quality in this equation. The coefficient of the road condition dummy variable is 2891.006, and is significant at the 1 percent level. It means that high quality road such as tarred road has absolutely influenced on the settlements of the Ayeyarwady region. To make it more economically interpretable, high quality of road condition such as tarred road would raise the number of houses in the settlements of the Ayeyarwady region by the quantity of 2891 if the population effect is held constant.

The value of R^2 for this regression equation is also 0.762, meaning that the explanatory variables explain 76% of the variations of the dependent variable of equation (5). This regression result asserts that population size and road condition definitely influences on the settlements of the Ayeyarwady region.

(vi) Discussion for Equation (6)

In this equation, population size, geographical situation and road condition are considered as explanatory variables. The estimated coefficient of the first explanatory variable POP_{it} is 0.135, and is statistically significant at the 1 percent level, indicating that population size has an effect on the settlements of the Ayeyarwady region. Based on the regression result, one unit increase in population generates the average number of houses by 0.135 units if other conditions are held constant. Particularly, the number of population increases by 1000, on average, the number of houses in the settlements of the Ayeyarwady region would be enhanced by 135 if the influence of geographical situation and road condition are held constant.

Then, the coefficient of the dummy variable for geographical situation "$Geog_{it}$" is 3202.217, and is statistically significant at 1 percent. It means that favorable geographical situation supports the growth of settlements. More precisely, favorable geographical situation increases the number of houses by the quantity of 3202, if other conditions remain unchanged.

Next, the coefficient of the road condition dummy variable "$ROADCon_{it}$" is 2100.383, and is at 5 percent level of significance. It implies that a high-quality condition of road has an effect on the settlements of the Ayeyarwady region. More specifically, a high-quality condition of road such as tarred road increases the number of houses in the settlements of the Ayeyarwady region by 2100, if other conditions are being the same.
Based on the above explanation of equation (6), it can be said that population size, geographical situation and road condition support the importance of the settlements in the Ayeyarwady region.

The coefficient of determination for the equation is 0.773, indicating that the regressors explain 77% of the variations of the regressand of the equation. Based on the above explanation of equation (6), it is obvious that population size, geographical situation and road condition of the settlements in the Ayeyarwady region have an effect on the settlements of the region.

(vii) Discussion for Equation (7)

In order to explore whether real GDP, population size and geographical situation influence the settlements of the Ayeyarwady region, $RGDP_{it}$, POP_{it} and $Geog_{it}$ are employed as the independent variables in this equation. According to the regression result, the coefficient of the first independent variable $RGDP_{it}$ is 0.116, and is strongly significant at 1 percent, indicating that one unit increase in real GDP enhances the average number of houses by 0.116 units if other things are being equal. To make it more economically interpretable, if real GDP increases by one thousand (kyat million), on average, the number of houses in the settlements of the Ayeyarwady region would increase by the quantity of 116, if the influences of population size and geographical situation are held constant.

Next, the coefficient of the second explanatory variable POP_{it} is 0.126, and is at 1 percent level of significance, implying that population size certainly has an effect on the settlements of the Ayeyarwady region. More precisely, if the population size increases by 1000, on average, the number of houses in the settlements of the Ayeyarwady region would be enhanced by 126, if other conditions are being the same.

After that, the coefficient of the dummy variable for geographical situation " $Geog_{it}$" is 2077.114, and is positively significant at 5 percent. It means that favorable geographical situation supports the settlements of the Ayeyarwady region. That is to say meaningfully, favorable geographical situation raises the number of houses in the settlements of the Ayeyarwady region by the quantity of 2077, if other things remain unchanged.

The value of R^2 of equation (7) is 0.778, implying that the three variables explain approximately 78% of the variations of the dependent variable of the equation. The above explanations of equation (7) affirms that the healthiness of the economy, population size and geographical situation have a considerable effect on the settlements of the Ayeyarwady region.

(viii) Discussion for Equation (8)

With the purpose of considering real GDP, population size and road condition variables in the equation, $RGDP_{it}$, POP_{it} and $ROADCon_{it}$ are utilized as the explanatory variables in equation (8).

The estimated coefficient of $RGDP_{it}$ is 0.132, and is at 1 percent level of significance, indicating that good economic opportunities support the settlements in the Ayeyarwady region by a considerable amount. According to the regression result of this model, a one unit improvement in economic opportunities boosts the settlements in the Ayeyarwady region by 0.132 units. This means that one thousand (kyat million) increase in real GDP enhances the average number of houses in the settlements of the Ayeyarwady region by the quantity of 132 if the influence of population and road condition are held constant.

The coefficient of the second independent variable POP_{it} is 0.123 and is strongly significant at 1 percent. This means that an increase in population certainly influences the settlements in the Ayeyarwady region if other conditions are held constant. Specifically, if one thousand population increases in the settlement, the average number of houses in that settlement of the Ayeyarwady region would be enhanced by the quantity of 123, if other things are being equal.

In order to grasp the importance of road quality, road condition dummy variable is employed as a proxy of the measure for road quality in this model. The estimated coefficient of the variable "road condition" is 1652.184, and is at 10 percent level of significance. The regression result certainly asserts that the quality of road actually influences the settlements in the Ayeyarwady region. Theoretical literature articulates that if an area has a high-quality condition of road such as tarred road, it raises people's desire to settle more in that area, and if an area does not have a high quality condition of road , it lowers people's desire to settle in that area. The regression result advocates that a high quality condition of road, that is, tarred road enlarges the number of houses in the Ayeyarwady region by the quantity of 1652, if other conditions are the same.

The coefficient of the determination (R^2) for equation (8) is 0.777, indicating that the control variables explain approximately 78% of the variation of the dependent variable of the equation. This regression result asserts that real GDP, population size and road condition actually influence the settlements of the Ayeyarwady region.

In a nutshell, in order to investigate which variables influence the settlements in the Ayeyarwady region, econometric analysis is employed in this section. In this econometric analysis, variables such as real GDP, population, geographical situation and road condition are used for exploring which variables influence on the settlements in the Ayeyarwady region. Based on the econometric analysis, real GDP, population, geographical situation and road condition significantly influence the settlements of the Ayeyarwady region.

In addition, it is observed that the degree of the effect of each variable on the settlements in the Ayeyarwady region is different: it depends very much on the variables considering in each equation.

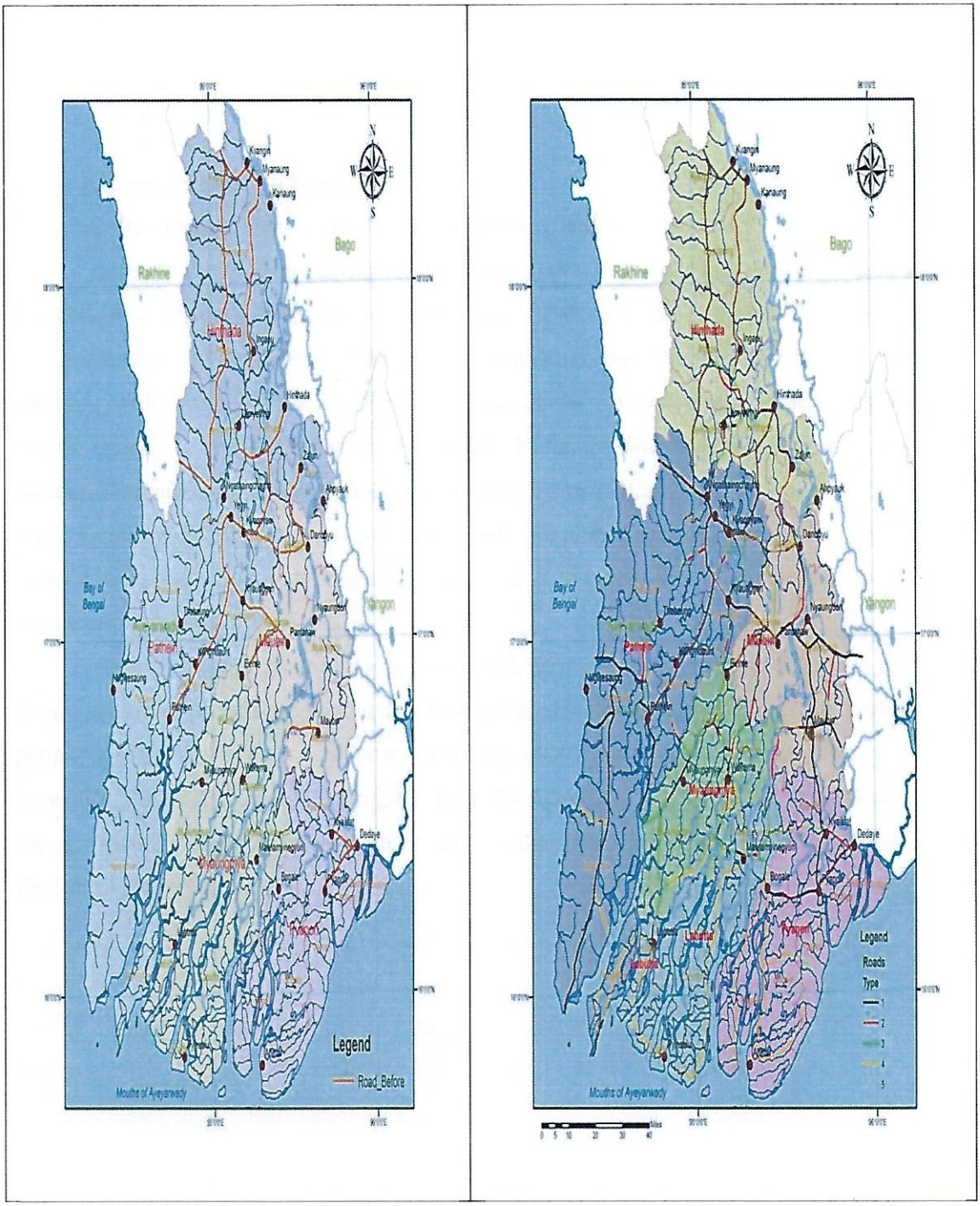
5.2 The Effect of Road Improvement on Settlement Pattern

Geographically, rivers and creeks are countless in the Ayeyarwady region. Hence, waterways became the only mode in ancient times. Then, the northern part of the region is much plain than the southern part of the region, there were a rail road from Pathein to Hinthada and Myanaung, and a few roads in the northern part before 1989 although they were not used extensively. Only after 1989, a number of roads connecting from one district to another, from district to township, one township to another, township to town, and one town to another have been constructed. At the present time, there are several roads to travel easily and smoothly from one place to place at any time.

Figure 5.1

Routes in the Ayeyarwady Region Before and After 1989

Routes before 1989 ***Routes after 1989***



Source: Public Works, Ayeyarwady Region

Legend

Routes before 1989

Red line – Road

Routes after 1989

1. Black line - Tarred Road
2. Red line - Rocky Road
3. Green line - Thick Earth Road
4. Orange line - Earth Road
5. Dotted Orange line - Earth Road (under construction)

As seen in the map of the Ayeyarwady region, several road networks such as Yangon- Nyaungdon – Pantanaw – Kyaungkone – Pathein road, Pathein – Shwemyintin – Thanlyaksun – Maungbiwa – Shawpyar – Chaungthar road, Pathein-Myaungmya road, Einme – Darka road, Warkhalma-Einme road, Lapputta-Myaungmya road, Myaungmya-Einme road, Kyaungkone-Kyonpyaw road, Pantanaw-Shweloung-Warkhema road, Maubin-Sarmalauk road, Daydaye-Kyaiklatt road, Pyapon-Bogalay road, Maubin-Tontay road, Kyaiklatt-Kyaikpi-Mawlamyinegyun road, Maubin-Kyaiklatt road and Kyaiklatt-Pyapon have been constructed. In addition, the 11 road networks have been implemented after storm – Nargis in 2008.

With an improvement in roads after 1989, people can move easily from one place to another either for business or for employment opportunities with less time. In addition, people may transfer from one place to another to seek better opportunities in life as roads improved within and outside the region. How the number of houses in the settlements of the Ayeyarwady region change with an improvement in roads in the region is shown in the following table.

Table 5.2

Numbers of Houses in Settlements of the Ayeyarwady Region

Before and After 1989

Township	No. of houses Before 1989	No. of houses After 1989
Pathein	31309	30054
Ngaputaw	1483	1903
Kyonpyaw	3744	4858
Yaykyi	5132	6324
Kyaungkone	2860	3675
Hinthada	18724	19198
Kyangin	3062	3292
Ingapu	1018	1191
Myaungmya	8595	10318
Einme	2122	2718
Maubin	3921	6467
Pantanaw	1740	2870
Nyaungdon	2832	4672
Danubyu	2497	4118
Pyapon	5647	8407
Bogalay	4872	9491
Kyaiklatt	3671	4824
Daydaye	2559	3499
Laputta	1515	6457
Mawlamyinegyun	4517	5706

Source: General Administrative Department, Ayeyarwady Region

As seen in the above table, the numbers of houses in most settlements increases. Based on this study, it can be said that the improvement of roads in the region may be a reason why the numbers of houses in settlements increase. For Pathein, Kangyidaunt, Ngwe Saung and Shwe Thaung Yan were separated from Pathein Township in 1994/95, 2000/01, and 2004/05 respectively. This is a reason why the number of houses decreases.

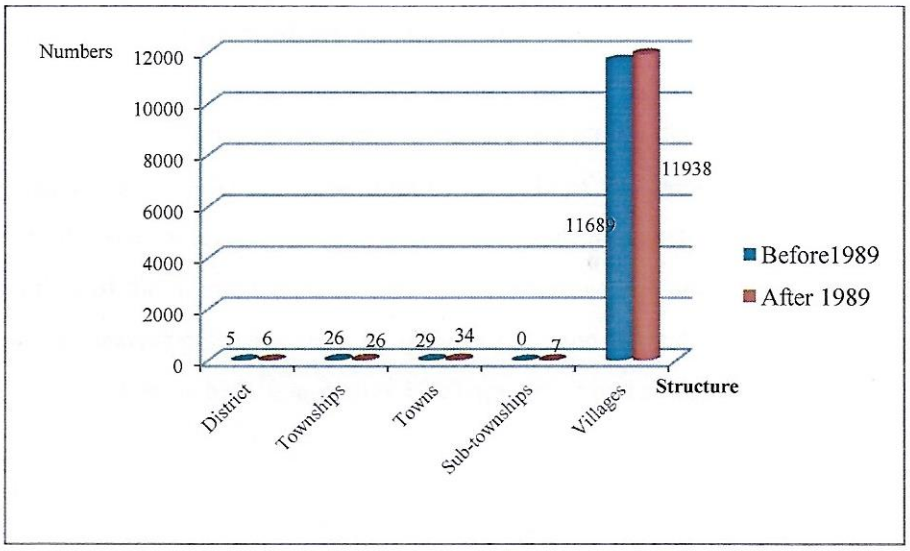
Another reason is that as road today from Yangon to Pathein is better than that of previous times, and communication today is also better than that of before, some people from Pathein usually move to Yangon. Without living in Pathein, they can manage their businesses in Pathein. When they need to go to their businesses in Pathein, they can

reach there within 4 hours by car. These factors, therefore, reduce the number of houses in Pathein.

Being an administrative region, the structure of the whole region has slightly changed according to administrative purposes. There were 5 districts, 26 townships, 29 towns, 11689 villages in one year before 1989. According to the current statistics, there are 6 districts, 26 townships, 7 sub-townships, 34 towns and 11938 villages. These changes are depicted in the following figure.

Figure 5.2

Structure of the Ayeyarwady Region Before and After 1989



Source: Administrative Department, Ayeyarwady Region

As can be seen in the above figure, these changes are just changes in structure according to administrative purposes. In order to analyze the changes of each settlement's pattern in Ayeyarwady region, nearest neighbor analysis is employed in this study.

The formula employed to calculate the ratio is:

$$Rn = \frac{Observed\ Mean}{Expected\ Mean}$$

$$Rn = \frac{\frac{\Sigma d_i}{n}}{0.5\sqrt{\frac{a}{n}}}$$

Where Rn = Nearest Neighbour Ratio

Observed Mean = $\frac{\Sigma d_i}{n}$

Expected Mean = $0.5\sqrt{\frac{a}{n}}$

d_i = the distance between one house and another

a = the urban area of each settlement

n = the number of houses in each area

In this calculation, only 6 feet is used as the average distance between one house and another in each settlement according to the rule of the Department of Development Affairs. Only the measure of urban area is used for each settlement due to the unavailability of the average distance between one house and another in the whole town. Based on the nearest neighbor ratio (Rn), the calculated Rn values of each settlement in the Ayeyarwady region before and after 1989 are stated in Table 5.3.

Table 5.3

The Value of Rn in Each Settlement of the Ayeyarwady Region

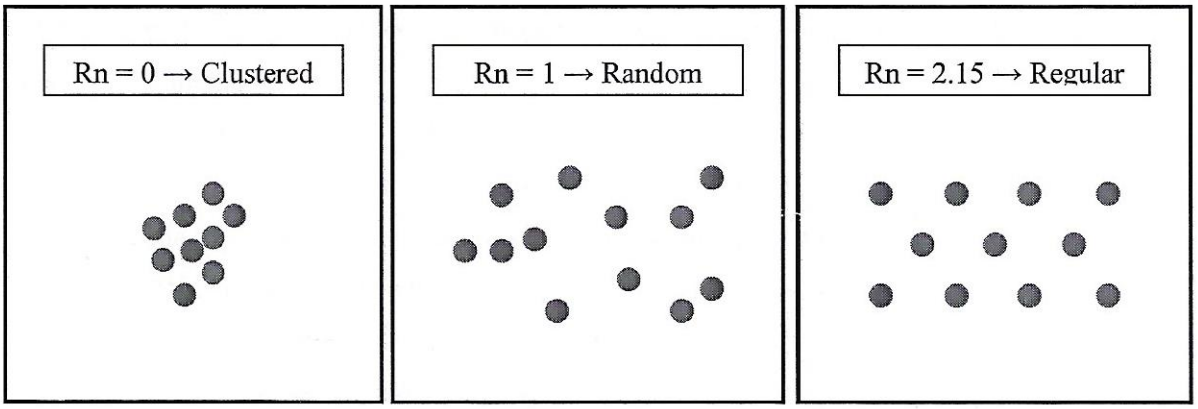
Before and After 1989

District	Township	Before 1989	After 1989	Remark
		Rn	Rn	
Pathein	Pathein	0.0999	0.0813	Tend to linear clustering
	Ngaputaw	0.1315	0.1489	Tend to random
	Kyonpyaw	0.1326	0.1219	Tend to linear clustering
	Yaykyi	0.1327	0.1473	Tend to random
	Kyaungkone	0.1273	0.1090	Tend to linear clustering
Hinthada	Hinthada	0.1601	0.1539	Tend to linear clustering
	Zalun	0.1615	0.1445	Tend to linear clustering
	Myanaung	0.1843	0.1671	Tend to linear clustering
	Kyangin	0.1915	0.1699	Tend to linear clustering
	Ingapu	0.1266	0.1369	Tend to random
Myaungmya	Myaungmya	0.1972	0.1814	Tend to linear clustering
	Einme	0.1150	0.1149	Tend to linear clustering
	Warkhema	0.1659	0.1195	Tend to linear clustering
Maubin	Maubin	0.0927	0.1191	Tend to random
	Pantanaw	0.0987	0.1071	Tend to random
	Nyaungdon	0.1208	0.1356	Tend to random
	Danubyu	0.1273	0.1405	Tend to random
Pyapon	Pyapon	0.0899	0.1022	Tend to random
	Bogalay	0.1265	0.1584	Tend to random
	Kyaiklatt	0.1479	0.1563	Tend to random
	Daydaye	0.1604	0.1724	Tend to random
Laputta	Laputta	0.0960	0.1212	Tend to random
	Mawlamyinegyun	0.1346	0.1332	Tend to linear clustering

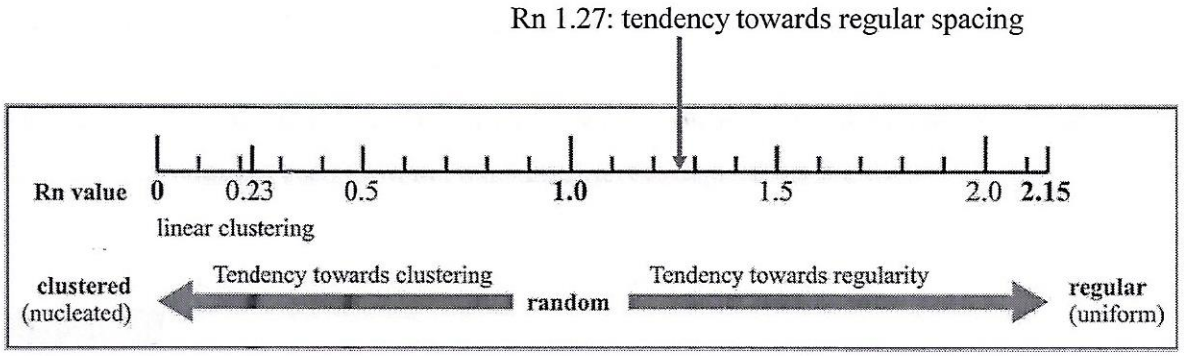
Source: Calculated based on data received from General Administrative Department and Department of Development Affairs, Ayeyarwady Region

Based on the theory, the result of the nearest neighbour analysis must lie between 0 and 2.15. If the value of the index "Rn" is equal to 0.00, the pattern of settlement is a totally clustered pattern. When "Rn" shows 1.00, the pattern will be a random distribution. If the result gives 2.15, the settlement pattern will be a completely regularly spaced pattern.

The patterns of settlements based on nearest neighbour analysis are shown in the following figures[19] (as shown in figure 2.5 and 2.6).



Source: Author's sketch based on "geogonline.org.uk/nearest neighbor"



Source: Author's sketch based on "geogonline.org.uk/nearest neighbor"

As shown in the above figure, if the Rn value of each settlement is nearer to 0, it shows that there is a tendency towards a clustered pattern of settlements. Once the value is less than 0.23, it can be said that there is a linear clustering pattern of settlements. The value of Rn is 1.27: it means that there is a fairly strong tendency towards a regular pattern of settlements. The value of Rn approaches to "0": it implies that the pattern tends to linear clustering.

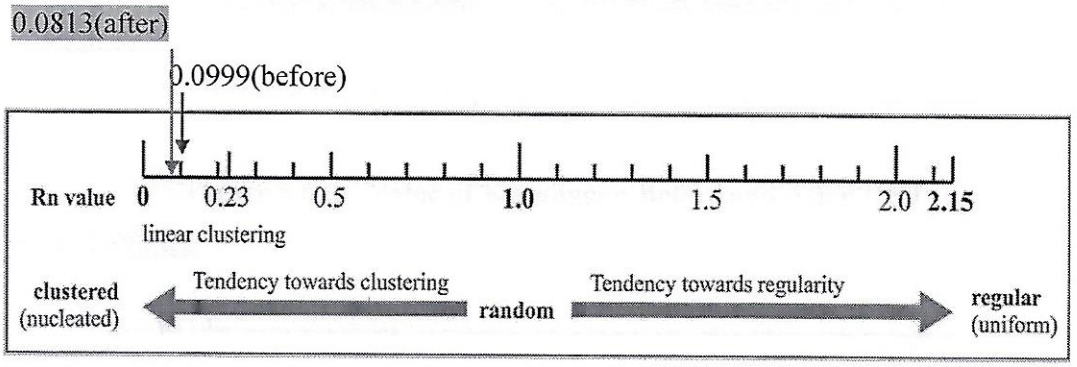
[19] www.geogonline.org.uk/nearest neighbour.ppt

The literature said that only when settlements are extremely nucleated or dispersed, the patterns could be said exactly; so the patterns of settlements in the real world are likely to be between these two extremes.[20]. Based on calculation, as the result of the value of Rn in each settlement is between 0 and 1, it can be said that the calculation fits with the literature.

As seen in Table 5.3, in Pathein District, the value of Rn in Pathein is 0.0999 before 1989, and becomes 0.0813 after 1989. For Kyonepyaw, the Rn value before 1989 is 0.1326, and turns into 0.1219 after 1989. The Rn value of Kyaunggon is 0.1273 before 1989, and changes to 0.1090 after 1989. Based on the results, it can be said that the patterns of Pathein, Kyonepyaw and Kyaunggon had a tendency to random before 1989. However, as the Rn values are closer to 0 after 1989, it can be understood that the patterns become linear clustering.

The Rn value of Ngaputaw is 0.1315 before 1989, and turns out to be 0.1489 after 1989. Similarly, The Rn values of Yaykyi before and after 1989 are 0.1327 and 0.1473 respectively. According to these results, it can be interpreted that the patterns of Ngaputaw and Yaykyi tend to random after 1989 from linear clustering before 1989. The extents of Rn values of each town in Pathein district are depicted as follows.

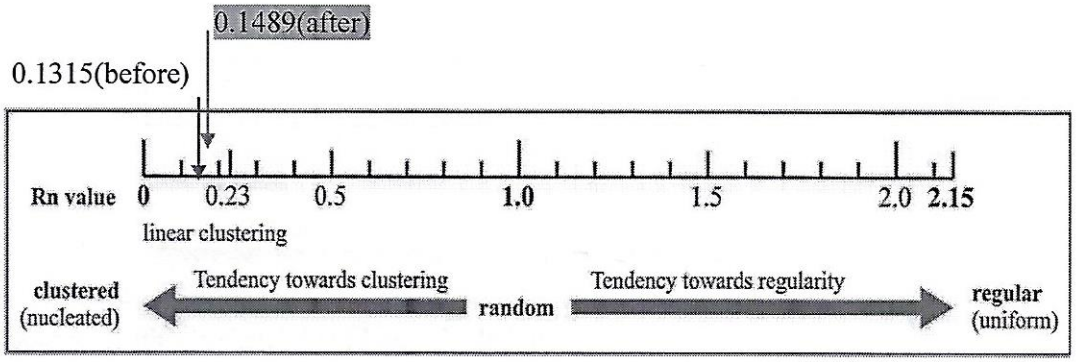
Figure 5.3 Rn Value of Pathein Before and After 1989



Source: Author's sketch based on calculation

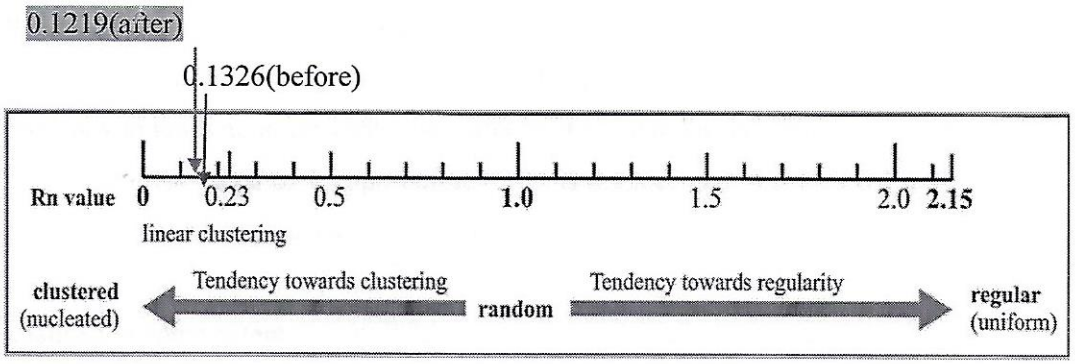
[20] ibid

Figure 5.4 Rn Value of Ngaputaw Before and After 1989



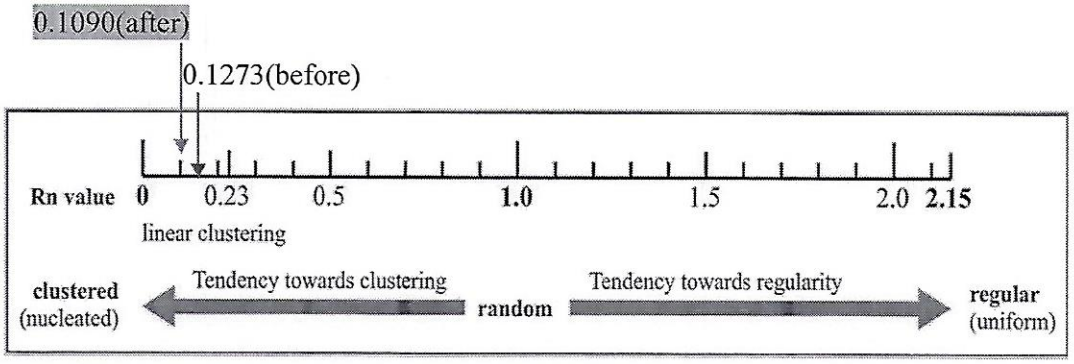
Source: Author's sketch based on calculation

Figure 5.5 Rn Value of Kyonpyaw Before and After 1989



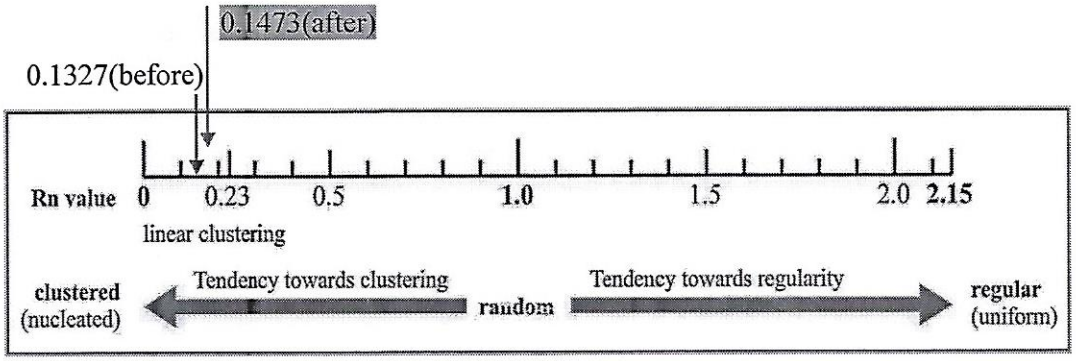
Source: Author's sketch based on calculation

Figure 5.6 Rn Value of Kyaunggon Before and After 1989



Source: Author's sketch based on calculation

Figure 5.7 Rn Value of Yaykyi Before and After 1989

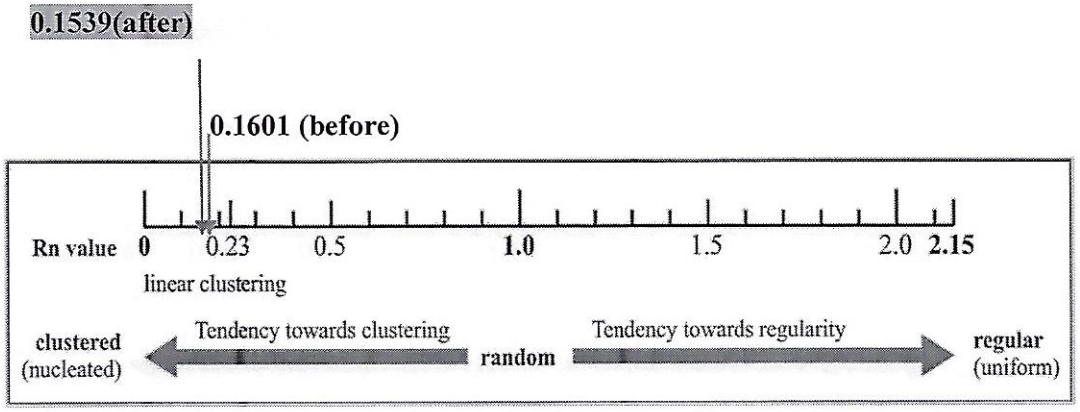


Source: Author's sketch based on calculation

In Hinthada District, the Rn valule of Hinthada is 0.1601 before 1989, and becomes 0.1539 after 1989. The value of Rn in Zalun is 0.1615 before 1989, and changes to 0.1445 after 1989. The values of Rn in Kyangin before and after 1989 are 0.1915 and 0.1699 respectively. For Myanaung, the Rn values before and after 1989 are 0.1843 and 0.1671 respectively. Based on these results, the patterns of these towns before 1989 had a tendency to random. After 1989, the patterns of these towns become linear clustering.

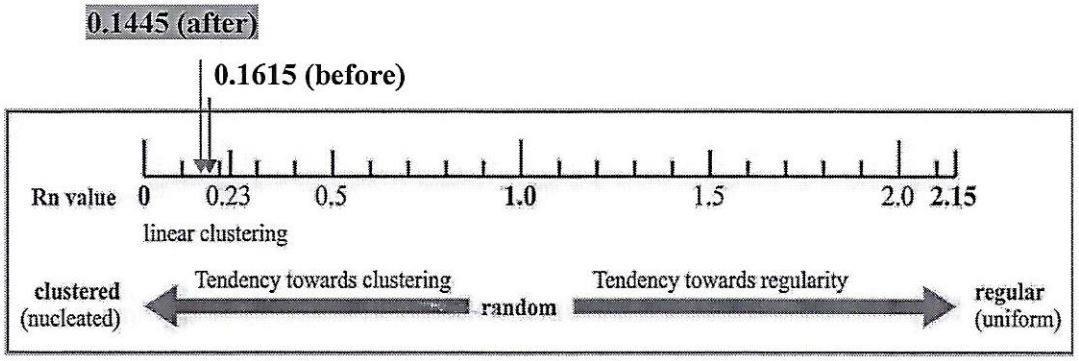
The Rn value of Ingapu before 1989 is 0.1266, and becomes 0.1369 after 1989. So the pattern of Ingapu tends to random after 1989 from linear clustering before 1989. Overall, it can be observed that the extent of clustering for each town in Hinthada district changed to some extent.

Figure 5.8 Rn Value of Hinthada Before and After 1989



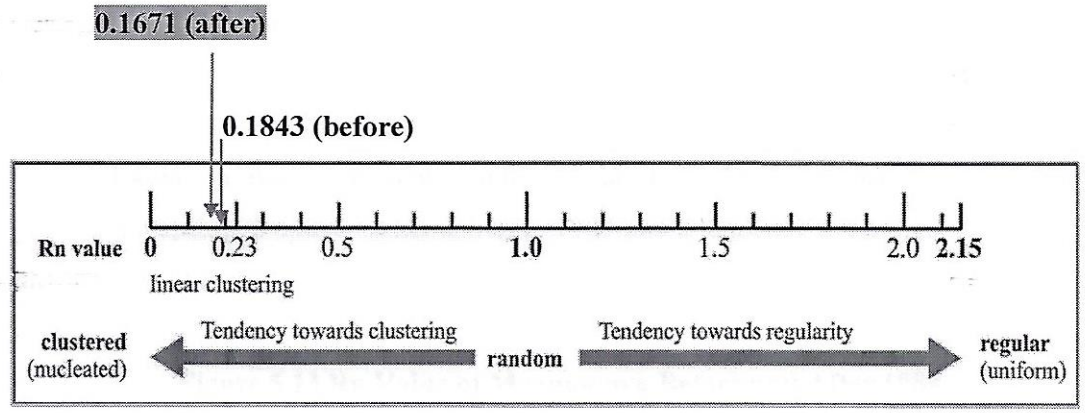
Source: Author's sketch based on calculation

Figure 5.9 Rn Value of Zalun Before and After 1989



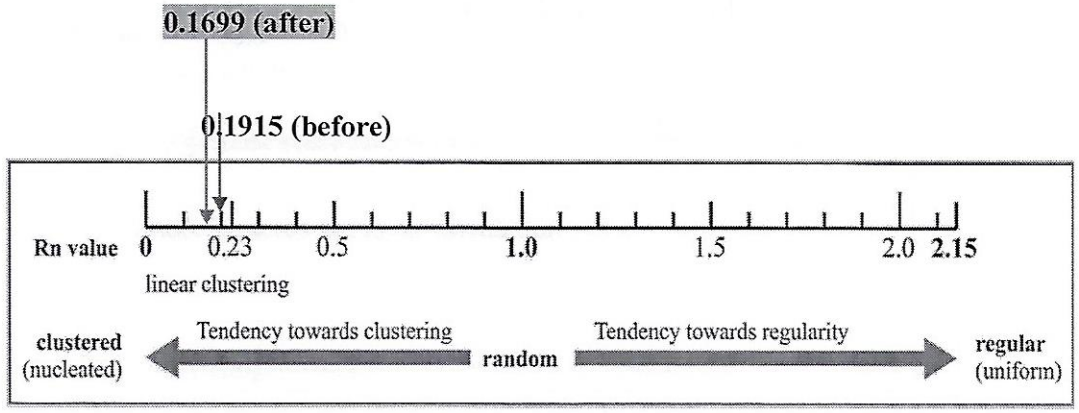
Source: Author's sketch based on calculation

Figure 5.10 Rn Value of Myanaung Before and After 1989



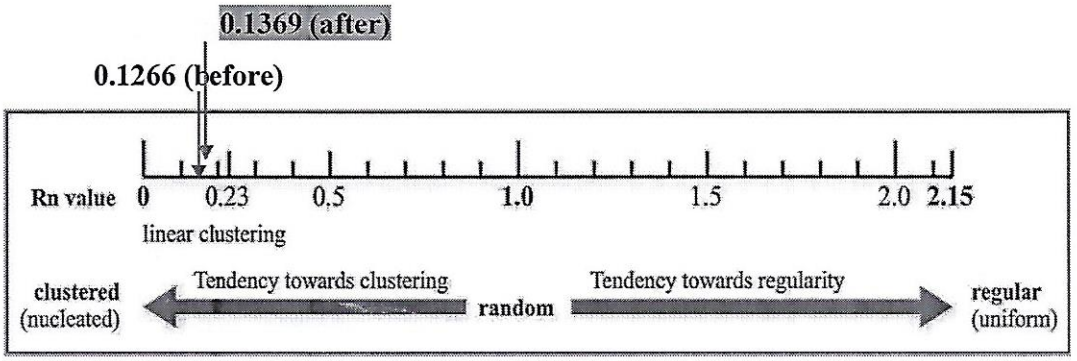
Source: Author's sketch based on calculation

Figure 5.11 Rn Value of Kyangin Before and After 1989



Source: Author's sketch based on calculation

Figure 5.12 Rn Value of Ingapu Before and After 1989

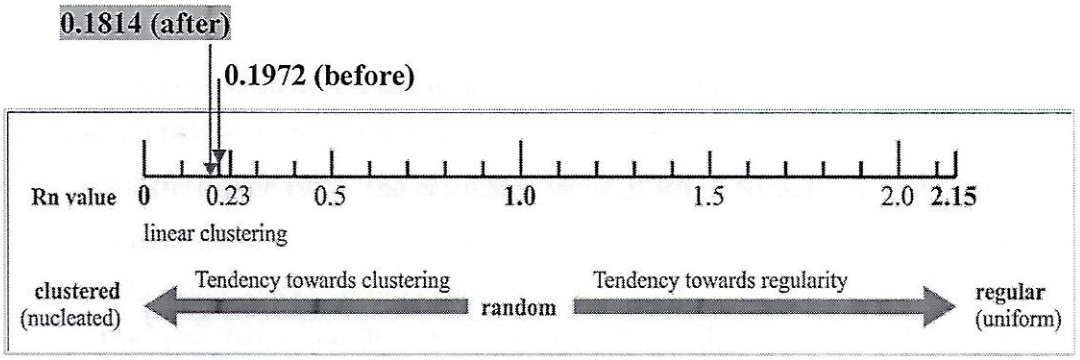


Source: Author's sketch based on calculation

In Myaungmya District, the Rn value of Myaungmya is 0.1972 before 1989, and changes to 0.1814 after 1989. For Einme, the calculated value of Rn is 0.1150 before 1989, and becomes 0.1149 after 1989. The Rn value of Warkhema is estimated as 0.1659 before 1989, and 0.1195 after 1989.

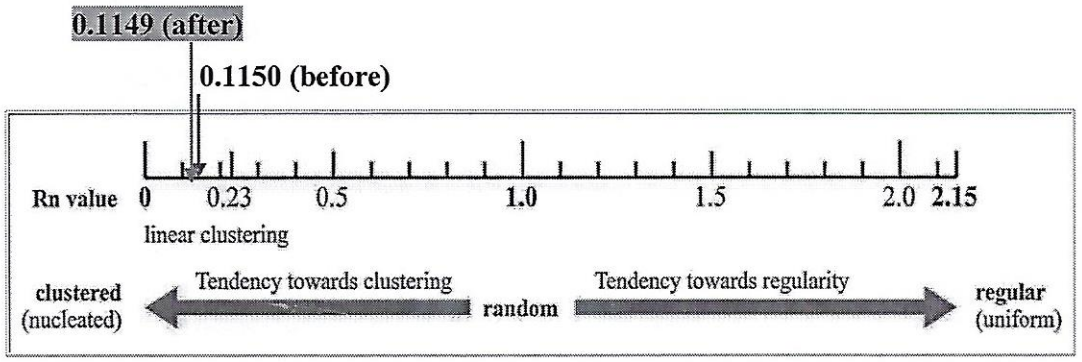
Based on the calculation results, it can be interpreted that the patterns of Myaungmya, Einme and Warkhema before 1989 had a tendency to random. After 1989, the patterns of these towns become linear clustering.

Figure 5.13 Rn Value of Myaungmya Before and After 1989



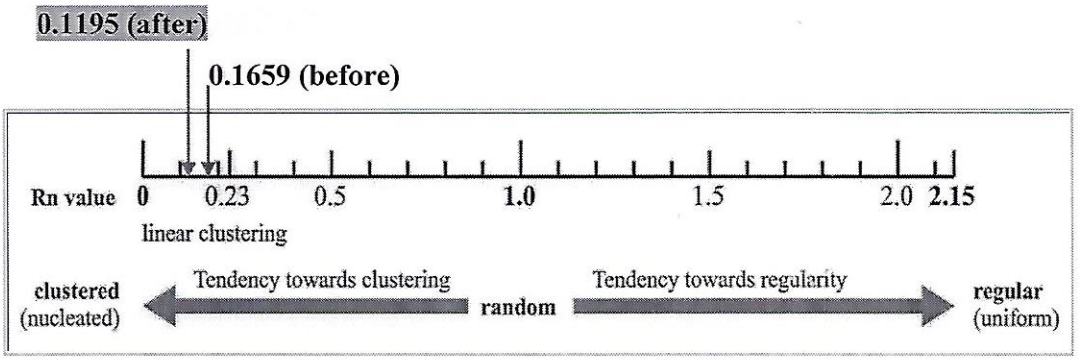
Source: Author's sketch based on calculation

Figure 5.14 Rn Value of Einme Before and After 1989



Source: Author's sketch based on calculation

Figure 5.15 Rn Value of Warkhema Before and After 1989

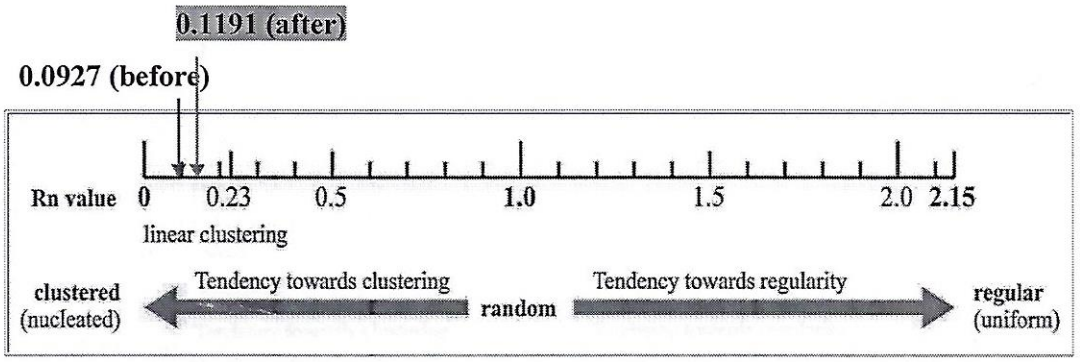


Source: Author's sketch based on calculation

In Maubin District, the calculated Rn value of Maubin is 0.0927 before 1989, and becomes 0.1191 after 1989. For Pantanaw, the result from calculation is 0.0987 before 1989 and 0.1071 after 1989. The calculated value of Rn in Nyaungdon is 0.1208 before 1989, and turns out to be 0.1356 after 1989. The calculated Rn value of Danubyu changes from 0.1273 before 1989 to 0.1405 after 1989.

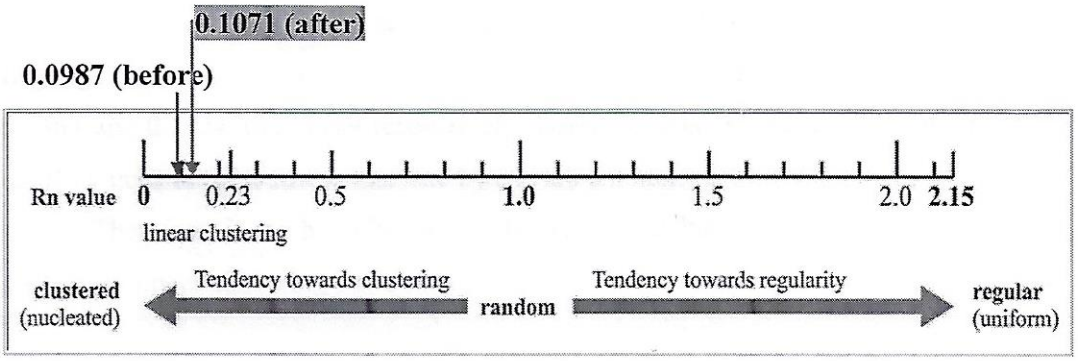
The calculation results observed that the patterns of Maubin, Pantanaw, Nyaungdon and Danubyu tend to random after 1989 from linear clustering before 1989.

Figure 5.16 Rn Value of Maubin Before and After 1989



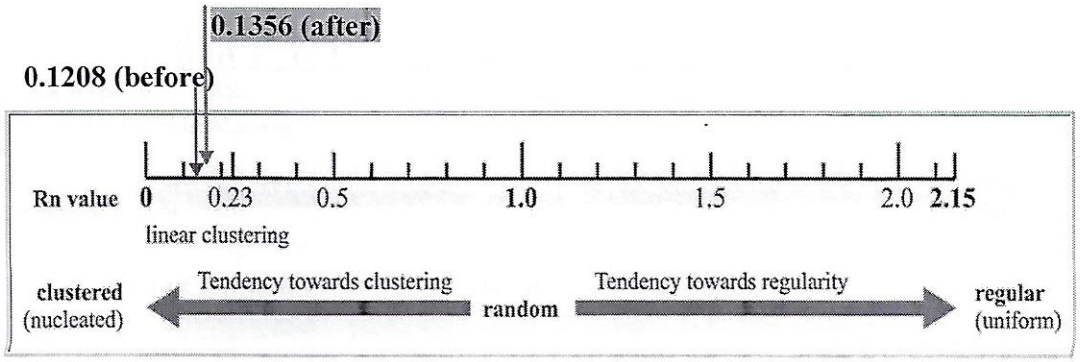
Source: Author's sketch based on calculation

Figure 5.17 Rn Value of Pantanaw Before and After 1989



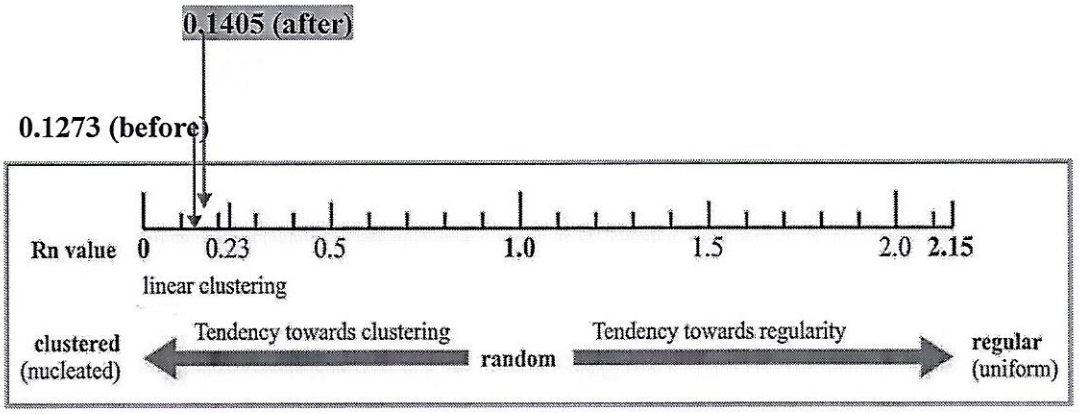
Source: Author's sketch based on calculation

Figure 5.18 Rn Value of Nyaungdon Before and After 1989



Source: Author's sketch based on calculation

Figure 5.19 Rn Value of Danubyu Before and After 1989

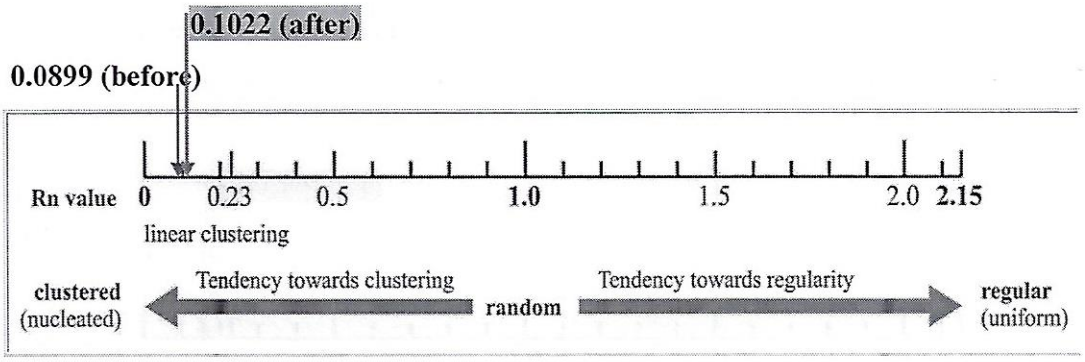


Source: Author's sketch based on calculation

In Pyapon District, the calculated value of Rn in Pyapon, Bogalay, Kyaiklatt and Daydaye raise from 0.0899, 0.1265, 0.1479 and 0.1604 before 1989 to 0.1022, 0.1584, 0.1563 and 0.1724 after 1989 respectively. Based on this calculation, it is observed that the Rn values of these towns increase by a small amount.

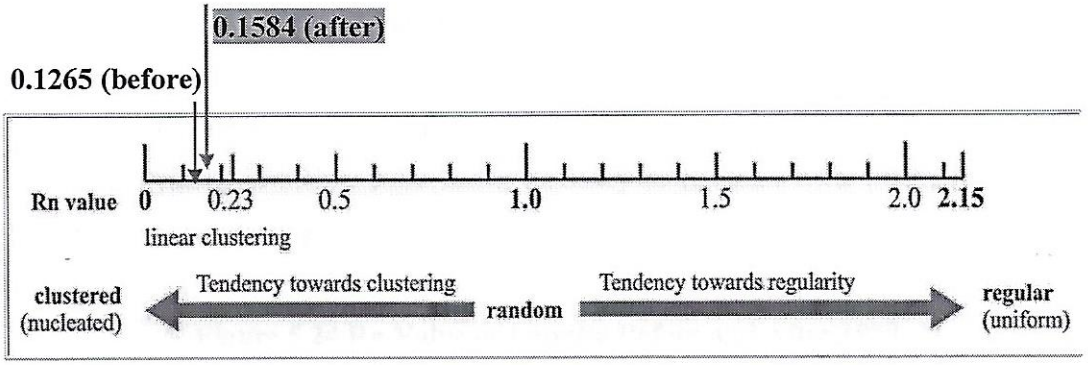
Therefore, it can be inferred that the patterns of these towns tend to random after 1989 from linear clustering before 1989.

Figure 5.20 Rn Value of Pyapon Before and After 1989



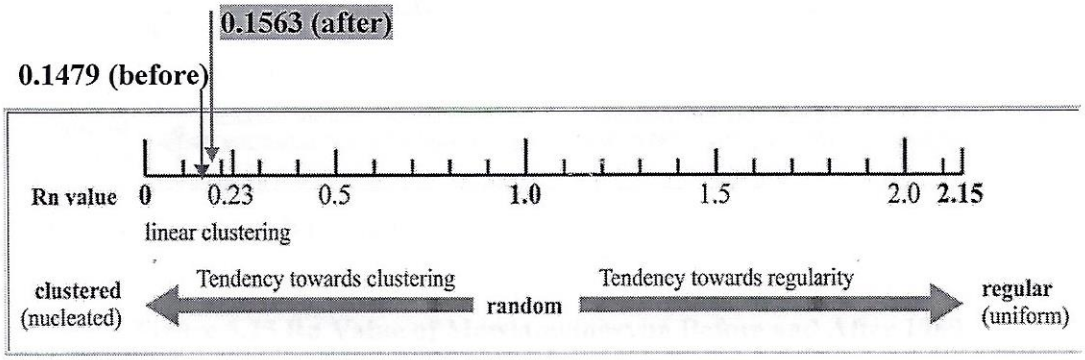
Source: Author's sketch based on calculation

Figure 5.21 Rn Value of Bogalay Before and After 1989



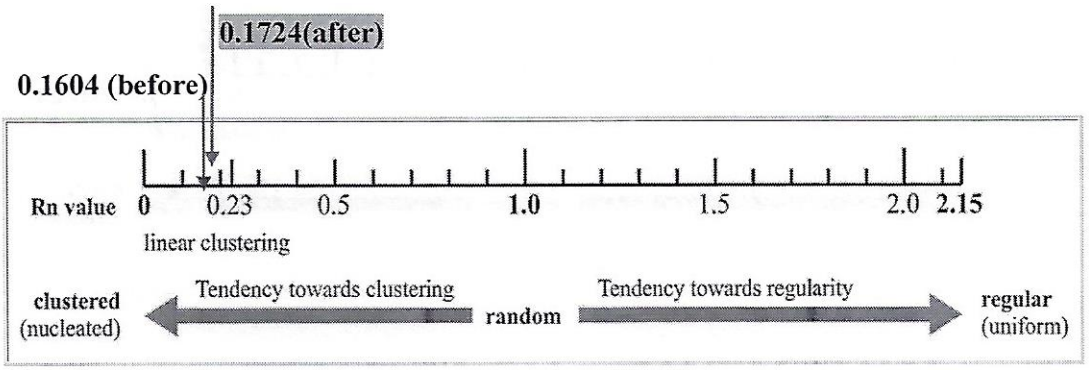
Source: Author's sketch based on calculation

Figure 5.22 Value of Kyaiklatt Before and After 1989



Source: Author's sketch based on calculation

Figure 5.23 Rn Value of Daydaye Before and After 1989

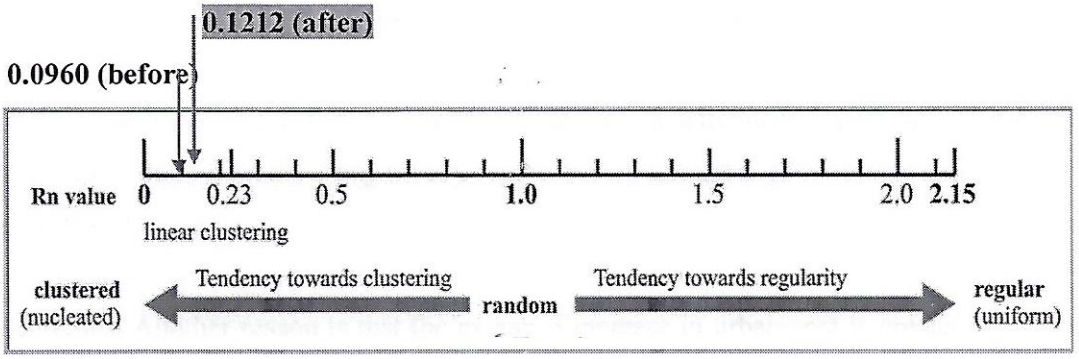


Source: Author's sketch based on calculation

In Laputta District, the result of Rn value of Laputta is 0.0960 before 1989, and becomes 0.1212 after 1989. Based on the results, it can be inferred that the pattern of Laputta tends to random after 1989 from linear clustering before 1989.

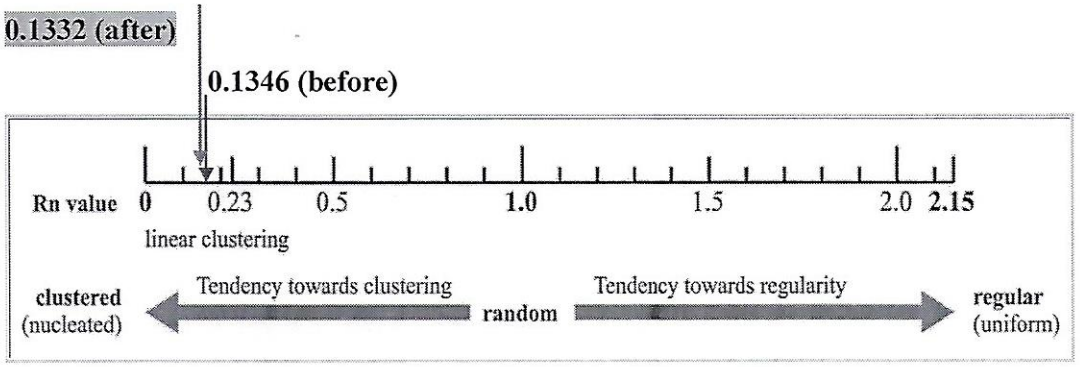
The calculated value of Rn in Mawlamyinegyun decreases from 0.1346 before 1989 to 0.1332 after 1989. According to this result, it can be understood that the pattern of Mawlamyinegyun before 1989 had a tendency to random. After 1989, the pattern becomes linear clustering.

Figure 5.24 Rn Value of Laputta Before and After 1989



Source: Author's sketch based on calculation

Figure 5.25 Rn Value of Mawlamyinegyun Before and After 1989



Source: Author's sketch based on calculation

On the whole, it is observed that Pathein, Kyonpyaw and Kyaunggon in Pathein district, Hinthada, Zalun, Myanaung and Kyangin in Hinthada district, Myaungmya, Einme and Warkhema in Myaungmya district, and Mawlamyinegyun in Laputta district tend to linear clustering after 1989. Ngaputaw and Yaykyi in Pathein district, Ingapu in Hinthada district, Maubin, Pantanaw, Nyaungdon and Danabyu in Maubin district, Pyapon, Bogalay, Kyaiklatt and Daydaye in Pyapon district and Laputta in Laputta district tend to random after 1989. It can be seen in Table 5.3.

Based on the above calculation, it can be said that the patterns of settlements in the Ayeyarwady region after 1989 vary from those of settlements in the region before 1989. In addition, the density of population in each settlement of the region changes during the period of over 20 years. Table 5.4 shows a change in population density of each settlement.

As shown in the following table, Kyangin is a settlement which has the highest population density in the Ayeyarwady region before and after 1989. However, it can be seen that the population density of some settlements after 1989 decreases compared with the situation before 1989. The extension of urban area is a reason why the density decreases. Another reason is that the extent of increase in urban area is greater than that of increase in population. The settlement with the lowest population density before 1989 was Pyapon, and its position was taken by Pathein after 1989. This is because, the extended area of Pathein is very large, while population size decreased considerably.

Table 5.4

Population Density in Each Settlement before and after 1989

Township	Before 1989		After 1989	
	U-Area(sq-mile)	Population density	U-Area(sq-mile)	Population density
Pathein	16.2	10556.04938	23.4890625	6365.217854
Ngaputaw	0.4430625	17918.46523	0.4430625	22793.62392
Kyonpyaw	1.10029375	9892.812715	1.687439063	9581.975645
Kyaungkone	0.911446875	15963.62926	1.596895313	9573.576853
Hinthada	3.771875	38451.69843	4.1890625	41930.86162
Zalun	1.340625	29435.52448	1.5703125	31016.1194
Myanaung	0.9703125	46808.63124	0.9984375	56031.5493
Kyangin	0.43125	66372.17391	0.5890625	59708.43501
Ingapu	0.328125	41819.42857	0.328125	50179.04762
Myaungmya	1.1421875	38422.76334	1.6203125	42030.16393
Einme	0.828125	33037.28302	1.0625	27714.82353
Warkhema	1.4125	28390.79646	2.4296875	27745.95498
Maubin	2.35625	11014.96021	2.35625	17716.71088
Pantanaw	0.921875	14708.0678	1.2921875	16876.80774
Nyaungdon	1.003125	14431.90031	1.3125	17741.71429
Danabyu	0.7953125	16329.43026	1.078125	19375.30435
Pyapon	3.609375	9349.818182	4.1546875	10915.62241
Bogalay	1.5714375	25251.40198	1.9546875	25062.31815
Kyaiklatt	0.8671875	24378.81081	1.0203125	22571.51608
Daydaye	0.5140625	28675.50152	0.6078125	29270.53985
Laputta	0.8484375	39014.06998	2.2703125	14429.29112
Mawlamyinegyun	1.2875	20019.41748	1.6609375	18703.29257

Source: Author's Calculation based on data received from General Administrative Department and Land Record Department, Ayeyarwady Region

To sum up, it is observed that real GDP, population size, geographical situation and road condition significantly influence the settlements of the Ayeyarwady region. With an improvement in roads in the region, it is also found that the numbers of houses in settlements of the region change. The patterns of settlements in the Ayeyarwady region after 1989 vary from those of settlements in the region before 1989. In addition, the density of population in each settlement of the region changes over 20 years.

Chapter (6)

Conclusion

This study analyzes the development of road network and the growth of settlements in the Ayeyarwady region from 1987/88 to 2010/11. In addition, it is revealed that how road affects the settlements in the Ayeyarwady region, and which variables influence the settlements in the Ayeyarwady region by utilizing panel data concerning real GDP, population, geographical situation and road condition of 24 settlements in the region during the period from 2001 to 2011. Besides, it is investigated how the patterns of settlements in the Ayeyarwady region change before and after 1989, by using calculation method, namely nearest neighbor ratio.

6.1 Findings

Based on the findings of the study, it is significantly observed that a number of roads connecting from one district to another, from district to township, from one township to another, from township to town, and from one town to another have been constructed. Moreover, it is found that the 11 road networks development plan has been launched after storm – Nargis, aiming at passing through the region. Amongst these 11 road networks, the construction work on 10 road networks were already completed in 2009 and 2010. The last one - Laputta-(Kyaukphyarlay)-Thonekhwa-Oaktwin-Htakesun road was also completed in 2012. Consequently, people can move to almost all cities in the Ayeyarwady region within a short time. It is also asserted that distance by road is closer than that by water way, and transport by road is time saving. According to Bottic, Sisinacki and Skuflic (2006), the improvements in road transport reduce travel times. Therefore it cannot be denied that the effect totally fits with the existing literatures. In addition, it is also observed that the interactions between district towns and towns significantly increase.

Due to the improvements of road transport within the Ayeyarwady region, people move from one place to another within the region either for commercial reasons or for recreational purposes. Thereby, business enterprises and employment opportunities for the people in the region has been enlarged. From the point of view of the growth of

settlements, enlargement of business activities, increases in social services and communication services are considerably seen during the period of 20 years. In addition, it is observed that gross regional products of settlements actually increase in 2011, compared to the situation of 2001.

In Pathein Township, it is found that most of the businesses significantly increased in the period after 1989 compared to the period before 1989. In particular, the business of motorcycle sales comes into sight on account of the convenience in moving from one place to another. In addition, the outcome which is appreciably seen as a consequence of road improvement is the development of the hotel industry. This is because, many local and foreign tourists could travel to Chaungthar and Ngwesaung beaches, which are very famous resorts in the Ayeyarwady region, without taking much time; only 4 hours drive from Yangon. With an improvement of business activities, it is also found that the growth rate of Gross Regional Product of Pathein has increased by 6.5 percent during the period of 2001 and 2011.

As long as road transport in Hinthada Township improves, increasing population enhances number of businesses, social services such as education and health, and improves communication services over the 20 year period. It is actually observed that most of the businesses in Hinthada Township steadily increase during the periods of 20 years. Soil in Hinthada area is very appropriate for cultivation of various crops, and road transportation has become good enough to distribute crops either to Yangon region or the middle part of Myanmar. It is, therefore, perceived that the number of crop trading businesses considerably increased in Hinthada. Another outcome from the improvement of road transport is that motorcycle sales businesses become visible. This is because, people in Hinthada area are aware of the usefulness of motorcycle alongside the road improvement. The Gross Regional Product of Hinthada has really increased by 4.3 percent through an improvement of business activities during the periods over 10 years.

With an improvement of road transport, growth of population in Myaungmya area led to increases in the number of businesses, schools, hospitals, health centers, telephone services and so on during the 20 year period. It is notably viewed that most of the businesses significantly increase in Myaungmya after 1989. With a growing population in Myaungmya area, it is found that grocery shops drastically increase. There were no

motorcycle sales before 1989. Starting from 2001/02, motorcycle sales business has come into view in Myaungmya caused not only by the improvement of road, but also people's awareness towards the usefulness of motorcycles. The growing number of guest houses is also the fruits of road improvement within the region. For the reason that people can move easily and smoothly from one place to another by road within a short time, and thereby become much travelling. In short, it is asserted that a variety of business activities have increased much during the period of 20 years. The Gross Regional Product of Myaungmya has also risen by 3.5 percent for the duration of 10 years.

In Maubin Township, it is actually found that the numbers of business, schools, hospitals, and communication services such as wireless phone noticeably increased with an increase in population during the period of 20 years. With an increase in population, grocery shops, stores, tea shops, cold drink shops, and household utensils shops has extensively been raised after 1989. Motorcycle sales business has been initiated in Maubin after 1989 seeing that people are aware of the effectiveness of motorcycles and the improvement of roads. Besides, it is found that the number of guest houses in Maubin increase for the duration of over 20 years. The improvement of road transport within the area has led to the development of the economic situation of that area, thus attracting people from other places to that area either for employment opportunities or for commercial purposes. This is the factor that facilitates to increase the number of guest houses. With an increase in business activities, the Gross Regional Product of Maubin has increased by 4.6 percent during the period of over 10 year period.

The construction of roads and bridges made the moving of people and freight from one place to another safe and smooth inside and outside the region. Consequently, the numbers and types of businesses, social services such as schools and hospitals, communication services such as wireless phones in Pyapon gradually grew during the period of 1989 and 2011. It is observed that the significantly growing business enterprises in Pyapon during the period over 20 years are grocery shops, stores, tea shops, hard ware shops and cold drink shops. In addition, it is scrutinized that the number of guest houses considerably increase in Pyapon area. If truth be told, fishery production in Pyapon area is a developing industry as Pyapon is not far from the sea. Accordingly, fish-paste, fish-sauce, dried fish and dried prawn trading businesses are prosperous in this location. With

a moving from one place to another by road besides waterway without difficulties, having a sufficient amount of employment opportunities attracts people to the area, thereby increasing the number of guest houses in the area. As business activities expand to some extent, the Gross Regional Product of Pyapon has been boosted by 5 percent during the over 10 year period.

Being delta region, there are countless rivers and creeks, and indigenous people depends very much on water ways. When the region was stricken by Nargis storm in 2008, indigenous people in Laputta township suffered very much because there was no way to escape from that natural hazard. Therefore this reality made obvious the important role of roads for people within the Ayeyarwady region in moving from one place to another. Accordingly, with an improvement in roads in Laputta Township, the number of businesses, education services such as schools and hospitals, and communication services such as wireless phones gradually changed over time. Over 10 years, it is found that the number of groceries, stores, fabric shops and tea shops significantly increase in Laputta township. According to its geographic situation, Laputta is located near the entrance of the ocean. Therefore fishery industry is very developing, and fish-paste, fish-sauce, dried fish, dried prawn and salt industries are very successful. Such an adequate amount of opportunity for business makes people attractive to go through this area, and thus the number of guest houses in the area has noticeably increased during the period over 10 years. With an improvement in road transport and being a satisfactory level for business opportunity in the area, it is found that the Gross Regional Product of Laputta has significantly increased by 6.5 percent during the period of more than 10 years.

With an improvement in road transport, it is found that people can move easily within and outside the region without using much time. It is also observed that the number of businesses, education and health services, and communication services such as wireless phones in each area gradually grow during the period over 20 years. In addition, it cannot be denied that the Gross Region Product of settlements has also gone up over the period of 10 years. Therefore it can be said that the above explanations support what the literature articulated.

In order to investigate which variables affect the settlements in the Ayeyarwady region, various variables that Henry (1981) recommended have been considered initially

in the models. However, the data for transportation system and social concerns are not reliable and satisfactory enough for the measurement of such variables. Therefore the study has emphasized only variables which are available but reliable, and significant for employing in the econometric analysis.

Employing panel data on real GDP, population, geographical situation and road condition, the study examines which variables influence the settlements in the Ayeyarwady region. Based on the econometric analysis, it can be investigated that real GDP, population size, geographical situation and road condition significantly have an effect on the settlements of the Ayeyarwady region.

It is obviously demonstrated that the robustness in the economy of the settlements substantially influences that area. The empirical result strongly recommends that there is no doubt that the economic situation of a region definitely influences people's decision to settle in that area. An area with a healthier economy has made more opportunities for people to settle than an area with a poorer economy, and thus the numbers of houses in that area increase. According to empirical results of the model employed in this dissertation, a one thousand (kyat million) improvement in real GDP of the settlements in the Ayeyarwady region greatly increases people living there by a considerable amount on average. Consequently, it cannot be denied that the empirical result advocates what the theory said.

Next, the effect of population size on the settlements in the Ayeyarwady region is also considered in the regression. The empirical result suggests that an increase in population size significantly influence the settlements in the Ayeyarwady region, if other conditions are being equal.

In addition, it is also investigated how favorable geographical situation supports the importance of the settlements in this dissertation. Based on the regression results, it is evidently affirmed that favorable geographical situation has an effect on the settlements of the Ayeyarwady region by a considerable amount.

What is more, regression has provided how important the quality of road is. A relatively low quality condition of road such as earth roads makes the importance of the settlements less if other conditions remain unchanged. Alternatively, a relatively high quality condition of road such as tarred roads makes the importance of the settlements

more if other things are being equal. In examining the effect of road condition on the settlements of the Ayeyarwady region, this regression result strongly reflects that an area with a high quality condition of road such as tarred road is more significant than an area with a low quality condition of road such as earth road. Therefore, it can be said that this regression result evidently indicates that the construction of roads is very supportive in the growth of settlements.

In this dissertation, the pattern of each settlement in the Ayeyarwady region has been analyzed by using the urban area of each settlement, the number of houses in each settlement and the distance between one house and another, for each of two time periods - before and after 1989. As the results lie between 0 and 1, it can be said that the calculation according to the nearest neighbor ratio absolutely fits with the literature.

According to the findings of the study, it is asserted that the patterns of Pathein, Kyonepyaw and Kyaunggon had a tendency to random before 1989; however, the patterns become linear clustering after 1989. For Ngaputaw and Yaykyi, the patterns tend to random after 1989 from linear clustering before 1989.

In Hinthada District, it is observed that the patterns of Hinthada, Zalun, Kyangin, and Myanaung before 1989 had a tendency to random. After 1989, the patterns of these towns become linear clustering, based on the results. The pattern of Ingapu tends to random after 1989 from linear clustering before 1989.

In Myaungmya District, it is asserted that the patterns of Myaungmya, Einme and Warkhema before 1989 had a tendency to random. After 1989, the patterns of these towns become linear clustering, as said by the calculation results.

In Maubin District, the calculation results suggest that the patterns of Maubin, Pantanaw, Nyaungdon and Danubyu tend to random after 1989 from linear clustering before 1989.

In Pyapon District, it is observed that the Rn values of Pyapon, Bogalay, Kyaiklatt and Daydaye increase to some extent. Therefore, it can be understood that the patterns of these towns tend to random after 1989 from linear clustering before 1989.

In Laputta District, the result of Rn value of Laputta increases from 0.0960 before 1989 to 0.1212 after 1989. According to this result, it can be asserted that the pattern of Laputta tends to random after 1989 from linear clustering before 1989. For

Mawlamyinegyun, the Rn value reduces from 0.1346 before 1989 to 0.1332 after 1989. This result suggests that the pattern of Mawlamyinegyun becomes linear clustering after 1989 although the pattern of the town had a tendency to random before 1989.

Accordingly, it is observed that the patterns of settlements in the Ayeyarwady region after 1989 vary from those of settlements in the region before 1989, based on the findings of the study.

It is also observed that the density of population in each settlement of the region changes during the period of over 20 years. Amongst the settlements in the Ayeyarwady region, Kyangin is a settlement with the highest population density in the Ayeyarwady region in the period before and after 1989. However, the density of population in Kyangin after 1989 decreases compared with the situation before 1989. The reason why the density decreases is the extension of urban area. The settlement which is the lowest population density before 1989 was Pyapon, and its position was taken by Laymyethnar after 1989.

6.2 Recommendations

In this study an attempt has been made to provide suggestions that are productive and beneficial for policy implementation. This study found that a large numbers of road miles have been constructed inside the Ayeyarwady region over a period of over 20 years. It is observed that due to the improvement of roads, there are a number of benefits such as reduced travel time and distance. Accordingly, the construction of roads should be provided to reach every corner of the area if possible.

With an improvement of road construction within the Ayeyarwady region, it is observed that the interaction between settlements increases, based on the gravity model which is the formula used to measure the interaction between settlements. Consequently, there is no doubt that the construction of roads should definitely be supported.

In this study, the empirical results advocate that the healthiness of the economy of the settlements have considerable effects on those areas. The healthier the economy of a

region, the more people wishes to settle in that area. Therefore, the opportunities which get better economic situation of an area should be provided.

In order to provide economic opportunities, the presence of greatly competitive power in the economy of an area is very imperative. To achieve greater competitive power, the efficiency of transportation; in other words, ease of movement is very important. At this point, only the construction of roads is not enough for the efficiency of transportation, the quality of roads needs to be strong enough. That is, if the constructed roads are to be really useful, the roads should be tarred roads. If the roads are not tarred road, it cannot be said that the effects of those roads are significant. The empirical result also support that a relatively high quality of road such as tarred road enhances the importance of the settlements in the Ayeyarwady region. Conversely, a relatively low quality of road such as earth road reduces the importance of the settlements in the Ayeyarwady region. Currently, most of the roads in the Ayeyarwady region are still earth roads. Based on the regression result, it is observed that the effect of tarred road construction in the settlements of the Ayeyarwady region is really strong. Accordingly, in order to effectively improve the usefulness of roads, high quality roads, that is, tarred roads should be made available.

Based on the observation of the regression result, population size has strongly effect the settlements in the Ayeyarwady region. People are usually fond of living in the world which can provide opportunities for their life. Accordingly, it can be said that an area with a large population is an area with a good economic situation. Therefore, it should be constructed economic opportunities for attracting people to settle more in a region so as to facilitate the growth of settlements.

According to the regression results, it is observed that favorable geographical situation is a considerable factor for the importance of the settlements in the Ayeyarwady region. In this study, the abundance of rivers and creeks is considered as favorable situation for the growth of settlements. The abundance of rivers and creeks develops the fishing industries, which in turn generates the desire of people to settle more in that area, and increases the number of houses in the area. Therefore, it can be said that the ample existence of rivers and creeks is also economically important. In fact, rivers and creeks

are endowed by nature. Accordingly, this natural world should be conserved to be sustained.

In brief, it is believed that if the above suggestions could be satisfactorily accomplished, it would be incredibly applicable for development projects in the Ayeyarwady region.

Regarding settlements pattern, based on the findings of the study, some settlements tend to random, and some tend to cluster. The reason why the patterns tend to random may be an extension of urban area. If the area of settlement cannot be extended, the pattern will definitely be a clustered one. According to the findings of the study, it is hard to articulate the extent of the relationship between settlements' pattern and settlements growth. For instance, the growth rate of Laputta is 6.5 percent although the pattern of Laputta tends to random. The growth of Pathein is 4.9 percent although the pattern of Pathein tends to be clustered.

In summary, this study investigates the variables that significantly influence the settlements in the Ayeyarwady region by employing panel data relating to 24 settlements during the period of 11 years. According to the empirical results, it is asserted that real GDP, population size, geographical situation and road condition considerably influence the settlements in the Ayeyarwady region. On the other hand, this study could not consider the effects of road improvements on each settlement in the Ayeyarwady region due to the inability to collect an adequate amount of data for each settlement in the region. If the availability of data is satisfactory to a sufficient degree, the empirical results could precisely inform which variables influence on each settlement in the Ayeyarwady region, and how these variables have an effect on each settlement in the region. In addition, it can be observed whether the effects of road improvements on each settlement are identical. If the effects are not indistinguishable, it could be investigated which settlement is healthier than others, based on the outcome resulting from the empirical analysis. These will be the opportunities for further research, from this study.

References

Aksoy, E. and N.T. Gultekan. Effects of Transportation on Urban Development: Sivrihisar, turkey. A Paper Presented in International Conference on Urban Transport and the Environment 2006.

Birch, B. and J. C. Hudson. On a Theory for Rural Settlement, *Annals of the Association of American Geographers*, Vol. 60, No. 3, pp.610-61,1970.

Bonavia, M. R. *The Economics of Transport*, James Nisbet & Co. Ltd. Cambridge, 1958.

Botric, V., J. Sisinacki, and L. Skuflic. "Road Infrastructure and Regional Development: Some Evidence from Croatia, Paper prepared for the 46th Congress of the European Regional Science Association Volos, Greece, August 30th - September 3rd, 2006.

Coelho, P. R. P. and K. H. Daigle. "The Effects of Developments in Transportation on the Settlement of the Inland Empire", *JSTOR Agricultural History,* Symposium on the History of Agricultural Tradeand Marketing, Vol. 56, No. 1, pp. 22-36, 1982.

Chandra, A. and E. Thompson. Does public infrastructure affect economic activity?: Evidence from the rural interstate highway system, Regional Science and Urban Economics, pp 457 - 490, 2000.

CSISS. Org Contributors, Agarwal, P., Walter Christaller: Hierchical Patterns of Urbanization, http:// www. csiss.org/classics/ content/67
Accessed on 20 May 2010.

Davidson, C, M,. and T. M. Bell. A Methodological Inquiry into the Determination of the Rural-Urban Interface, *Western Journal of Agricultural Economics*, 1977.

Deldot Contributors, Archaeology research,
http://www. deldot.govarchaeologydraft_research_designpdfderies19_set_dev,
Accessed on 16 May 2010.

Ducruet, C., and I. Lugo. Structure and Dynamics of Transportation Networks: Models, Methods, and Applications, *halshs – 00605653, Version 1,* 2011.

Ehow Contributors, Settlement Pattern,
http://www.ehow.com/facts_7460776_settlement-pattern_.html,
Accessed on 16 May 2010.

General Administration Department of Ayeyarwady Region, *Regional facts of Ayeyarwady Region,* Ministry of Home Affairs, 2007 and 2010.

General Administration Department of Hinthada District, *Hinthada District Gazetteer*, Ministry of Home Affairs, 2010.

General Administration Department of Laputta District, *Laputta District Gazetteer*, Ministry of Home Affairs, 2010.

General Administration Department of Maubin District, *Maubin District Gazetteer*, Ministry of Home Affairs, 2010.

General Administration Department of Myaungmya District, *Myaungmya District Gazetteer*, Ministry of Home Affairs, 2010.

General Administration Department of Pathein District, *Pathein District Gazetteer*, Ministry of Home Affairs, 2010.

General Administration Department of Pyapon District, *Pyapon District Gazetteer*, Ministry of Home Affairs, 2010.

Geogonline Contributors, Nearest Neighbour Analysis, http://www.geogonline.org.uk/nearest neighbour.ppt, Accessed on 17 July 2011.

Goodbody Economic Consultants, Transport and Regional Development, 1998. http://www.irishspatialstrategy.ie/docs/pdf/Transport%20and%20Regional%20Development.pdf Accessed on 18 August 2011.

Gujarati, D. N. *Basic Econometrics,* Fourth Edition, McGraw-Hill/Irwin, New York, 2003.

Hilhorst, J.G.M. *Regional Studies and Rural Development*, Gower Publishing Company Limited, England, 1990.

Holl, A. Manufacturing location and impacts of road transport infrastructure: empirical evidence from Spain, *Regional Science and Urban Economics,* Vol. 34, pp. 341– 363, 2004.

Hudson, J. C., A Location Theory for Rural Settlement, *Annals of the Association of American Geographer,* Vol 59, No.2, pp. 365-381, 1969.

Iloveindia Contributors, history of transportation, http://lifestyle.iloveindia.com/lounge/history-of-transportation-4121.html , Accessed on 16 May 2010.

Jamal, Z. and M. Ashraf. Development of Intermediate-size Towns: An Alternative Form of Urbanization, *Quarterly Science Vision,* Vol.9 No.1-2, 2003.

Johnston, R. J., Central Places and the Settlement Pattern, *Annals of the Association of American Geographers,* Vol. 56, No. 3, pp.541-549, 1966.

Kariel, H. G., Analysis or the Alberta Settlement Pattern for 1961 and 1966 by Nearest Neighbor Analysis, *Geografiska Annaler. Series B, Human Geography,* Vol. 52, No. 2, pp. 124-130, 1970.

Kyaw Oo. Lectures on Transportation Economics, Department of Economics, Institute of Economics, Yangon, Myanmar, 1981.

Liu, L. Settlement Patterns, Chiefdom Variability, and the Development of Early States in North China, *Journal of Anthropological Archaeology,* Vol. 15, pp. 237 – 288, 1996.

Mathew, T, V,. and K. V. K. Rao. Introduction to Transportation Engineering, *NPTEL May 24,* 2006.

Meshkini, A. and H. Rahimi, Changes in Population Settlement Pattern in Urban System of Tehran Province from 1966 to 2006, *Journal of Geography and Regional Planning* Vol. 4, No.7, pp. 371-382, 2011.

Ministry of Home Affairs, *District, Township, Sub-township, Town, Ward, Village and Village tracks in Each State and Region,* Various Issues.

Ministry of Information, *Chronicle of National Development Comparison between Period Preceding 1988 and After*, Various Issues.

Ministry of National Planning and Economic Development, Ayeyarwady Divisional Gazetteer, 2007.

Ministry of Transportation Contributors, History, Policies, Strategies in Ministry of Transportation, http://www.mot.gov.mm/dot/organization.html, Accessed on 16 May 2011.

Molar, T. Factors Influencing Development Level of Settlements in South Transdanubia, *Journal of Central European Agriculture,* Vol. 8, No.3, pp. 277–284, 2007.

Munnell, A. H., Infrastructure Investment and Economic Growth, *The Journal of Economic Perspectives*, Vol. 6, No. 4, pp. 189-198, 1992.

Musa, I, J,. and B. A. Ndawayo. The Role of Transportation in the Development of Tourism in Nigeria, *Tourismos: An International Multidisciplinary Journal of Tourism*, Vol.6, No.1, pp. 297-305, 2011.

Mya Than, Changing faces of the Ayeyarwady (Irrawaddy) Delta (1850-2000), Paper presented at the Chao Phraya Delta: Historical development, dynamics, and challenges of Thailand's rice bowl, Bangkok, 2006.

Myanmar Business Directory (Lower), *Myanmar Lower Region Business Directory,* Yangon, Myanmar, 2011.

Myat Thein, *Economic Development of Myanmar*, Institute of Southeast Asian Studies, 2004.

Naw Hteemulo Htoo, A Study on Yangon – Pathein Road (1962-63 to 1996-97), Unpublished M.Econ Thesis, Yangon Institute of Economics, 1998.

Nourse, H. O. *Regional Economics: A Study in the Economic Structure, Stability, and Growth of Region,* McGraw-Hill Inc, the United State of America, 1968.

Portageandmain Contributors, Settlement – Lesson Plan, http://www.portageandmainpress.com/lesson_plans/plan_258_1.pdf, Accessed on 16 May 2010.

Richardson, H.W. *Elements of Regional Economics*, Penguin Books Ltd, Harmondsworth, Middlesex, Englind, 1969.

Rodrigue, J. P., Transportation and Economic Development, http://people.hofstra.edu/geotrans/eng/ch7en/conc7en/ch7c1en.html Assessed on 18 August 2011.

Sampson, R. J., M. T. Farris, and D. L. Schrock. *Domestic Transportation: Practice, Theory, and Policy,* Sixth Edition, Houghton Mifflin Company, New York, 1990.

Schmitz, J. A. and A. Teixeira. Transportation and Development: Insights from the U.S., 1840—1860, *Federal Reserve Bank of Minneapolis Research Department Staff Report 425*, May 2009.

Schurmann, C., K. Spiekermann, and M. Wegener. Trans-European Transport Networks and Regional Economic Development, *ERSA conference papers,* 2002.

Shahumyan, H., S. Convery, and H. Casey. Exploring Land Use-transport Interactions in the Greater Dublin Region Using the MOLAND Model, *Proceedings of ITRN2010, 31st August to 1st September 2010,* p. 1-7, University College Dublin, Ireland, 2010.

Smith, C. A. *Regional Analysis, Volume I, Economic Systems*, Acedemic Press Inc. New York, 1976.

Thida Kyu, A Study on the Development Activities of Kokant Border Area, Unpublished M.Econ Thesis, Yangon Institute of Economics, 1994.

Toe Toe Lwin, A Study on Passenger Transportation by Ma-Hta-Tha in Yangon, Unpublished M.Econ Thesis, Yangon Institute of Economics,1998.

Treumer, P. and I. R. Junesch,. *Introduction to Regional Development Planning*, Lecture Notes, Institute of Regional Development Planning, University of Stuttgart, 2002.

Tulane.edu Contributors, Descriptive Analysis, http://www.tulane.edu/panda2/Analysis2/one-way/pg1%20descriptive%20analysis/oneway01, Accessed on 25 March 25 2011

United Nations Centre for Human Settlements, Cities in A Globalizing World, Global Report on Human Settlements, 2001.

VTI Contributor, Road Measurement, http://www.vti.se/en/vti-offers/on- road-measurement, Accessed on 25 March 25 2011

Wood, D. F. and J. C. Johnson. *Contemporary Transportation*, Third Edition, Macmillan Publishing Company, the United State of America, 1989.

Wanmali, S. *Rural Infrastructure, the Settlement System, and Development of the Regional Economy in Southern India,* Research Report, International Food Policy Research Institute, 1992.

Win Zaw Htoon, Transportation Development in Myanmar with Special Reference to Road and Rail Sectors, Unpublished M,DevS Thesis, Yangon Institute of Economics, 2009.

Worku, I., "Road Sector Development and Economic Growth in Ethiopia", *EDRI Working Paper 004, September 2011,* Ethiopian development Research Institute, 2011.

Yago, G., The Sociology of Transportation, *Ann. Rev. Sociol*, pp: 171-190, 1983.

Appendices

Appendix Table A.1

Increase in Business Enterprises in Pathein Before and After 1989

Types of Business	Before 1989	1989/90	1994/95	1999/2000	2004/05	2009/10	2010/11
Grocery	10	10	15	22	49	62	77
Stores	8	10	15	29	46	73	84
Tea Shop	35	40	55	97	128	157	169
Crop Trading	1	1	1	2	2	3	3
Gold Smith	2	2	4	8	9	3	3
Fabric Shop	3	3	4	6	10	17	125
Cold Drink Shop	5	7	10	13	22	25	27
Bakery	9	9	15	18	11	22	23
Household Utensils	30	30	40	70	96	222	153
Drug Stores	5	5	7	9	16	16	19
Electrical goods	5	5	8	10	13	15	17
Bicycle Sales	1	1	2	2	7	10	7
Bicycle Repair	4	4	5	9	5	5	8
Timber Shops	2	2	2	3	4	12	15
Fuel Shops	2	2	2	3	4	4	5
Hardware	20	24	25	28	35	45	43
Agricultural Inputs Shops	3	4	9	14	22	17	21
Motorcycle sales	0	0	0	1	1	12	14
Hotel*	0	0	1	13	35	43	43
Guest House	15	19	20	28	33	38	37

Source: Department of Development Affairs, Ayeyarwady Region

*Department of Hotel and Tourism, Ayeyarwady Region

Appendix Table A.2

Situation of Education, Health and Communication Services in Pathein Before and After 1989

Education Services	Before 1989	1989/90	1994/95	1999/2000	2004/05	2009/10	2010/11
Post Primary	0	0	0	0	20	30	31
Primary School	207	207	207	233	223	213	212
Affiliated Primary School	0	0	0	0	1	1	1
Middle School	16	16	16	17	11	7	6
Branch Middle School	0	0	0	0	1	1	2
Affiliated Middle School	1	1	1	1	1	1	0
High School	6	6	6	7	12	12	12
Branch High School	0	0	0	0	3	6	8
Affiliated High School	0	0	0	0	2	4	3
Health Services							
Government Hospital - 250 Bed	0	0	1	1	1	1	1
- 200 Bed	1	1	0	0	0	0	0
- 16 Bed	2	2	2	2	2	2	2
Township Health Care Centre	1	1	1	1	1	1	1
Private Hospital	0	0	0	0	0	2	2
Private Dispensary	0	0	0	0	0	0	12
School Health Centre	2	2	2	2	2	2	2
Maternal & Child Health Centre	4	4	4	4	4	4	4
Communication Services							
Post Office	6	6	6	6	8	9	9
Telegraph Office	1	1	1	1	1	1	1
Wireless	0	0	0	0	490	6362	14970
Auto Telephone Office	1	1	1	1	1	1	1
Manual Telephone Office	1	1	1	2	2	0	0

Sources: Department of Basic Education, Ayeyarwady Region

Department of Health, Ayeyarwady Region

Department of Posts and Telecommunication, Ayeyarwady Region

Appendix Table B.1

Increase in Business Enterprises in Hinthada Before and After 1989

Types of Business	Before 1989	1989/90	1994/95	1999/2000	2004/05	2009/10	2010/11
Grocery	48	49	60	72	64	68	87
Stores	18	21	25	21	30	37	39
Tea Shop	43	47	60	57	54	52	51
Crop Trading	38	42	52	58	64	106	108
Gold Smith	28	30	37	30	37	37	29
Fabric Shop	10	12	15	27	27	36	40
Cold Drink Shop	8	10	13	13	16	18	20
Bakery	5	5	8	7	10	10	12
Household Utensils	18	19	20	29	32	37	40
Drug Stores	8	11	10	15	20	21	22
Electrical goods	2	4	5	7	8	12	15
Bicycle Sales	4	6	4	6	10	7	8
Bicycle Repair	24	25	29	35	23	20	17
Timber Shops	5	5	4	3	4	4	4
Fuel Shops	3	4	5	5	8	5	8
Hardware	12	10	12	12	6	7	10
Agricultural Inputs Shops	3	5	5	4	5	13	10
Motorcycle sales	0	0	0	2	2	2	3
Guest House	10	10	10	11	11	13	14

Source: Department of Development Affairs, Ayeyarwady Region

Appendix Table B.2

Situation of Education, Health and Communication Services in Hinthada Before and After 1989

Education Service	Before 1989	1989/90	1994/95	1999/2000	2004/05	2009/10	2010/11
Post Primary	0	0	0	0	10	17	23
Primary School	318	318	318	318	318	314	314
Branch Primary School	0	0	0	0	0	1	1
Middle School	18	18	18	18	18	18	20
Branch Middle School	0	0	0	6	6	11	12
Affiliated Middle School	1	1	1	1	1	1	1
High School	7	7	7	7	7	8	10
Branch High School	0	0	0	6	6	6	7
Affiliated High School	0	0	0	0	0	0	2
Health Services							
Government Hospital - 200 Bed	0	0	0	1	1	1	1
- 100 Bed	1	1	1	0	0	0	0
- 16 Bed	4	4	4	4	4	4	4
Township Health Care Centre	1	1	1	1	1	1	1
Private Hospital	0	0	0	0	0	0	2
Private Dispensary	0	0	0	0	0	0	35
School Health Centre	1	1	1	1	1	1	1
Maternal & Child Health Centre	2	2	2	2	2	2	2
Communication Services							
Post Office	3	3	3	3	3	4	4
Telegraph Office	1	1	1	1	1	1	1
Wireless	0	0	0	0	0	2255	3693
Auto Telephone Office	1	1	1	1	1	1	1

Sources: Department of Basic Education, Ayeyarwady Region

Department of Health, Ayeyarwady Region

Department of Posts and Telecommunication, Ayeyarwady Region

Appendix Table C.1

Increases in Business Enterprises in Myaungmya Before and After 1989

Types of Business	Before 1989	1989/90	1994/95	1999/2000	2004/05	2009/10	2010/11
Grocery	3	3	3	3	47	57	78
Stores	0	0	0	0	14	15	17
Tea Shop	50	51	59	54	62	68	65
Gold Smith	11	12	14	12	17	14	14
Fabric Shop	0	0	0	0	6	8	9
Cold Drink Shop	15	15	18	15	25	17	14
Bakery	10	12	17	25	25	30	25
Household Utesils	4	5	6	5	7	6	7
Drug Stores	5	5	7	25	28	21	21
Electrical goods	0	0	0	1	7	8	8
Bicycle Sales	1	1	4	3	4	7	7
Bicycle Repair	0	0	0	0	3	5	5
Timber Shops	15	16	20	20	16	13	13
Fuel Shops	8	9	13	7	5	2	2
Hardware	8	10	10	12	22	18	21
Agricultural Inputs Shops	1	2	4	4	3	11	11
Motorcycle sales	0	0	0	0	2	2	2
Guest House	3	4	6	7	9	12	11

Source: Department of Development Affairs, Ayeyarwady Region

Appendix Table C.2

Situation of Education, Health and Communication Services in Myaungmya Before and After 1989

Education Service	Before 1989	1989/90	1994/95	1999/2000	2004/05	2009/10	2010/11
Post Primary	0	0	0	3	7	40	40
Primary School	215	285	285	285	285	186	186
Branch Primary School	0	0	0	2	2	25	25
Affiliated Primary School	34	32	32	30	30	14	14
Middle School	5	7	7	15	15	15	15
Branch Middle School	0	0	0	2	2	12	12
Affiliated Middle School	7	5	5	16	16	8	8
High School	4	7	7	7	7	7	7
Branch High School	0	0	0	1	1	8	8
Affiliated High School	3	3	3	5	5	0	0
Health Services							
Government Hospital - 100 Bed	1	1	1	1	1	1	1
- 16 Bed	2	1	2	2	2	2	2
Township Health Care Centre	1	1	1	1	1	1	1
Private Hospital	0	0	0	0	0	0	1
Private Dispensary	0	0	0	0	0	0	19
School Health Centre	2	2	2	2	2	2	2
Maternal & Child Health Centre	2	2	2	2	2	2	2
Communication Services							
Post Office	1	1	1	1	3	3	3
Telegraph Office	1	1	1	1	1	1	1
Wireless	0	0	0	0	0	1436	3219
Auto Telephone Office	0	0	0	1	1	1	1
Manual Telephone Office	1	1	1	0	0	0	0

Sources: Department of Basic Education, Ayeyarwady Region

Department of Health, Ayeyarwady Region

Department of Posts and Telecommunication, Ayeyarwady Region

Appendix Table D.1

Increases in Business Enterprises in Maubin Before and After 1989

Types of Business	Before 1989	1989/90	1994/95	1999/2000	2004/05	2009/10	2010/11
Grocery	2	2	5	8	8	12	12
Stores	0	0	5	8	8	20	20
Tea Shop	5	5	5	25	50	72	83
Crop Trading	0	1	1	1	1	1	1
Gold Smith	0	0	2	2	2	2	2
Fabric Shop	0	0	1	1	1	1	1
Cold Drink Shop	2	3	5	12	18	19	20
Bakery	2	2	2	3	4	5	6
Household Utensils	3	6	12	12	12	20	20
Drug Stores	1	1	3	4	4	4	4
Electrical goods	1	1	3	3	3	6	6
Bicycle Sales	0	0	3	3	3	3	3
Bicycle Repair	0	0	5	3	3	5	5
Timber Shops	2	5	10	10	8	9	9
Fuel Shops	2	2	2	2	2	2	2
Hardware	0	0	6	7	7	7	7
Agricultural Inputs Shops	1	1	1	1	1	2	2
Motorcycle sales	0	0	2	2	2	2	2
Guest House	1	2	3	4	5	7	7

Source: Department of Development Affairs, Ayeyarwady Region

Appendix Table D.2

The Situation of Education, Health and Communication Services in Maubin Before and After 1989

Education Services	Before 1989	1989/90	1994/95	1999/2000	2004/05	2009/10	2010/11
Post Primary	0	0	0	0	9	27	29
Primary School	272	272	271	272	262	241	233
Branch Primary School	0	0	0	0	0	1	10
Affiliated Primary School	0	0	0	0	0	3	1
Middle School	10	10	11	7	8	4	7
Branch Middle School	2	2	2	2	2	6	12
Affiliated Middle School	3	3	3	3	3	4	0
High School	5	5	5	5	5	5	7
Branch High School	1	1	1	1	2	6	7
Health Services							
Government Hospital - 200 Bed	0	0	0	1	1	1	1
- 100 Bed	1	1	1	0	0	0	0
- 16 Bed	2	2	2	0	2	2	2
Township Health Care Centre	1	1	1	1	1	1	1
Private Dispensary	0	0	0	0	0	0	10
School Health Centre	1	1	1	1	1	1	1
Maternal & Child Health Centre	2	2	2	2	2	2	2
Communication Services							
Post Office	3	3	3	3	4	4	4
Telegraph Office	1	1	1	1	1	1	1
Wireless	0	0	0	0	0	1628	3535
Auto Telephone Office	0	0	0	1	1	1	1
Manual Telephone Office	1	1	1	1	0	0	0

Sources: Department of Basic Education, Ayeyarwady Region

Department of Health, Ayeyarwady Region

Department of Posts and Telecommunication, Ayeyarwady Region

Appendix Table E.1

Changes of Business Enterprises in Pyapon Before and After 1989

Types of Business	before 1989	1989/90	1994/95	1999/2000	2004/05	2009/10	2010/11
Grocery	3	3	4	6	7	11	13
Stores	10	11	12	14	14	18	26
Tea Shop	50	52	56	60	62	67	71
Gold Smith	7	9	13	17	19	20	20
Fabric Shop	1	1	1	1	1	2	2
Cold Drink Shop	3	3	6	10	10	12	18
Bakery	1	1	1	1	1	1	2
Household Utensils	1	1	1	2	2	3	2
Drug Stores	1	1	2	3	3	3	6
Electrical goods	2	2	2	4	5	6	8
Bicycle Sales	1	1	1	2	2	2	2
Bicycle Repair	1	1	1	2	3	2	2
Timber Shops	6	6	10	14	15	14	16
Fuel Shops	3	3	5	7	8	7	4
Hardware	2	2	4	6	7	9	13
Agricultural Inputs Shops	1	1	1	1	1	2	5
Motorcycle sales	0	0	0	0	1	1	1
Guest House	4	4	5	7	9	11	11

Source: Department of Development Affairs, Ayeyarwady Region

Appendix Table E.2

The Situation of Education, Health and Communication Services in Pyapon Before and After 1989

Education Services	before 1989	1989/90	1994/95	1999/2000	2004/05	2009/10	2010/11
Post Primary	0	0	0	0	12	18	22
Primary School	170	170	163	163	151	123	116
Branch Primary School	0	0	0	0	0	0	1
Middle School	6	6	3	3	3	2	2
Branch Middle School	0	0	1	1	1	3	9
Affiliated Middle School	4	4	10	10	10	6	2
High School	4	4	6	6	6	6	6
Branch High School	0	0	2	2	2	3	3
Affiliated High School	1	1	4	4	4	3	3
Health Services							
Government Hospital - 200 Bed	0	0	0	0	0	0	1
- 100 Bed	1	1	1	1	1	1	0
- 16 Bed	1	1	1	2	2	2	0
Township Health Care Centre	1	1	1	1	1	1	1
Private Hospital	0	0	0	0	0	0	2
Private Dispensary	0	0	0	0	0	0	26
School Health Centre	1	1	1	1	1	1	1
Maternal & Child Health Centre	1	1	1	1	1	1	1
Communication Services							
Post Office	3	3	3	3	2	2	2
Telegraph Office	1	1	1	1	1	1	1
Wireless	0	0	0	0	0	2172	4236
Auto Telephone Office	0	0	0	0	1	1	1
Manual Telephone Office	1	1	1	1	0	0	0

Sources: Department of Basic Education, Ayeyarwady Region

Department of Health, Ayeyarwady Region

Department of Posts and Telecommunication, Ayeyarwady Region

Appendix Table F.1

Changes of Business Enterprises in Laputta After 1989

Types of Business	1994/95	1999/2000	2004/05	2009/10	2010/11
Grocery	15	42	50	54	55
Stores	9	12	18	24	27
Tea Shop	9	20	33	39	41
Fabric Shop	4	6	8	10	11
Cold Drink Shop	2	3	4	4	4
Bakery	0	0	2	3	2
Household Utensils	0	2	3	4	4
Drug Stores	1	2	2	3	4
Electrical goods	1	1	2	3	4
Bicycle Sales	0	1	1	2	2
Bicycle Repair	0	1	3	4	5
Timber Shops	1	1	2	3	3
Fuel Shops	2	2	2	2	2
Hardware	1	2	3	4	4
Agricultural Inputs Shops	1	1	1	2	2
Guest House	1	3	4	8	13

Source: Department of Development Affairs, Ayeyarwady Region

Appendix Table F.2

The Situation of Education, Health and Communication Services in Laputta Before and After 1989

Education Services	Before 1989	1989/90	1994/95	1999/2000	2004/05	2009/10	2010/11
Post Primary	0	0	0	0	28	41	50
Primary School	236	236	236	225	200	134	126
Branch Primary School	0	0	0	0	0	5	11
Affiliated Primary School	37	37	30	37	36	89	86
Middle School	5	5	5	4	3	2	2
Branch Middle School	0	0	0	3	3	7	8
Affiliated Middle School	16	16	16	24	24	26	27
High School	3	3	3	4	4	5	6
Branch High School	0	0	0	0	0	4	2
Affiliated High School	3	3	3	3	4	0	0
Health Services							
Government Hospital - 200 Bed	0	0	0	0	0	0	1
- 25 Bed	1	1	1	1	1	1	1
- 16 Bed	0	0	1	1	1	1	1
Township Health Care Centre	1	1	1	1	1	1	1
Private Dispensary	0	0	0	0	0	0	15
Maternal & Child Health Centre	1	1	1	1	1	1	1
Communication Services							
Post Office	1	1	1	1	1	1	2
Telegraph Office	0	0	0	1	1	1	1
Wireless	0	0	0	0	0	608	1521
Auto Telephone Office	0	0	0	0	0	1	1
Manual Telephone Office	1	1	1	1	1	0	0

Sources: Department of Basic Education, Ayeyarwady Region

Department of Health, Ayeyarwady Region

Department of Posts and Telecommunication, Ayeyarwady Region