A GEOGRAPHICAL ANALYSIS ON TRANSPORTATION SYSTEM IN PAKOKKU DISTRICT

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Abstract

Transportation is vital to an economy of any region and it is the largest industry in the world. Movement of people and flow of commodities are mostly dependent upon the transportation infrastructures. Pakokku District is one of the economic centre of Central Myanmar. Transportation systems are fundamental factors for all-round development of any regions. It is important to be able to determine the level of transportation system that contributes to all-round development and to predict the future trend of transportation system of the study area. This research analyzes the transportation system and level of transportation in Pakokku District by using the quantitative methods and qualitative analysis. Results indicate that level of transportation system in the study in the study area is poor although it continues to develop year after year.

Keyword: Land Transportation, Water Transportation, Air Transportation

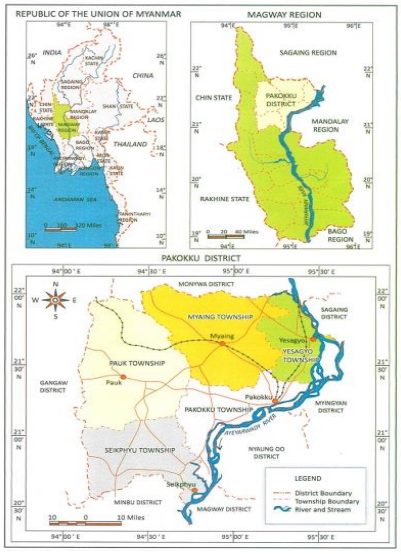
1.INTRODUCTION

Transportation is the movement of people and goods from one location to another. Transportation provides access to natural resources and promotes trade, allowing a nation to accumulate wealth and power. Transportation systems and the routes they use have greatly influenced both how and where people live. Reliable transportation allows a population to expand throughout a country's territory and to live comfortably in remote areas far from factories and farms. Transportation is vital to an economy of any region and it is the largest industry in the world.

2.THE STUDY AREA

Astronomically, Pakokku district is located between north latitude 20°45' and 21°50' and east longitudes 94°15' and 95°20'. It lies in central Dry Zone of Myanmar and is situated on the western bank of Ayeyarwady River and Chindwin River. Transportation systems are fundamental factors for all-round development of any regions. Movement of people and flow of commodities are mostly dependent upon the transportation infrastructures. Pakokku District located at the western part of Ayeyarwady River is poor in transportation system although it has two good waterways: Ayeyarwady and Chindwin. Really, Pakokku District is one of the economic center of Central Myanmar. For all-round development of the district, planning and managing for the development of transportation infrastructures will urgently needed. In order to partially fulfill the development of transportation system, Pakokku District is selected as a study area.

Map(1) LOCATION OF PAKOKKU DISTRICT



Source: Department of Agricultural land Management and Statistics

3.AIM AND OBJECTIVES

The main aim of this research work is to investigate level of transportation systems and to give some suggestions that lead to promote the transportation system of the study area. As the supportive elements for aim mentioned above, following objectives are also adopted:

- to examine the physical features that influence the transportation system of the study area
- to study the social characteristics effecting the transportation system of the study area
- to trace the development pattern of trans-portation system in this area,
- to analyze the network structure of trans-portation system and level of transportation system in this area and
- to give an effective contribution to the projected plan that can promises future development of transportation system and the related local development in this area.

4.MATERIALS AND METHODS

For the preparation of this research, required data and maps are available from the secondary source. However, data collection, open talk and discussion with local people have been made and also collected by questionnaires as primary sources. Some facts and figures are obtained from the Gazetteer of the study area.

Methodology here is basically quan- titative and some qualitative analyses are also conducted. In this research, Beta Index and Connectivity Matrix are used to determine the level of connectivity in transportation system and the Maximum Routes and Degree of Connectivity Methods are applied to determine the accessibilities of transportation in the study area.

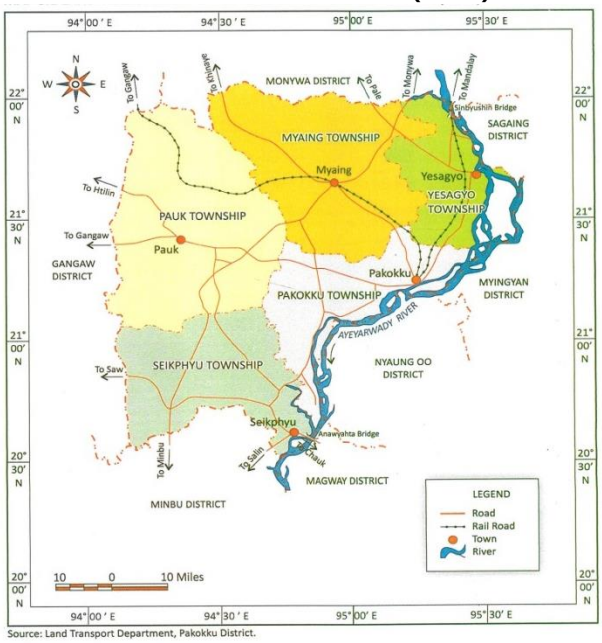
5.ANALYZING THE TRANSPORTATION SYSTEMIN PAKOKKU DISTRICT

Transportation is usually classified by the medium in which the movement occurs, such as by land, air, water, or pipeline. Within each of the first three media, many different methods are used to move people and goods from place to place. Pipelines are used mainly to transport liquids or gases over long distances. Generally, modes of transportation found in Pakokku District can be classified into (1) Land Transportation, (2) Water Transportation and (3) Air Transportation.

5.1. land transportation

Land transportation is the dominant form of transportation in the world. People can move about land under their own power, either by walking or by other forms of human-powered transportation such as the bicycle. People also use domestic animals as a means of transportation, both for riding and for pulling wheeled wagons or carts. Nowadays, the most common forms of land transportation combine the wheel with electric or fuel-powered engines to move people and freight quickly and efficiently. Generally, land transportation network of Pakokku District can be divided into road and railway transportation networks.

Map (2) LAND TRASPORTATION NETWORKS OF PAKOKKU DISTRICT (2015)



Source: Land Transport Department Pakokku District

5.1.1. Road Transportation

At the beginning of the 20th century, gasoline-powered automobiles began to emerge as the dominant form of motor vehicle. Motor vehicles make up a broad

class of self-propelled land-transportation devices that generally use internal-combustion engines and gasoline or diesel fuel for power. Motor vehicles range from motorcycles and automobiles for personal use to trucks, which can transport large amounts of cargo, and buses, which can carry many pasengers.

Like other urban regions of the world, the motorcycle is one of the most prolific forms of individual urban transportation in Pakokku District. The growth of motorcycle use has been especially large in urban areas of Pakokku District. According to 2015 data, there were 8 main roads in Pakokku Township, 4 main roads in Yesagyo Township, 7 main roads in Myaing Township, 5 main roads in Pauk Township and 5 main roads in Seikphyu Township, respectively.

5.1.2. Railways Transportation

Railroads are paths of parallel metal rails that allow a wheeled vehicle to move more easily by reducing friction. After the invention of the steam locomotive in 1804, steam engines replaced horses as the primary means of power. Modern locomotives commonly use electric motors or diesel engines and pull long trains of passenger or freight. The benefits of rail transportation in both speed and carrying capacity made it superior to other methods of transportation in the 1800s.

In Myanmar, the first railway between Yangon and Pyay was constructed on 1st May 1877. From that time on, railways were built up along the east bank of Ayeyarwady River because the regions located along the west bank of Ayeyarwady River are hilly and mountainous. In Pakokku District, Pakokku-Minywa Railway Section (33.50 miles long) was opened on December 12, 1993 and Gangaw-Kalay Railway Section (83. 75 miles long) was opened on February 5th, 1996 and then Pakokku-Gangaw Railway Section (142.50 miles long) was opened July 17th 1997.

Furthermore, Kyangin-Pakokku Rail Road (320 miles) is under construction. Like many other regions of Myanmar, railway transportation continues to be the main mode of passenger travel and freight movement in Pakokku-District. Nowadays, railway transport-tation services had been carried out by three routes in Pakokku District. They are

(1) Pakokku-Minywa Railway Section (33.50 miles)
(2) Pakokku-Gangaw Railway Section (142.50 miles)
(3) Pakokku-Kyangin Railway Section (320 miles)

5.1.3. Water Transportation

Water Transportation is some of the greatest achievements in transportation relate to methods of crossing water. Two-thirds of Earth's surface is covered by water, so the progress of civilization is naturally tied to the ability to move over water.

Being located on the west bank of the Ayeyarwady River, Pakokku District has a good opportunity for water transportation since long ago. Out of the five towns of the district, Pakokku and Seikphyu are located on the bank of the Ayeyarwady while Yesagyo is on the bank of Chindwin River. Pakokku is an important river port within the towns of the district and has been developed as a wet-point settlement.

The Pakokku-Nyaung Oo waterway is 16 nautical miles long and water transportation services are carried out by using five motor-boats. The Ayeyaraung boats leave Pakokku at 05:00 hrs and 13:00hrs for (2000) kyats per head. Nyaung Oo boats leave Pakokku at (6) a.m, (9) a,m and (2) p.m respectively, charging (1500) kyats per person. Private owned motor boats are also running for the trips of Yesagyo, Monywa, Kalay, and Kalaywa. Virginia-tobacco, local products of Pakokku is shipped to Kalay and Kalaywa by private owned motorboats.

5.1.4. Air Transportation

Air travel has revolutionized global transportation by dramatically reducing the time needed to travel great distances. Journeys across nations or oceans that might have taken weeks or months can now be made in a matter of hours. Advances in technology produced faster, larger, and more durable airplanes.

Pakokku Airport has an area of 922.2 Acres with a runway of 8500` feet and 100 feet shoulder, of asphalt. Formerly, runway was an
earthen type with 3600 feet long and used to land for light aircraft. Later it can be up graded to 10,000 feet by 200 feet. Having a thickness of 24 inches, this runway can be landed by F-28 Jet.

Air transport services from Pakokku to Mandalay and Kyaukhtu were started by Myanmar Airways on 1st January 2005. There was also a flight to Yangon. These services were not successful because,

according to Record of Aviation office, only 840 passengers used these air trips during 6 months. After 6 month later, air transportation services from Pakokku were stopped a while on 7th July 2005. Therefore, air transportation service is not important in Pakokku District.

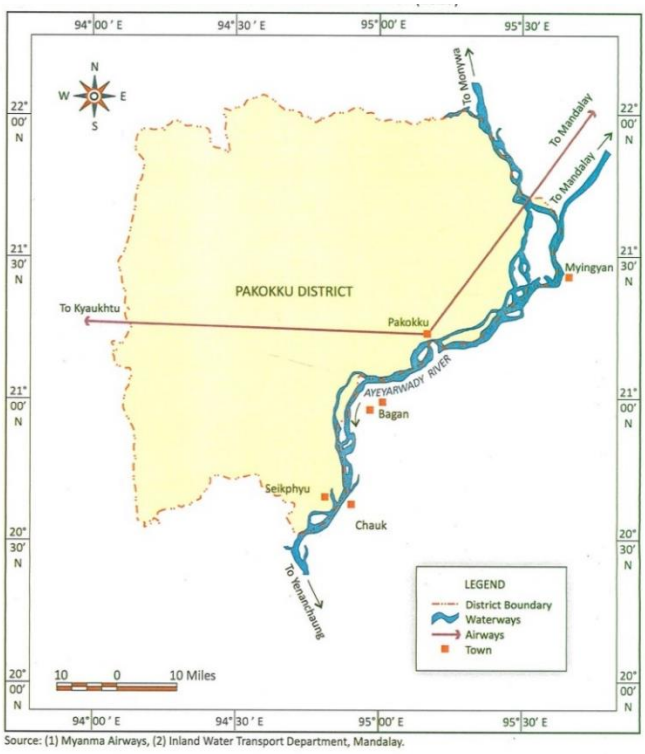
6.DETERMINING THE TRANSPORTATION NETWORK OF PAKOKKU DISTRICT

The mathematical study of the connectivity between objects is sometimes called network analysis. The term ''network'' can be defined as a set of links or routes (in this case referring to roads or lines) that cross or meet one another (at nodes) in the manner of these in a net. According to Kansky (1963), and American Geographer, a network is geographic location interconnected in a system by a number of routes. For a transportation network, it is defined as a transportation framework, composed of interconnected nodes and links. The efficiency of a network can be measured through graph theory and network analysis. These methods rests on the principle with the efficiency of a network depends partially on the layout of points and links.

6.1. Network Connectivity

The easiest way to assess the level of connectivity is the use of transport indices such as Beta, Alpha and Gamma. These indices are used to analyze in this section for two phases such as (1) before 1988 period and (2) After 1988. In this research, transportation network of Pakokku was analyzed by using Beta Index only because of time constraints.

Map (3) WATERWAYS AND AIRWAYS OF PAKOKKU DISTRICT (2015)



Source: (1) Myanma Airways, (2) Inland Water Transport Department, Mandalay.

Source: (1) Myanmar Airways, (2) Inland Water Transport Department, Mandalay

The Beta Index expresses, in numerical form, the ratio between the number of roads (edges) in a system and the number of nodes (vertices) in this system.

$$\beta = e/v$$

A network with a β index of connectivity of less than a unit can be described as partially connected. If β is equal to 1, the number of vertices and the number of connected edges, are equal. If β is equal to zero, then is, of course, no network system, but with values greater than zero, but less than unity there are some routes along which goods or commodities can flow. A network with a β index of connectivity equal to unity can be described as a sample connected graph, for all vertices are connected by the minimum number of edges required for complete network connection. β -index of greater than unity therefore indicates higher degree of inter connection.

The transportation network of Pakokku District can be determined by β index. All the motor car roads, railroads

and waterways of Pakokku District are described by Graph. The value of the β index is calculated by using the vertices and edges from the Graph.

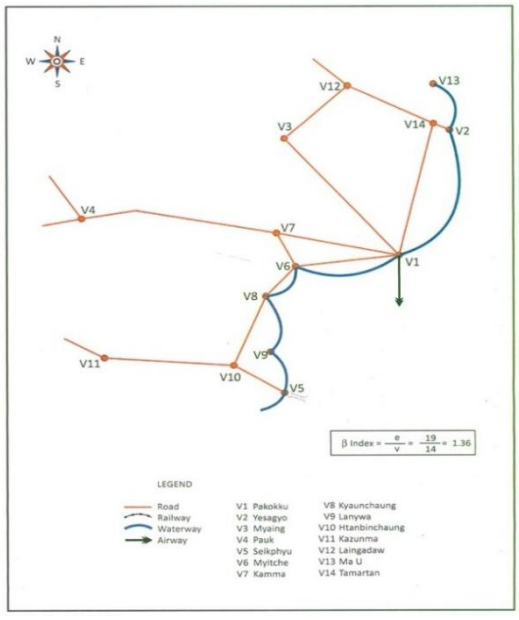
The degree of connection between all the vertices is defined as the connectivity of the network. It is probably the most important structural property of the network. Connectivity is a useful concept pertaining to network development.

Table. 1 Value of Beta Index and Connectivity

Value of Beta Index	Condition of Connection
Below (1)	Partial Connectivity
1	Complete simple connectivity
1 to 1.2	Inter-connectivity
Over 1.2	Advanced Inter Connectivity

Source: Maurice. R. Yeates (1968): An introduction to Quantitative Analysis in Economic Geography, Pp-130

figrue (1) a simulated planner graph for transpor-tation network of pakokku district (1988)



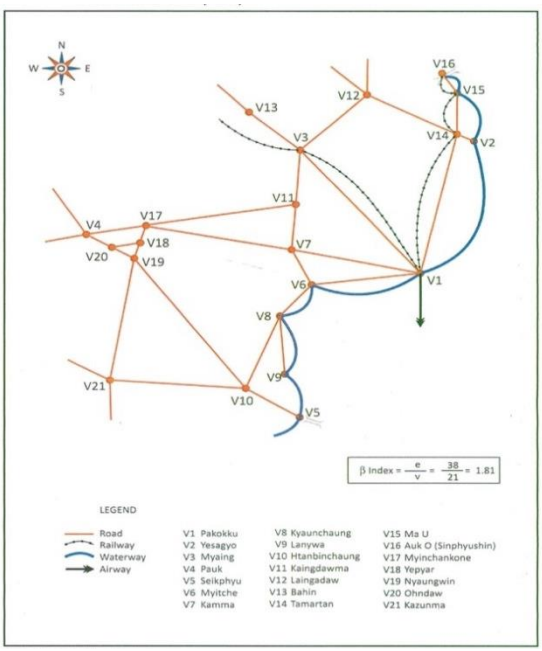
Source: Based on Map (2)

The comparative study of the development of transportation network in Pakokku District is based on data collected before 1988 and after 1988. To calculate the connectivity of the transportation networks in Pakokku District, β index is used.

By connectivity Matrix, Beta Index of Pakokku District was 1.36 in the years before 1988 and 1.81 in the years after 1988. Pakokku has the highest value with 7 and Myitche is the runners up with5. Seikphyu and Kyunchaung have index value 4 respectively. Other townships and vertices are less than 1.36 of mean value. Pakokku ranks first in the level of connectivity due to its location on the Ayeyarwady river bank. Moreover, the β index value of transportation networks in Pakokku District is 1.36. It can be concluded that, before 1988, the transportation networks in Pakokku District has advanced inter connectivity condition. The β index value of 2015 for transportation networks in Pakokku District is 1.81. It is easily seen that the transportation networks in Pakokku District has improved t Advanced Interconnection.

The comparison of β index values shows that in 1988, there were just 19 edges and 14 vertices and 38 edges and 21 vertices in 2015. The increase was 20 edges and 7 vertices. The average index also rose to 1.3 in 2015.

figrue (2) a simulated planner graph for transpor-tation network of pakokku district (2015)



Source: Based on Map (3)

The reason of increase in edges and vertices is primarily due to the construction of new roads such as pathein-Monywa highway as well as that of new bridges over rivers and streams. The area of increase includes Pank Township, Myaing Township, Yesagyo Township, Seikphu Township and Pakokku Township. However, edges and vertices were developed in plains of the District and progress was relatively slow in hilly regions.

In 1988, there were just one big circuit and a small one in the transportation network of Pakokku District. In 2015, there were five big circuits and three small ones.

According to 2015 data, transportation networks in Pakokku district shows that the motorways network has 28 edges and 21 vertices, with · index of 1.33. Railway network has 4 edges and 5 vertices with · index of 0.8 Waterways network has 7 edges and 8 vertices with · index of 0.9 while the airway has no edge but 1 vertex with · index (zero).

Out of the transportation networks, the road network has the highest · index value and handles most passengers and second most amount of commodities. Waterways, which claim second highest · index value have second largest number of passengers and the largest amount of commodities. Railroads, the third highest in · index value, stand third in transportation of passengers and freight. Airways, the least · index holder, also handle the least number of passengers.

6.2. The Connectivity Matrix

It is made up of points (vertices, nodes) connected by path (lines, links, edges), but there is no concern for length, sinuosity, or even direction. The paths are considered as direct links.

The connectivity matrix of a graph show direct links between vertices by binary coding ''1'' if direct link exists, ''0'' if no direct link exists. Both the row and column of the matrix refer to the point or nodes. Here ''unity'' or ''1'' is in the diagonal, as each place is considered to be connected with itself. To construct such a matrix, the points of the graphs are labeled or numbered and the label used to identify rows and column of the matrix. If two points are connected, this is recorded by placing ''one'' at the intersection of the relevant row and column. If they are not connected, a ''0'' inserted instead.

In calculation the transportation network connectivity of Pakokku District in 1998, the mean connectivity values were 7 for Pakokku, 3 for Yesagyo, 2 for Myaing, 3 for Pauk and 5 for Seikpyu. In studying the transportation network connectivity in 2015, the respective mean values were 9 for pakokku, 3 for Yesagyo, 6 for Myaing, 4 for Pauk and 4 for Seikpyu. Pakokku leads by 8 and Myaing comes up by 6 and Yesagyo comes last by 3. (See Table 1 and 2).

Table (2) Connectivity Matrix for Transportation Network in Pakokku District

	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}	V_{11}	V_{12}	V_{13}	V_{14}	Other	Total
V_1	-	1	1	-	-	2	1	-	-	-	-	-	-	1	1	7
V_2	1	-	-	-	-	-	-	-	-	-	-	-	1	1	-	3
V3	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2
V_4	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	3
V_5	-	-	-	-	-	-	-	-	1	1	-	-	-	-	2	4
V_6	2	-	-	-	-	-	1	2	-	-	-	-	-	-	-	5
V_7	1	-	-	1	-	1	-	-	-	-	-	-	-	-	-	3
V_8	-	-	-	-	-	2	-	-	1	1	-	-	-	-	-	4
V_9	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	2
V_{10}	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	3
V_{11}	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	2
V_{12}	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1	3
V_{13}	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
V_{14}	1	1	-	-	-	-	-	-	-	-	-	1	-	-	-	3
Other	1	-	-	2	2	-	-	-	-	-	1	1	-	-	-	7
Total	7	3	2	3	4	5	3	4	2	3	2	3	1	3	7	52

Source: Data based on Figure (1)

Table (3) Connectivity Matrix for Transportation Network of Pakokku District (2015)

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20	V21	Other	Total	Remark
V_1	-	1	2	-	-	2	1	-	-	-	-	-	-	2	-	-	-	-	-	-	-	1	9*	The highest
V_2	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	3	
V_3	2	-	-	-	-	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	1	6	
V_4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	2	4	
V_5	-	-	-	-	-	-	-	-	1	1		-	-	-	-	-	-	-	-	-	-	2	4	
V_6	2	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	
V_7	1	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	4	
V_8	-	-	-	-	-	2	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	5	
V_9	-	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	
V_{10}	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	1	4	
V_{11}	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	3	
V_{12}	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	4	
V_{13}	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	
V_{14}	2	1	-	-	-	-	-	-	-	-	-	1	-	-	3	-	-	-	-	-	-	-	7	
V_{15}	-	1	-	-	-	-	-	-	-	-	-	-	-	3	-	3	-	-	-	-	-	-	7	
V_{16}	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	1	4	
V_{17}	-	-	-	1	-	-	1	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	4	
V_{18}	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	-	-	3	
V_{19}	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	1	1	-	4	
V_{20}	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	3	
V_{21}	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	2	4	
Other	1	-	1	2	2	-	-	-	-	-	-	2	1	-	-	1	-	-	-	-	2	-	11	
Totel	9	3	6	4	4	5	4	5	3	4	3	4	2	7	7	4	4	3	4	3	4	11	103	

Source: Data based on Figure2

Table (4) Connectivity for Railway Transportation Network in Pakokku District (2015)

	V_1	V_2	V_3	V_4	V_5	Other	Total
V_1	-	1	1	-	-	-	2
V_2	1	-	-	1	-	-	2
V_3	1	-	-	-	-	1	2
V_4	-	1	-	-	1	-	2
V_5	-	-	-	1	-	1	2
Other	-	-	1	-	1	-	2
Total	2	2	2	2	2	2	12

Source: Figure (2)

Table (5) Connectivity for Waterway Transportation Network in Pakokku District (2015)

	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	Other	Total
V_1	-	1	-	-	-	1	-	-	-	2
V_2	1	-	-	-	-	-	1	-	-	2
V_3	-	-	-	1	-	-	-	-	1	2
V_4	-	-	1	-	1	-	-	-	-	2
V_5	-	-	-	1	-	1	-	-	-	2
V_6	1	-	-	-	1	-	-	-	-	2
V_7	-	1	-	-	-	-	-	1	-	2
V_8	-	-	-	-	-	-	1	-	1	2
Other	-	-	1	-	-	-	-	1	-	2
Total	2	2	2	2	2	2	2	2	2	18

Source: Figure (2)

Table (6) Connectivity for Airway transportation Network in Pakokku District (2015)

	V1	Other	Total
V1	-	3	3
Other	3	-	3
Total	3	3	6

Source: Figure (2)

6.3. The Degree of Connectivity

It is interesting to analyze the maximum possible number of routes in a network having m number of places where there will be ***m*** times ***m*** cells in the matrix or m^2. From this total ***m*** cells are deducted in the diagonal because a route cannot connect a place with itself, thus the maximum number will be (m^2- ***m***) cells. One can note that once a route is built between places i and j, there is no need to duplicate the route by building another parallel rule from j to i in a symmetrical network. So once the diagonal is removed, a symmetrical matrix remains and half of it describes the maximum possible number of route: $R_{max} = ½(m^2-m)$.

Next, based on maximum possible number of route, network connectivity can of find out. The Degree of connectivity represents the ratio between observed number of routes (Or) and the maximum number of route (Rmax). Thus the index of connectivity (Cd) can be calculated as follows.

$$C_d = O_r / R_{max} = O_r / 0.5\ (m^2\text{-}m)$$

There range of index is from a value of ''0'' (complete non-connectivity), 0.001-0.35 (Poor connectivity), 0.35-0.7 (moderate connectivity), 0.7-0.99 (highly) and 1 or unity (complete connectivity). Therefore, according to Cd value, degree of connectivity can be differen-tiated as follows.

Table (7) Degree of connectivity

C_d Value	Comments
0.0	Complete non-connectivity
0.001-0.35	Poor connectivity
0.35-0.7	Moderate connectivity
0.7-0.99	Highly connectivity
1.0	Complete connectivity

In 1988, as there were 19 places connected to each other in Pakokku District, maximum possible numbers of routes were 171. Therefore, degree of connectivity will be 0.08. The result shows that degree of connectivity in transportation network of Pakokku District was poor level.

According to planner graph in 2015, as there 38 places connected to each other in Pakokku district, maximum possible numbers of routes were 703. Thus, degree of connectivity will be 0.03. It can be found that degree of connectivity in transportation network of Pakokku District was also poor in 2015.

6.4. Accessibility

Accessibility of individual nodes or town in Pakokku District can be analyzed by using Line Distribution Network Method such as Accessible Matrix.

The accessibility of the district can be expressed in terms of either the links (routes) by which it is connected with the rest of the network. Thus, the modality of the district can be simply measured and compared by counting the number of roads converging upon each.

According to accessibility matrix shown in Table 6, out the 21 towns of Pakokku District, Pakokku is the most accessible node of transportation network, interns, of the specified criteria as links. The second most accessible node is Kanma and the third most accessible node in Myitche while Auk O is the least accessible node in the network.

7.RESULT

Pakokku flourished waterways, transporting the products from Chin State and Gangaw District to lower Myanmar and eastern Ayeyarwady Regions. Pakokku Township possesses the best transportation network within the other townships of the district. Accessible by land, water and air, the township handles the most number of passengers and largest amount of goods.

In the railway transportation, beside the existing railway lines such as Pakokku-Gangaw-kalay and pakokku-Monywa-Mandalay, as Pakokku-Kyangin Railroad was also newly constructed; railway transportation is also developed in the district.

Regarding the waterways, the district possesses the two best waterways: the Ayeyar-wady and the Chindwin rivers. As the development of land transportation is very slow, waterways still play an important role in the transportation of Pakokku district. Pakokku is, in fact, a major port for distributing and exchan-ging commodities come from upper and lower Myanmar.

Although an airport was located in Pakokku, public air transportation was not developed in the district. Due to the high cost and difficulty to get ticket, only a few numbers of passengers were travel by airways. As a result, public air transportation was abolished on 7th July 2005 after 6 months from opening. Therefore, air transportation service is not important in Pakokku District.

After 1988, transportation network of the district were sharply developed because new roads as Pathein- Monywa Road, Kyak-khut- Letpando Road, Myaing-Kanma Road, Seikphyi-Kandaw- Pauk Road, Kazunma- Yepyar Road were buit up and new bridges such as Anawyahta Bridge (Ayeyarwady) (2001) and Sinbyushin Bridge (Chindwin, 1999) were constructed.

Because railroads over Sinbyushin Bridge were joined to Pakokku- Kalay railroad and Pakokku-Monywa-Mandalay railroad, Sinbyushin Bridge became the northeast gateway to pakokku District.

The Anawyahta Bridge over Ayeyar-wady Rive makes motorways and the passengers and commodities flow from Seiklphyu, Sinphyukyun and Salin Township possible. Especially, Mandalay and Yangon markets become accessible and Seikphyu onions flow directly to Yangon. Thus Anawyahta Bridge becomes southeast gateway to Pakokku District.

Gangaw district which relied solely on motor-roads can now utilize the railways. Products of Pakokku District can now be sent to Monywa and Mandalay directly. One more advantage is the flow of passengers and goods from Shwebo, Monywa, Sagaing and Mandalay.

Before 1988, water transportation had been the most important for Pakokku District. After 1988, its dominance declined to second rank due to the opening of Sinbyushin and Anawyahta Bridges.

Due to development and extension of motorways, rails, waterways and airways, the connectivity of transportation network in Pakokku District sharply developed in recent years.

8.CONCLUSION

Pakokku Distirct located in central dry zone of Myanmar, has an area of 3,205,417 sq miles. It is bounded by neighbouring 7 districts. Chindwin and Ayeyarwady rivers serve as natural boundary between Pakokku District and Sagaing, Myingyan, Nyaung Oo and Magway districts. Pakokku District, situated on the west banks of the rivers, is surrounded by mountains and hills on west and southwest and is separated by Tangyi Range in the middle portion.

The eastern areas, especially Ayeyar-wadiy and Chindwin valleys, are plains, Tangyi range run across the district from north to south and effect as a natural barrier to the transport-tation of Pakokku District.

Although the climate is relatively hot, it is favourable for the settlement. Total population of the district sharply increased from 725,069 persons in 1973 to 1,528,390 persons in 2015. With the population growth, infrastructure development is urgently needed for local people to get better transportation and communication.

The modes of transportation found in Pakokku District are land transportation, water transportation and air transportation.

The waterways are important for transportation of Pakokku District. Ayeyarwady and Chindwin rivers are important waterways and also serve as national barriers for the transportation. Nowadays, these barriers are successfully overcome by construction of new bridges such as Sinbyushin and Anawyahta. Sinbyushin Bridge over Chindwin (1999) and Anawyahta Bridge over Ayayarwady (2001) have been opened. They link Pakokku District with other regions located in the east bank of Ayeyarwady and Chindwin. Pakokku Bridge, the longest bridge over the Ayeyarwady is also constructed.

In order to promote air transportation, a new airport was built up in Pakokku. It has an area of 922.29 acres with an asphalt runway measuring 8500 feet long and 100 feet wide and 24 inches in thickness. Although air transport-tation services for public use were formerly carried out by Myanmar. Airway, it was abolished after 6 months. Therefore, air transportation is not developed in the district.

Concomitant with the construction of new roads, railway lines and bridges, and with upgrading of existing ones, transportations system of pakokku District will more develop in near future than before.

With the development of transportation infrastructures, socio-economic conditions, living standard and lifestyle of the local people will be promoted in the future.

9.SUGGESTIONS AND FUTURE SCENARIO

The study area, Pakokku District is one of the economic core areas of Myanmar. To promote the socio-economic conditions of local people, measures that lead to infrastructure development will urgently need for the district.

Pakokku District rich in natural resources and produces several agricultural products, forest products, oil, etc. The large amount of products calls the more transportation facilities to export them.

Extension railway lines where necessary areas and upgrading the existing lines to get better and speeded flows of passengers and commodities

Waterways, the cheapest mode of transportation play an important role in Pakokku District. Hence, maintaining the good water channels, promoting the quality of motorboats which running along the waterways should be undertaken.

Air transportation for public use is very weak in Pakokku District. Special programs should be adopted to develop and improve air transportation services in both internal and international flights.

The transportation infrastructures of Pakokku District are mostly unqualified conditions. For the development of transport-tation system in Pakokku District, the measures should be taken are as follows:

- Extending the road and railway transportation lines in the hilly regions of Myaing, Pauk and Seikphyu Township.
- Upgrading the existing narrow roads such as Tangyi road to wide and smooth roads.
- Upgrading and extension the existing seasonal roads to all weather roads.
- Constructing the qualified road and rail networks
- Making effective utilization of existing transportation capacity and providing new transport facilities as much as possible,
- Construction of extending and renovating railroads and motor roads,

- Facilitating transportation and communica-tion services not only in area crucial for social and economic activity but also remote areas,
- Striving for expansion of modernized transportation and communication services,

Transportation is a major sector to cause socio-economic development of any region. The regions with less transportation facilities can never become advanced community, although it has numerous potential resources. As rule and regulation is very important in every sector, security for transport route is also important. The development of the study area is mainly relying only on its transportation systems to connect other Regions and State of Myanmar. In summing up, in order to get excellent transportation systems, extension, upgrading and maintaining all transportation routes and planning the transportation system should be laid down by respective sectors. Nevertheless, it is found that transportation system of Pakokku District sharply developed after 1988. Therefore, one can be expected that transportation system of study area will continue to develop in foreseeable future.

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