International Journal of Applied Social Science ***RESEARCH PAPER***
Volume 5 (8), August (2018) : 1135-1140 ISSN : 2394-1405
Received : 01.06.2018; Revised : 15.06.2018; Accepted : 01.07.2018

Connectivity efficiency of Rail Network in Alipurduar Division, Northeast Frontier Railway, India

ANUP SEN*[1], SANJOY AHIR[2] AND PIYAL BASU ROY[3]
[1&2]Ph.D. Research Scholar and [3]Associate Professor & Head
[1&3]Department of Geography, Cooch Behar Panchanan Barma University, Vivekananda Street, Near Pilkhana, Cooch Behar (W.B.) India
[2]Department of Geography, University of Calcutta, Kolkata (W.B.) India

ABSTRACT

Rail transportation includes movement of people, goods and services in larger volume with cheaper cost and plays incredible role in long distance passenger travel with comfort and hustle free journey. But despite having advantages, there are areas having limited accessibility or inaccessibility in terms of availability of rail network. It is also hard to evaluate the level of connectivity of different location facilitated by rail network since there are a lot of other factors working behind it. But whatever the degree the rail connectivity has, its analysis is helpful to find out the position of an area in terms of efficiency of rail network and to devise plans accordingly. In this paper, an attempt has been made to measure the connectivity efficiency of Rail transportation in Alipurduar division of Northeast Frontier Railway (NFR), India.

Key Words : Rail transportation, Accessibility, Connectivity, Efficiency

INTRODUCTION

The concept of efficiency is an integral part of transport study since it identities areas with both efficient and deficient transportation system. With the initiation and growth of transportation, there has been playing continuous endeavour to increase spatial efficiency by reducing geographical distance through maximisation of speed along with passengers comfort and safety (Flaherty and Bell, 1997). To achieve the spatial efficiency in terms of transport development of an area, it is highly essential to develop comprehensive plan keeping in mind about the hindrance on the way of transport development and technological supports required to supplement the efficiency. The rail route connectivity ensures the smooth movement of passengers and goods from one region to another region and largely determines the economic prosperity of regions (Schönharting *et al.*, 2003).

The Alipurduar railway division is the largest division among Northeast frontier railway and it has been considered as a backward railway division in terms of railway infrastructural development i.e. single line, slower movement of train, non connected electrified railway tracks, etc. (Roy and Sukumar, 2017). The delay of train is the basic problem; almost all the trains run by more than 1h late on an average in the division. During the winter season, it becomes more. In addition, the

How to cite this Article: Sen, Anup, Ahir, Sanjoy and Roy, Piyal Basu (2018). Connectivity efficiency of Rail Network in Alipurduar Division, Northeast Frontier Railway, India. *Internat. J. Appl. Soc. Sci.,* **5** (8) : 1135-1140.

situation of the local train is not satisfactory. Few trains are cancelled often due to unexpected delay which is a common fact of this railway division. However, almost all people have chosen train service in the area for low coast hustle free journey. For these reasons, connectivity efficiency of rail route network is more important and relevant in the study.

Objectives :

The study encompasses the following objectives –

– To know about the existing rail network of the study area.

– To analyze structural measures of rail transportation; and

– To find out the level of connectivity efficiency of the study area and variation thereof.

METHODOLOGY

The study is based on the Transport efficiency of Railway network in Alipurduar Railway Division. Centrality has been identified at few selected rail route junction points in the study area. To assess the railway connectivity within Alipurduar division, few indices of graph theory namely Cyclomatic number, Alpha, Beta and Gama index have been applied. All the indicators are considered as measures of connectivity of transport network. Apart from the indices as mentioned, Average Transport Score (ATS) *i.e.* sum total of Cyclomatic numbers, Alpha, Beta and Gamma index has also been calculated. Here, higher value indicates more connectivity or higher efficiency whereas medium and low values represent the moderate and poor connectivity or efficiency.

Koenig number is one of the important measures to identify the centrality through the analysis of transport route network (Irwin, and Hughes, 1992). Lower associate number indicates higher degree of connectivity and vice versa.

Detour index is the ratio between the actual route distance and straight-line distance between two places (Gutiérrez and García-Palomares, 2008). It is another measure to identify the efficiency of a transport network by reducing distance hurdles *i.e.* if an index scores 100, the network is considered more efficient in comparison to other networks.

The Study Area:

Alipurduar railway division is one of the most significant divisions of the Northeast Frontier Railway (NFR) zone. The Northeast Frontier Railway zone consists of five divisions namely Alipuduar, Rangia, Tinsukia, Lumding and Katihar (Raghuram, 2007). The Alipurduar division is the largest division among all the divisions. The railway division of Alipurduar is used as a corridor or gateway to get inside to North Eastern states of India. Geographically, this division is enclosed by Bhutan and Sikkim in the North, Bangladesh in the South, Assam in the East and the West is bounded by few parts of Bangladesh and Darjeeling district. Elongated shape of the railway division is expanded from Northwest to Southeast direction.

Rail Network of Alipurduar Division: Present Outlook:

The Alipurduar railway division comprises part of the northern districts of west Bengal, namely Jalpaiguri, Cooch Behar, Alipurduar and some portion of the lower Assam in Kokrajhar, Dhubri, and Bongaigoan district. The division consists of 716.87 km Broad Gauge line, out of which 623.88 km single line and 92.99 km double line with 1015.95 km Railway tracts. There is no meter gauge line in the division at present (Chaudhay and Iqbal, 2011). In addition, the Rail route density in

Alipurduar Railway division is 3.91 km / 100 sq km, where as Indian Rail route density is 2.05 km / 100 sq km. Therefore, the scenario of Rail route density is satisfactory in the Railway division under study. The total numbers of Railway stations or Nodes in the Alipurduar division are 85, out of that only four stations are under A category, namely New Cooch Behar (NCB), Alipurduar Jn (APDJ), Cooch Behar (COB) and New Alipurduar (NOQ).

In Alipurduar Railway division, the entire Railway route has been categorised into two groups *i.e.* Major and Minor Railway routes. The Railway routes have been identified on the basis of number of train availability, flow of passengers and services of goods (Assad, 1980). The study reveals that the railway route from Jalpaiguri Road (JPE) to Dangtal (DTX) via New Cooch Behar (NCB), Samuktala Road (SMTA), Fakiragram Jn, (FKM) has been considered as a major Rail route for more number of train availability, flow of passengers and services of goods. The total length of this Railway route is 213.72 km. Another major Railway route has been passing through Gulma (GLMA) to Samuktala Road (SMTA), via New Mal Jn (NMZ), Alipurduar Jn (APDJ), and total length of this route is 145.5 km. Routes from New Mal Jn (NMZ) to New Cooch Behar (NCB) via Maynaguri (MUGD); Alipurduar Jn. (APDJ) to Bamanhat (BXT) via New Cooch Behar (NCB); Fakiragram Jn. (FKM) to Dhubri (DBB); and New Cooch Behar (NCB) to Dhubri (DBB) may be considered as minor Railway routes under the study.

RESULTS AND DISCUSSION

The Rail Connectivity is actually relative degree of connectedness of rail line to an area (Reusser, Loukopoulos, Stauffacher, and Scholz, 2008). From Table 1, it is clear that, only the New Cooch Behar station holds very good position in terms of rail connectivity scoring ATS value 16. The Railway connectivity is comparatively lesser in Siliguri Jn (ATS 5.4), Dhubri (ATS 2.6), and Raninagar Jn (ATS 5.4). Rest of the Railway stations namely New Mal Jn, Samuktala, Fakiragram Jn, Maynaguri Road, Golakganj, and Gouripur have more or less uniform character of Average Transportation Score (ATS) with medium level of Railway connectivity or lesser transport efficiency.

Table 1 : Connectivity of Railway Network of Alipuduar Division

Rail Zone	Cyclomatic Number	Alpha Index	Beta Index	Gamma Index	Average Transport Score (ATS)
Siliguri Jn.	2	0.7	2	0.7	5.4
New mal Jn.	3	1	3	1	8
Alipurduar Jn.	3	1	3	1	8
Samuktala Jn.	3	1	3	1	8
Fakiragram Jn.	3	1	3	1	8
Raninagar Jn.	2	0.7	2	0.7	5.4
Mayanaguri Road	3	1	3	1	8
New Cooch Behar	6	2	6	2	16
Golakganj	3	1	3	1	8
Gouripur	3	1	3	1	8
Dhubri	1	0.3	1	0.3	2.6

Source: Calculated by the Authors

Koenig number or Associated number helps to find out the number of links or edges or routes that need to cross to reach another node. Here, if the number of links to be crossed is less, the nodal efficiency increases and with the increasing number of links or edges to be covered, the nodal efficiency decreases (Turton, 2008). In the study area, as New Cooch Behar scores lowest Koenig number (3), it is mostly efficient in the entire Railway network under study.

The railway route linkage between Dhubri to Siliguri Jn. is found with lowest transport efficiency in terms of Koenig numbers (Table 2). Dhubri and Siliguri Jn., both the stations score highest Koenig number (6). In addition, New mal Jn., Alipurduar Jn., Samuktala Jn., Fakiragram Jn., Raninagar Jn., Mayanaguri Road, Golakganj, and Gouripur, etc railway nodes are score in between 4 to 5 Koenig number with medium nodal efficiency in terms of rail route linkage.

Table 2 : Koenig Number of Alipurduar Division to show the Centrality

Nodes	Siliguri Jn.	New mal Jn.	Alipurduar Jn.	Samuktala Jn.	Fakir gram	Raninagar Jn.	Mayanaguri Road	New Cooch Behar	Golakganj	Gouripur	Dhubri	Koenig Number
Siliguri Jn.	0	1	2	3	4	2	2	3	4	5	6	6
New mal Jn.	1	0	1	2	3	2	1	2	3	4	5	5
Alipurduar Jn.	2	1	0	1	2	2	2	1	2	3	4	4
Samuktala Jn.	3	2	1	0	1	2	2	1	2	3	4	4
Fakiragram Jn.	4	3	2	1	0	3	3	2	1	2	3	4
Raninagar Jn.	2	2	2	2	3	0	1	1	2	3	4	4
Mayanaguri Road	2	1	2	2	3	1	0	1	2	3	4	4
New Cooch Behar	3	2	1	1	2	1	1	0	1	2	3	3
Golakganj	4	3	2	2	1	2	2	1	0	1	2	4
Gouripur	5	4	3	3	2	3	3	2	1	0	1	5
Dhubri	6	5	4	4	3	4	4	3	2	1	0	6

Source: Calculated by the Authors

The Detour index is used for assessing the effects which the addition or abstraction of links produce in a given network (Taylor and D'Este, 2007). It is simply calculated as:

Detour Index = (Actual route distance ÷ Straight line distance) ×100

Table 3 : Detour Index of Alipuduar Railway Division to show the Efficiency

Nodes	Siliguri Jn.	New mal Jn.	Alipurduar Jn.	Samuktala Jn.	Fakiragram	Raninagar Jn.	Mayanaguri Road	New Cooch Behar	Golakganj	Gouripur	Dhubri
Siliguri Jn.	0	142.42	122.51	121.47	121.2	113.79	116.59	156.47	171.43	173.11	170.28
New mal Jn.	142.42	0	115.83	115.15	116.78	129.03	109.1	152.19	167.58	169.33	166.88
Alipurduar Jn.	122.51	115.83	0	109.09	118.33	160.53	137.57	110	172.34	175.93	169.75
Samuktala Jn.	121.47	115.15	109.09	0	120.41	100.78	126.99	126.09	176	178.95	170.08
Fakiragram	121.2	116.78	118.33	120.41	0	159.28	158.14	87.24	97.92	98.31	99.81
Raninagar Jn.	113.79	129.03	160.53	100.78	159.28	0	121.79	140.45	162.05	163.67	160.97
Mayanaguri Road	116.59	109.1	137.57	126.99	158.14	121.79	0	147.48	170.7	172.99	169.3
New Cooch Behar	156.47	152.19	110	126.09	87.24	140.45	147.48	0	218.52	214.71	200
Golakganj	171.43	167.58	172.34	176	97.92	162.05	170.7	218.25	0	200	160
Gouripur	173.11	169.33	175.93	178.95	98.31	163.67	172.99	214.71	200	0	109.09
Dhubri	170.82	166.88	169.75	170.08	99.81	160.97	169.3	200	160	109.09	0

Source: Calculated by the Authors

Less Efficiency :

In the Alipurduar Railway division, the railway link between New Cooch Behar to Golakganj (218.52), Dhubri (200), Gouripur (214.71) and Golakganj to Gouripur (200) are under high detour value zone. These railway routes are less efficient than others railway routes with expensive costs and prolonged journey (Taaffe, 1996).

Medium Efficiency :

Medium detour value is found from Siliguri Jn to New Cooch Behar (156.47), Gouripur (173.11), Golakganj (171.43), Dhubri (170.28). In addition, the route from New Mal Jn. to Dhubri (166.88), via New Cooch Behar (152.19), Golakganj (169.33), Gouripur (166.88), have also under medium transport efficiency. However, rail route between Alipurduar Jn. to Dhubri (169.75), Alipurduar Jn. to Raninagar (160.53), Alipurduar Jn. to Golakganj (172.34), Alipurduar Jn. to Gouripur (175.93), Samuktala Jn. to Dhubri (170.08), Samuktala Jn, to Golakganj (176), Samuktala Jn, to Gouripur (178.95), Raninagar to Dhubri (160.97), Raninagar to Golakganj (163.67), Raninagar to Gouripur (160.97), Maynaguri Jn, to Dhubri (169.3), Maynaguri Jn, to Golakganj (170.7), Maynaguri Jn, to Gouripur (172.99), Fakiragram Jn. to Raninagar (159.28), Fakiragram Jn. to Maynaguri Jn. (158.14), and Golakganj to Dhubri (160), these nodes or railway stations represent the moderate deflection from the straight-line distance of the said routes followed by moderate transport efficiency.

High Efficiency :

Rest of the rail way stations or (nodes), are found with lower detour vales. These rail routes are efficient in terms of transport efficiency with cheaper cost and short time journey.

Conclusion:

It is clear that rail transport plays significant role favouring regional development as well as economic development. Likewise, the development of transportation is achieved through the efficiency of route network. The status of rail network of the study area is found satisfactory in terms of Rail route density because of its position above the National average. But, there is spatial variation of transport efficiency between the nodes or station in the railway division that need to be analysed with care in order to develop enhanced level of efficiency between nodes or stations. The modern technologies of railway management system, like electrification, signalling, GPS system, anti collision device etc, have not been used in the division. Railway tract management system need to be handed over reliable, transparent and entrusted agencies to resist the existing hurdles and flaes. To review the cost-benefit analysis, the policy based gains and losses need to be supervised by an accounting mechanism through collecting information about areas having lower level of connectivity. Monitoring and evaluation of existing routes may be indexed for future strategy planning purpose and to identify illness of the routes. Accordingly, innovative ideas for reformation need to be taken in further decision making processes.

REFERENCES

Assad, A. A. (1980). Models for rail transportation. *Transportation Research Part A: General*, **14**(3) : 205-220.

Chaudhay, A. and Iqbal, R. (2011). An empirical study on effect of welfare measures on employees' satisfaction in Indian Railways. *Internat. J. Res. Commerce & Management*, **2**.

Gutiérrez, J. and García-Palomares, J. C. (2008). Distance-measure impacts on the calculation of transport service areas using GIS. *Environment & Planning B: Planning & Design*, **35**(3) : 480-503.

Irwin, M.D. and Hughes, H. L. (1992). Centrality and the structure of urban interaction: measures, concepts, and applications. *Social Forces*, **71**(1) : 17-51.

O'Flaherty, C. and Bell, M.G. (Eds.). (1997). *Transport planning and traffic engineering*. Elsevier.

Raghuram, G. (2007). 'Turnaround' of Indian Railways: A Critical Appraisal of Strategies and Processes.

Reusser, D.E., Loukopoulos, P., Stauffacher, M. and Scholz, R.W. (2008). Classifying railway stations for sustainable transitions–balancing node and place functions. *J. Transport Geography*, **16**(3) : 191-202.

Roy, M. and Sukumar, R. (2017). Railways and Wildlife: A Case Study of Train-Elephant Collisions in Northern West Bengal, India. In *Railway Ecology* (pp. 157-177). Springer, Cham.

Schonharting, J., Schmidt, A., Frank, A. and Bremer, S. (2003). Towards the multimodal transport of people and freight: interconnective networks in the RheinRuhr Metropolis. *J. Transport Geography*, **11**(3) : 193-203.

Taaffe, E.J. (1996). *Geography of transportation*. Morton O'kelly.

Taylor, M.A. and D'Este, G.M. (2007). Transport network vulnerability: a method for diagnosis of critical locations in transport infrastructure systems. In *Critical infrastructure* (pp. 9-30). Springer, Berlin, Heidelberg.

Turton, B. (2008). The geography of transport systems. *Geography*, **93**(2) : 127.

****