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CONNECTIVITY AND ACCESSIBILITY OF THE ROAD TRANSPORT NETWORK: A REVIEW

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ABSTRACT:

Transport system has got priority in the Nation of India after independence which is evident by different Govt. Projects on surface road network. In India a good number of works are done on to analyse the surface transport network system. The author has been benefited by getting various details published in books, reports, journals, theses etc. related to his study. The total work has been divided into some major segments like Surface Transport, Topology, Typology, Connectivity, Accessibility, Regional Development Disparity etc. This work is a humble attempt to identify the research

voids in the domain of connectivity and accessibility of road transport network.

KEYWORDS: Topology, Typology, Connectivity, Accessibility.

INTRODUCTION

Transport network connects places which can supports the development of a particular place as it is evident that all the megacity, city, town, district head-quarters are well connected with the surrounding places. World Bank also has accepted the importance of transport system and says that for country's continued economic growth requires 'major improvements in the transport sector' (Eddington, 2006, p.11). Nodes act as a growth point from where development spreads through linkages to the other nodal points. Higher nodal point and linkage can reduce the development disparity.

Progress of this transport network system enhances the regional development with reference to economy, education, health etc.

The concept of connectivity is the degree to which all pairs of lines or routes are connected or the degree of completeness between riders. Connectivity refers to the density of connections in path or road network and the directness of links. A well-connected road or path of network has many short links, numerous intersections, and minimal dead-ends. As connectivity increases, travel distances decrease and route options increase, allowing more direct travel between destinations, creating a more accessible and resilient system. A well-connected road or path network has many short links, numerous intersections, and

minimal dead-ends. As connectivity increases, travel distances decrease and route options increase, as this allowing more direct link between the rural settlement and farm sites creating a more accessible and connectivity in terms of easy movement of both farm inputs and farm outputs to the market and other places of demand within the neighborhoods. Natural barriers such as big rivers, roads that are seriously eroded and its major arterials sometimes create barriers to direct local movement, particularly for non motorized movement, called the barrier effect.

Accessibility is the inherent characteristics of overcoming some form of spatially operating sources of friction in terms of time and distance. In addition, it is an extent to which the land-use

transport systems enable groups of people or an individuals and goods to reach points of activities and or destination by means of a combined transport mode (Geure and Ritsema 2001). Accessibility can be measured as the quantity of economic or social activities that can be reached using the transport system. Improvement in accessibility will increase the market size for manufacturing, tourism and leading to increased competition and/or centralization. On the other hand, the impact for the region concerned could be both positive and negative, depending on its initial level of competitiveness (Adeniyi, 2014).

REVIEW OF LITERATURE

The literature output related to this topic is primarily arranged as follows:

- Topology and Typology
- Parameters to Assess Connectivity and Accessibility
- Transport network and other social Dimensions
- Regional Development Disparity
- Research Voids

TOPOLOGY AND TYPOLOGY:

Journal of royal society interface shows that, on the basis of street pattern a quantitative method apply for cities classification. Louf and Barthelemy applied a simple hierarchical clustering method for a typology of cities. Two cities represents similar patterns which are depend on their blocks have both similar shape and area.

Hülsermann described a set of typical transport networks scenarios and also shows their topology and traffic feature. The continuity is a suitable for network planning analysis. The author emphasises on the method of traffic matrix, traffic mix, and growth rates which are derived from real data sets.

'Transport Reviews: A Transnational Transdisciplinary Journal' Vol. 33, No. 6, pp. 658-685, 'Complex Network Topology of Transportation System' shows that the present situation of topological research on transportation systems. We follow this by summarizing network measures that describe topological characteristics of transportation networks. The authors discuss the empirical observations on real transportation systems at a variety of spatial scales. (Lin and Ban, pp. 658-685).

European journal of geopolitics represents the typology of basic academic notion which is related to academic notions connected with the transport system. Falkowski and Pytel discussed on transport typology with regards to its categories such as relocation type, types of transaction, Organisation, Environment, Availability, Types of load, Use of loading unit. (Falkowski, Pytel. pp. 37-60) Journal of Engineering Science and Technology Review studies about Greek railway network by using complex network analysis. Researcher shows that Greek railway network's topology complies with the empirical findings on railway network. (Tsiotas, pp. 175-187).

Author Jean-Paul Rodrigue in his book 'The Geography of Transport Systems' described about topology. He mentioned that arrangement and connectivity of a network is known as its topology. Every transport network has a particularly topology indicating its structure and structure means the network geometry and the level of connectivity. Transport networks also classified in specific categories depending on a set of topological attributes that describe them. Typology of a transport networks are related to its geographical setting, and its modal and structural characteristics. (Rodrigue, pp.49-51)

PARAMETERS TO ASSESS CONNECTIVITY AND ACCESSIBILITY

Connectivity the term has wide acceptance in several field of study like road transport, nutrient transport through hydrologic connectivity (Stieglitz, M. Shaman, J. *et al.*, 2003). The sense or philosophy of Connectivity stands for the link between two points or nodes.

Structural analysis of road networks of Cooch Behar district, West Bengal is done by D. Sarkar (2013). For the structural analysis of existing road networks the author considered some indices like

road density, Beta index, Alpha index, Gamma index, Cyclomatic number and Aggregate transportation score (ATS). Variation in different indices among the nine Blocks of that district is found by analyzing the data and lower connectivity in the Blocks (Cooch Behar I and II) also confirmed. He concluded with the words that without the required number of roads 'transport optimacy and related development never be attained'.

Baig and Zaman (2015) tried to find out the efficient shortest path by using Shimbel's algorithm. They also used Dijkstra's shortest path algorithm and compared these two methods. They applied Shimbel's method to find out the average distance between nodes and calculated the 'degree of separation' which indicates the average number of nodes steps away to each other.

The elements of accessibility and connectivity in public transport network and service mode choice are analysed by Papioannou and Martinez (2015). In their research paper accessibility and connectivity is considered to assess the impact of public transport network design on mode choice. Factor analysis and structural equation model are applied to inspect the role of accessibility and connectivity on drive mode choice. Finally, they came into conclusion that, for an individual trip accessibility is playing a more pivotal role rather than connectivity elements like time.

In 2015 Hongwei and Xizhaofocused on the concept of 'connect reliability' which is used to analyse the degree of connectivity between two nodes. They made their observation mainly on the nearness of the transportation network nodes and their importance which varies due to their different positions. Traffic volume and dual graph theory are considered in the calculations. According to them 'key links' facilitation' is very important to improve the reliability of the whole transport network. They uttered that this method can be applied for 'transportation planning and management'.

Rajendran, Bindu, and Kumar (2013) calculated Public Transport Accessibility Index for Thiruvananthapuram Urban area to assess Public Transport Accessibility Level(PTAL) based on household data by using mathematical formula. It is confirmed by the authors that the variation of accessibility to public transport can be well judged by PTAL measure.

Brands, Romphet *al.* (2014) gave importance on the modeling of public transport route choice, with multiple access and egress modes. For shortest path analysis and route choice considered time and cost respectively. They applied zenith method, includes multiple routing, multiple access and egress modes and finally find out the 'realistic routes in a real network'.

Ford, Barr *et al.* (2015) assessed sustainable transport in London by transport accessibility analysis using GIS. In this paper they considered merely employment accessibility, each transport mode in isolation and calculated the accessibility. According to them the GIS based model is helpful to 'parameterisation', 'visual exploration' and also to 'interpretation'.

TRANSPORT NETWORK AND OTHER SOCIAL DIMENSIONS

The impact of rural road connectivity and accessibility on farming is assessed by Adeniyi, (2014). The case study was done in Akoko South-West local Government area of Ondo-state, Nigeria. Poor road accessibility makes constrain to reach the food crops to the market, which results into 'wastage' and 'spoilage' of food in the fields. According to the author improvement of transport can solve the problem of 'rural to market accessibility' which can further improve the lifestyle and standard of living of the people in the study area.

Geurs and Wee (2004) reviewed 'accessibility measures of landuse and transport strategies'. Different components are described and finally 'location- and utility-based accessibility measures' are considered more effective rather than 'infrastructure-based accessibility measures' as input for socio-economic evaluation. Person-based measures are also evaluated and it is concluded that 'individual's spatial-temporal constraints' should be taken into consideration for accurate analysis of accessibility.

REGIONAL DEVELOPMENT DISPARITY

Regional development disparity is a common phenomenon among the states of India as well as among the villages within the districts in respect to a various social and economic components. To analyse such disparities at a remarkable number of techniques are applied by a host of research

scholars. Different statistical techniques are used by the researchers like Z-score, composite index, Kendall's co-efficient technique *etc.* In the present study PCA (Principal Component Analysis) is adapted to calculate Village Development Index (VDI). Factor analysis is commonly used in multivariate technique (Kothari, 2004). Principal component analysis was first developed by Karl Pearson in 1901 and later H. Hotelling gave the description of computing technique of PCA (Manly, 1986, pp.59-71). The author has tried to avoid the problem of arbitrary choice of weighting scheme and used PCA to transform a large set of correlated variables into a smaller set of uncorrelated variables, called Principal Component. Disparity is measured in socio-economic, agricultural, industrial, literacy *etc.* aspects by a host of research scholars which is incorporated in the edited book entitled "Regional Disparities and Development in India" (Tripathi and Tiwari, 1993; Prasad and Sarkar, 2011). Though, a considerable work has been done on regional development disparity measurement but at village level no such work is done still on disparity with reference to road transport network connectivity.

RESEARCH VOIDS

The literature review has been done on surface road transport network accessibility and connectivity. The review is divided into some parts like Topology and Typology, Parameters to Assess Connectivity and Accessibility, Transport network and other social Dimensions, Regional Development Disparity to find out the research gap. In this connection national and international level works on spatial context have been reviewed. Each and every part has its significance and weightage which may improve the total research work and can give proper idea to develop the method of study. Although literature review is a continuous process but due to shortage of time

The main objective of literature survey is to identify the research void and to make the research framework. The author has identified some methodological, technical as well as spatial gap of analysis. In Uttar Dinajpur district disparities in the accessibility and connectivity of surface road transport network has not studied before. How does surface road transport network can influence the regional development disparities at village level has not done yet.

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