*International Journal of Applied Social Science* ***RESEARCH PAPER***
***Volume 5 (9&10), September & October (2018) : 761-768*** ISSN : 2394-1405 (Print)
*Received : 21.04.2018; Revised : 03.05.2018; Accepted : 18.05.2018*

# On identification of block level road network efficiency in the backward regions of West Bengal

**SELIM CHISTI**
Assistant Professor
Department of Economics, Sabang Sajanikanta Mahavidyalaya
Temathani, Lutunia, Paschim Medinipur (W.B.) India

## ABSTRACT

In 2017 NITI Aayog identified 115 backward districts in India among which there exist 5 backward districts in West Bengal. . Govt. of India proposes to work with the States to launch a special initiative to rapidly transform these 115 backward districts by their specific developmental needs. The policy makers should focus on these backward districts so that these districts can reap the benefits of development potential. The policy makers have to concentrate on lot of policy measures like poverty alleviation, increases in education and health spending, and so on. Whatever may be the policy measure, infrastructure is the very basic component of any policy measure aimed at eliminating deprivation of these backward districts. Efficient infrastructure warranting accessibility attracts centres of production and consumption and thus impacts positively on the regional economy. More efficient infrastructures enable a better mobility for people and goods as well as a better connection between regions. Greater connectivity of road network is a necessary condition for socio-economic progress of most backward regions (Roy and Bhandari, 2003). This paper tries to identify the Block-level road network efficiency of backwards districts of West Bengal identified by NITI Aayog.

**Key Words :** NITI Aayog, Infrastructure, Backward district, West Bengal, Road network

## INTRODUCTION

Transport network is one the crucial factor for competitive performance and internationalization of regional economies. The development of effective transport connectivity creates a significant contribution to the addition to the potential productivity of a region or of an economy. Road transport is relatively economic mode of transport for short and medium distance because it transports perishable goods at a faster speed by road carriers, it helps people to travel and carry goods from one place to another, even in remote and inaccessible areas where other means of transport do not exist, like hilly, tribal, desert, forest, border and backward areas, it provides frequent loading and unloading at any destination and it prevents the pilferages and wastage of the produce (Mamoria and Goel, 1979). Economic efficiency refers to the degree that consumer benefits provided by a good exceed the costs of producing that good. From this perspective roads are most efficient if managed or priced to favor higher-value trips and more resource-efficient modes over lower-value trips and less efficient modes.

**How to cite this Article:** Chisti, Selim (2018). On identification of block level road network efficiency in the backward regions of West Bengal. *Internat. J. Appl. Soc. Sci.,* **5** (9&10) : 761-768.

### Survey of Literature :

Lot of studies in developing countries have showed the importance of transport infrastructure for economic development of backward regions. Influence of the new transport links was very strong which was shown by World Bank on the basis of case studies in India, Pakistan and Brazil (Creightney, 1993; Lall and Shalizi, 2001). Road improvements facilitated the marketing of local products. After the improvement of road network in Lao P.D.R, petty traders visited the villages more regularly, and there had been also an increase in the production of cash crops, an increase in cottage industry production for the market and an increase in selling trips to the market (Chris, 1998). Africon (2004) investigated the impact of improvements of the feeder road network in the Copper belt of Zambia. The study indicated that economic activities involved self employment among both men and women, and constituted a wide range of economic activities such as trading, logging, saw milling, carpentry, wood fuel selling, vending, beer brewing, baking, sewing, knitting and vending in makeshift markets. Agriculture was found as an alternative economic activity to mining, for economic growth. The study indicated that many individual farmers organized their own transport to market places in the urban centers due to a lack of a mechanism such as an agricultural marketing board to Aderamo and Magaji (2010) examined the relationship between road network development and the distribution of public facilities in Edu Local Government Area of Kwara State, Nigeria. This study showed that rural road network had significant effect on the distribution of facilities in rural areas and had the potential of reducing poverty. Improved rural accessibility and mobility are capable of reducing the level of poverty of rural people because the basic necessities of life such as healthcare delivery, education, postal services and customary courts will be closer to them (Howe, 1981; Levy, 1996). Baldwin (1996) examined the role of Appalachian highways for many local communities, focusing on the economic impacts that highways have on rural areas. He pointed out the effect of the Appalachian Development Highway System (ADHS) in attracting manufacturing plants along highway corridors. He advocated the need for investment in low-volume rural roads.

## METHODOLOGY

### Backward regions in West Bengal identified by NITI Aayog :

India is on a high growth trajectory that is expected to lift millions out of poverty. However, presently the quality of life of many of its citizens is not consistent with this growth story, a fact reflected in UNDP's 2016 Human Development Index wherein we are ranked 131 out of 188 countries. A closer look at the data reveals high heterogeneity in the living standards in India. There are significant inter-state and inter-district variations. By uplifting the districts which have shown relatively lesser progress in achieving key social outcome, India can move ahead in the human development index. The 115 districts were identified from 28 states, at least one from each state, in a transparent manner by a committee of Senior Officers to the Government of India, in consultation with State Officials using a composite index of key data sets that included deprivation enumerated under the Socio-Economic Caste Census, key health and education sector performance and state of basic infrastructure. Amongst these 115 districts, five districts of West Bengal, namely, Birbhum, Dakhsin Dinajpur, Malda, Murshidabad and Nadia are identified as 'Backward' by NITI Aayog (GOI, 2018).

### Efficiency of road network of backward regions :

In recent researches, efficiency measures are highly used for judging the development scenario of road network. Two structural measures (e.g. beta and gamma) are widely used as efficiency measures in the current research on road network. Beta index is very simple in respect of calculation and interpretation. It measures the level of connectivity of network. Kansky (1963) recommended this index. It is expressed as the ratio of the number of links (e) to the number of vertices (ν).

It is written as –

$$\beta = e / \nu$$

where, e is the number of edges, and ν is the number of vertices.

Higher β values are produced by more sophisticated network structures. Beta index takes the value zero for network, which consists just of vertices without any edges. This index takes the value one and greater where networks are well connected. For example, very simple networks and tree type networks show values less than one, a connected network involving a single circuit has a value of one, while the networks with greater complexity, which includes several circuits have values higher than one. The whole range of the β index is for non-planer graphs from zero to infinity; for planer graphs, the range is from zero to three (Raja and Agarwal, 1986).

In a completely disconnected network, where each edge has two vertices, the beta index is obtained by using the following formula –

$$\beta = e / 2e$$

In this case, the beta index takes the numerical value less than one. When the disconnected network changes its structures and its connectivity increases with increasing number of edges for the given number of vertices. The increasing connectivity of the network will be accompanied by a decreasing number of vertices relative to the number of edges and the β index will take higher numerical values (Kansky and Dascoine, 1989).

The gamma index (Garrison and Marble, 1965) is a quotient of the observed number of edges to the maximum number of edges. For a non-planer graph it may be written as –

$$\gamma_N = \frac{e}{\frac{v(v-1)}{2}}$$

where $\gamma_N$ -Gamma index for planer graph.

For planer graphs, the following modified formula is used –

$$\gamma_P = \frac{e}{3(v-2)}$$

where $\gamma_P$ -Gamma index for planer graph

The gamma index varies from zero to one, where zero means that the nodes are not connected at all and one means that the graph is completely connected. Moreover the gamma index can be used as a measure of network efficiency over time because it indicates the progression of a network in time, that is, whether the network in one period has developed or not after some time (Rodrigue, 2004).

## RESULTS AND DISCUSSION

Table 1 shows the results of efficiency measures of road transport network of backward regions of West Bengal. In terms of β index, Malda district has the highest value of 1.1259. The districts of Murshidabad and Dakhsin Dinajpur having lower â values are in relatively poor position in the state of West Bengal. In respect of gamma index the highest value (0.0791) is found in Murshidabad. The district of Dakhsin Dinajpur has relatively lower efficiency in road network.

| **Table 1 : Efficiency measures of road infrastructure of backward districts** | | |
|---|---|---|
| District | β | γ |
| D. Dinajpur | 1.0548 | 0.0497 |
| Malda | 1.1259 | 0.0708 |
| Murshidabad | 1.0371 | 0.0791 |
| Birbhum | 1.1067 | 0.0610 |
| Nadia | 1.0653 | 0.0595 |

Source: Calculated by Author from data of West Bengal Administrative Atlas, 2001 and District Statistical Handbooks of West Bengal, 2004, BAES.

**Block-level efficiency of road network in backward districts :**

The picture of block level efficiency of road network of the backward districts is highlighted. The results are shown in Table 2.

| **Table 2 : Efficiency measures of road infrastructure in blocks of backward districts** | | | | |
|---|---|---|---|---|
| Districts | Block Sl. No. | Blocks | β | γ |
| Dinajpur-S | 1 | Khusmandi | 1.0612 | 0.0442 |
| Dinajpur-S | 2 | Harirampur | 1.0500 | 0.0538 |
| Dinajpur-S | 3 | Banshihari | 1.1154 | 0.0892 |
| Dinajpur-S | 4 | Gangarampur | 1.0606 | 0.0326 |
| Dinajpur-S | 5 | Kumargang | 1.0250 | 0.0526 |
| Dinajpur-S | 6 | Tapan | 1.0600 | 0.0433 |
| Dinajpur-S | 7 | Balurghat | 1.0417 | 0.0293 |
| Dinajpur-S | 8 | Hili | 1.0250 | 0.0526 |
| Malda | 1 | Harishchandrapur-1 | 1.2000 | 0.0828 |
| Malda | 2 | Harishchandrapur-11 | 1.2222 | 0.0940 |
| Malda | 3 | Chanchal-I | 1.3200 | 0.1100 |
| Malda | 4 | Chanchal-II | 1.0417 | 0.0906 |
| Malda | 5 | Ratua-1 | 1.1081 | 0.0616 |
| Malda | 6 | Ratua-11 | 1.1200 | 0.0933 |
| Malda | 7 | Gazole | 1.0602 | 0.0259 |
| Malda | 8 | Bamongola | 1.0400 | 0.0424 |
| Malda | 9 | Habibpur | 1.0260 | 0.0270 |
| Malda | 10 | Old Malda | 1.0526 | 0.0376 |
| Malda | 11 | English Bazar | 1.1111 | 0.0250 |
| Malda | 12 | Manikchak | 1.1111 | 0.0635 |
| Malda | 13 | Kaliachak-I | 1.1333 | 0.0782 |
| Malda | 14 | Kaliachak-II | 1.0800 | 0.0900 |
| Malda | 15 | Kaliachak-III | 1.2632 | 0.1404 |
| Musshidabad | 1 | Berhampur | 1.0294 | 0.0307 |
| Musshidabad | 2 | Beldanga-I | 1.1667 | 0.1014 |
| Musshidabad | 3 | Beldanga-II | 1.2258 | 0.0817 |
| Musshidabad | 4 | Nowda | 0.9167 | 0.0797 |
| Musshidabad | 5 | Hariharpara | 1.0000 | 0.1429 |
| Musshidabad | 6 | Kandi | 1.0930 | 0.0520 |
| Musshidabad | 7 | Khargram | 1.0800 | 0.0900 |
| Musshidabad | 8 | Burwan | 0.9853 | 0.0294 |

*Table 2 contd..*

*Table 2 contd…*

| | | | | |
|---|---|---|---|---|
| Musshidabad | 9 | Bharatpur-I | 1.0645 | 0.0710 |
| Musshidabad | 10 | Bharatpur-II | 1.1923 | 0.0954 |
| Musshidabad | 11 | Farakka | 0.9512 | 0.0476 |
| Musshidabad | 12 | Samsergang | 0.8800 | 0.0733 |
| Musshidabad | 13 | Suti-I | 1.0000 | 0.2857 |
| Musshidabad | 14 | Suti-II | 1.0000 | 0.0690 |
| Musshidabad | 15 | Raghunathgang-I | 1.0000 | 0.0357 |
| Musshidabad | 16 | Raghunathgang-II | 1.0000 | 0.1250 |
| Musshidabad | 17 | Sagardighi | 1.0000 | 0.0260 |
| Musshidabad | 18 | Lalgola | 1.0000 | 0.0417 |
| Musshidabad | 19 | Bhagobangola-I | 0.9524 | 0.0952 |
| Musshidabad | 20 | Bhagobangola-II | 1.0000 | 0.0952 |
| Musshidabad | 21 | Msd-Jiagang | 1.1449 | 0.0337 |
| Musshidabad | 22 | Nabagram | 0.9861 | 0.0278 |
| Musshidabad | 23 | Domkal | 1.0400 | 0.0867 |
| Musshidabad | 24 | Jalangi | 1.0541 | 0.0586 |
| Musshidabad | 25 | Raninagar-I | 1.0667 | 0.0736 |
| Musshidabad | 26 | Raninagar-I | 1.1364 | 0.1082 |
| Birbhum | 1 | Murarai-I | 1.0702 | 0.0382 |
| Birbhum | 2 | Murarai-II | 1.0794 | 0.0348 |
| Birbhum | 3 | Nalhati-I | 1.1786 | 0.0873 |
| Birbhum | 4 | Nalhati-II | 1.2353 | 0.1544 |
| Birbhum | 5 | Rampurhat-I | 1.1818 | 0.1126 |
| Birbhum | 6 | Rampurhat-II | 1.0625 | 0.0337 |
| Birbhum | 7 | Mayureshwar-I | 1.0526 | 0.1170 |
| Birbhum | 8 | Mayureshwar-II | 1.0508 | 0.0362 |
| Birbhum | 9 | Md.Bazar | 1.0000 | 0.0500 |
| Birbhum | 10 | Sainthia | 1.1373 | 0.0455 |
| Birbhum | 11 | Dubrajpur | 1.1099 | 0.0247 |
| Birbhum | 12 | Rajnagar | 1.1351 | 0.0631 |
| Birbhum | 13 | Suri-I | 1.0864 | 0.0272 |
| Birbhum | 14 | Suri-II | 1.1081 | 0.0616 |
| Birbhum | 15 | Khoyrasol | 1.0741 | 0.0826 |
| Birbhum | 16 | Bolpur-Shantiniketan | 1.1636 | 0.0431 |
| Birbhum | 17 | Labhpur | 1.1111 | 0.0419 |
| Birbhum | 18 | Nanoor | 1.1282 | 0.0594 |
| Birbhum | 19 | Illambazar | 1.0638 | 0.0463 |
| Nadia | 1 | Karimpur-I | 0.875 | 0.250 |
| Nadia | 2 | Karimpur-II | 0.667 | 0.667 |
| Nadia | 3 | Tehatta-I | 0.909 | 0.182 |
| Nadia | 4 | Tehatta-II | 0.667 | 0.267 |
| Nadia | 5 | Kaliaganj | 0.909 | 0.182 |
| Nadia | 6 | Nakashipara | 0.714 | 0.238 |

*Table 2 contd..*

*Table 2 contd...*

| | | | | |
|---|---|---|---|---|
| Nadia | 7 | Chapra | 0.833 | 0.400 |
| Nadia | 8 | Krishnanagar-I | 0.909 | 0.182 |
| Nadia | 9 | Krishnanagar-II | 0.500 | 1.000 |
| Nadia | 10 | Nabadwip | 0.500 | 0.333 |
| Nadia | 11 | Santipur | 0.750 | 0.214 |
| Nadia | 12 | Hanskhali | 0.900 | 0.200 |
| Nadia | 13 | Ranaghat-I | 0.889 | 0.222 |
| Nadia | 14 | Ranaghat-II | 0.889 | 0.222 |
| Nadia | 15 | Chakdaha | 0.750 | 0.214 |
| Nadia | 16 | Haringhata | 0.909 | 0.182 |

Source: Same as Table 1

**Dinajpur-S district :**

The value of β index lies between 1.0250 and 1.1154. Bansihari block is in the best position in respect of β index and Kumarganj and Hili block are in the worst position regarding the same. Khusmandi block (1.0612) is the 2nd best one and Gangarampur block (1.0606 is the 3rd best one in terms of β index. Balurghat block (1.0417) and Harirampur block (1.0500) have inefficient road network in terms of β index.

The value of γ index lies between 0.0293 and 0.0892. Bansihari block has the best connected road network in respect of γ index and Balurghat block has the worst connected road network regarding the same. Harirampur block (0.0538) has the 2nd best connected road network and Hili and Kumarganj block (0.0526) have the 3rd best connected road network in terms of γ index. Gangarampur block (0.0326) and Tapan block (0.0433) have less connected road network in terms of γ index.

**Malda district :**

The value of β index lies between 1.0260 and 1.3200. Chanchal-1 block is in the best position in respect of β index and Habibpur block is in the worst position regarding the same. Kaliachak-111 block (1.2632) is the 2nd best one and Harishchandrapur-11 block (1.2222) is the 3rd best one in terms of β index. Bamongola block (1.0400) and Chanchal-II block (1.0417) have inefficient road network in terms of β index.

The value of γ index lies between 0.0250 and 0.1404. Kaliachak-111 block has the best connected road network in respect of γ index and Englishbazar block has the worst connected road network regarding the same. Chanchal-1 block (0.1100) has the 2nd best connected road network and Ratua-11 block (0.0933) has the 3rd best connected road network in terms of γ index. Gazole block (0.0259) and Habibpur block (0.0270) have less connected road network in terms of γ index.

**Murshidabad district :**

The value of β index lies between 0.8800 and 1.2258. Beldanga-11 block is in the best position in respect of β index and Samserganj block is in the worst position regarding the same. Bharatpur-11 block (1.1923) is the 2nd best one and Msd-Jiaganj block (1.1449) is the 3rd best one in terms of β index. Nowda block (0.9167) and Farakka block (0.9512) have inefficient road network in terms of β index.

The value of γ index lies between 0.0260 and 0.2857. Suti-1 block has the best connected road network in respect of $\gamma$ index and Sagardighi block has the worst connected road network regarding the same. Hariharpara block (0.1429) has the 2nd best connected road network and Raghunathganj-11 block (0.1250) has the 3rd best connected road network in terms of $\gamma$ index. Nabagram block (0.0278) and Burwan block (0.0294) have less connected road network in terms of $\gamma$ index.

**Birbhum district :**

The value of $\beta$ index lies between 1.0000 and 1.2353. Nalhati-11 block is in the best position in respect of $\beta$ index and Md. Bazar block is in the worst position regarding the same. Rampurhat-1 block (1.1818) is the 2nd best one and Nalhati-1 block (1.1786) is the 3rd best one in terms of $\beta$ index. Mayureshwar-11 block (1.0508) and Mayureshwar-1 block (1.0526) have inefficient road network in terms of $\beta$ index.

The value of $\gamma$ index lies between 0.0247 and 0.1544. Nalhati-11 block has the best connected road network in respect of $\gamma$ index and Dubrajpur block has the worst connected road network regarding the same. Mayureshwar-1block (0.1170) has the 2nd best connected road network and Rampurhat-1 block (0.1126) has the 3rd best connected road network in terms of $\gamma$ index. Suri-1 block (0.0272) and Murarai-1 block (0.0382) have less connected road network in terms of $\gamma$ index.

**Nadia district :**

The value of $\beta$ index lies between 0.500 and 0.909. Tehatta-I, Kaliaganj, Krishnanagar-I and Haringhata blocks are in the best position in respect of $\beta$ index and Krishnanagar-II and Nabadwip blocks are in the worst position regarding the same.

The value of $\gamma$ index lies between 0.182 and 1.000. Krishnanagar-II block has the best connected road network in respect of $\gamma$ index and Tehatta-I, Kaliaganj and Haringhata blocks have the worst connected road network regarding the same.

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