Chapter 6

Measurement of Connectivity and Accessibility of Rural periodic Market centres

6.1 Introduction

Human beings manage their lives in geographical space. They exist and perform their activities at specific locations and move or distribute things in certain directions (Smith, 1977).The need for the movement of things and persons underlie every sort of societal setting. The process of cultural evolution has further increased the level of occupational specialization, concomitantly the level of spatial interaction (Lowe and Moryadas, 1975). Periodic Markets are the rural hub where people congregate at particular time intervals for marketing activities. The magnitude of trade in periodic market places depends on their levels of connectivity and accessibility. On the other hand connectivity brings more varieties of commodities to periodic market places. This study mainly focuses on the assessment of connectivity and accessibility of Periodic Market Centres in Uttar Dinajpur District. The accessibility to markets create a large scale rural to urban and urban to rural interaction in which agricultural commodities may penetrate into urban markets and manufactured goods may also get onto the rural Periodic Market Places. In rural area, periodic markets are the nodes of spatial organization and insights into the transport network and infrastructure. It is this circulation of the people, goods and information amongst various nodes that makes the society on organic whole and the region a spatial system. It is well known that the interaction between people and places requires access and access is only possible if there are connecting links (Kisslong, 1969). Thus the spatial organization of market centres is conditional by their relative locations. Improved transportation can help in strengthening the ties among rural markets, town markets and larger cities. The transport networks help in linking the food surplus and food deficit areas in the form of internal trade links. As soon as the internal trade begins to dominate local exchange at a market place, the functions of a market tend to achieve a complex system. In the villages with well-developed agriculture and good transportation facilities, the commoditization of agricultural products is already very high.

Methodology:

The study has given emphasis on primary survey in accordance with secondary data collection. The stratified sample survey has been done to assess the

accessibility of periodic market centres. Connectivity is the degree to which the vertices of a network are directly connected to each other (Yeats, 1968).For determining the transport connectivity graph theory has been applied. The connectivity of a network can be measured by the uses of 'graph theory'-a branch of typology which is concerned with the elementary structure in which the 'locations (nodes) are reckoned in terms of their position on the geometric net and not by their actual locations (Hurst, 1974, pp.55).

6.1.1 Graph Theoretic Measures of Connectivity: The graph theoretical studies of networks purpose to ascertain the structure of network in terms of specific measures for this purpose and the relation of these measures to the characteristics of the region (Ramaswami, 1976). There are a number of measures which may be inferred from the concepts of graph theory for measuring the connectivity of market centres. In the present case the measures selected are:

- **Cyclomatic number (μ or N):** It is a very important non ratio measure abstracted from graph theory. It is also known as Ist 'Betti Number' and is the count of the number of fundamental circuits existing in the graph. It may be considered to be measure of redundancy in the system and is expressed as:

$$\mu = e - v + g$$

Where, v is the number of vertices, e the number of edges and g the number of maximal no connected sub-graphs. The magnitude of the Cyclomatic number is directly related to the connectivity of the graph. Greater the Cyclomatic number, greater the connectivity of the graph and vice-versa.

- **Alpha index (ά):** The alpha or redundancy index was developed by Garrison and Marble in 1962.It shows the ratio between the actual number of the circuits and the maximum possible number of the circuits which may exist in a network. The value of alpha varies from Zero (no circuits) to 1 (maximum number of circuits).The alpha index (ά) for planner network is defined as:

$$\text{Alpha Index } (\acute{\alpha}) = \frac{e - v + 1}{2v - 5}$$

The index is also multiplied by 100 to express the redundancy in percent.

- **Gamma index (γ):** It represents the ratio between the observed numbers of edges to the maximum number of edges. Therefore, for a planner graph the gamma index will have the formula

$$\textbf{Gamma index } (\gamma) = {}^{e}/_{3(v-2)}$$

The index may be multiplied by 100 to give it a range from 0 to 100 and interpretation as percent connected with a completely unconnected system having a zero value and a completely connected system, a value of 100 percent.

- **Beta Index:** The Beta index is another important measure of connectivity. It is the ratio between the number of edges and the number of vertices and is calculated as follows:

$$\textbf{Beta Index } (\beta) = {}^{e}/_{v}$$

Where, 'e' denotes number of edges and 'v' denote number of vertices. The value of the index ranges from 0 to 3 for a planner graph. A value of zero indicates a completely unconnected system (i.e. zero edges) while a value of 1 describes a network with one circle. As the network structure becomes more complex with an increasing number of edges in relation to vertices, so the Beta index goes up to reach maximum three.

Application of the measures: It is necessary to adopt an operational definition of vertices and edges before applying these afore mentioned measures of connectivity. The present study is based on some parameters:

- All the periodic market centres are recognized as vertices or places provided they are connected by metalled and unmetalled roads.
- Each intersection of two edges is recognized as an additional vertex or place, regardless of whether or not it was occupied by a periodic market centre.
- Only metal and unmetal roads are taken into account for the determination of edges or routes.
- Each edges or route joints two different places and thus, is a set consisting of two places.
- At the most, a pair of places may be joined only by one route.

Result and discussion:

On the basis of the criteria outlined above, all the periodic market centres have been identified as vertices, including few additional vertices which are intersection of routes, various connectivity indices such as, Cyclomatic number (μ), alpha (ά), gamma (γ),

and Beta (β) have been calculated for various development blocks. To compare the structural complexity of different development block's connectivity in respect of Periodic market centres, the study should go through the alpha and gamma indices calculation.

Cyclomatic Number: The value of Cyclomatic number for the district is 11 indicating low redundancy of the system. The block-wise analysis shows that six out of nine blocks have only one path. Some blocks are witnessing no fundamental circuits in this regard. Only Raiganj, Islampur and Chopra have additional paths carrying the value of Cyclomatic number 4, 3, and 4 as follows, bearing a poor connectivity.

Alpha Index: If a link is added to the network, the connectivity is increased beyond the minimum configuration which only a single and unique path can be identified between all pairs of nodes. Additional links in the network create circuitry. A circuit is defined as a finite, closed path in which the initial node of the linkage sequence coincides with the terminal nodes. The table shows a sign of minimally connected network as all the alpha value of the blocks bearing minimum circuit but not up to the mark. The district total of alpha value denotes only 31%.

Gamma Index: When the calculation deal with the comparison of ratio of the observed number of edges and maximum number of edges of various development blocks the values ranges from .02 to .4. So for convenience it may be said that Goalpokhar II shows the minimal connection, i.e. 2% in comparison to Chopra and Islampur i.e. 40% connected.

Beta Index: When the ratio between the number of edges and vertices is calculated, the value ranges from 0.91 to 1.13 showing the low connectivity of the system. Hemtabad, Karandighi, Itahar and Goalpokhar II have less number of edges in respect of vertices so the values are less than 1 and denote a minimal connection.

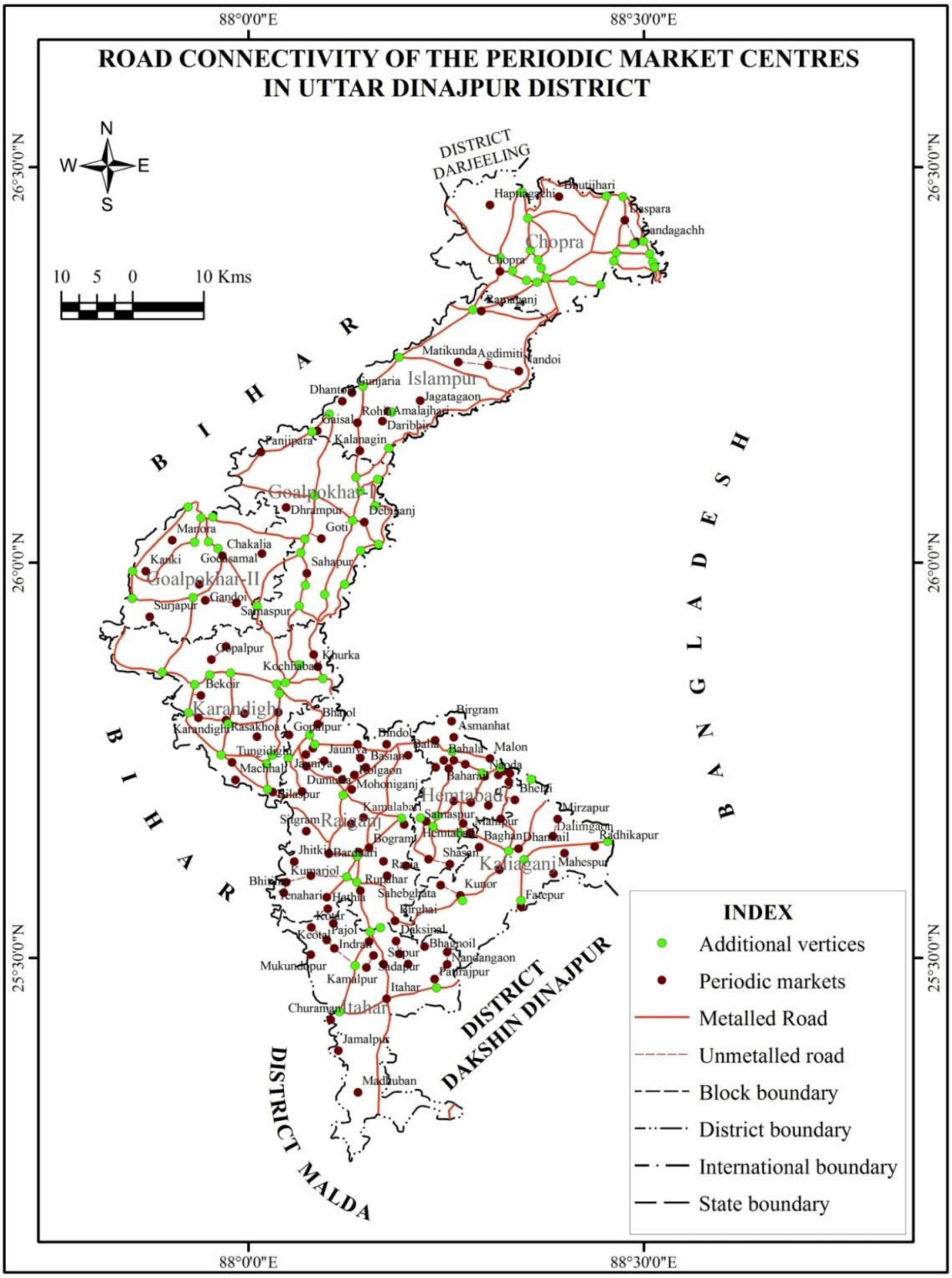
ROAD CONNECTIVITY OF THE PERIODIC MARKET CENTRES
IN UTTAR DINAJPUR DISTRICT
88°0'0"E
88°30'0"E
26°30'0"N
26°0'0"N
25°30'0"N
N
S
E
W
10 5 0 10 Kms
DISTRICT DARJEELING
B I H A R
B I H A R
B A N G L A D E S H
DISTRICT DAKSHIN DINAJPUR
DISTRICT MALDA
Chopra
Islampur
Goalpokhar-I
Goalpokhar-II
Karandighi
Raiganj
Hemtabad
Kaliaganj
Itahar
INDEX
Additional vertices
Periodic markets
Metalled Road
Unmetalled road
Block boundary
District boundary
International boundary
State boundary

Figure No. 51

Table No. 43 Degree of Connectivity of Periodic Market Centres in Uttar Dinajpur District

Sl. No	Name of blocks	Cyclomatic Number(μ)	Alpha Index (ά)	Alpha(ά) IN %	Beta Index	Gamma Index(γ)	Gamma index in (γ)%
1	Raiganj	4	0.034	3.48	1.04	0.36	36
2	Hemtabad	2	0.03	3.33	0.91	0.32	32
3	Kaliyaganj	1	0.03	3.57	1	0.37	37
4	Itahar	1	0.02	2.32	0.96	0.35	35
5	Karandighi	0	0.01	1.85	0.93	0.33	33
6	Goalpokhar I	0	0.02	2.94	1	0.36	36
7	Goalpokhar II	0	0.04	4.16	0.94	0.02	2
8	Islampur	3	0.08	8.1	1.09	0.4	40
9	Chopra	4	0.01	1	1.13	0.4	40

Source: Computed by Researcher

ANALYSIS OF ROAD NETWORK OF PERIODIC MARKET PLACES IN

UTTAR DINAJPUR DISTRICT

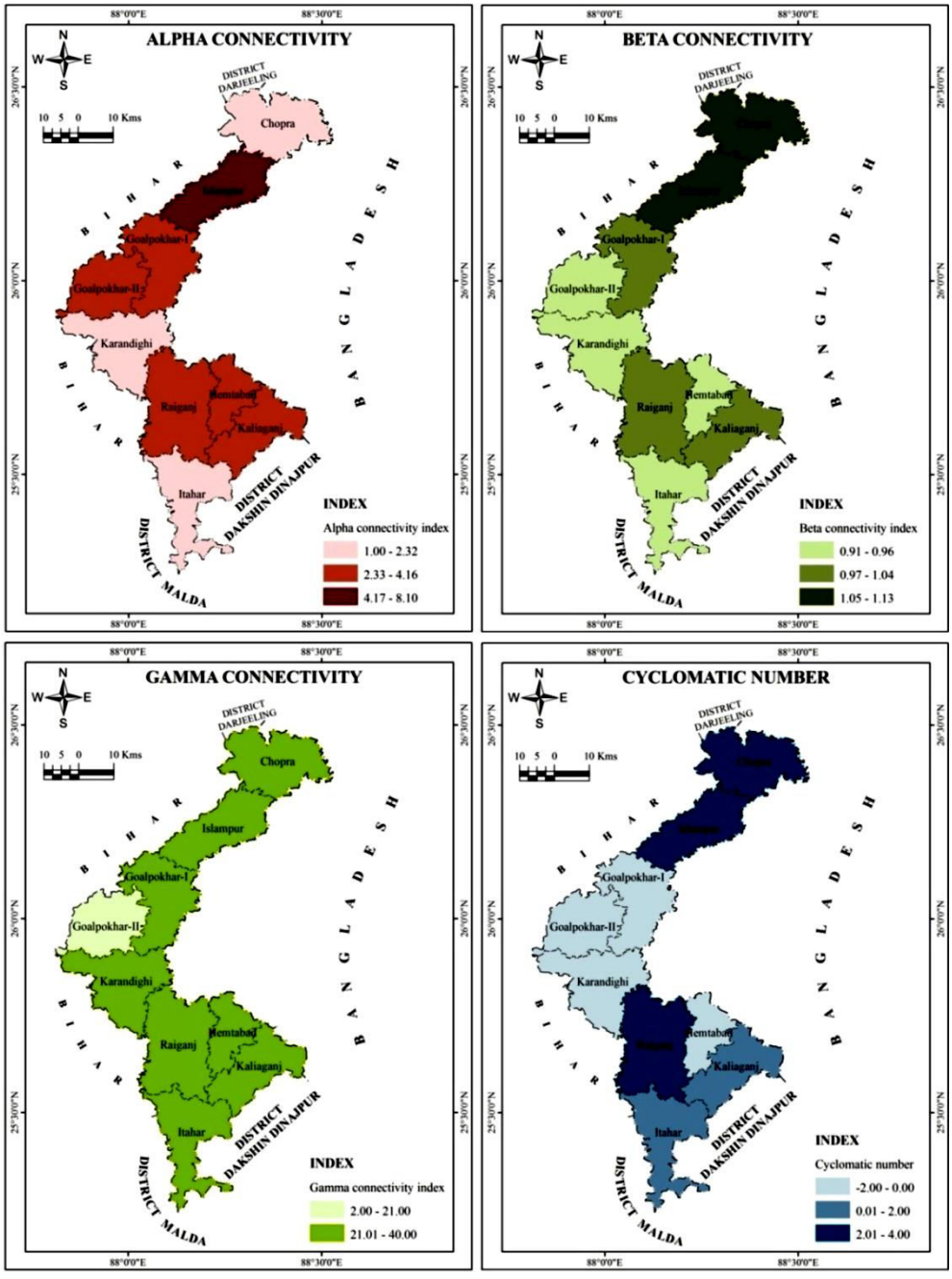

Figure No. 52

6.2 Accessibility:

The basic notion of accessibility is closely related to the concept of movement-minimization (Chorley & Hagget, 1967). Accessibility is a measure of the ease of an individual to pursue an activity of a desired type, at a desired location, by a desired mode, and at a desired time. Accessibility should relate to changes in travel opportunities, their quality and impediment: 'If the service level (travel time, cost and effort) of any transport mode in an area increases (decreases), accessibility should increase (decrease) to any activity in that area, or from any point within that area. As the study deals with the spatial organization of an area, it not only displays the aggregate characteristics of the network of periodic markets itself but also highlight the function and accessibility of periodic markets with rest of the market centres. The structure of a network changes in response to the addition of new linkages or the improvement of existing linkages. It is probable that the accessibility or relative position of individual nodes (Periodic Market centres) in the network will be affected.

Methodology: In the present case, accessibility is treated as relative degree of ease with which a location may be reached from other location. It is measured with reference to:

1. The physical distance from motor able roads and termed as' physical accessibility'.

2 .Relative Accessibility measurement of travel time distance in between municipal towns within the district with periodic market centres in its vicinity consider as 'relative accessibility' which has a great significance in strengthening the interaction of rural urban and urban rural counterparts and ultimately would enhance trading activities.

6.2.1 Physical Accessibility:

It is measured with reference to the physical distance from motor able roads. As a motor able road may link the nodes (Periodic Market) with other counterpart of the region and subsequently lead to the development of periodic market centres in respect of marketing transaction. It is clear from the figure 33 that among sample periodic markets, nearly 62.8% of the total periodic market centres of the district are located beside the motor able roads while about 20.9% within a distance of about 2.5 to 5 km from motorable road. Only 16.3% periodic markets lie beyond 5 km from motor able roads. It is clear from the table among the sample market centres that there are 8 periodic markets on

the motor able roads among which are Kamalabari, Karnojora, Maharaja, Mohiniganj, Rupahar, Barduari, Bhatol and Bindol. On the contrary, in Islampur and Itahar block, there are 6 market centres which lie beyond 5 km from motorable roads. These are Churaman, Dakshinal and Parbatipur in Itahar Block and Matikunda, Gaisal and Amlijhari in Islampur Block.Less physical accessibility has lessened the probability of growth prospect of these market centres.

Table No. 44: Physical Accessibility of Sample Periodic Market Centres in Uttar Dinajpur District

Sl no.	Name of the blocks	Beside Motorable road	Within 2.5-5 km from motorable road	Beyond 5 km from motorable roads	Total
1	Raiganj	8	2	-	10
2	Hemtabad	5	-	-	5
3	Kaliyaganj	4	1	-	5
4	Itahar	2	1	3	6
5	Islampur	1	1	3	5
6	Karandighi	3	2	-	5
7	Goalpokhar I	1	-	1	2
8	Goalpokhar II	1	1	-	2
9	Chopra	2	1	-	3
District total		27	9	7	43
District total in %		62.8	20.9	16.3	100

Source: Field survey, 2012-13

6.2.2 Relative Accessibility:

Accessibility is measured in terms of travel time/distance from market centres. The district has four municipal towns viz. Raiganj, Kaliyaganj, Dalkhola and Islampur. As the rural periodic markets are located around the urban market centres like Raiganj, Kaliyaganj, Dalkhola and Islampur, a considerable number of urban traders and consumers prefer to visit these market places. There are time and distance factors which determine the movement of traders and consumers as they prefer to visit the market places in their vicinity. So, on the basis of motor able time distance a participant would visit a periodic market. However, close proximity would determine the attendance of market places and vertical flow of commodities from periodic market to urban market and vice versa. A large scale of vegetables, grains, mustered and jutes is transported to Urban Bazaar. During the sample survey, it was found out that in Raiganj Block comprising Raiganj Municipality from where, out of 10 periodic market places 7 periodic marketplaces have better access as all these marketplaces lie within just 1 hrs travel time distance from nearby municipal town and rest of three market places lie within 1 to 2 hrs travel time distance from their nearest urban centres. As Hemtabad block does not comprise any municipality, the visitors are coming from nearest town's viz. Raiganj and Kaliyaganj. There are 2 marketplaces within 1 hour travel distance and 3 market places situated in remote locations within 1-2 hours travelling distance. Kaliyaganj consists of 5 periodic market places lying within 1 hour travelling distance to their Kaliyaganj municipality markets. Itahar has 2 market places which lie within 1 hour and 3 market places lie within 1 to 2 hours travelling distance. Islampur subdivision has five community development blocks in which Islampur and Dalkhola are the municipal towns. In Islampur block, there are 4 periodic market places within the vicinity of 1 hour travelling distance. In Goalpokhar I & II block there are 5 periodic market places within 1hour proximity of Islampur town's market centre. In Karandighi block Bilaspur, Tungidighi as closer to 1 hour distance Raiganj's municipal market centres and connected by NH 34, priority is giving to continuous touch of participant's from Raiganj Municipal Area. Among sample periodic market places only Daspara periodic market place lies within 1 hour proximity of Islampur municipal market centres.

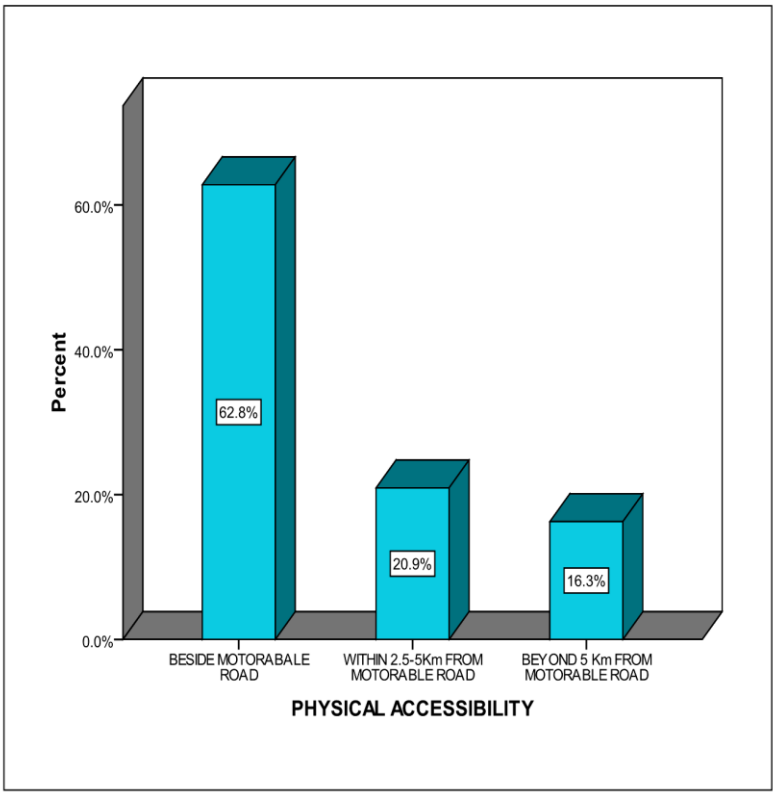

Figure No. 3

The study reveals that 62.79% of Periodic Marketplaces lie within 1 hour travel time distance from municipality towns. It can be said that following the proximity of the municipal town periodic market have a scope of development and incursion of manufactured goods. As a result it would increase the prosperity of the entire area.Urban consumers and traders would like to participate in periodic marketing.The district show a variability of connectivity and accessibility among the periodic markets.Influx of products and services into periodic markets depend on the connectivity and accessibility of those market centres.For this reason those markets which are not properly accessible to municipal town remain lag behind the market situated beside the metal road.

Table No. 45 Relative Accessibility of periodic market centres

Sl. No.	Name of the blocks and Nearest Town	Time distance from municipal towns / frequency of periodic market centres	
		<1hrs	**1.0-2.0 hrs**
1	Raiganj **(Raiganj)**	07	03
2	Hemtabad(**Raiganj & Kaliyaganj)**	02	03
3	Kaliyaganj(**Kaliyaganj)**	05	-
4	Itahar(R**aiganj)**	02	04
5	Islampur(**Islampur)**	04	01
6	Karandighi(**Dalkhola & Raiganj)**	03	02
7	Goalpokhar I(**Islampur**)	02	-
8	GoalpokharII(**Islampur)**	-	02
9	Chopra(**Islampur**)	01	02
District total		26	17

Source: Field Survey, 2012-13

Conclusion:

In conclusion, it may be mentioned that without proper connectivity or accessibility, any nodal functional centres cannot be flourished with a full vigour. In this study, connectivity and accessibility of sample market centres has been highlighted. Policy for further strengthening the link between periodic market centres and also between urban and rural periodic market centres would enrich the periodic marketing activity and regional economic development.

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