

A Brief Review on the Role of Regional Transport Accessibility in the Development Process of Distant Sub-Regions

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Abstract

Regional transport accessibility is essential for the socioeconomic development of deprived sub-regions of developing countries, which intended to provide basic access to rural inhabitants. The availabilities of road facility together with transport service are responsible for the provision of basic accessibility to rural inhabitants. Hence, this study reviewed the suitable literature to determine the methods or techniques, which can assist policy makers in their decision-making process targeting rural-regional accessibility issues. This investigation could show a way forward to concerned planning agencies in the execution process of low-cost transport services for the remote sub-regions of developing countries.

Keywords: Deprived Sub-Regions, Low-Cost Transport Services, Rural Accessibility

1. Introduction

The rural population often suffered from poor access to transport services, e.g. road or public transport facilities. In the same way, the transport sector also suffered from the energy crises¹, which enhanced its provision, especially within the context of rural sub-regions. The communication through roads is an imperative element for promoting the physical and socioeconomic development of pastoral sub-regions. Their vitality has been evidently revealed in history, which have been developed tremendously after providing rural road facilities. Even in this modern era, roads have proven their importance from socioeconomic aspects. Inadequacy of roads is responsible for the stagnant economies of most of the rural areas². On the other hand, rural roads provide basic access to backward societ-

ies from health, education, employment, recreation and job aspects. The purpose of providing road facilities at a rural-regional level is not much a clear concept in most of the developing world. For the first time, *Hine*³ gave the conceptual framework for rural roads and searched out that most of the rural trips are actually based on household needs. It is expected that better road facilities at the rural-regional level can conveniently serve the rural population and can be helpful in fulfilling the rural household's demands. *Hine*³ also explained that in developing countries, rural road facilities are more provided for the economic purpose, e.g. farm to market roads; rather to access health and education facilities in a rural-regional level. One of the reasons of urbanization in the developing world also reflected inaccessibility and shortage of

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rural roads, and infrastructure facilities in most of the rural regions.

The objective of writing this article is to highlight the importance of transport accessibility and services in the development process of destitute sub-regions of developing countries. It was found that rural road facilities can up-grade and improve the socioeconomic conditions of the rural population. Therefore, rural road facilities should be provided by keeping in view the travel demands with better opportunities to markets, education, health and work or employment sites⁴. There are various social diverse effects of land-use and transportation system on societies and settlements. These effects may include health facilities in a given area and reaching them with ease and comforts⁵. Accessibility can be utilized as a social indicator if accessibility will provide various socioeconomic breakthroughs for the local population. These opportunities may include better health and education services, together with accessing job locations and commercial facilities. Economic indicators of any land-use transport project can be viewed from direct economic advantages. These benefits may include cost-benefit analysis in which transport user's cost is given more importance with respect to infrastructure projects. An improvement in accessibility standards of rural households can uplift their living standards and assist in the process of poverty alleviation. This would help in reducing urbanization process and lessen the burden on urban areas.

2. Transport and Accessibility

Transport systems are planned and designed for the welfare of people. In rural sub-regions, transportation services assist rural inhabitants, as these can participate in their daily routine activities efficiently. Accessibility highlights the relationship between transportation systems and various land-use activities in order to rectify transportation and land-uses related problems. Various transportation departments focus on the improvement of mobility in order to increase accessibility⁶. Fast and safe transportation systems, with accessible and convenient network facilities are necessary for planned regional development. The sustainable transportation system should meet with the ever-increasing needs of common men, the quality of life, and living standards⁷. In a similar fashion, accessibility improvement with respect to markets, jobs, goods, services, and perfection in mobility by

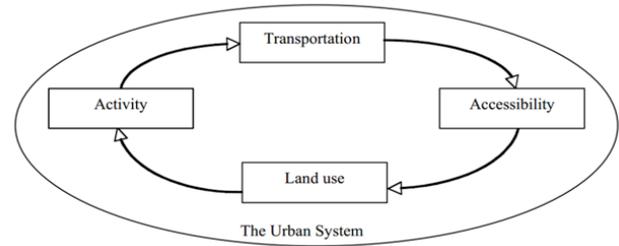


Figure 1. Urban and regional transportation system⁹.

financial assistance and policy proposals can help rural people traveling safer.

For public sector organizations, accessibility can be tackled as a performance indicator of a land-use transportation system, which can be implemented in any rural-regional study. Accessibility criterion is important for the quality of life in rural regions⁸. For any transportation agency, the problem is not just the construction and widening of roads; it is a subject of giving rural population proper and equal opportunities to take part in diverse regional activities. The link between transportation system, land-use, accessibility, and different regional activities can be seen in Figure 1. Conceptualizing the improvement in transportation system, infrastructure or services takes to an improvement in accessibility standards for any particular land-use. This will lead to a positive shift in land-use patterns and certain activities.

Accessibility evidently explains the advantages of the transportation system, linking people to their desired destinations with ease and comfort. Accessibility measures can be supportive in evaluating transportation plans, policies, and used to locate the scattered settlements, where transportation services are unavailable. If planned and utilized properly, accessibility elements and approaches can be used for the betterment of rural-regional communities.

3. Accessibility Concepts

Accessibility concepts can be observed from many aspects. A research was carried out by *Thill*¹⁰, which described the divergent approaches in a way that accessibility is defined by the number of destinations that can be traveled in a given distance or in a given time. *Niemeier*¹¹ has given the explanation in terms of the basic services, where accessibility clarified by the certain values that travelers allocate

Table 1. Evaluating perspective of transportation¹⁷

Parameters	Vehicle Travel	Mobility	Accessibility
Transportation	Journey Vehicle	People and Goods Movement	Potential to Gain Goods, Services and Activities
Measurement Units	Vehicle/km	Persons/km and Tons/km	Cost of the Trip
Modes	Cars, Jeeps and Trucks	Truck and Transit	Truck, Transit, Cycling and Walking
Indicators Used	Vehicular Traffic Volume, Speed, Road Service, Cost/Vehicle/km, Parking Facilities	Distance and Speed of Journey and Available Services, Cost of Person/km and Journey Facilities	Transport Availabilities, Cost/Trip
Stakeholder's Benefits	Maximum Speed and Journey Time	Maximum Goods Movement and Personal Journeys	Maximum Transport Choice and Reduction in Total Cost
Land-use Consideration	Consider Land-uses as Static Inputs with respect to Transport Policy Decisions	Land-uses can Affect Choices of Journey	Conceives that Land-uses have Prominent Effects on Transportation
Transportation betterment Policies	Facilities related to Parking and along the Roads to Enhance Speed, Safety and Reduce Travel Time	Improvement of Transportation System that Enhances Capacity, Speed and Safety	Formulation of Relevant Policies that Enhance Efficiency and Safety

to their trips to work places. Accessibility approaches often based on a time-space theory, which was given by Hägerstrand¹²; Kwan and Miller^{13,14} to overcome the problem of social exclusion¹⁵, and space-time related glitches of rural inhabitants. Further, Litman¹⁶ said that accessibility could be defined, according to the nature of the related disciplines.

Table 1 evaluates different aspects of transportation sector related to vehicle travel, mobility and accessibility. Table 1 also offers a clear view about the measurement of the general components of the transportation sector.

Accessibility¹⁸ can offer an analytical view about the provision of transportation facilities for deprived rural regions from cost reduction and service provision aspects. Ellis focused on the development of deprived regions by increasing the rural-regional accessibility and targeting two important aspects of rural development, i.e. planning guidelines for smooth development and provision of low cost transportation facilities. It is found that various transport modes from non-motorized to motorized are responsible for infrastructure changes¹⁹. In many of the "Sub-Saharan African Countries," the shortage of low-cost transportation facilities decreased the mobility of rural-regional population. As a result, poverty level increased in "Sub-Saharan African Rural Regions" with a gradual fall in mobility for the local population. It is explained that both increased poverty and decreased mobility are the

important determinants of rural-regional accessibility in the developing world.

4. Accessibility and Mobility

Accessibility approaches were first modeled in the decade of the 50s and the concept remained attached to the discipline of transportation over about the last six decades^{20,21}. The accessibility is the most detailed and generalized measure of communication between land-use and transportation. The improvement of accessibility is a common objective of most of the *United States (US)* regional transportation planning departments or agencies²². Various definitions have put forward by different scholars, which are stated as follows:

1. Accessibility may be referred to ease or comfort while reaching desired destinations, together with facilities and services with respect to the movement of people and goods²³. For example, different grocery stores give access to food items. Newspapers, Internet facilities and libraries give access to information. Simultaneously road networks, different paths and travel modes provide access to daily routine works. These are called activities, and different connecting activities in this regard known as opportunities;
2. Accessibility may be defined as the liberty of people whether to participate or not in a certain activity¹⁴;

the facilities and advantages given by transport and land-use systems²⁴ and any land-use activity that can be reached comfortably from any location through the particular transport service;

- Mobility is related to the people's ability to travel from one place to another^{25,26}. Mobility links to physical movement calculated by trips, distance and speed, like *people per kilometer (p/km)* with respect to personal travel or tones (p/km) for goods traveling.

The improvement in mobility increases the accessibility and makes travel speed quicker. This improvement positively affects the ability of people in reaching more destinations in lesser time, which could be helpful to reduce rural-regional poverty.

5. Accessibility and Rural-Regional Poverty

In the developing world, the reasons for poor economic growth and development are almost similar at the local and regional levels. These are described as social exclusion and scattered locations of rural settlements without road connectivity, and lack of proper transportation services and infrastructure. Poor accessibility services are considered as one of the prominent factors responsible for the economic recession and less development in rural areas²⁷. Although, poor accessibility is not an only factor, but considered as an important parameter of socioeconomic development of deprived regions. Access to basic services, like education, health, water supply and planned residential facilities is not related to the economic stability of the local population. These provisions of services just offer the base for the planned development and growth. From economic point view, better access to economic activities is crucial for economic development in rural areas. For example, if farmers have limited or no access to markets, the markets would lack fresh agricultural products and at the same time, farmers would not get genuine prices for their agricultural products. For example, in Pakistan, one household from every three lives below the poverty line²⁸. This observed situation now is even worse as inflation; economic recession and the reduction in household income curtailed people's ability to spend on transportation or accessing their daily routine jobs. It is a general perception and seems nearer to reality that rural areas are poorer and less developed than urban areas.²⁹ Previous studies showed

that the poverty level in a country significantly increased since the year 1990. This situation certainly has smashed the purchasing power of households at rural level. From a transportation perspective, household income affected the accessibility criterion of rural population³⁰. Stability or increase in income helped rural people to spend more on transport services to complete their daily routine jobs. However, lower-income groups struggled over the years from an accessibility point of view, because of unstable socioeconomic conditions and inflation. This would cut their expenses on transport, which resulted in declining standards of the rural household accessibility. For example, in Pakistan, gender discrimination truly enhances the poverty level, where women's earnings are lower due religious and cultural barriers or restrictions. In rural areas, females are illiterate and unskilled, which earn lesser than males³¹. This is also true that the proportion of rural work women is higher than urban due to higher accessibility³². This is mainly because of the rural women's participation in agricultural activities, which are most of the times closer enough (walking distance) to their homes. While in urban areas, employment accessibility for women is a big question mark due to numerous reasons, including unavailability of proper transportation facilities and distant work places. Literature has shown that particularly females were not well-served by the public transportation facilities³³ in developing countries, including Pakistan.

Accessibility studies in the decades of late 80s and 90s were much focused on the strategies for rural development³⁴⁻³⁶. Traditional accessibility improvements would focus on the availability of road facilities, infrastructure and provision of *Intermediate Means of Transport (IMT)*³⁷. As transportation seems an indispensable tool for improving accessibility, but other accessibility-increasing elements should also be considered, like time limits and spatial factors, which can augment the services for rural individuals. The analysis of household socioeconomic data conveys an in-depth analysis between household income, size and locations of settlements (origins) from services or facilities (destinations). Transportation facilities should be given high priority, while implementing suitable accessibility options for rural regions. This should also be recognized that inaccessibility is the main cause of their deprivation in rural sub-regions. Transport policies and proposals should be made for the development of rural areas, focusing the accessibility issue at high precedence.

6. Accessibility Analysis of Deprived Rural Regions

Inaccessibility and unavailability of proper transportation infrastructure or services undoubtedly considered as a key determinant, responsible for the deprivation of rural regions³⁸. The shortage of transport facilities often caused inaccessibility, which is considered as a prominent deprivation factor of rural-regional socioeconomic conditions³⁹. Therefore, it is good to understand this problem of remote regions and try to devise policy measures, which can counter these difficulties and provide opportunities for deprived rural regions. Moseley⁴⁰ has given many solutions to solve the problem of inaccessibility of rural regions. Moseley designed and developed transportation land-use plan, which explained the regional wise accessibility ratings. Moseley explained that population potential index based on the gravity model and accessibility of locations that can be quantified in terms of transportation cost. Moseley expressed two approaches, which can be helpful in understanding rural-regional accessibility:

- Mobility: deals with regional transportation solutions to rural accessibility problems;
- Sitting of services: deals with non-regional transportation solutions to rural accessibility problems.

These approaches considered as a basic work carried out with respect to accessibility planning in depressed sub-regions. It is worth to notify that different travel modes have different accessibility criteria, as speed vary from one mode of transport to another⁴¹. For example, as shown in Figure 2, pedestrians can only walk half a

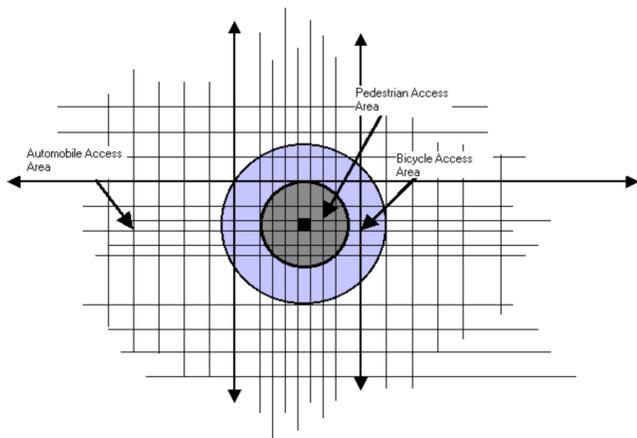


Figure 2. Accessibility with different travel modes¹⁷.

mile in five minutes and thus can access only 36 square blocks; while a cyclist can move up to a mile and access 256 square blocks; and a person having motor vehicle can reach about two miles and access 2500 square blocks at the same time.

Gradual improvement in travel speed can make larger areas more accessible. The travel speed and density can also put a positive impact on accessibility standards. The speed can be increased with well-maintained transportation services and road facilities.

6.1 Speed and Density Effects of Accessibility: General Concept

The common accessibility measurement concept is totally about destinations that are going to be accessed in a given time⁴². This notion is here further illustrated that how the high speed of any journey may increase the accessibility level. The map of any destination, which is accessible in the 'A' time, will certainly depend on the existing road system, like rectilinear or irregular street pattern, but here it is clarified with a circular shape as shown in Figure 3. Xs represent different destinations in a circle. It is obvious, when speed will be doubled than the normal, the radius of the circle will also be doubled from r to $2r$. Ultimately, the area of a circle will quadruple from πr^2 to $4\pi r^2$. Therefore, the number of destinations, which were reachable by giving time, will also quadruple with the doubling of speed. As a result, in a simple circular shape, accessibility increases together with the square of speed.

In a same way, the effect of increasing densities on accessibility criterion can be explained. In Figure 4, speed of vehicles is constant, but the density of destina-

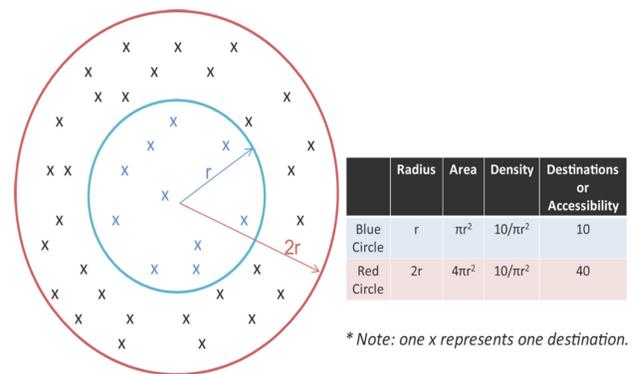


Figure 3. Illustration of speed effect of accessibility (Destination Constant)⁴².

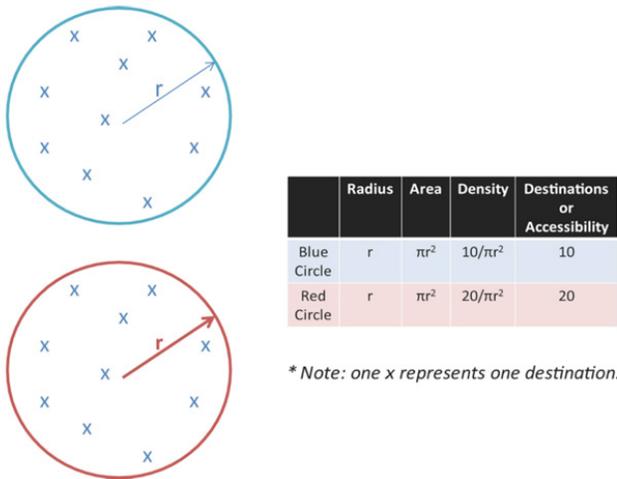


Figure 4. Illustration of density effect of accessibility (Speed Constant)⁴².

tion is doubled, leading to doubling accessibility. Thus, as accessibility increases along with the square of speed, it enhances density. Therefore, increasing speed provides a significant advantage, which would be difficult to solve with the effects of proximity.

In a rural environment, the accessibility criterion of the local population can be affected by growing socio-economic concerns. These factors included household income, size, income, travel-distance and time, which are often called “impedance factors.” Impedance factors negatively affect the rural household travel decision-making process and resulted inaccessibility.

7. Influencing Factors of Accessibility and Models

Considering particular criterion of mobility, there are numerous activities that rural people used to perform in their daily routine lives^{43,44}. Most of the times, the rural population makes four to five trips on a daily basis to meet with different household needs. Rural population activities may exist within the context of markets, health, education, job, shopping and recreation facilities, etc. Rural-regional transportation demands can be classified as follows:

- Population socioeconomic characteristics, like household size and income, dependency ratio and employment status, etc;
- Purpose of traveling, like shopping or earning, etc;

- Destination-based travel, like employment, schools, markets and shops. These traveling purposes may further be classified into general destinations, like daily groceries or special destinations, e.g., family gatherings or different religious and cultural ceremonies;
- Time or temporal component, like the peak and off hours, days, or may be different seasons;
- Travel Mode, such as personal vehicles, cycling, walking, animal-driven carts, public transport and freight transport, etc;
- Trip distance (origin to destination or from origin to any transport mode, like walking distance to bus bays).

There are various constraints available in addition to above defined elements, which can negatively affect the accessibility improving strategies and policies. These can be subdivided into transportation, temporal, spatial, socioeconomic, and cultural constraints. Different models can be devised for the decision-making process and development of accessibility-based policies, which could benefit aloof sub-regional of developing countries. These theoretical models are described as follows:

- To forecast population, travel demands, household size and density, the “Compound Interest Model”⁴⁵ can be used. Mathematical expressions are given as follows:

$$P_1 = P_0(1+r)^n \tag{1}$$

$$r = \left(\frac{P_1}{P_0} \right)^{\frac{1}{n}} - 1 \tag{1.1}$$

Where,

- P_1 = Future population
- P_0 = Current population
- r = Growth rate
- n = Number of years

- The “Population-Based Gravity Model”⁴⁶ depended on suppositions that a cluster of customers within the boundary can be drawn to the commercial area based on variables, like market distance or catchment population. Mathematical expressions are given as follows:

$$(B_a / B_b) = [(P_a) / (P_b)] [(D_b / D_a)]^2 \tag{2}$$

Where,

- a,b = Settlements
- P = Population
- D = Distance

$$I_{ij} = K \times P_i \times P_j / D_{ij}^2 \quad (2.1)$$

Where,

I = Interaction

i, j = Settlements

K = Constant

P_i = Population of settlement i

D_{ij} = Distance between the settlements i and j

(iii) To determine the possibilities that consumers from the destination (i) would shop at a location (j), “Competing Destination Model (CDM)” (47) is pretty much useful. Mathematical expression is given as:

$$P(C_{ij}) = (S_j / T_{ij}^k) / \sum_j (S_j / T_{ij}^k) \quad (3)$$

Where,

$P(C_{ij})$ = Probability that a villager from (i) would go for accessing services at (j)

S_j = Space of service area (j)

T_{ij} = Time from (i) to (j)

The aforementioned influential factors of accessibility and models can play their role in the socioeconomic development of the rural sub-regions of developing countries. Meanwhile, computer-based systems or models can eliminate the data-related glitches of rural development authorities, which can be helpful in the process of policy formulation focusing inaccessibility (48). The research gap and the future directions are discussed hereafter, which can show the way for future studies and action proposals.

8. Research Gaps, Contribution and Future Directions

The research gaps what this study abridged are the clarification of accessibility problems of rural inhabitants, and the suggestion of action proposals to overcome them. In addition, this study also provided strategies to resolve the accessibility issues of rural households, which can bring the socioeconomic development within backward sub-regions of developing countries. The major contribution of this research is to highlight the future directions for rural planning agencies, targeting accessibility-related matters of rural sub-regions, which are neglected in developing countries over the years. From the literature, it was clarified that accessibility-related problems lessen the income levels of the rural population of developing countries on one hand; and on the other, accessibility issues also enhanced the social problems of rural inhab-

itants, like higher mortality rates and lower educational standards.

Delayed travel activities and rural household’s travel impedance factors shivered the socioeconomic characteristics of the rural population. Long commuting times and travel impedance factors reduced the activity times of rural households; and as a result, they could not be able to fulfil their socioeconomic activities efficiently. The consequences of inaccessibility are severe, particularly in rural sub-regions, i.e. falling literacy rates, increasing mortality rates (infants), poverty, backwardness, and above all higher proportion of the urbanization process. Mostly, these pre-defined problems occurred due to the absence of transport policy proposals, which could provide a framework to pacify the accessibility issues of the rural population. In addition, this situation highlighted the failure of rural planning agencies in devising the proper policy proposals to rectify accessibility problems of rural households. Hence, there is a dire need of action proposals to be taken by rural planning agencies, to fix the accessibility-related glitches of the rural population.

This study suggests that rural planning agencies should come forward and play their role in the development process of aloof sub-regions. The policy plans should be timely implemented to resolve the accessibility problems, which must be revised after every five years at least. The existing road infrastructure should be upgraded and the road network hierarchy should be maintained, which could encourage the traffic and transportation flows between remote areas and sub-regional headquarter towns. Whereas, low-cost transportation facilities should also be provided to rural inhabitants, which could assist them to access essential activities, i.e. work, employment opportunities, commercial centers, urban markets, health and education services.

Winding-up this whole discussion with comments, that accessibility can be improved with the help of transport policy proposals developed by concerned planning agencies at local level. In this regard, this research can provide information to decision-makers and planners about rural accessibility characteristics, rural-regional accessibility-related problems, and the importance of accessibility in the development phase of rural sub-regions. In the same way, this study can also be able to provide solutions to rural-regional accessibility problems of the developing world, which can assist planning agencies in the development process of apposite policy plans.

9. Conclusion

This research article can convey a bunch of information to researchers, who are working on rural transportation studies for the prosperity of depressed sub-regions. A comprehensive review was conducted to analyze the different case studies related to regional transport accessibility, and their prime role in the development process of rearward communities. The transport inaccessibility can be considered as a root cause for the most of the problems of the rural population. As poverty, hunger, dejected economic conditions, unavailability of transportation facilities, together with shortages of basic education and primary health services are prevailing in the indigent sub-regions of developing countries. In under-developed and developing countries, the rural sub-regions abandoned by the decision makers and policy planners over the years. The policy plans are mostly focused on urban areas in order to solve their problems, while the rural sub-regions usually left on their own. It was observed that rural planning agencies also struggled to meet with the ever-increasing catastrophic ambience in these sub-regions, and unable to provide solutions to the problems of rural inhabitants. This study can be considered as a step further towards the proper provision of rural transport facilities for rearward communities to resolve accessibility-related problems. The availability of transport facilities, including the rural road and low-cost bus services can improve the accessibility standards of the rural population, which may put a positive impact on their socioeconomic conditions.

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