

## **Research Framework Focusing Transportation Accessibility Planning, Computer Based Modeling and Transportation Policy Outlines for Remote Regions of Developing World**

Mir Aftab Hussain Talpur, Madzlan Napiah, Imtiaz Ahmed Chandio and Shabir Hussain Khahro  
Department of Civil Engineering, Universiti Teknologi PETRONAS, Malaysia

**Abstract:** The main objective of this proposed research study is the formulation of a regional transportation policy plan which can mitigate the problems of data storage, rural individual accessibility and unavailability of transportation policy guidelines for sustainable development. Land Transportation is considered as a backbone for rural regions. Rural areas of the developing world get depressed and struggled to meet with the ever increasing household and other basic needs without road connectivity. Sustainable transportation planning approaches can assist the rural population in accessing various socioeconomic activities. Rural accessibility is closely related to the physical and socioeconomic problems of the rural population. Authentic data availability seems impossible in rural regions due to their remoteness and carelessness of concerned agencies. Regional transportation plan can be developed to counter the problems of rural inaccessibility, un-availability of quality data and its easy retrieval and unavailability of general transportation policy for rural regions. The purpose of this study is to address and remedy such problems within the limited available resources. The proposed study can definitely open up the new ideas for planning agencies and can assist in achieving regional socioeconomic development targets.

**Keywords:** Data unavailability, land transportation, regional transportation policy plan, rural accessibility, rural regions

### **INTRODUCTION**

The transport sector has a prodigious role in the socioeconomic development process of deprived rural regions (Glasson and Marshall, 2007). Mobility and accessibility are important factors of transportation which can greatly affect this process in remote rural areas. In previous studies transportation availabilities assessed with respect to mobility or physical movement. After a considerable time period this was taken with respect to accessibility or the ability of people who are interested in access to goods and services and opportunities towards employment. The broader social and economic problems of rural regions like poverty, health, trade, education, agriculture and markets do exist because of the unavailability of transportation services and infrastructure (Guagliardo, 2004; Kam *et al.*, 2005; Nanayakkara, 2006; Olsson, 2006).

The construction of various roads throughout the rural regions is more beneficial than any other construction for the peasants in backward areas where mostly the economy is agriculture dependent. Different market prices of food items in various rural markets indicated the demand and supply gap of agricultural products and definitely because of monopoly of various market stakeholders (Hine and Ellis, 2001). Accessibility-based transportation planning provides

credible solutions to these sorts of problems which are not only beneficial for the market oriented problems but rural health and education. Consequently, enhancement in rural accessibility can play a crucial role in alleviating poverty and simultaneously this may give many chances to rural individual to take part in different activities like employment and market trade. This approach directly or indirectly can increase the living standards of rural individuals as they may get more opportunities towards their businesses (Bryceson *et al.*, 2008). The objective of this research study is to develop transportation policy document which can mitigate the physical and socioeconomic problems of deprived rural regions and can provide a framework for future planned development.

The regional transportation policy plan can prove to be much useful for the rural population especially from physical and socioeconomic aspects. It can be viewed that prosperity and development would prevail all over the jurisdiction areas of the plan. The possible result of the study will be regional transportation plan for deprived rural regions. The planned document can bring smart economic development and growth to deprived regions. This research study can assist in physical and socioeconomic development process and bring prosperity within the depressed regions. This can be obliging in poignant deprived regions towards prosperity and a sustainable future-a future with more choices and better opportunities.

**LITERATURE REVIEW**

Vickerman (2002) argued that the transportation sector is a crucial component to not only regional economies but local and national as well which has a significant role in socioeconomic development. The remote or deprived rural regions are characterized as a traditional agricultural society with low labor productivity. The backward regions are believed to be agriculture dependent most of the times, having low labor productivity and considerably small income population. The urbanization process in the rural areas of the developing world is much higher due to lack of employment, health, education and trade facilities (Hu, 2002). The shortage and unavailability of transportation services and infrastructure affected agriculture sector which tumbled to meet with the needs of the local population. Hence, growers most of the times struggled with providing fine agricultural products to urban markets on a continuous basis (Gulati *et al.*, 2007).

The transportation sector has changed remarkably the overall shortages of the household items especially for the rural population and availability scenario of valuable goods wherever and whenever they are required (Masood *et al.*, 2011). New technologies invented through research which are really helpful for designing and planning of road networks ultimately helpful for the betterment of these aloof regions (Chandio *et al.*, 2011). As the demand to develop remote areas apparent; there was a shift in priorities towards rural transportation facilities. However, this concentration of roads facilitated travel but failed to induce greater mobility in remote regions. The transportation services are not being provided according to the needs of rural population in these remote areas. The study shows that time spend on survival tasks alone can reach up to 40 h/household/week using conventional transportation services that operate on them which failed to address the fundamental needs of rural people (Dawson and Barewell, 1993). Therefore, more integrated and professional approaches are required for the transportation related issues in these remote regions.

This is claimed that accessibility towards both opportunities and transportation facilities are much

linked approaches (Farrington, 2007). The availabilities of transportation services can unquestionably improve the rural accessibility standards. It is believed that both accessibility and land use phenomenon are taken as vital ingredients for the development of urban and deprived rural regions (Nagendra *et al.*, 2003; Verburg *et al.*, 2004; Castella *et al.*, 2005; Etter *et al.*, 2006). Providing financial assistance for the uplifting of rural areas has been a major concern of donor agencies (Ellis, 1996). This process has been well documented because of problems associated with subsequent neglect. The availability of proper transportation services and infrastructure considered as inevitable for proper functioning and growth of economic activities in the production and distribution of goods, services, trade and employment (ECE, 2011). The discipline of transportation planning is not only taking into account the availability of appropriate infrastructure and services but this also provided for the promotion of regional economic development (Quinet and Vickerman, 2004). The transportation sector is well capable of bringing physical and socioeconomic development and prosperity within remote regions by opening up the opportunities towards development and civilization.

The Fig. 1, describes the relationship between transportation sector and economic development.

Socioeconomic development of any backward region cannot be achieved by promoting transportation system only but non-transport factors should also be considered in the planning and development of rural regions. Non-transport factors provided a clear explanation about numerous development elements and clarification about the sustainable approaches of socioeconomic activities (Weneger and Bokemann, 1998). Unavailability of transportation services and less accessibility in remote rural regions of developing countries perpetuates the deprivation trap by denying communities reach to their most basic needs. Isolation plays crucial role in development of deprivation. It is expected that any one of these factors such as poverty, isolation, vulnerability, powerlessness and low standard of infrastructure can develop deprivation trap (Chambers, 1983). Isolation or scattered location of remote settlements is the result of a social exclusion

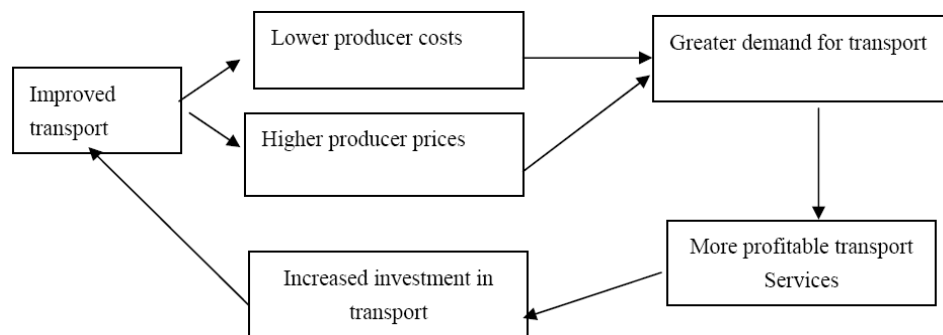


Fig. 1: Relationship between transport and economic development (Carapetis *et al.*, 1984)

process (Burchardt *et al.*, 2002). Hine and Mitchell (2001) exemplified transportation as a major element in this process as it connects remote settlements to participate in their physical, economic as well as social activities. Isolation through poor accessibility can curtail the advancements of modern technologies, increase marketing and production costs and reduce approaches to better living conditions. Therefore, reduction of transport related social exclusion is considered as a key factor of transport policies (Cebollada, 2009).

It is a grave reality that many of the developing countries have lesser road facilities. The country like Pakistan is facing almost (50-75%) shortage of roads; in India (70%) of rural settlements are not being provided with direct access to all weather roads, while (53%) in a total not connected to any road link. In Asia vehicle ownership levels are higher as compared to Africa. As in Sri Lanka less than two percent (<2%) of rural households owned tractors and only about (10%) possessed bullock carts. Farm level transport operated by smaller vehicular loads (10-150 kg) over short distances about (1-25 kms).

In recent years inaccessibility has been accepted as a major constraint to agricultural productivity and an element of backwardness to rural regions. On the other hand many villages in Sub-Saharan African countries have no or very less vehicle ownership. Major donor agencies have allocated large proportions of their budget for the building and development of rural roads in order to uplift the rural economy and alleviate poverty from these deprived rural regions (Hine, 1984).

The construction of road network hierarchy is regarded as a base for economic development within developing world (Hall and Taylor, 1996). In order to make basic facilities accessible in rural regions, it is mandatory to first clarify the concept about basic needs. At the lowest level of basic needs, there are three requirements-food, clothing and shelter. But with respect to transportation services and infrastructure planning, this perception about the accessibility has to be further enlarged in order to encompass transportation elements with respect to basic needs. In rural areas most of the journeys will take place for the purposes of health, education, markets, water, firewood and other subsistence tasks (principally farming and agriculture). These aforementioned six major requirements represent the most important level of accessibility in the context of remote and deprived rural regions (Howe *et al.*, 1983).

An ideal transportation system maintains quality of life and ensures accessibility for urban as well rural areas together with physical, social and economic development that maintains the quality of life (Nandi, 2008). Therefore, long term strategy should be formulated for the development of the transportation sector, which can ensure all above defined elements and efficient movement of people and goods (Paavan, 2006). This research study would focus on the core issues of deprived regions with respect to the

transportation sector. The issues like rural inaccessibility, unavailability of proper transportation policy plan and shortage of germane data and its easy retrieval for proper utilization.

**Research objectives:** The aim of the proposed research study is to focus on the accessibility related problems, unavailability of planning data and transportation policy plan. Accessibility criteria can ease out the difficulties of rural regions with respect to the availabilities of basic amenities and services. The computer database model can be developed for storing rural data with respect to various development sectors but mostly physical, social and economic. This can help in the development of relevant policies as the model can be developed for the utilization of concerned development agencies. The primary and secondary data will be collected from various public and private organizations, which will be facilitated with surveys, questionnaires and interviews etc.

The precise objectives are:

- To develop the regional transportation policy framework
- To enhance accessibility of deprived rural regions for markets, health, education and services
- To design and develop information systems (computer based database model)
- To formulate transportation and related policy measures for deprived rural regions

**Scope of research:** Planning is considered as a continuous process which is based on the assumptions and proposals. Throughout the evolution of mankind different tools are developed for the planning of regions, cities and villages. These tools may be physical, social, economic or technical. Thus, this research study can be a credible tool for economic growth and sustainable physical development of depressed rural regions.

The need and scope of research process may vary from one aspect to another, however in a broader sense it may generalized following ideas:

- The research study analyses physical and socioeconomic elements (like population distribution, household size and income, housing and infrastructure, open spaces and propose measures which can help in increasing accessibility of rural deprived regions, development of computer based model and some policy proposals for the betterment of rural regions), that led to the plan development.
- It examines the special problems and opportunities within study area related to rural population with respect to transportation sector and according to the basic needs of the rural area population.

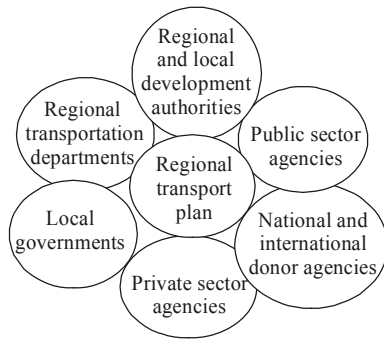


Fig. 2: Major areas of application

- It proposes regulations and policies, aimed to bring prosperity and planned growth within such remote regions.

The scope of the end product of the research i.e., Regional transportation plan and its major areas of application can be seen in the Fig. 2.

The scope of the proposed research study is considered as broader in a sense that it evolves around the crucial problems of developing word's rural population. The focal points of research study are to increase rural regional accessibility with the provision of better transportation services and infrastructure, development of a computer model which can help in storing data and its analysis and preparation of transportation policy guidelines. It can be viewed that due to successful formation and implementation of research suggestions by any local authority ultimately can remedy the problems of aloof regions.

**Research premise:** Research premise is a type of statement which is considered as a factual statement without any proves or any real time relevant example. From this proposed research point of view, it is assumed that facilitating transportation system to be used for the major socioeconomic sectors can inject planned development and bring prosperity. All the facilities and services including provision of basic infrastructure, health, education, trade and employment opportunities can increase the quality of life and boosting up the economy of depressed and deprived study area.

**Research hypothesis:** It is hypothetically expected that the research's output can play an important role in the smooth and planned development of rural regions. This can assist in alleviating poverty and upgrading lifestyles of rural people. This plan would not only solve existing transportation and related problems but this also would provide a road map for future planned growth and development.

**Research rationale:** In the context of the problems as described in this study, the rationale of the research study is to increase rural accessibility together with

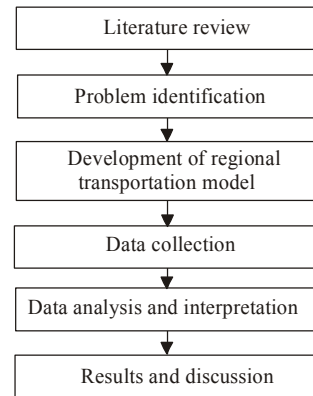


Fig. 3: Steps of research methodology

the development of computer based model and the formulation of a general transportation policy framework. In applied terms, the design of the study can be defined as the initial planning of a research project which is based on the particular study goals. Simultaneously, research problems being asked literature review, data collection and survey design, processing and analysis. These all listed criteria can be considered as research rationale.

## RESEARCH METHODOLOGY

There are varieties of data collection and survey techniques available to planners (Talpur *et al.*, 2012). The research methodology for the proposed research will definitely be depend on personal visits, interviews, questionnaires and field surveys. The study area will be surveyed and data will be collected through personal observations and questionnaires. This should also be noted that both primary as well as secondary data can be utilized for the proposed study. The emphasis will be put on the collection of a broad range of information that could be brought together in order to draw conclusions on the study area problems and can provide a framework for other development studies. Therefore, data collection techniques for the proposed study should be rigorous enough to allow cross regional comparisons. Furthermore, these should be flexible enough that the design of the questionnaires and interviews were not influenced by the designer's preconceived ideas of the problem.

The Fig. 3 is clearly describing the research methodology steps which can be utilized throughout the research process.

**Study area:** Pakistan is a developing country and facing many physical and socioeconomic (Ahmed, 2011) problems related to the research study. These problems include a huge number of inhabitants about over 170 million (Batool *et al.*, 2011), unemployment,

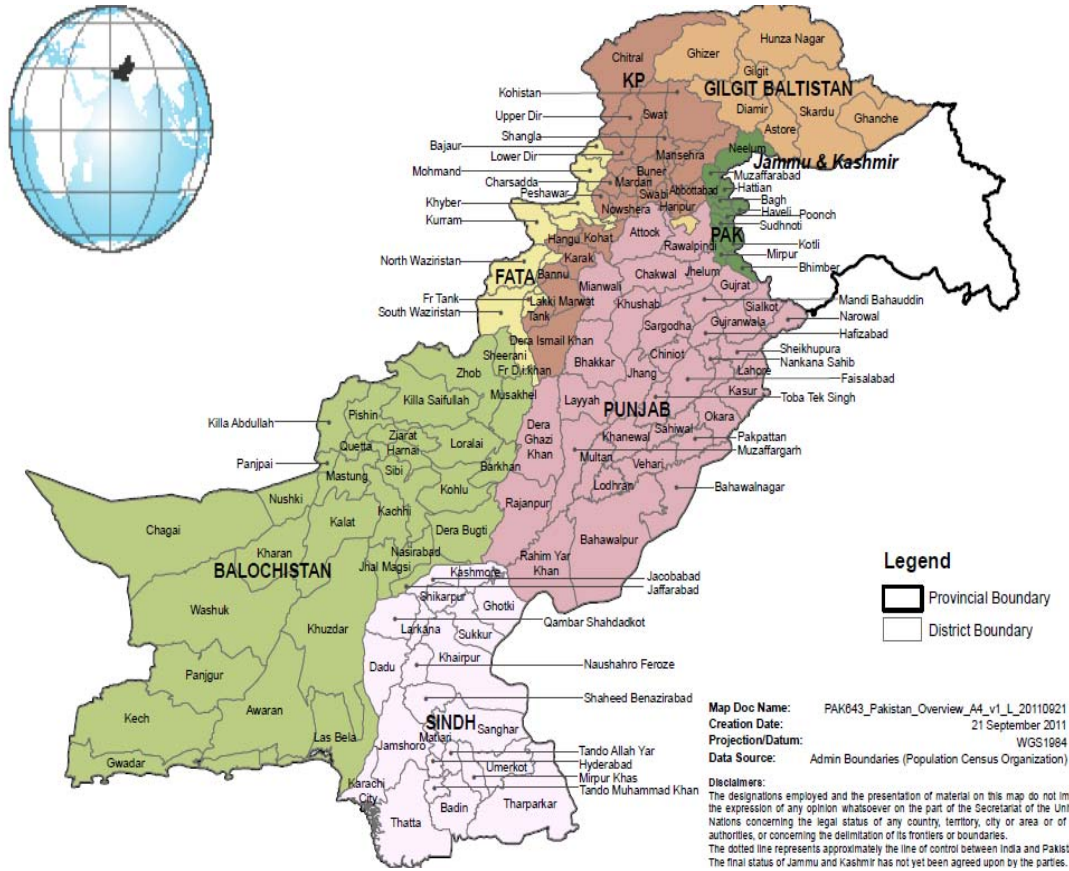


Fig. 4: Map of Islamic Republic of Pakistan (Pakistan, H.R. <http://pakresponse.info/mapdatacenter.aspx>, 2011)

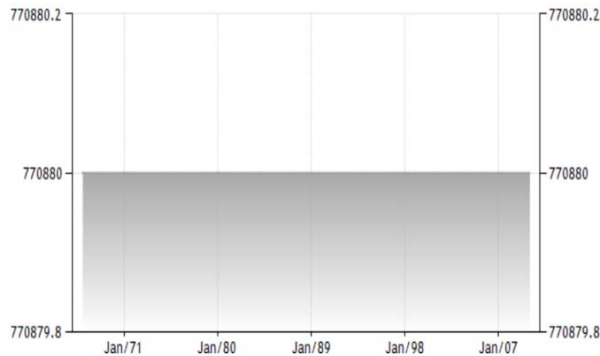


Fig. 5: Total land area of Islamic Republic of Pakistan (The World Bank, 2012)

According to The World Bank (2012) total land area of the country is about 770,880 km<sup>2</sup>.

The Fig. 5 explains the total geographic area of Islamic Republic of Pakistan since January 1971 up till January 2007. It is expected that the existing geographic area is still the same as shown in the figure.

The province of Sindh is the second largest province amongst the four from a population point of view, i.e., 30.44 million and having an area of about 140,914 km<sup>2</sup> or 54407 M<sup>2</sup> (Naem, 2011). Transportation sector plays an enormous role in tie ding up the different regions of the country in terms of physical, socioeconomic, cultural and political activities.

unavailability of credible transport policy (Masood *et al.*, 2011), higher rate of rural-urban migration, lack of services and basic amenities, unavailability of proper infrastructure and poverty (Khan *et al.*, 2011; Ali and Tahir, 1999). Pakistan is a state of four provinces; namely Punjab, Sindh, Khyber Pakhtoon Khuwa and Balochistan; one capital territory of Islamabad and newly developed state of Gilgit Baldistan which is considered as a de-facto province and Pakistani Kashmir. The Fig. 4 shows the map of Pakistan.

For rural regional accessibility issues, the proposed study area is “Badin Sub Region”. This is the southern part of Islamic Republic of Pakistan and the most deprived region of Sindh province (Jamal and Lohano, 2008). For the development of computer based database model Hyderabad Master Plan data will be utilized which is the second largest city of Sindh province. Consecutively, at the end general transportation policy guidelines will be formulated which can be productive for the rural regions and eventually for whole developing world.

Participatory techniques of rural rapid appraisals (Loader and Amartya, 1999) and pilot surveys (Denstadli and Hjorthol, 2003) could be the best ideal survey techniques to collect data from the rural region of Badin. These survey methodologies consisted different ideas about the relevant data collection which may help in collecting authentic data. The other research techniques that can be used during the study are:

**Documents:** In this parameter of research data can be collected through previous research study, government policies, regulations and different documents. Reports and research study s of social organizations related to the development of the deprived rural regions can be used for the development of the sub regional transportation plan.

**Observation:** This is the simplest form of data collection in which data can be collected through visual survey. Observations can be saved in the form photographs and movie clips. Surveys can be carried out in the study area to gather relevant data and information.

**Interviewing:** This is a very important technique in which data can be collected through different types of interviews. Interviews are taken from the sampled

population living in selected research areas. Visits can be made in rural study areas investigating the real problems and their impact upon the rural regional population.

**Questionnaires:** Varieties of questionnaires can be produced in this research to investigate the concerned rural officials and population. These questionnaires can be designed on special parameters to meet the requirement of investigation and considering the ethical values of society and according to the objectives of the proposed research study.

### DATA ANALYSIS

The data collected through different sources will be compiled in sequence during the study. The collected data will be matched to the standards (United Nations Standards with respect to transportation and other socioeconomic indicators). The sources of data can be field surveys, questionnaires, different public and private sector organizations, photographs, research reports, papers and dissertations etc. The data may be analyzed and compiled manually and then it will be saved in a computer using different computer related programs and software like SPSS, MS Project Planner, MS Office, AutoCAD and MATLAB etc.

Table 1: Quantitative models

Model	Formula	Purpose/usage
Compound interest model (Mehta, 1996)	1) $P_t = P_o (1 + r)^n$ 2) $r = (P_t/P_o)^{1/n} - 1$	To forecast population, travel demands, household size and density.
Gravity model (population based) (Anderson <i>et al.</i> , 2010)	$(Ba/Bb) = [(Pa) / (Pb)] [(Db / Da)]^2$	This model is used to calculate expected traffic flow attracted towards certain facility. Many variables are used in this model like market distance from residential settlements and the population of settlements.
	OR	
Regional economic growth model (Weisbrod, 2007)	$I_{ij} = K * P_i * P_j / D_{ij}^2$ $\Delta ECON (i, j) = fn \{ \Delta LMKT (i, j), \Delta LQUAL (i, j), \Delta LCOST (i, j), \Delta SMKT (i, j), \Delta SQUAL (i, j), \Delta SCOST (i, j), \Delta CMKT (i, j), CQUAL, \Delta CCOST (i, j) \}$	This model expresses the linkages between economic growth and accessibility criteria with respect to factors like access, cost and market quality. These factors vary from one location to another as demand varies accordingly.
Competing Destination Model (CDM) (Nagurney, 2007)	$P (C_{ij}) = ( S_j / T_{ij} k ) / \sum_j ( S_j / T_{ij} k )$	To calculate the probability that consumer from i will shop at zone j.
Trip generation models (Nagurney, 2007)	# of trips attracted to a certain area or generated in a certain area Ox: Dy: trip ends Ox = # of trips produced (generated) at zone x (production zone) Dy = # of trips attracted to zone y (attraction zone)	This can assist with a number of trips generating from any origin to any destination.
Travel demand (Nagurney, 2007)	$d_{xy} = k O_x D_y f (c_{xy})$ $c_{xy}$ : travel cost from zone x to zone y *dxy increases as cxy decreases	This model is helpful in calculating demand for any particular area.
Traffic assignment models (Nagurney, 2007)	This model is used to calculate travel need and provide assessment about traffic and different transport modes	Gives information about the origin and destination and overall transport network characteristics.
Alonso model (Based on three equations) (Nijkamp and Poot, 2011)	$T_{ij} = A_i^{1-\alpha} V_j B_j^{1-\beta} W_j F_{ij}$ $A_i = [\sum_{j=1}^N B_j^{1-\beta} W_j F_{ij}]^{-1}$ $B_j = [\sum_{i=1}^M A_i^{1-\alpha} W_i F_{ij}]^{-1}$	A family of models that aimed to analyze and predict various types of spatial interaction (gravity models). Applied to regional issues such as migration, trade, commuting and traffic flows but also to less obvious spatial allocation problems such as patients flow to hospitals.
Observed flows between i (origin) and j (destination)		
Break-point model (Ghosh and McLafferty, 1987)	$D a \rightarrow b = d/1 + \sqrt{Pb/Pa}$	This model explains the break point of trade between two cities. Any customer living near to this breaking point has 50% possibility of shopping in any of the two closest cities.
Trade model (Huff's) (Timmermans, 1981)	$P_{ij} = (S_j \div T_{ij}^b) / (\sum_{j=1}^n S_j \div t_{ij}^b)$	This model is often used to calculate the probability of any trade location which is attracted to customers.



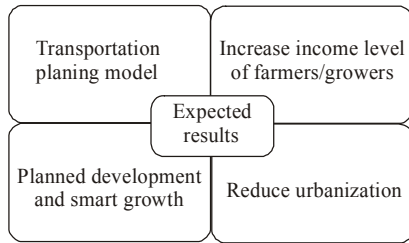


Fig. 6: Expected outcome

Two types of models can be used in this research study, i.e., Qualitative and Quantitative Models (QQM). Qualitative models are mostly theoretic in nature and included economic base, location, growth pole and central place, new model of trade and basic product models. These are basically policy based models which are very much essential for rural regional economic development process. Quantitative models are mathematical models used for analysis of data and decision making.

Some of the quantitative models, which can be used in the research study are listed in Table 1.

### EXPECTED RESULTS AND DISCUSSION

The expected outcome of the research study will be the regional transportation plan. This can mitigate rural regional problems with respect to accessibility and mobility of concerned rural population. Furthermore, this transportation model can also provide solutions with respect to the unavailability of data and its processing. Overall policy guidelines can be formulated at the end which can play credible role in the development process of rural regions. The end product can definitely assist rural population with respect to their accessibility to socioeconomic activities.

As shown in the Fig. 6 this plan can help in enhancing the income levels of the rural population which are mostly agriculture dependent and can bring smart growth within said rural regions.

### CONCLUSION

The transportation system does not only provided for the movement of people and goods but also for the economic development and completion of various necessary activities. Transportation influences patterns of growth and development with the help of increased accessibility towards rural areas. A competent transportation network is pretty much necessary for efficient agricultural marketing and development. It is observed that a higher percentage of the total population of third world countries lives in rural areas and most of them are depending on agriculture sector. Transportation sector helps shaping area's economic condition and increase the living standards. The

research study could play a significant role in the planned development and growth which can certainly mitigate the problems related to divergent development sectors i.e., physical (provision of Roads facilities and vehicular services, affordable housing for lower income groups with basic services and infrastructure) and socioeconomic (including poverty alleviation, agricultural sector development and up gradation related transportation facilities which can benefit farmers/growers). Moreover, there is an urgent need of government involvement to solve the problems of the nation without any political interests. New transportation policy be made and implemented on urgent basis, to solve the agriculture sector issues because it is the sector which mainly contributes the economy of the developing world.

Urbanization process mostly occurred due to search of a better life by the people, which are living in the remote and deprived regions. This study can definitely help to reduce this process to some extent. Remote areas should be given special importance by formulating the policy plans which can focus on the core issues of the rural population. Issues like provision of basic services and infrastructure with affordable housing, provision of employment facilities, better accessibility together with transportation facilities. Regional transportation planners and decision makers should formulate and devise policies for the betterment of the community in which community's suggestions must be involved. Financial assistance must be given to deprived regions and yearly allocation of budget should be made for the betterment of community's living standard, lifestyle, education, basic health facilities and infrastructure.

The proposed study undoubtedly a first step at regional level as far as developing world is concerned with tackling the problems of the growers and people living in remote areas. Without any doubts policy plans are required to deal with such issues, planning concepts should be introduced at National level as developing world's deprived and remote areas could get maximum benefits. The proposed research can be taken as a role model for the smooth and planned regional growth and socioeconomic development of the developing world.

This study can be helpful in providing solutions to the existing problems with respect to the rural regional transportation issues and surely can show the way for smooth future development.

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