ABSTRACT

Development of a procedure for planning road network configurations in rural areas in relation to potential service centres is the objective of this study. Transportation planning in rural areas appears to be complex due to the presence of multiple activities, having non-specific interactions among them. The non-commuter types of rural travel demand makes it difficult to relate the connectivity patterns with the supply of a network system. The inconsistent travel patterns and supply deficiencies are generating a wide gap in development of interactive capabilities among villages having potential for development in future. This deficiency in network planning is not promoting balanced growth in rural areas by keeping them inaccessible for their economic development.

Travel Demand is the basic input to develop a road network, but developing the rural road network based on origin-destination type of distribution matrices is cumbersome because of divergent travel attributes of users and also the high magnitude of micro level desires of travel. The existing practices are therefore based on empirical computations: ad-hoc criteria and policy based recommendations on road length. These practices are not giving any insight on connectivity hierarchy and economical network coverage. Researchers in various countries have attempted on network development with consideration of indices, scores and weightages and identified pattern between demand and supply centres. Such approaches are not capable of identifying potential service centres for estimating their attraction values and travel impedances. Non consideration of potential service centres has the inherent drawback of orienting the network, which is insensitive to the overall coverage of a study area. The literature review has further revealed that there are no established theories for relating user behaviour with rural transportation network in developing linkage patterns. The hierarchical connectivity
among villages with reference to service centres is mostly based on one to one interactions as against many to many interactions among production and attraction centres. The concept of wider coverage, travel cost preference over construction cost, etc are also necessary to prepare theoretically sound network planning procedures.

An attempt is made in this research to identify potential service centres followed by the generation of network configurations working from different angles like general user, specified user, uniform coverage, policy based hierarchical road connectivity and minimum cost approaches. Demand potential, a proxy to travel demand, is proposed by relating it with demographic and socio-economic characteristics, which can trace trip interchanges at various levels. The concept of “potential service” centres is initiated by identifying the villages, which have potential to become service centres, with the help of p-Median method. This concept has the ability to generate interchanges among multiple service centres and with other villages. Software to apply p-Median technique is developed in C language for this purpose. These identified centres and demand-based villages are used as a skeleton for developing alternative network configurations. Five methodologies are proposed based on different perspectives to generate various network configurations. The concept of wider coverage (with incorporation of inherited villages and break point of influence of rate) is proposed to identify intra area travel road network for general user of a region. INTRA-GRAV package is designed in VISUAL BASIC to develop intra area road network. Coordinated approach between construction and travel cost with importance to travel cost is incorporated in a package entitled INTER-TRAV in C++ to identify inter area travel road network having higher level interaction among service centres. The concept of hierarchical connectivity of villages with different functions of roads is formulated to identify optimal spacing of primary and secondary roads, which connects to
tertiary road system. A SHORT-SPAN package in C-language enables to identify hierarchical configuration. The concept of uniform connectivity with service centres by demand based villages is suggested with accessibility indices as criteria. The generated network has a scope for many to many interactions for uniform development of a region. The concept of minimising the gap between direct and indirect cost of user is proposed which can minimise the impedance and maximise the connectivity to potential villages. A TRANS-ROUTE package in C-language enables to identify feasible route linkages from above concept.

These methodologies and approaches are applied on Medak district for evaluation and validation. Various surveys are conducted at 28 villages covering a sample size of 10-15% to know the trip generations travel attributes and other socio-economic characteristics. The data on road infrastructure, demographic characteristics and topographic and land use features are collected from secondary sources. The networks generated from each method are coordinated individually with the existing road network and observed the differences in network configurations for evaluation.

Evaluation of each network is conducted with quantitative tools of graph theory. The operational evaluation is performed with factors like total road length, number of villages connected, road length per 100sq-km of geographical area, population served per kilometre, dominant shape of polygon and minimum and maximum travel distance to connected villages by unconnected villages. Validation of the concepts and methodologies is conducted on different databases and found that these concepts and methodologies can be generalised. It is found that policy based hierarchical contribution is ideal, followed by uniform coverage, intra area and inter area road network configurations.
The main contribution of this research is on identification of a proxy to estimate travel demand of rural areas, identification of potential service centres for future transition as service centres and generation of alternative network configurations from various perspectives of general user, specified user, system owner, uniform development and economics point of view. It is possible to extend these concepts by incorporating engineering factors; trip interaction factors and includes micro level economic analysis for development of efficient rural road network configurations. Thus this research work lays emphasis on providing rational and feasible solutions in developing rural road networks in relation to rural travel behaviour.