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Rural Road Network Planning Approaches in India: Review of Earlier Works

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Abstract: ***Well planned rural road connectivity is a vital component for the socio-economic development of rural people by providing access to amenities like education, health, marketing etc. It has been established that investments in rural roads lifts rural people above the poverty line. The evidence also indicates that as the proper rural connectivity improves the economy and rural roads always leads to increase in agricultural production and productivity by bringing in new land into cultivation the rural poverty levels come down. In India there had been imbalanced development of the rural road network and basically based on population only. But several researchers have already established that there is strong relationship between rural road network planning and agricultural development. Hence this paper reviewed some earlier works and Govt. polices about the rural road network plan and makes some concluding remarks for the development of rural road network planning.***
Keywords: Rural Road network, Transportation, Planning approaches

I. INTRODUCTION

Road network is one of the basic infrastructures in rural areas, which plays a vital role in socio-economic development of the community. It contributes significantly in rural development by creating opportunities to access goods and services located in nearby villages or major town and market centers. Several studies have already established that there exists a strong positive co relation between rural roads investment and socio-economic and agricultural development. Roads reduce transportation costs and the costs of consumption and production of goods and services. With easier access to markets and technology, improved roads expand farm and non-farm production through increased availability of relevant inputs and lower input costs (Binswanger, Khandker, and Rosenzweig, 1993; Levy, 1996). At the household level, road development contributes to higher productivity and demand for labour (World Bank,2000), and improved education and health, including those for women and girls (Bryceson and Howe, 1993; Levy, 1996). The importance of infrastructure in agriculture and rural development is well documented. It is estimated that 15 percent of crop produce is lost between the farm gate and the consumer because of poor roads and inappropriate storage facilities alone, adversely influencing the income of farmers (World Bank, 1997). About 600 million people of India live in nearly 6 lakh villages scattered all over the country. A good road network reduces transport cost, accelerates efficient delivery of farm inputs and enhances special agricultural production and distribution. A good network of roads will expand the distribution of agricultural goods as well as open up additional opportunities for agricultural trade (Inoni 2009). Construction of rural roads inevitably leads to increase in agricultural production and productivity by bringing in new land into cultivation or by intensifying existing land use to take advantage of expanded market opportunities (P.K. Samanta 2015).

In India several government initiatives were taken for the development of rural road like Nagpur plan, Bombay plan, PMGSY, Bharat Nirman etc but all the Government policies were based on population only although researcher established that there is a direct relationship between increase in average of export crop cultivation and the standard of roads and distance from the main commercial centers. There is enhanced entrepreneurship activity, sharp decline in freight and passenger charges and improved services as a result of investment in rural roads (Bonney, 1964).Road are always recognized as an infrastructure and arteries of the nation. Rural infrastructure assumes great importance in India because of the country‘s predominantly rural nature. Rural roads were not only providing connectivity to rural area but also affecting change in cropping pattern due to access to markets, increasing productivity by facilitating availability of inputs like seeds, fertilizer and pesticides, realization of better prices to the farmers for agriculture and allied products like milk, improving attendance in schools and above all opening new employment opportunities in non-farm and service sectors (Sangwan S S, 2010).

This study aims to reveal the history of rural road development plan in India and earlier works done about the road network plan in India. This paper is organized as follows: Section 2 shows the history of rural development in India. Section 3 gives an overview

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about Road Network Planning and Review of Earlier Works. Section 4 focuses on major findings after review from earlier works and section 5 made a concluding remark about the future scope of rural road network planning in India.

II. HISTORY OF RURAL ROAD DEVELOPMENT IN INDIA

Since 1940's the Government of India and the State Government had drawn several policies, programs and conceived various schemes for the development of rural roads in India. The policies framed and targets were set under the long-term road development plans and accordingly funds were allocated in various rural development programs/schemes under the Five Year Plans Development laid down during these plans are presented in Table no.2 (Source: Rural Road Development Vision 2025 (Draft) 2021 has been brought out to guide the Central and State Governments in developing the road infrastructure of adequate standards in the country.
The strategy proposed in the vision document for planning rural roads emphasized the need for preparation of master plans for rural road network in each district. The planning of network for the district may cover all habitations with minimum population of 100 and above to be served by all-weather roads. Following Table presents the prioritized targets for the provision of all-weather roads. Currently, the Road Development Plan Vision

A. Progress of Road Network after Independence (Table no: 1) in ('000 km)

	1950-51	1960-61	1970-71	1980-81	1990-91	2000-01	2005-06
Major District Roads and Rural Roads	333	429	821	1358	2166	2994	3117
Percentage of villages with population above 1000 connected with all-weather roads	32%	36%	40%	46%	73%	90%	92%
Overall village accessibility	20%	22%	25%	28%	44%	54%	60%

Source: Vision 2021- Target for Connectivity of Villages

Villages (population category) to be connected by all-weather roads	Target Year
Villages with population above 1000	2003
Villages with population 500-1000	2007

Source: IRC (2001): Road Development Plan-Vision 2021

B. Rural Road Development Programmes In India

The first road development plan of 1943- 61, popularly known as Nagpur Plan, looked at the road needs of the country on a long-term basis, and for the first time classified the road system into a functional hierarchy comprising National Highways (NH), State Highways (SH), Major district roads (MDR), Other District roads (ODR) and Village roads (VR). The last two classes of roads form the rural road system in the country. Secondly in 61-81 Bombay plan was launched

Name of the Plan	Basis of fixation of targets	Targets km	Achievement Km	Target density (All roads)
Jayakar Committee (1929)	First organized effort at road building at the national level.	-	-	-
Nagpur Plan (1943–61)	Length of ODRs + VRs assessed on the basis of number of villages with population 500 and less, 501-1000, 1001-2000 and 2001-5000.	332,335	500,802	0.32 km per sq. km
Bombay Plan (1961-81)	Length based on the number of villages with population less than 500, 500-1000, 1000-2000 and 2000-5000	651,780	912,684	0.46 km per sq. km
Luckhnow Plan (1981-01)	Length assessed on the basis of number of villages and towns.	2,189,000	2,994,000	0.82 km per sq km

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C. Progress of Rural Road Development Plan INDIA (Table No.2)

based on the number of villages with population less than 500, 500-1000, 1000-2000 and 2000-5000. The third road development plan known as Lucknow Plan (1981-2001), estimated rural road requirement for the country and had spelt out various measures to develop rural roads. This plan suggested several approaches for rural road development. These approaches include preparation of long-term master plan for rural roads; stage construction in view of the low level of traffic in the initial stage of development of a rural road; integration of rural road development plan with the other rural

development programs. During all the road development plans the rural roads have received significant attention and emphasis. A number of programs were launched under several employment generation and poverty alleviation programmes of the Central and State Governments to achieve the goal of rural connectivity such as the Minimum Needs Program (MNP), National Rural Employment Program (NREP), Rural Landless Employment Guarantee Programme (RLEGP), Jawahar Rozgar Yojana (JRY) etc.; but these programmes failed to achieve their desired goals. A pragmatic analysis of the past schemes reveals many deficiencies in the whole process from planning to implementation and monitoring to evaluation (Lokesha and Dr. Mahesha).There was largely a misconception that rural roads being the lowest category of roads need no elaborate design and engineering. The Ninth Five Year Plan acknowledges that several thousand kilometers of such roads were constructed in the past without proper design and engineering and hardly commensurate with the resources that were allocated to the effort. As a result, rural roads had poor geometrics, inadequate compaction of embankment and inadequate drainage, so the roads that were built were hardly all-weather roads. Consequently, these roads did not last long.

D. Rural Roads in Five Year Plans

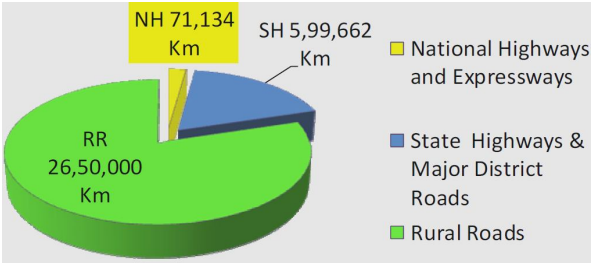
In the fifth Five Year Plan, funds are allocated under various rural development programs such as

1) *Minimum Needs Program (MNP):* A major thrust to the development of Rural Roads was given at the beginning of the Fifth Five Year Plan in 1974, when it was made a part of the Minimum Needs Programme (MNP), along with electricity, primary health centre, primary school and dwelling unit with a view to bringing the rural population into the mainstream of national development. Funds were provided by the States. The objective of the rural road programme under the MNP was to:

Link all villages with population more than 1500 by all-weather roads

Link 50 per cent of villages with population between 1000 and 1500 by all-weather roads.

2) *National Rural Employment Program (NREP)***:** Development of composite homestead projects for the shelter less in the form of housing complexes-cum-production estates within a larger concept of habitat development, fieldworks in irrigation command areas and micro watersheds, roads according to well-defined techno- economic norms and within planned priorities such as those arising out of the MNP and need-based construction of buildings, which apart from schools, panchayat building etc. would provide vital economic infrastructures like buildings for storage, banks and workshops for target-group beneficiaries.
3) *The Road Development Plan Vision: 2021 (IRC 2001)* proposes the long term strategy for planning rural roads in India. It emphasizes preparation of master plans for rural road network in each district and building up from block level-needs. The road alignments should be optimized to serve maximum population and utilization of existing tracks including those constructed under different rural development programs. Due consideration should also be given to the improvement of existing fair-weather road to all-weather standards and to provide adequate cross drainage structures wherever these are missing.
4) *Ministry of Rural Development (MORD)* in India (MORD 2002) and World Bank (World Bank RT-4 2000) has suggested master planning rural roads based on the identification of core network, which ensures minimum connectivity for each village to a nearby main road or market center. The core network was identified through a rural road master planning process based on guidelines for preparation of 'District Rural Road Plan'. This procedure is also adopted for planning and selection of through routes and link roads under the Prime Minister's rural roads program (MORD 2002) in India. The drawback of this method is that core network is identified based on judgment on accessibility of settlements (Rao et al. 2007).



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E. Pradhan Mantri Gram Sadak Yojana (PMGSY)

Government of India launched the Pradhan Mantri Gram Sadak Yojana (PMGSY) on 25th December, 2000 as a Centrally Sponsored Scheme to assist the States. Objectives of PMGSY are follows

The Pradhan Mantri Gram Sadak Yojana seeks to provide Road Connectivity, through good All-weather roads, to all Rural Habitations with a population of more than 500 persons by the year 2007 (end of Tenth Plan

period). In the process, all unconnected Habitations having a population of more than 1000 persons would be covered in the next three years. Where a State has no uncovered Habitation of this population size, smaller Habitations may also be covered, subject to the minimum population size being 500. In case of hilly/desert tracts, this may not be less than 250.

The PMGSY covers only 'Other District Roads' (ODRs) and 'Village Roads' (VRs). Urban roads are excluded from the purview of this Programme.

Under the PMGSY, the primary focus of the Programme will be on providing connectivity to Unconnected Habitations in a District. Priority would be accorded to providing road connectivity, by means of All-weather roads of desired specifications, to Unconnected Habitations having a population of 1000 persons or more (according to 2001 Census).However, if there are no such Unconnected Habitation, then Unconnected Habitation with population between 500-999 persons can be taken up under the Programme. In all cases, preference should be given to Habitations having large Scheduled Caste/ Scheduled Tribe population. The District will be the unit for determining the presence or absence of Habitations of the targeted population size.

The objective under the Pradhan Mantri Gram Sadak Yojana is that every Habitation (of the designated population size) should have one All-weather road connectivity. It follows that if a Habitation is already connected to another Habitation or an All-weather road by way of an All-weather road, then this Habitation can not be taken up under the Pradhan Mantri Gram Sadak Yojana. In other words, already connected habitations can not be provided with more roads under the Programme unless all Unconnected Habitations with population

above 500 persons have been provided connectivity in the District.

F. Bharat Nirman,

One of the important Programmes launched by the Government of India in December 2005 identified six core infrastructure sectors in rural areas viz. rural housing, irrigation, drinking water, rural roads, rural electrification and rural telephone connectivity. Initially, it was launched as a time bound programme of construction of rural infrastructure for implementation during the four year period 2005-09. Rural Road, one of the six components of the program with a goal to provide with an all-weather road connectivity to all eligible unconnected habitations with a population of 1,000 persons and above (as per 2001 census) in plain areas and 500 persons and above in the case of Hilly or Tribal (Schedule V) areas. The Bharat Nirman Programme envisages a massive scaling up in terms of habitation connectivity coverage, construction targets, and financial investment. Up to March, 2014 a total of 51,253 habitations have been connected out of 63,940 habitations to be connected and works for connecting 62,876 habitations have been sanctioned. The targets and achievements of rural road network under Bharat Nirman are given in Table 4.

III. ROAD NETWORK PLANNING: REVIEW OF EARLIER WORKS

Bonney (1964), observed that there was a direct relationship between increase in acreage of export crop cultivation and the standard of road and distance from main commercial centers. There is enhanced entrepreneurial activity; sharp decline in freight and passenger charges and improved service as a result of investments on rural roads. While analyzing the socio-economic impact of a new road on a small and isolated village community in Mexico.

Pathak (1969), in his study points out that road and Road transport system is the fife-blood of civilization and constitutes an important item of infrastructure for economic growth. From his study Pathak found that improved road and road transportation creates values, utility and also helps production of perishable commodities by carrying them to consumers in distant markets, Like fishing, meat, poultry, dairy, sericulture and fruit farming, directly dependent to the rural transport.

K.P. Bhatnagar et al, have come to a conclusion that "The road is one of the greatest fundamental institutions of mankind". They also found that: roads have profound economic and social significance in the modern world:

A good road system aids to agriculture, indirectly it breaks up the isolation of villages and the provision of good roads and transport facilities in rural areas foster the development of rural industries, particularly dairy-farming, bee-keeping, and poultry-farming.

Roads affect agriculture directly by enlarging the areas under cultivation, and also promote a change in the type of a agricultural production by diversion of cultivation from food crops to commercial crops.

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Bansal and Patil (1970), studied the socio-economic impact of roads on village development based on a survey of 1662 villages in India, found that the effect of accessibility was greater for unimproved than for improved roads suggesting that in bringing about socio-economic change, the existence of some kind of trafficable route is of major importance, its quality is a second-order consideration.

Moore (1980), revealed that impact of roads was more on isolated areas that were brought into the mainstream. The area under cultivation and the intensity of land use increased significantly wherever access to markets is improved.

Hans Binswanger et.al (1989), used macro data from eight-five randomly selected districts of India to examine the role of rural roads, among other factors, in agricultural investment and output. The study found that road investment contributed directly to the growth of agricultural output, increased use of fertilizer, expansion of commercial bank operations, etc. The study through 129 villages in various parts of Bangladesh categorized the villages into two groups based on an aggregate index developed to reflect the ease of access of a village to various services such as markets, schools, banks, and local administrative offices.

Gulati (1997), observed a positive impact of 'social development' and irrigation intensity factors on the composite index of economic development, at the district level. Within the 'social-development' factors, the surfaced road length and electricity turned out to be the crucial indicators.

Ghose and De (1998), has found positive and significant relationship between level of physical infrastructure and per capita net state domestic product between 1971-72 and 1994-95.

Ahmed (1996), put it "the most profound effect of infrastructure development could be on the attitude and values of rural households. Development of transport and communication infrastructure enhances the mobility of people and information through reduction in cost and time. The resulting increase in interaction contributes to changes in attitude and human capital development. The effects of these attitudinal changes are reflected in the increasing adoption of family planning practices, diminishing faith in superstition, increasing preference for processed/ value added products and also on various consumer goods produced outside."

Majumdar (2002), on the basis of regression analysis of the State level cross-section data for each of the years from 1971 to 1995 indicated that among various physical infrastructures, it was the transport infrastructure that significantly affected the agricultural output level and the agricultural development index. However, besides physical infrastructure, social infrastructure also had significant positive impact on the dependent variables. At the district level, from the regression analysis at three points of time, viz., 1971, 1981 and 1991, the study observed that agricultural and transport infrastructure are important determinants of agricultural output and agricultural development index.

Singh (1983), found a positive correlation between infrastructure and agricultural development. Among the various infrastructural facilities, agricultural development was strongly correlated with agricultural infrastructure index, followed by index of transport and communication.

Thorat and Sirohi (2002), attempted to analyse the impact of infrastructure on agricultural development using larger data set, both in terms of time period (pooling the data for four time periods, viz., 1961, 1971, 1981 and 1991) and coverage of infrastructural variables to include ten explanatory variables, viz., transport, power, irrigation, tractorization, research, extension, access to primary agricultural credit societies, regulated and wholesale marketing infrastructure, access to fertilizer sale points and commercial banks, covering physical, financial and research infrastructure.

Ahmed and Hossain (1990), provided the evidence linking poverty alleviation with infrastructure development. Infrastructure leads to increase in crop income among small farmers.

World Bank study (1997), estimated that 15% of the agricultural produce is lost between the farm gate and the consumer because of poor roads and inappropriate storage facilities alone, adversely influencing the income of farmers. Poor rural road infrastructure limits the ability of the traders to travel to and communicate with remote farming areas, limiting market access from these areas and eliminating competition for their produce. Easier access to market allows expansion of perishable and transport-cost intensive products.

International Fund for Agricultural Development (1995), observed that construction of rural roads almost inevitably leads to increase in agricultural production and productivity by bringing in new land into cultivation, intensifying existing land use to take advantage of expanded market opportunities. Better roads also lowered the transaction costs of credit services, resulting in increased lending to farmers, higher demand for agricultural inputs and higher crop yields.

According to Wharton (1967), agricultural infrastructures are categorized into [i] capital intensive, like irrigation, roads, bridges [ii] capital extensive, like extension services and [iii] institutional infrastructure, like formal and informal institutions. Infrastructure, such as irrigation, watershed development, rural electrification, roads, markets, in close coordination with institutional infrastructure, such as credit institutions, agricultural research and extension, rural literacy determines the nature and the magnitude

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of agricultural output in India. Adequate infrastructure raises farm productivity and lowers farming costs and its fast expansion accelerates agricultural as well as economic growth rate. It is acknowledged that infrastructure plays a strategic role in producing larger multiplier effects in the economy with agricultural growth.

Ramanandam (1980), made a detailed attempt to study the rural transport system in India. He attempted an economic analysis of road transport operation and found that the road transport is a powerful agent of social transformation, breaks isolation of rural habitations and rural communities, brings new ideas and dispels their ignorance. Ramanandam concludes that adequate and efficient road and road transport system 16 a vital national asset from the economic, cultural and social points of view.

Mahendru et al. (1983, 1985, 1988, and 1989), used the concept of settlement interaction, link efficiency, route efficiency and network efficiency to generate, analyze and evaluate alternative rural road linkage pattern. Integrated area development approach was considered to develop the road network so that it serves the area in a balanced way. Gravity hypothesis was used to quantify the inter-settlement interaction, based on level of socio-economic development, population and spatial separation between settlements.

Swaminathan et al. (1982), used the concept of minimum spanning tree for connecting the settlements to existing nearby roads or to the nearest market. In this method, it was claimed that the network generated is optimal but no analysis for optimality was carried out. Kumar and Tilloston (1985) proposed the rural road network planning methodology based on minimization of total cost, which consisted construction and travel costs. Alternative networks were generated from a set of predetermined road links by providing connectivity to the rural settlements with different link options. The optimum network was selected as the one with minimum construction cost, which was generated using minimum spanning tree concept.

UNCHS (United Nations Centre for Human Settlements, 1985), suggested procedures for generation of network option for connectivity, and then, based on a set of simple evaluation criteria or indicators screening the options to a few which are considered for detailed engineering/economic evaluation. It also proposes to evaluate the road network by developing indicators based on graph-theoretic measure of connectivity in a network and/or gravity concept based measure of spatial accessibility. The drawback of these measures is that they are limited to the analysis of topological properties of the network and do not deal with characteristics such as capacity, type of use and cost of construction. The procedure is aimed to identify the most accessible routes between settlements.

Manohar Lal (1989), studied the roads and their socio-economic impact on the rural community of Bihar. He found that the road development has bestowed a package of benefits on the village people. In agriculture sector, Lal found that the development of road network has resulted in faster and more equitable distribution of inputs as also marketing of products. Allied agricultural and non-agricultural activities have also started growing with expanding road communication. Small trade and business establishments have come up in some of the villages linked with roads. Lal also observed that the rural road network generated a better access to facilities for schooling, health, banking and postal services to the rural people.

Mineetha (1992), in her work on "Generation and testing of alternatives for rural road network development -a case study of Kozhikode District", has made an attempt to identify village hierarchy based on the trip rate produced from each village. Factor analysis was used for analysis.

Purushottam, (1993), in their paper “Scientific preparation of Master plans for Rural Roads in Andra Pradesh” has suggested that rural road network planning is to be carried out in three stages viz: node choice, link choice, network choice which are decided on the basis of Transport Priority index, Link Priority index and Village Affinity index.

Daya Krishnankutty (1997), in her dissertation work on “Rural Road Network Planning for Kasargod district”, conducted primary household surveys to understand the travel characteristics of the rural community and predicted the average trip rate of villages using data from census reports and using multiple regression analysis.

Kumar et al. (1997), suggested facility based approach for rural road planning. The road network was developed by connecting settlements to the nearest market in such a manner that maximum number of educational institutions fall along it. Although, in this study, the trip pattern of rural area was captured precisely, it was not used effectively in the network planning. The existing accessibility pattern of already connected settlements was extrapolated to the unconnected one in developing the linkage pattern. The total access needs of unconnected settlement due to its missing functions were not considered in developing the network.

H.C. Kantharajappa (1998), in his thesis proposed that efficient road connectivity would promote the production of agricultural commodities. Its impact is likely to be relatively greater in the production of soft and highly perishable farm products such as milk, eggs, poultry, fresh fruits, fresh vegetables, etc. Those would lend themselves to year-round production.

Bruno F. Santos et al, suggested that road network planning (or design) problems consist of determining the best investment decisions to be made with regard to the improvement of a road network. In this paper, he propose an optimization model for long-term interurban road network planning where accessibility and robustness objectives are simultaneously taken into account. Three

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network robustness measures were defined to assess different robustness concerns: network spare capacity; city evacuation capacity; and network vulnerability.

Kim and Chung (2001), proposed measuring accessibility in terms of disutility index for spatial location - allocation of multiple centre villages using rural roads. The location allocation method optimizes some functions of access to the facilities but it does not provide accurate information needed for improving or ranking the road linkages between settlements.

David Tighe (2002), in the topic 'Roads and Poverty Reduction' a social road will be assumed to contribute mainly to the well-being of the local population rather than economic growth (although the latter can be seen as merely postponed) and tools must take account of this.

Prasada Rao, (2003), in their paper "Information system for rural road network planning - a case study", GIS has been used for planning of rural road connectivity for a Community Development block and the information system was developed for village and rural roads.

Praveen Kumar, (2004), in their paper "Facility Based Network Planning of Rural Roads Using GIS", a computer based user friendly rural road network design model was developed.

Rao et al. (2007), discussed about GIS based technique for identification of core network and rural road planning. Core network, consisting through routes and link roads, provides basic minimum access to all habitations with single all weather connectivity. Minimum spanning tree procedure is adopted for identification of core network. The efficiency of core network and link roads in meeting the access requirements of connecting settlement is not explained.

Anjaneyulu et al. (2007), presented methodology for planning rural roads based on secondary data sources. The road network was planned based on functional dependencies of settlement and potential interactions resulting from them. The developed network was evaluated using structural properties of the network. In this approach also the accessibility needs of the settlements were not considered in developing the network. In the planning process the cost of construction of road links and their actual alignment were not considered.

Misra (2008), proposed inter-settlement interaction and functional accessibility approach for rural road network planning. In the proposed model prioritization and ranking of settlements for rural road connectivity was based on their population size and socio-economic status. An index parameter was developed for the settlements which reflects the importance or deprivation of the habitation and helps in selecting the target habitations for connectivity. For selecting the suitable road link among available link options, which provides connectivity to unconnected settlement, the accessibility benefit concept was used.

J. K. Shrestha et al (2013), in his paper "A Methodology for Definition of Road Networks in Rural Areas of Nepal'' considered in the development of road networks, using objectives such as maximization of accessibility to settlements, maximization of equity (distribution), robustness of network and maximization of covering of settlements and public facilities during planning of a rural road network.

K. Shalini et al (2017), made an attempt to develop a need based approach for rural connectivity which would ensure Accessibility to the basic facilities. Using GIS platform, It also suggested that it is not necessary to construct high quality roads for each link and depending on the usage and population served they could be constructed as earth, gravel or black top/concrete roads.

Shaheen Begum (2017), in his study has undertaken an extended attempt to develop Geographic Information System (GIS) based rural network plan .It also aimed to select the shortest and alternative paths from different villages towards growth centers. Network analysis has been conducted to select shortest path in terms of travel time between two locations in the study area.

III. SALIENT FINDINGS FROM THE LITERATURE REVIEW

It is well known that the roads are playing an important role in 'uplifting the social, economic and cultural life of the people, under the transitional stage of any society. India though it is a developing country, it has given prime importance for constructing roads to her people in rural areas. It is very much eager to know, the impacts of the roads on the living standard of the people in rural areas. It is known that how far these roads have helped in getting educated an individual and how far it has acted as important factor to adopt the day to day changes the pattern of agriculture, industry and economy in India as around the world. In view of studying the cited problems in a systematic way, it is undertaken in this study. It helps in adopting the required plans and policies for governments and for professionals in the area of the rural development.

A. Network Rather Than Link Analysis

Also important is the need to examine roads as rural networks rather than on an individual basis. Too often, single links are identified and presented for financing without taking into account the state of the complementary connections on which its

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contribution to local mobility depends. This in turn, leads to a need for models which can help to determine the core network, that is, that sub-network which will ensure, once upgraded and maintained, an adequate level of service for motor vehicles while at the same time providing sufficient coverage to permit simpler complementary networks to benefit from them. Certain formal tools are more easily applied to single links and this to some extent has driven project formulation. The rural roads are tertiary roads in the existing classification of the road network system. The planning for such detailed level network is required to take advantage of the other higher categories of roads in the network hierarchy to provide a policy guided level of accessibility to the rural habitations (Sikdar, 2002). Although, initially PMGSY did not commit for network approach, soon difficulties were faced with isolated links surrounded by roads of poor quality. The present policy and guidelines ensure the network planning for linkages as well as prioritization.

B. Gaps In The Planning Process

The structure of the network was not subjected to evaluation through the assessment of indices concerning accessibility, connectivity, and circuitry and so on. Though the conceptual plans and targets had been worked out, the absence of detailed work plans resulted in a non-integrated network, with several missing links and critical bridges. This invariably resulted in the loss of mobility due to discontinuities in the network and forced circuitous journeys. During the development of the roads interfaces among the hierarchical roads were not properly addressed, resulting in deficiency in the functionality and efficiency of the total network.

C. Network Development Prioritize Based On Population

The construction of a road connecting a habitation must be augmented by means of transportation, enhanced by appropriate facility creation in health, education and so on. The utility of the network can be best appreciated with such integration of accessibility with social infrastructure. Keeping this in mind, the agricultural land is also a important factor for the development of economy. The report of NRRDC 2000 resulted in the formulation of the Pradhan Mantri Gram Sadak Yojana (PMGSY) with an aim to provide all-weather roads to almost all rural habitations in the country (MoRD 2000).

IV. CONCLUSION

The literature review suggests that the development of rural roads network based on the size of settlement as the sole criterion is incorrect, the agricultural produces and other primary activities (dairy, pisciculture, bee-keeping, small scale industry etc.) may be the factors for determination of the road linkage. The rural roads will be assumed to contribute mainly to the well-being of the society. These are essentially non-monetary, at least it always to be hoped that gains in social indices, health, education, and so on will eventually be translated into increased incomes and hence more sustainable poverty reduction. The rural road network in developing countries, like India, needs to be developed so that the travel requirements of people or community are met to the maximum in a collective way at the lowest cost of road development. The unconnected settlements need connectivity with at least one all weather road type to the existing regional roads so that it can have access to all its missing functions. The above study also suggests connecting road links for a settlement need not always have the straight alignment, as considered in most of the rural road planning methodologies it is used to find the actual road alignment of link options and is used in network planning. It is observed that, the efficiency of network generated using accessibility criteria is more than the network generated using minimum construction cost criteria. The rural road network developed using accessibility criteria is thus more economical in long run and meet the travel requirement of settlement in the most efficient manner.

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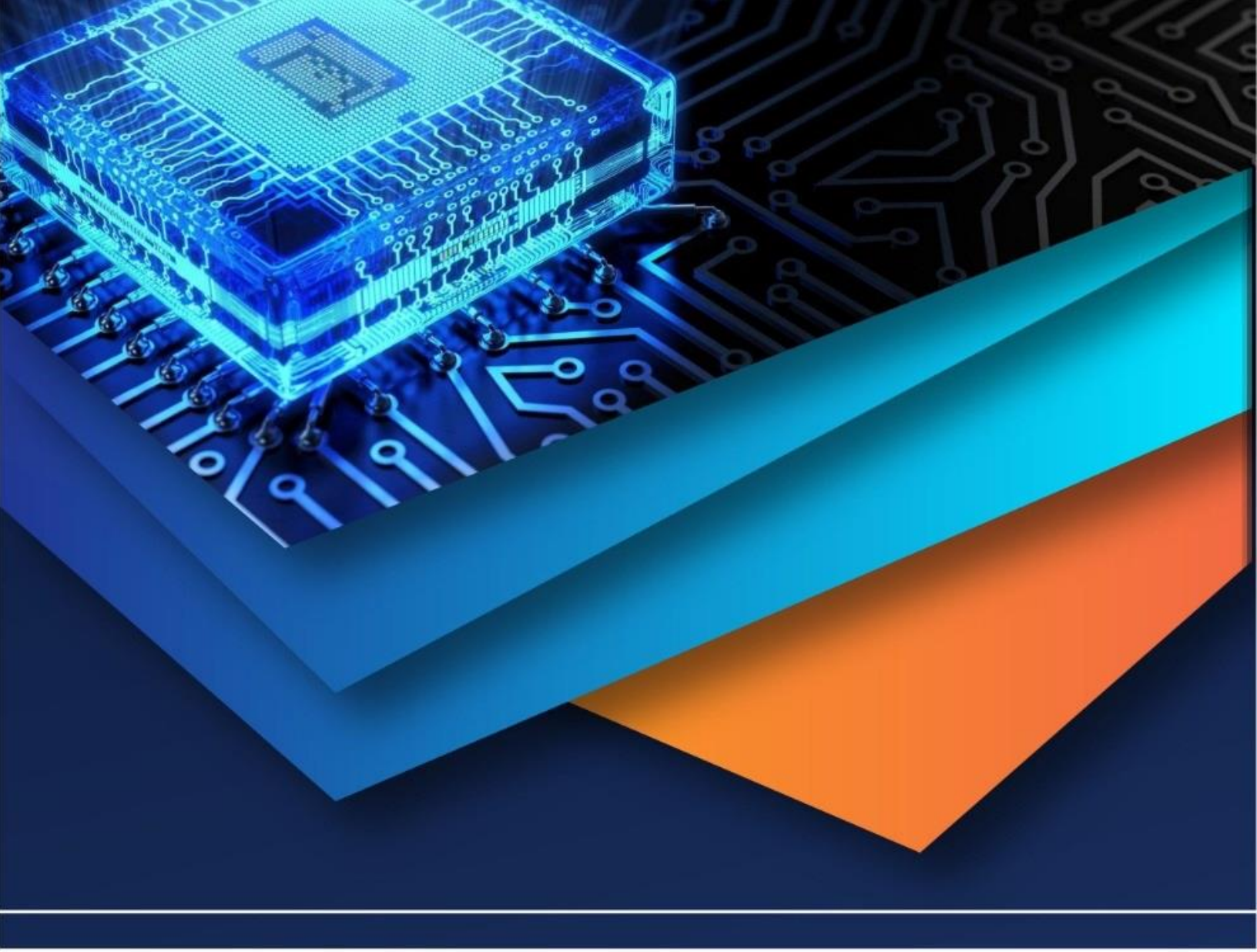

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