INTERNATIONAL JOURNAL OF BUILT ENVIRONMENT AND SUSTAINABILITY
Published by Faculty of Built Environment, Universiti Teknologi Malaysia
Website: http://www.ijbes.utm.my
IJBES 2(3)/2015, 150-157

Exploring the Planning Design Opportunities for Road Transportation Network of Kanyakumari District, Tamil Nadu, India

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History:
Received: 8 August 2015
Accepted: 10 September 2015
Available Online: 30 September 2015

Keywords:
Transportation Network, Vehicular Population, Design Options, Kanyakumari District

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ABSTRACT

The transportation system in Kanyakumari District has met the grim situation over the years due to numerous parameters like increasing population, increasing economic activity, increasing vehicular population, negligence from the administrative officials, unethical practices of the locals, etc.; led it to a pathetic condition, especially on National Highway-47. However, to simplify the situation, the National Highway Authority of India (NHAI), Government of India is taking up the effort for developing the new bypass road to the existing NH-47 by diverting form selected few junctions. Unfortunately, this partial solution for the existing NH-47 will give birth to numerous other physical, socio-economic, and ecological problems. The objectives of this study is to identify the possible causes of the inadequacies in prevailing transportation network of Kanyakumari District and put forward logical, scientific and economical conceptual level solutions for the betterment of road users and people of the district. In order to revamp the present dreadful condition, the authors have worked out some simple remedial measures as a solution by conducting exhaustive observation survey, analytical work, discussions with experts and the locals, etc. It includes assessing the prevailing conditions of transportation system in the district, proposing planning design options for rectifying the short comings of the transportation network of the district, conceptualization of the standard flyover design for the NH-47 and ring roads for selected towns of high importance. Further, the paper concludes with plausible and executable recommendations. It is recommended that, in the light of these findings of opportunities and possibilities, the administrative authorities and officials of Kanyakumari district might look into rejuvenating the road transportation scenario of the district.

1. Introduction

The growth of vehicular population is constantly increasing over the years and its rate of growth is much higher than the growth rate of National Highways and other highways in length. As a consequence, the main arteries have been facing capacity saturation and tremendous amount of pressure in them. The vehicular population grew at a compound annual growth rate (CAGR) of about 11 per cent compared to total length developed between 1951 and 2002 (Planning Commission, 2007). However, the increase in National Highway segment is observed as just 2.1 per cent. In recent years, it has been grown around 5 per cent, while the growth of vehicular population is observed closer to 10 per cent during the period between 1991 and 2004.

In India, about 50 per cent of roads are in abysmal state and are not apt for movement of vehicle to ply, and these problems magnify due to the pitiable or in some cases absence of maintenance practices (World Bank, 2007). Even the National Highways suffer from the deficiencies of inadequate capacity, weak pavement, poor riding quality, distressed bridges, unabridged level crossings, congested cities (lack of by-pass roads), lack of wayside amenities and safety measures, which resulted in to increase in travel time, congestion, pollution, road accidents, consumption of more fossil fuel, etc. The scarcity of maintenance and other managerial funds is the general observation regarding construction and upkeep of roads. Instead of giving high priority to this task, the percentage allocation has decreased over the years. Every year, new highways are coming up and added into the national network that results into the same abysmal state as discussed above. Thus, it is an inevitable requirement to plan and design the highways with sustainability approach and in a case specific manner. Having the above knowledge in mind, a sustainable planning design is evolved for the transportation network in Kanyakumari district, Tamil Nadu State. This paper is the successive analytical work done by the authors, after analyzing the magnitude of transportation related problems observed and published in the paper (Devadas et al., 2013).

2. Background of the Study

2.1 Kanyakumari District Profile

Kanyakumari district, having the area of 1672 Square Kilometer, is the smallest districts of Tamil Nadu State (Kanyakumari District, 2014), and is presented in Figure 1. There are three distinct geographical divisions of the district, which include Western Ghats in the North, a plain sea-coast in the South and the fertile area in the midland. Nagercoil is the

Figure 1 *Kanyakumari District*
(Source: www.kanyakumari.tn.nic.in)

biggest city and headquarter of the district. The administrative division of the district is as follows: two Revenue Divisions, four Taluks, nine Community Development Blocks, 97 Village Panchayats, 56 Town Panchayats and four Municipalities.

The Kanyakumari district has a total population of 1,870,374 (Census of India, 2011). The district has a population density of 1118.64 per sq.km. By excluding the forest area, the density turns out to be 1655.30 person per Sq. Km. The decadal population growth rate of the district is 11.6 per cent (Census of India, 2011), and there is a population drop in the rural segment of this district from 582,107 (Census of India, 2001) to 330,572 (Census of India, 2011). The proportion of urban population in this district is drastically increased from just 16.88 per cent in 1991, 65.27 per cent in 2001 to 82.33 per cent in 2011.

This district has 32.42 per cent of the area under forest; and 52.45 per cent of the area under crops, of which 89.85 per cent is confined under net sown area. This district is blessed with two monsoons, including South-West and North-East. The irrigation infrastructure of the district includes 5 reservoirs, 5 rivers, 53 canals and 2051 wells. The district has almost 32.73 per cent of the cropped area covered under irrigation (Kanyakumari District, 2014). Verity of plantation crops, such as rubber, clove, nutmeg, pepper and pineapple are cultivated in this district. The district has a total of 330,053 land holders of which 91.85 per cent land holders possess just less than 0.005 Square Kilometer area of land (2005-06). Total area under the forest is 541.55 Square Kilometer, which represent almost 32.39 per cent of the total geographic area of the district. The forest is rich in flora and fauna. This district has a coastline of 60 Kilometer, and it has 44 fish landing centers, and 47 fishing hamlets covering 37,405 families with the population of 148,539, and this holds about 18.79 per cent of the total fishing population of the Tamil Nadu State (Kanyakumari District, 2014).

Figure 2 *Road Map of Kanyakumari District*
(Source: www.gis.nic.in)

Despite the district has higher literacy and education rates, this district is industrially backward. It also possesses a wide range of natural resources, well connected roads, transport and communication systems, availability of formal credit support through banks, etc. The district has well established tourism, which attracts numerous tourists from across the globe. It has unique architectural beauty, culture, customs and traditions, and are having blend of Kerala and Tamil Nadu State. This district has a well-developed road network but the quality of the roads is very poor (Figure 2). In the year 2013-2014, the district had total 5197.754 Kilometer of roads, which include 78 Kilometer of National Highway, 321 Kilometer of State Highways, 1980 Kilometer of major district roads, and other roads of 2781 Kilometer. Besides this, it has a single broad gauge railway line, and Nagercoil functions as the biggest junction of the district. Other facilities and services like electricity, postal services, telephone, banking, etc., are present in almost all the villages of the district (Kanyakumari District, 2014).

As per Census of India 2011, the urban area is altogether identified as a settlement having population of minimum 5000 people, at least 75 percent of the of the male working population should be engaged in non -agricultural pursuits, and should be having a density of population of at least 400 persons per Square Kilometer (Government of India, 2011). According to this definition Kanyakumari district has 1,863,174 population (which is more than 5000); Kanyakumari district stands first in the literacy rate in Tamil Nadu State and thus its male working population is about 81.41 percent which is associated in nonagricultural activities (Table 1), and as discussed previously by excluding the reserved forest area, the density turns out to be 1655.30 person per Square Kilometer. Based on this argument, the characteristics of the region can be observed as urban district. The civic amenities and facilities of the district are still of rural nature, whereas it has to be according to the urban standards based on the population demands. There is a huge gap between the demand and supply of the transportation needs and other infrastructure facilities like water supply, drainage, storm water drain, electricity, solid waste management, etc.; social infrastructure like dispensaries, hospitals, schools, colleges, universities, community centers/ halls, recreational areas, parks, communication facilities, etc.; economic infrastructure like

Table 1: Demographic profile of Kanyakumari District

Population	Persons	Males	Females
Total	1,870,374	926,345	944,029
In the age group 0-6 years	182,350	92,835	89,515
Scheduled Castes (SC)	74,249	36,817	37,432
Scheduled Tribes (ST)	7,282	3,554	3,728
Literates	1,548,738	780,541	768,197
Illiterate	321,636	145,804	175,832
Total Worker	679,620	524,629	154,991
Cultivator	18,991	15,477	3,514
Agricultural Laborers	94,384	78,396	15,988
Total Agricultural Workers	113,375	93,873	19,502
Household Industries	50,500	16,130	34,370
Other Workers	642,707	492,360	150,347
Total Non-Agricultural Workers	693,207	508,490	184,717
	81.41 % of male workers associated in non-agricultural pursuits		

Source: Census of India, 2011

government/private/co-operative banks, commercial hubs, retail/ wholesale markets, etc.

2.2 Significance: Present Condition National Highway-47

The National Highway-47 (NH-47) connects Salem City and the Kanyakumari town and has 620 Kilometer. length, which connects Southern parts of Kerala and Tamil Nadu States. In Kanyakumari District, the NH-47 stretch lies from Kalyakkavilai to Kanyakumari and it has two lanes throughout. This part of NH-47 has been facing numerous amounts of problems within itself due the flawed practices of locals and neglect of State Government and the Central Government. For the wellbeing of the locals and inclusive development of the district, the biggest opportunity so far has been missed by the district administration is that the road has not yet been widened, in spite of, the entire stretch is having adequate Government land on both sides, which can be used for widening (Devadas et al., 2013). Being one of the busiest roads, which is heavily used in India, it is facing several problems

Figure 3 *Traffic Jam on National Highway – 47*
(Source: http://www.skyscrapercity.com)

Figure 4 *Traffic Congestion at Marthandam Junction*
(Source: http://www.skyscrapercity.com)

ranging from physical problems like, accidents, traffic jams, increased travel time, wastage of fossil fuels; to social problems like, apathy among the travelers, and so on (Figure 3). However, to simplify the situation, the National Highway Authority of India (NHAI), Government of India (GoI) is taking up the effort for developing the new bypass road to the existing NH-47 by diverting form selected few junctions (Draft Feasibility Report, 2004). Unfortunately, this partial solution for the existing NH-47 will give birth to numerous other physical, socio-economic, and ecological problems, and this would spoil the entire existing road network system; destroy the inhabitation; destroy the fertile agricultural land; affect the trees, vegetation cover; destroy the water bodies, streams, rivers, canal networks; medicinal herbs and other flora and fauna. Having the above knowledge in mind, the authors have critically analyzed the existing NH-47 road and its associated problems, (Devadas et al., 2013) and recommending solution for the same.

The existing NH-47 road lies in almost center of the Kanyakumari District, excluding the forest area. The existing NH-47 road functions as a backbone, and number of roads are intersecting at various junctions that further connects the edges of the district in all directions.

As a consequence, the entire road stretch as a whole is under terrific pressure, and the district population is using this road without any interference. The extreme congestion and traffic jams are generally seen at the junctions because the width of the NH-47 at these junctions is little less compared to the rest of the stretch in between the junctions, and these junctions include Kaliyakavilai, Kuzhithurai, Marthandam, Swamiyarmadam, Tuckalai, Vadasery, Kottaar, Suchindram, etc. The major reason for this severe congestion and traffic jams in these junctions is the larger size of encroachment done on both sides of the junctions of the existing NH-47 road by the local people and constructed either commercial or residential establishments on the encroached land. Through traffic is totally disturbed, higher fuel consumption for traveling little distances, increased journey time, higher levels of air and noise pollution around the roads, increased accidents and many other problems are resultant of this condition (Draft Feasibility Report, 2004). In Marthandam junction area (Figure 4), it is observed that the Government of Tamil Nadu gave legal rights (Pattas) over the Government of India's land (Puramboku land), which lies on both sides of the existing NH-47 road, which reflects the inefficient Government administration in the district (Devadas et al., 2013).

The biggest social issue, of the current chaotic circumstance, is of accidents. Every year number of fatal accidents and accidents involving serious injuries occur on the NH-47, which has resulted in to heavy loss of qualified human resource. It is evident that in literacy and qualification of the people, the district is topping the charts in the state as well as in the nation (Census of India, 2011). Since the available human resources in this district are highly qualified, the increasing number of accidents every year, has resulted in to heavy losses for the development of district, state, and the nation as a whole. Another biggest problem that has sprung out of the critical state of the present NH-47 is of wastage of fossil fuel and increased travel time for very little distances.

The constant and over usage of roads, especially NH-47, has generated great number of problems related to travel quality and surface conditions of the roads. The major reason behind this can be observed primarily as noncompliance of the government bodies for repairs, remediation and revivification of poor quality, withered roads; and secondly the reason can be understood as the over usage of the roads, in other words, in spite of providing best quality of materials and construction practices, the overburdened roads wither out more often and reach up to the design life way more earlier than actually anticipated (Draft Feasibility Report, 2004). Some of these conditions are shown in the following photographs in Figure 5.

Figure 5 *Dilapidated Road Conditions of NH-47*

3. Objectives and Methodology

The objectives of this study is to identify the possible causes of the inadequacies in prevailing transportation network of Kanyakumari District and put forward logical, scientific and economical conceptual level solutions for the betterment of road users and people of the district.

The methodology of this study primarily consists of observational and qualitative assessment processes, which are as follows:

(a) To assess the prevailing conditions of transportation system in Kanyakumari District.

(b) Proposing planning design options for rectifying the short comings of the transportation network of the district.

(c) Conceptualization of the standard flyover design for the National Highway – 47.

(d) Conceptualization of ring roads for selected towns of high importance.

(e) Deriving findings and concluding the study with plausible and executable recommendations, based on which the detailed projects can be evolved by the competent government authorities.

4. Planning Design Options

The plausible options that have been developed based on the current condition, needs & demands of users, planning principles and with economic & limited monitory funding considerations are as follows:

- Widening of the Existing NH-47 to four lanes
- Standard flyover temple design for
- Provision of ring roads around selected towns

4.1 Four-Laning and Junction Flyovers

A proposal for constructing the flyovers on the major junctions and widening the NH-47 was evolved by looking at the pitiful present condition of national highway in the district (Figure 6). The conceptual design is evolved based on Four-Laning of Highways through PPP: Manual of Specifications & Standards, by the Indian Roads Congress (Four-Laning of Highways, 2010). The conceptual proposal consist only the graphical representation of the flyover and geometric cross section of proposed widening. The actual design and detailed project report can be worked out when the conceptual proposal is accepted for implementation. As per the proposed conceptual design, the road will have total 4 lanes, two lanes (7 meters) on each side, divided by 2 meter median throughout the alignment. The highway will be accompanied with 4 meter of service road and 2 meters of pedestrian walkway on both the sides to accommodate the slow moving vehicles and pedestrians respectively, to allow the free movement of high-speed traffic on the highway without hindrance.

As said previously, the existing NH-47 road functions as a backbone, and number of roads are connecting in different junctions, which connect to the edges of the district in all directions. This result in tremendous

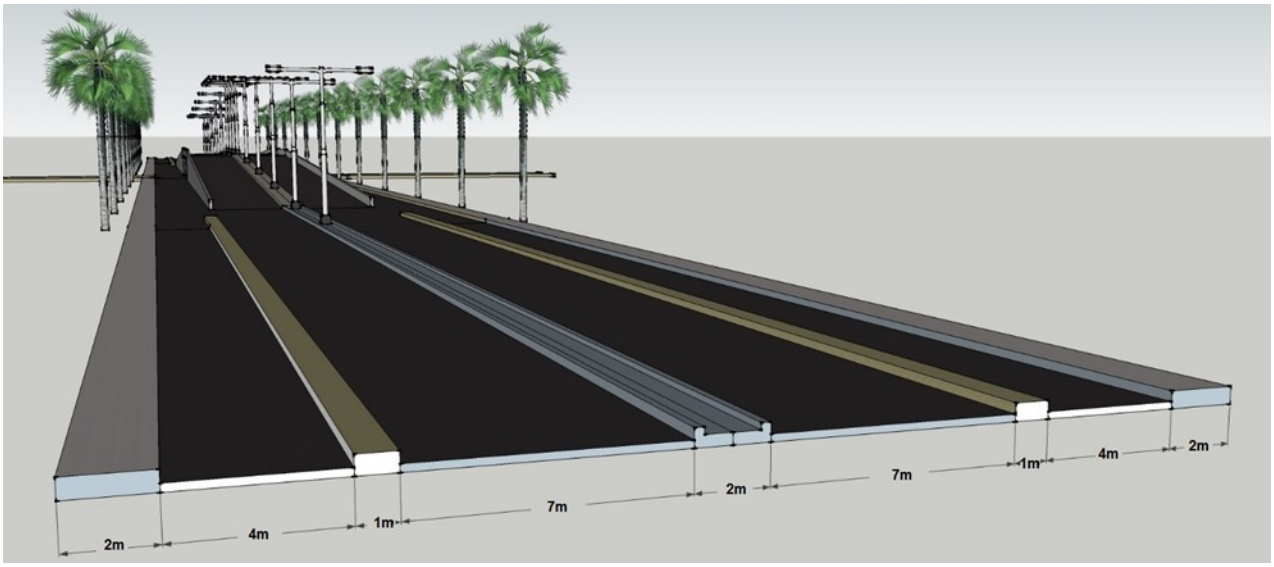

Figure 6 *Conceptual Road Design of NH-47*

pressure on NH-47 at junctions. The congestion indexes at these junctions go above to roof. At few places, it takes more than an hour just to cross the junction on NH-47 at present. As a consequence, numerous man-hours and precious fossil fuel is wasted. It has also resulted in heavy amount of air pollution near the areas of NH-47 by vehicle exhaust. This has given rise to need of provision of flyover at such critical junctions on the highway. The vehicles, which have to turn at the junction will change from the main traffic lane to service lane and will reach below the flyover. There is a provision of a roundabout under the flyover so that the traffic can move freely without any assistance of traffic police. The roundabout helps vehicle drivers to turn to right, left or U-turn smoothly. This technique for bifurcating traffic is practiced everywhere in India. The graphical representation for conceptual design of such flyover, especially for Marthandam junction is presented below in Figure 7.

Provision of under passes on NH-47 would also be considered for crossing the local modes of transportation, local goods vehicles, pedestrians, bicyclists, etc. without any hindrance and also to avoid accidents, after conducting thorough analysis.

This new design will cater to the high amount of traffic flow with least exertion to the vehicle drivers and transportation management authorities, and can become a peaceful option for the frequent users of the highway, i.e., locals, residents and commercial activity practitioners along the highway. The salient features of the proposed design are presented as below:

Compared to the present available width of bituminous surface area of 7 to 8 meters, the developed road will have at least 30 meters of the carriage way throughout the alignment of the NH-47, with all the geometric requirements of the road design as per the Government norms, which is lacking absolutely at present.

All the amenities and infrastructure services lines will have enough space throughout the alignment to accommodate itself under the medians and footpaths of the proposed design road. These service lines consists of drainage, sewerage, storm water drains, telephone cables, electricity lines, information and communication cables, water supply lines, etc. This further enables easy repairs and effortless maintenance of these service lines laid under the medians and footpaths, as shown in Figure 8.

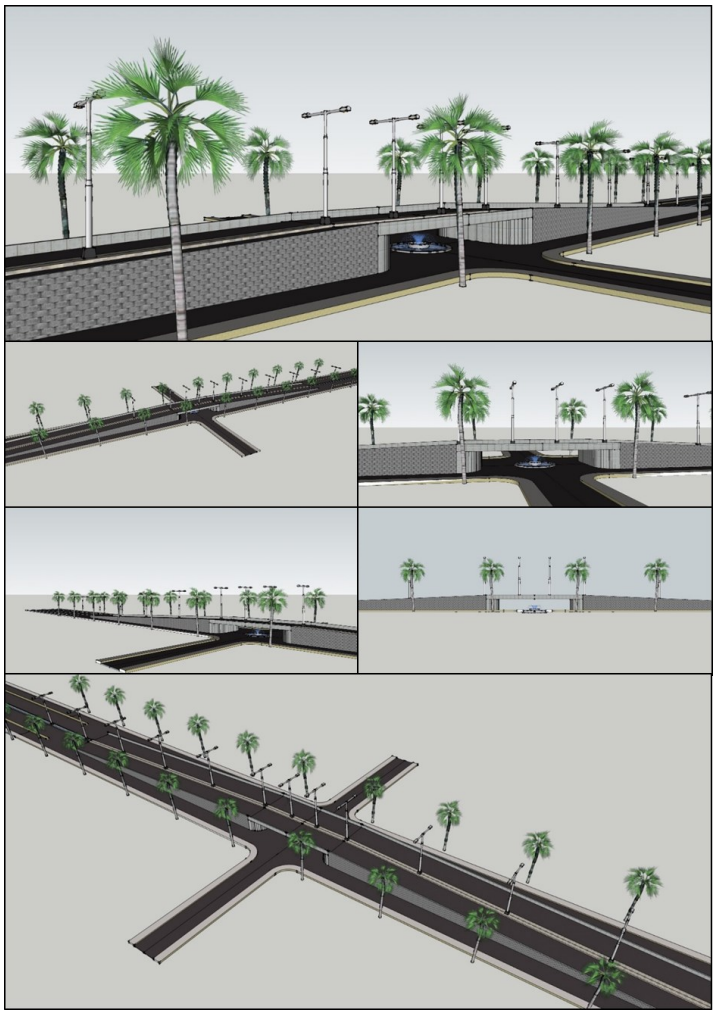

Figure 7 *Conceptual Design of Flyover*

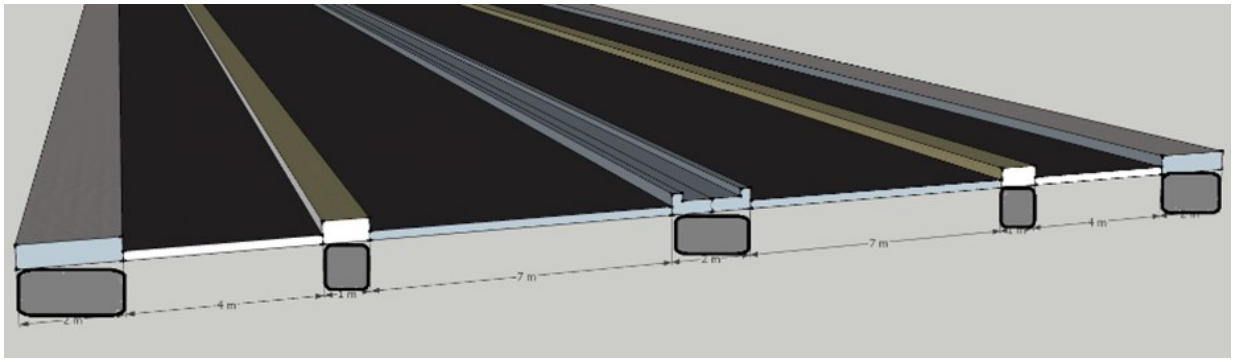

Figure 8 *Space Allocation for Amenities and Services Lines*

The design also consists of service poles at every 20 meters to distribute electricity and telephone cables to the neighboring residential and commercial establishments. This will enable the service lines crossing by the highway through underground ducts, which will maintain the ambient quality of the road and surroundings, urban design point of view. This is also be helpful to avoid any kind of faults in the service lines, due to adverse weather.

Feasibility report for the new alignment of NH-47 by NHAI (Draft Feasibility Report, 2004), argued that the widening of the present NH-47 is not a viable option because the road has lots of curvatures and smoothening those curvatures cannot be considered as an option because lots of private properties has to be moved away for doing so, but in reality the case is absolutely different, and most of these properties along NH-47 are illegally encroached and constructed basically over the encroached land. These illegal encroachments worsened the situation, and present NH-47 has lost its original alignment and made the present alignment curvy throughout the length.

The curvatures can be rectified and smooth free flowing alignment can be achieved by removing the illegal encroachment and by implementing the proposed design as shown in Figure 9. This process will help to provide deep vision of road for drivers for effortless driving. The fuel efficiency of the vehicles will improve, traveling time will decrease, accident rates will decrease and maintenance cost of vehicle would also reduce because of the smooth journey without any interruption caused by frequent breaking actions compared to the present condition.

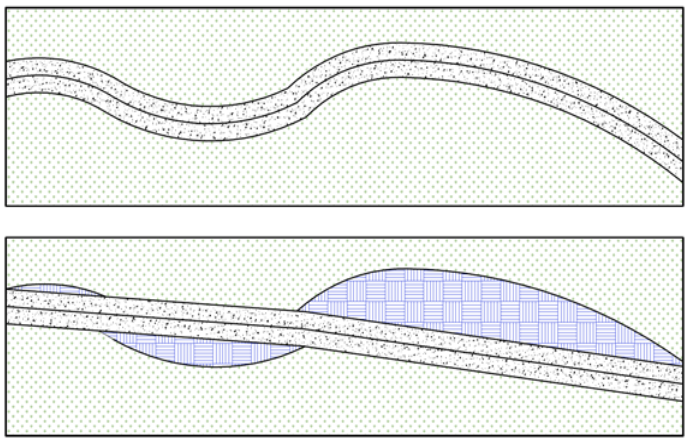

Figure 9 *Highway Curvature Smoothening*

By straightening the curvatures and after deducting the required land width for the new design requirements, lot of land will be freed and that land can be utilized further for various road side activities like petrol pumps, vehicle repair stations, parking, bus stops, taxi/ auto stands, truck laybys; and recreation facilities like, restaurants, cafeterias, etc., as shown in Figure 9. Apart from these, other facilities like temporary markets or weekly markets for locally produced vegetables, fruits, fish, handicraft, goods, etc., can be accommodated at few selected locations to support the local trade and commercial activities for better utilization of the physical resources along the national highway and to support the social setup as well.

The design also include the environmental improvement aspect. The proposed design has provision of appropriate amount of tree plantations along both sides of the roads. These tree plantation would help to minimize the adverse impact caused by the vehicular traffic exhaust. The native endangered species of trees and plants can be preserved by planting them along the road.

4.2 Ring Roads & Its Significance

There are three major settlements in the district which act as the key economic hubs in the district, namely Nagercoil (district headquarter), Thuckalay, and Marthandam (Draft Feasibility Report, 2004). These towns contributes substantial amount of gross domestic product other than agriculture in the district. The economic activities pertaining to these town largely consists of small, medium & large scale commercial activities; service based industries; they provide the prime markets for the agricultural and fisheries produced in the district. The strategically advantageous geographical locations add to the importance of these towns.

The population concentration and accumulation is observed at a greater scale compared to any other regions in the district. This situation has created tremendous amount of pressure on the infrastructural needs, especially on transportation system, of these city and towns. This is because entire district depends on the transport network of these towns and the district as well, for physical communication of personals and goods.

NH-47 passes through Nagercoil, Thuckalay and Marthandam, the three prevalent settlements of the district. This has added numerous problems related to traffic and congestion, as the through traffic also has to pass through these settlements. The intra city traffic mixes with the highway traffic at various locations and increases upon the congestion, travel time and reduces the travel speed. To simplify this situation the ring roads are proposed as shown in Figure 10.

4.2.1 Nagarcoil

Nagercoil city is a big municipality and administrative headquarters of Kanyakumari District, having population of 2,24,329 of which 1,10,132 are Males and 1,14,197 are females. Nagercoil city has the population density 9243 personas per Square Kilometer. as per the census 2011 (Census of India, 2011), which is much higher than the Thiruvananthapuram City's population density, which is 4454 persons per Square Kilometer. as per census 2011. There is a proposal to convert the status of Municipality to Municipal Corporation. Nagercoil, a major town of Kanyakumari District, Tamil Nadu is very close to Thiruvananthapuram, Kerala State capital (65 Kilometer). Thiruvananthapuram is dependent on Nagercoil for major trades and supplies of goods, as many items area available cheaper in Tamil Nadu compared to Kerala, this adds to it being a thriving business center. Nagercoil act as a major node between the Chennai and Thiruvananthapuram corridor and is a commercial center for a rich agricultural area (Nagercoil City Portal, 2015). Overseas export markets, of marine and agricultural products, are thriving in Nagercoil because of close vicinity of Kerala exporters. One of the unavoidable contributor to the local economy is the Non-Resident Indians (NRIs). Among the city's expanding industries are cotton and rice milling, motor repairing, and the manufacture of rubber goods.

Here, in this proposal two ring roads are proposed for Nagercoil city, one of 4 Kilometer (four) radius and second of 8 Kilometer (eight) radius. These two distinct ring roads are to cater to the intra-city and intercity passing traffic. Nagarcoil city is situated at the junction of NH-47A and NH-47B; where NH-47A meets with NH-7 at Kanyakumari town and; NH-47B finally converges with NH-7 at Kavalkinaru and it further goes towards Tirunelveli in Tirunelveli district, as shown in Figure 10.

The outer ring road of 8 Kilometer diameter will serve the dual purpose. It will act as a bypass to the city for uninterrupted vehicular traffic which does not have to go inside the city. It will run by periphery of the city and connect NH-47A to NH-47B by means of this bypass cum ring road. Presently, the vehicles have to travel 14.7 Kilometer to cross Nagercoil within the city from NH-47A to NH-47B, while the outer ring road will connect both the NH-47A and NH-47B by the bypass having length of 15.4 Kilometer, which shows that travel distance wise the difference is as mere as 0.7 Kilometer.

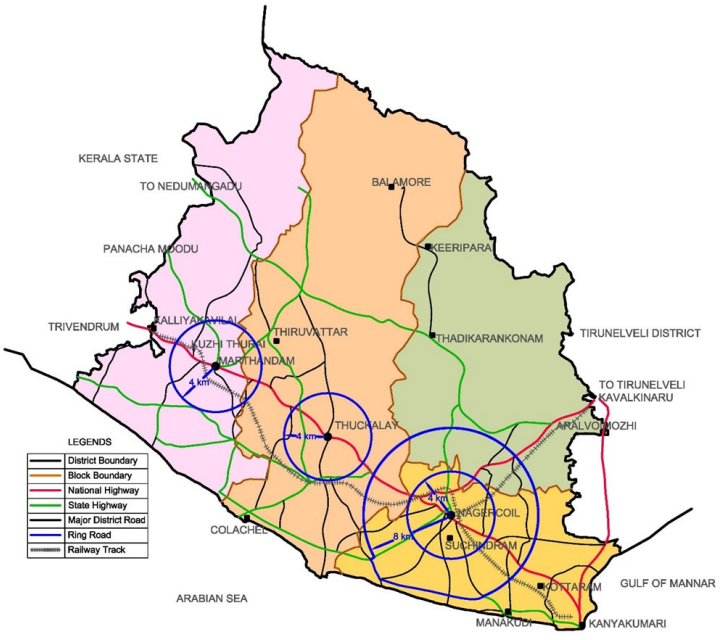

Figure 10 *Proposed Ring Roads in Nagercoil, Thuckalay and Marthandam*

Another leading advantage of this outer ring road would be to demarcate the physical boundary of the city. The land covered inside the ring can be changed to the required purpose according to the master plan of the city for better holistic development of the city and consecutively the district. With the change in land use pattern in this area, several industries and service based industries will come up in future and will ultimately provide abundant employment opportunity to the people of the district.

The inner ring road will solve the problems of the traffic congestion in the city. It will act as the intra-city freeway, which will enable fast and easy commutation of the city dwellers within the city, which will save upon travel time, travel cost, fuel consumption, operations and maintenance cost etc. within the city. Therefore, constructing dual ring road in Nagercoil city is the best possible option after having thorough project formulation analysis.

4.2.2 Marthandam & Thakalay

Marthandam The second biggest town next to Nagercoil, is a part of Kuzhithurai municipality, and well established business center in Kanyakumari district. Around the town the land is most fertile due to excellent climatic condition, and have made the town one of the major agricultural business hub in the district. The town is linked to Chennai, Mumbai, Bangalore and Tamil Nadu state in general by rail and bus service. Marthandam is well known for honey production, cashew nut processing, rubber and hand-embroidered motifs. Marthandam has some famous educational institutions including Nesamony Memorial Christian College and Victory Embroidery School (Kanyakumari District, 2014).

Thuckalay is part of Padmanabhapuram Municipality and administrative center of operations of Kalkulam Taluk. The town has many leading hospitals and important educational institutions of the region. Principal civil hospital of the district is located in this town. Institutes like Government Higher Secondary School, Amala Convent, and few international schools attract many students in the district for education and primary, secondary and higher studies (Kanyakumari District, 2014). Therefore, both towns are considered for designing ring roads (Figure 10). For Marthandam and Thuckalay, 4 Kilometer radius ring roads are suitable, looking at the geography and the development pattern; land use pattern; severe congested condition; and traffic problems of the towns. The ring roads will help divert the through traffic to avoid the congestion in the heart of these towns. This will reduce upon the travel time, fuel consumption, operations & maintenance of vehicles, operations & maintenance of urban roads, air pollution, noise pollution, traffic jams, chaos due to congestion arise, etc. Same as Nagercoil, the ring roads here of respective radiuses will serve the dual purpose. It will act as a bypass to the city as well as additional principal benefit of these ring roads would be to demarcate the physical boundary of their respective municipalities.

5. Findings

Kanyakumari district, is the smallest district in Tamil Nadu State; and is blessed with good monsoons and various irrigation facilities, as a consequence, the entire land is almost cultivated for cereal crops,

plantation crops and others. The density of population in the district is quite higher than the State or even National average. It has the density of 1118.64 persons per Square Kilometer. (Census of India, 2011), and its actual density is 1655.30 persons per Sq. Km., excluding the forest area, which shows that the population is densely spread over the entire district. As per the Govt. of India Census 2011 urban definition, Kanyakumari district devours population density more than 400 persons per square kilometer, and more than 75 percent of the working male population is associated in the non-agricultural activities. That means, the district has urban, city like, characteristics throughout the region. Though many of the basic amenities and facilities are lacking.

The NH-47 road stretch lies in Kanyakumari District from Kalyakkavilai to Kanyakumari, has been facing numerous amounts of problems, since this road is not yet widened. The existing NH-47 road functions as a backbone, and number of roads are intersecting at various junctions, which connect the edges of the district in all directions. The highway stretch is one of the busiest roads in India, and has been facing numerous amount of problems like accidents, traffic jams, time consuming travel, wastage of fossil fuels, apathy among the travelers, air pollution, etc. Larger sizes of encroachments are observed at few junctions, on existing NH-47 road by the local people, which has totally disturbed through traffic. Number of accidents occur every month on existing NH-47, which result in heavy loss of qualified human resource, further resulting in to heavy loss to national development. The constant and over usage of NH-47, has generated tremendous amount of problems related to travel quality and deteriorated surface conditions of the roads.

The proposal for widening the existing NH-47 and constructing the flyovers at the major junctions, as these are the most affected and encroached locations on NH 47, is understood to be the most suitable. Inferences from Four-Laning of Highways through PPP: Manual of Specifications & Standards, by the Indian Roads Congress (IRC) are taken to evolve the conceptual design of NH-47. The road will have total 4 lanes, divided by median throughout the alignment. For free movement of high-speed traffic, the highway will be accompanied with service road and pedestrian walkway on both the sides. Provision of flyover would be there to direct the through traffic above the intersection to cross the junction without difficulty. Provision of subways or underpasses would be to facilitate easy and safe crossing of vehicles and pedestrians, without coming in to the contact of through moving traffic. All the amenities and infrastructure service lines would be accommodated throughout the alignment under the medians and footpaths of the proposed design road. Provision of service poles at regular intervals, will help the highway to remain wire free. Reclaimed encroached lands, would help to rectify the curvatures, to achieve smooth free flowing alignment. Further this will improve the driving vision. Reclaimed land further can be utilized for providing road side facilities and socio-economic activities. The provision of appropriate amount of tree plantation along both sides of the road will benefit in noise and air pollution reduction; and also in preserving the nature.

There are three major settlements in the district, which act as the key economic hubs in the district, namely Nagercoil (district headquarter), Thuckalay, and Marthandam. The population concentration and accumulation is observed at a greater scale in these cities and towns compared to any other regions in the district. NH-47 passes through Nagercoil, Thuckalay and Marthandam, the three prevalent settlements of the district. This has added numerous problems related to traffic and congestion, as the through traffic also has to pass through these settlements. Two ring roads are proposed for Nagercoil city, one of 4 Kilometer (four) radius and second of 8 Kilometer (eight) radius. These two distinct ring roads are to cater to the intra-city and intercity passing traffic. Advantage of outer ring road in Nagercoil would be to demarcate physical boundary of city. For Marthandam 4 Kilometer radius and Thuckalay 4 Kilometer radius ring roads are suitable, looking at severe congested condition and problems of traffic. It will act as a bypass to the city as well as would demarcate the physical boundary of their respective municipalities.

6. Conclusions and Recommendations

In the present investigation, qualitative analytical works have been done on the existing road network of Kanyakumari district, based on the available literature, photographs, and having discussion with experts and local people. In order to revamp the present dreadful condition, the authors have formulated a planning design for widening NH-47 and construction of ring roads around the selected urban settlements. Further, some interesting finding based on the analysis have been observed, and as a part of future scope of research the study concludes with plausible recommendations, they are; it should be thought of to consider the entire Kanyakumari district to be designated as an Urban District, and accordingly civic facilities and amenities also can be formulized to be provided according to the urban standards and guidelines. Widening of the existing NH-47 as per its design (Figure 6), and construction of ring roads (Figure 10) around the selected urban settlements also can be anticipated as a part of remedial measures for never ending problems like, accidents, traffic jams, increased travel time, wastage of fossil fuels, congestion on roads, etc. The planning design concepts worked out in this research paper can be the precursor for actual detailed project formulation for enhancement of the district road network, and for development of the district. Thus, it is recommended that, in the light of these findings of opportunities and possibilities, the administrative authorities and officials of Kanyakumari district might look into rejuvenating the road transportation scenario of the district.

Acknowledgements

This study is part of ongoing PhD research which is registered with Indian Institute of Technology Roorkee, India. This research is funded by the Ministry of Human Resource Development, Government of India. We, the authors, thank the funding agency and home institute for providing the monetary and infrastructure support for pursuing the research and this particular study.

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