STUDY OF TRAFFIC VOLUME AND TRAFFIC FORECASTING ON STATE HIGHWAY-41

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Abstract - *India has the second largest road network in the world. Traffic forecasting is the study and estimation of traffic volume and number of vehicles and number of people that will use a specific type of transportation facility in the future. Traffic growth flow is an essential input in the planning and development of the transportation system and also helps to Estimate the required Investment. In order to provide the best level of service to the long term durations forecasting the future traffic flow is necessary. After studying several journals developed the methodology in the present paper, the complete process of Traffic forecasting of two stretches in State Highway-41 by Elasticity method. To establish the future traffic growth the Traffic volume data of a stretches are collected from PWD Vijayapur city, but these data are not showing the definite trend, so with the help of Vehicular Registration Data collected from the RTO Vijayapur District, Along with the help of GDP, per-capita income and population of Vijayapur district are used to find the future growth rate as per IRC recommendations. With the with the constraints of availability of proper data and fluctuation of developing economy, the task of Traffic Growth Estimation could be quite subjective and approximate. Thus, by suggesting the number of Lanes required after ten years at a selected stretches as per IRC recommendations.*

Key Words: ***Traffic volume, traffic Forecasting, capacity, Econometric analysis, Case Study, Traffic Growth Rates***

1. INTRODUCTION

The objective of this study is to estimate traffic growth using transport demand elasticity method and to compare how different these values are from the vehicle registration data. In this present study, attempt has been made to forecast the future traffic growth rate by selecting two stretches as a case study at a State Highway- 41. By studying the past Traffic volume data collected from PWD Vijayapur district were not showing the definite trend so with the help of Vehicle registration data of Vijayapur district traffic growth rates are estimated. The influence factors of various zones were found out. Socio-economic data viz -Per capita income and Net District Domestic Product such as Population and registration of vehicle data of Vijayapur District influencing the study stretch were collected.

To determine elasticity values, the regression analysis is carried out between socio economic variables growth index and vehicle growth index. The elasticity values for the future years are calculated based on the growth trend of vehicles.

1.1. STUDY AREA CHARACTERISTICS

The Project stretch is a part of state highway 41 in the state of Karnataka which runs from connecting Shiradon to Lingasur. The total length of SH-41 is about 197km, out of which maximum portion of this road runs in Vijayapur district some part runs in Raichur district. This case study deals with Shiradon to Lingasur state highway stretch.

This case study deals with study of two stretches selected from the state highway 41 at count post at Indi- 43.0 and near Davalagi-136.

1.2 DATA COLLECTION

For the purpose of forecasting traffic on the study stretch,

Several primary and secondary data were collected.

- The traffic Volume data of a selected stretches are collected from the PWD Vijayapur District.
- Previous year vehicular Registration Data of a Vijayapur District.
- Previous year's data on Per capita Income, District Gross

  Domestic Product (GDP), Population data of a District influencing the project corridor.

1.3 Objectives of the study

Main objectives of the present project work are as follows:

1) To find the growth rate of different class of vehicles.

2) To analyze the existing growth road capacity of state highway near Indi-43.0 and Davalagi-143.0 stretches.

3) To forecast the GDP and population forecast of a Vijayapur district for 2026.

4) To forecast the vehicular growth rate for 2026 of Vijayapur district.

5) To check the suitability of forecasted Road capacity.

1.4 AVERAGE DAILY TRAFFIC (ADT)

ADT (average daily traffic): ADT is the total traffic volume counted for a year and divided it by 365 days. ADT helps in the study of road and planning in transportation Engineering.

Table-1: Showing Average Daily Traffic

Project corridor	**Near Indi- 43.0**		
Vehicle category	**ADT vehicles**	**ADT PCU**	**% share traffic**
Two wheeler	1113	556.5	16.0%
Auto rickshaw	541	541	7.75%
Car/jeep/taxi	740	740	10.61%
Van/tempo	543	543	7.78%
Mini bus	405	607.5	5.80%
Buses	442	1326	6.34%
LCV	489	733.5	7.01%
Trucks	1683	5985.15	24.15%
Tractors	752	3384	10.79%
Pedal cycle	224	112	3.21%
Cycle rickshaw	24	48	0.34%
Horse drawn	11	66	0.15%
Bullock carts	5	30	0.07%
Total	**6972**	**14672.65**	**100%**

Table-2: Showing Average Daily Traffic

Project corridor	**Near Davalagi- 136.0**		
Vehicle category	**ADT vehicles**	**ADT PCU**	**% share traffic**
Two wheeler	1070	535	17.71%
Auto rickshaw	463	463	7.66%
Car/jeep/taxi	687	687	11.40%
Van/tempo	510	510	8.44%

Mini bus	67	100.5	1.10%
Buses	306	918	5.06%
LCV	460	690	7.61%
Trucks	1204	3943.5	20%
Tractors	769	3460.5	12.73%
Pedal cycle	233	116.5	3.986%
Cycle rickshaw	0	0	0
Horse drawn	0	0	0
Bullock carts	271.5	2168	4.50%
Total	**6040.5**	**13592**	**100%**

1.4.1 Road Stretch details at near Indi -43.0

Table-3: stretch details

Classification of road	State highway
Width of carriage way	5.5
Type of surface for the length	BT

1.4.2 Road Stretch details at near Davalagi-136.00

Table-4: stretch details

Classification of road	State highway
Width of carriage way	5.5
Type of surface for the length	BT

2. TRAFFIC GROWTH RATES

To establish the future traffic growth rates, following

Approaches have been explored.

- Past trends in Traffic growth on the Project Road.
- Growth of registered motor vehicles.
- Transport demand elasticity approach.

2.1 Growth Rate based on Past Traffic Data

Past traffic data as collected from PWD is available for two Locations (near Indi and near Davalagi) along the project Corridor. These data are available from last 5 years. due to Non-Uniformity in past traffic data of PWD may be attributed to errors during collection and processing of data and policy measures of the Government and other influences etc. this road mainly runs through the Rural areas, so the main occupation of rural area is agriculture so the use of Trucks and Tractors and two wheeler vehicles are the main reason for the traffic.

As the past traffic data on the Project Road is not showing any definite trend, one should not be guided by past Traffic for deriving the Growth rates.

2.2 Growth Rate based on Vehicle Registration

An alternative approach is to explore the registered motor Vehicles growth in the influence area and assume a growth rate equal to the average growth of vehicle registration. Such an assumption may not be correct, unless the area of influence is well defined and the general development pattern of influence area remains same. The growth rates for various modes of Vehicles are estimated and presented in Table-3, Growth of Registered Motor Vehicles in Vijayapur District. It can be observed from the Table, during the last 5 years, average growth of two wheelers, cars , three wheels, and trucks , buses are around 15%, 24%, 18%, 30%, respectively This high growth rate of more than 10% may not sustain in future. Therefore other rational approaches were explored in order to derive realistic growth rates.

The Cumulative Average Annual Growth Rate of Vehicles (%) in Vijayapur district are calculated with the help of formulae as per IRC: 108-1996

$Pn = Po\ (1+r)^{n}$

Where, Pn and Po = Traffic in nth and base year

n = number of years

r = annual Rate

Table-5: Summary of Cumulative Average Annual Growth Rate of Vehicles (%)

VEHICLES	2wheels	3wheels	Car/jeep /taxi
2012	122300	3299	12697
2013	141728	3501	14662
2014	169478	3670	16816
2015	198476	4086	19425
2016	229835	4216	22100
2017	248489	7577	37759
CAAGR (%)	**15.23%**	**18.09%**	**24.35%**

Table-6: Summary of Cumulative Average Annual Growth Rate of Vehicles (%)

VEHICLES	goods	bus	Tractors/Const vehicles
2012	6465	816	23346
2013	8041	994	25950
2014	9619	1162	29248
2015	11520	1253	33929
2016	13170	1329	37445
2017	24463	638	43075
CAAGR (%)	**30.49%**	**-4.80**	**13.03%**

2.3 Traffic Growth Estimation by Transport Demand

Elasticity Method:

The exercise of traffic growth rate estimation has been carried out by us using the elasticity approach. The Elasticity method relates traffic growth to changes in the related economic parameters. According to IRC-108-1996, elasticity based econometric model for highway projects could be derived.

As the traffic contribution is mainly from the Vijayapur district, so we developed the transport demand elasticities with respect to economic indicators of Vijayapur district. The methodology involved fitting log-log regression equations to the time series data. NSDP, Population, Per Capita Income, Industrial Index and number of registered motor vehicles in Vijayapur district are considered as independent variables for passenger and Elasticity values for registered motor vehicles with respect of GDP, Population, and Per Capita Income Index are worked out and conclusions are drawn. According to IRC: 108 - 1996, an econometric model could be derived in the form

$$\mathbf{Log_e P = A0 + A1 Log_e (E.I)}$$

Where:

P = number of vehicles of any particular category

E.I = Economic Indicator such as GDP, Per-capita income or population

A0 = Constant

A1 = Regression coefficient (Elasticity value)

The value of Ai is known as the Elasticity Coefficient. The Elasticity Coefficient is the factor by which the GNP growth rate has to be multiplied to arrive at the growth rate of traffic.

The main steps followed are

- Defining the Project Influence Area
- Estimating the past elasticity of traffic growth from Time Series of registered vehicles of influencing states.
- Assessment of future elasticity values for major Vehicle Groups, namely, cars, buses and trucks, two wheelers.

Elasticity Values

Elasticity value is the factor by which the socio-economic growth rate is multiplied to get the growth rate of traffic is directly linked to the economic growth such as Percapita income, population and NSDP/GDP. Considering the time series data on category wise registered vehicles and the economic variables, by regression analysis elasticity values are estimated.

2.3.1 Estimation of Growth Rates

To arrive at a realistic and rational assessment of growth factor, efforts have been made to collect various secondary data and statistical information. The growth factors derived from past traffic data on the stretch supplemented by registration trend and the statistical parameters would have been the ideal method. However, due to irregular, erratic and insufficient past traffic data available, the derivation of elasticity and growth factors was based on registration data of vehicles and the economic parameters.

2.4 Econometric models

1) Two wheels

Table-7: Two wheel registrations

year	Two wheels	Per-capita income
2012	122300	24728
2013	141728	24843

2014	169478	59511
2015	198476	65170
2016	229835	71481

Regression analysis

Y = a+ bx

a = y' – bx' = 7.33

b = $\Sigma xy - nx'y' / \Sigma y^2 (x')^2$ = 0.439

ECONOMETRIC MODEL TWO WHEELS

Ln P = 7.33 + 0.439 Ln PCI

2) Three wheels

Table-8: 3-wheel registration

year	Two wheels	population
2012	3299	2215906
2013	3501	2257495
2014	3670	2299877
2015	4086	2343080
2016	4216	2387106

Regression analysis

Y = a+ bx

a = y' – bx' = -42.56

b = $\Sigma xy - nx'y' / \Sigma y^2 (x')^2$ = 3.46

ECONOMETRIC MODELTHREE WHEELS

Ln P = -42.56+ 3.46 Ln POPULATION

3) Cars/jeeps

Table-9: cars/jeep registrations

year	Cars/ jeeps	Per-capita income
2012	12697	24728
2013	14662	24843
2014	16816	59511
2015	19425	65170
2016	22100	71481

Regression analysis

Y = a+ bx

$a = y' - bx'$ = 5.697

$b = \Sigma xy - nx'y' / \Sigma y^2 (x')^2$ = 0.376

Econometric model cars/jeeps

Ln P = 0.5697 + 0.376 Ln per capita income

4) Trucks

Table-10: Trucks registrations

year	Cars/jeeps	GDP (lks)
2012	6465	547951
2013	8041	560828
2014	9619	1368700
2015	11520	1526996
2016	13170	1706531

Y = a+ bx

$a = y' - bx'$ = 2.68

$b = \Sigma xy - nx'y' / \Sigma y^2 (x')^2$ = 0.467

Econometric model for trucks

Ln P = 2.68 + 0.467 Ln GDP

5) Buses

Table-11: Bus registrations

year	buses	population
2012	816	2215906
2013	994	2257495
2014	1162	2299877
2015	1253	2343080
2016	1329	2387106

Regression analysis

Y = a+ bx

$a = y' - bx'$ = -88.034

$b = \Sigma xy - nx'y' / \Sigma y^2 (x')^2$ = 6.48

Econometric model buses

Ln P = -88.034+ 6.48 Ln POPULATION

Econometric models Table

Table-12: Econometric models of all vehicles

vehicles	Econometric models	R^2	constant
2 wheels	Ln P = 7.33 + 0.44 Ln PCI	0.86	0.44
3 wheels	Ln P = -42.56 + 3.46 Ln POP	0.97	3.46
Cars/jeeps	Ln P = 5.69 + 0.367 Ln PCI	0.85	0.367
Trucks	Ln P = 2.68+ 0.467 Ln PCI	0.88	0.467
buses	Ln P = -88.034 +6.48 Ln POP	0.96	6.48

2.5 Rate of growth of GDP and Population

To forecast the future growth of GDP with the help of Excel- 2016 which helps to get the growth rate of GDP, Population and Per-capita income.

1) GDP Growth Rate

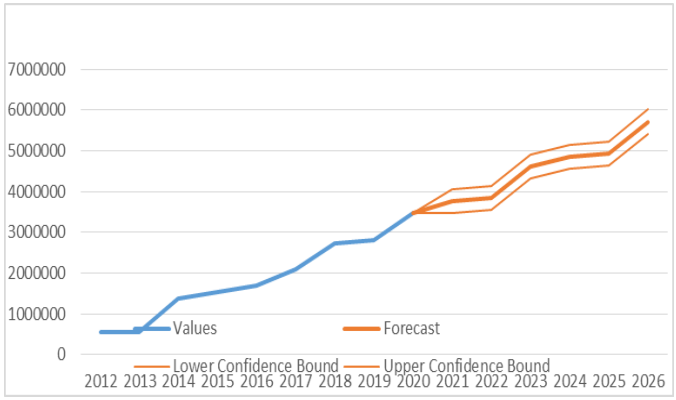


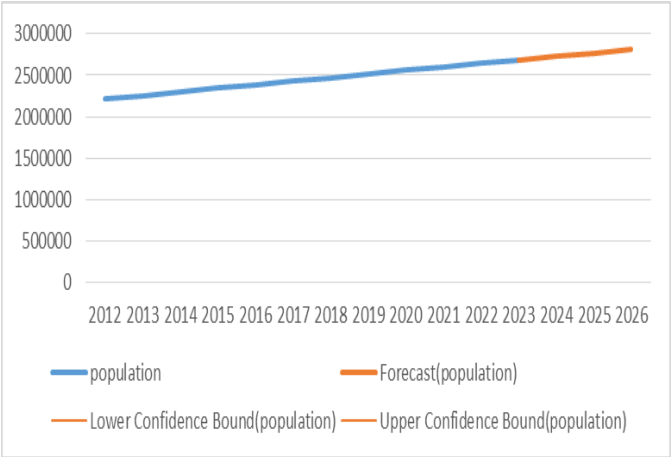
Chart 1: GDP forecasting from 2016 to 2026

Forecasted GDP from past growth

Table-13: GDP forecast

GDP growth(2017-2021)	GDP growth(2021-2026)
2079034	3845793
2740876	4624117
2820547	5169918
3482389	5715718
3760546	6054997
r= 17.12%	**r = 10%**

2) Population forecast



Char 2: Population forecasting from 2016 to 2026

Forecasted Population from past growths

Table -14: Population forecast

Population (2017-2021)	Population (2017-2021)
2429426	2643765
2472281	2686639
2515150	2729516
2558014	2772394
2600890	2815271
r = 1.73%	**r= 1.6%**

2.6 Traffic Growth Rates

The growth rate of Vehicles are calculated with the help of formula given in the IRC: 108-1996 with the help of Econometric model.

Table-15: growth rates from 2017-21

vehicles	Elasticity co-efficient	R^2	Growth rate of GDP,PCI (2017-2021)	Traffic growth rate(2017-2021
2 WHEELS	0.44	0.86	8.6	4%
3 WHEELS	3.46	0.97	1.60	5.5%
CAR/ JEEPS	0.367	0.85	8.6	3.15%
Trucks	0.467	0.88	10.0	4.7%
Buses	6.5	0.96	1.60	10.4%
tractors	0.317	0.88	10.0	3.17%

Growth Rate = Elasticity Value * Rate of Growth of PCI/ GDP and Population

The growth rate estimated form elasticity values are shown in the table below:

Table-16: growth rates from 2021-26

vehicles	Elasticity co-efficient	R^2	Growth rate of GDP,PCI (2017-2021)	Traffic growth rate(2017-2021)
2 WHEELS	0.44	0.86	15.13	**7%**
3 WHEELS	3.46	0.97	1.73	**6%**
CAR/ JEEPS	0.367	0.85	15.13	**5.5%**
Trucks	0.467	0.88	17.12	**8%**
Buses	6.5	0.96	1.73	**11.2%**
tractors	0.317	0.88	17.12	**5.4%**

The growth rates obtained from transport demand elasticity method is being widely used method all over India. These Growth rates are adopted to predict future traffic volumes and Laning Requirements.

2.7 Traffic growth at selected stretch

Table-17: Traffic growth

years	Near Indi-43		Near Davalagi-136	
	vehicles	PCU/DAY	VEHICLES	PCU/DAY
2017-2022	10072.5	21229	8218	16299
2022-2026	13317	28322.5	10671	20991.5

Recommended Design Service Volumes for Intermediate Lane Roads, According to IRC 64-1990

Table-18: Design service volume for intermediate Lane Roads

Nature of Terrain	Design service volumes for two lane highway	
	Without paved shoulder	With mini. 1.5m paved shoulder
Plain	6000	6900
rolling	5700	6555
mountainous	5200	5980

2.8 Capacity analysis

Table-19: Capacity Analysis

	Near Indi-43.0	
	ADT (pcu/day)	Remarks
2021	21229	2-Lane with 1.5m Earthen shoulder
2026	28322.5	4-lane with 1.5m Earthen shoulder
	Near Davalagi -136.0	

	ADT(pcu/day)	REMARKS
2021	16299	2-Lane with 1.5m Earthen shoulder
2026	20991.5	2-Lane with 1.5m Paved Shoulder

Discussions

- As per IRC recommendations Maximum capacity has already reached at these two sections.
- By the year 2026 4-laning of state highway is necessary at the Indi-43 stretch.
- By the year 2026 2-lane with 1.5m paved shoulder is necessary Near to Davalagi-136 stretch.

3. CONCLUSIONS

- The highest growth rate of 10% was calculated for Buses and less growth rate 3.17% was calculated for tractors
- By analyzing present traffic volumes of both the stretches maximum capacity has been already reached as per IRC recommendations.
- The forecasted population rate of Vijayapur district is 1.73% from 2017-2021 and 1.6% from 2021-2026.
- The forecasted GDP rate of Vijayapur district is 17.12% from 2017-2021 and 10% from 2021-2026.
- Volume of road will be increased to 28322.5pcu/day at Indi-43.0 stretch in 2026 so as per IRC recommendations the 4-Laning of highway is necessary.
- Volume of a road has increased to 20991.5pcu/day in 2026 at davalagi-146.00 stretch as per IRC recommendations the 2-lane with 1.5m paved shoulder of the highway is necessary.

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