Computation of the Traffic Parameters for a proposed Symmetrical Round About along Enugu – Port Harcourt Expressway

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ABSTRACT

For several decades now, there have been incessant traffic conflicts experienced at several road intersections along Enugu – Port Harcourt expressway. The conflicts are mostly recorded at the 4 - way cross intersection located at Umuahia Tower junction. In this research,

4 – Legged recently, the annual average daily traffic (AADT) on Nigeria highways is relatively influenced by the economic and demographic factors prevalent in the geographical location of the road. Onitsha – Owerri road is a populated pass – way encompassing several commercial activities proximally located on the sides of the highway. A 20-year data of the population density (P) and the gross domestic products (G) were obtained from the Ministries of Budget and Planning. AADT count was conducted using the automatic traffic recorder (ATR) and automatic vehicle classifier (AVC). The data obtained were chronologically tabulated. A discrete and graphical relationship between the AADT as the dependent variable and the various independent variables are computed separately. The generated model equations are compared with the model generated using a linear regression equation obtained by the application of mathematical laboratory (MatLab) in generating the variable coefficient. The graphical equation relating AADT, (T), the gross domestic product (G) and the population density (P) are $T = 0.02G + 814188$ and $T = 0.77P + 1x10^6$ respectively. The model equation obtained from the linear regression is $T = 8.23x10^5 + 0.02G - 0.4P$. These equations can be applied in the assessing and forecasting the AADT on the highway which can be used as a vital parameter in highway rehabilitation and maintenance programs.

Key words: Gross domestic products, linear regression, coefficient of correlation, annual average daily traffic, population density.

1. Introduction

Annual Average Daily Traffic, (AADT) values are obtained by calculating the quantity of vehicles passing through a definite highway section where a manual or automated counting system is mounted. There are specific methods developed for conducting AADT computation [1], [2]. The calculation is expressed using annual average traffic value, signifying the fact that most highways have disparity in the traffic record on periodic basis as a result of changes in the density of traffic present on the road [3].

Conventionally, it means the ratio of the volume of vehicular traffic on a highway in relation to the total number of days in a year [4]. Annual average daily traffic can also be defined as the summation of the total automotive and vehicular traffic loads (animals inclusive) that trespass a given highway in relation to the daily ratio in one year. Mathematically,

$$\textbf{AADT} = \frac{\text{number of automobiles navigating a highway in the year}}{\text{365 days}} \qquad \textbf{(1)}$$

AADT study on highways entails the ability of the researcher to identify the possible potentials of a road network to accommodate some traffic elements using the geometrical and infrastructural characteristics of the road design developed in the preliminary location of the highway. When the AADT estimation becomes high, it necessitates the rehabilitation and/or total reconstruction of the highway pavement structure, putting into consideration the effective geometrical layout that can accommodate the rise in traffic volume. The development of roads and the expansion of vehicles course implies an expansion of the highway dimensions, necessitating a further study on the environmental impact assessment on the natural objects already existing on the proximity of the rehabilitation points. This also affects the wild life comfort, territorial boundaries, impacts a capital expenditure on the national budget, and an eventual loss of energy during the process [5].

AADT estimations and forecasting are always available on log profile of most highways within some acceptable accuracy obtained as the main daily traffic counts over a period of one year. It is often applied in determination of transportation planning methodologies and modeling [6], [7]. The approximated values of AADT are also applied in the design of highway rehabilitation. Various factors that can affect the values f AADT includes but not limited to previous variation of AADT, variations on the financial system of the country, changes in the number of vehicle owners and the population, and the distance of the industrial zones available within the area where the AADT is recorded. AADT forecasting becomes cumbersome due to the variation of the mean distance travelled by automobiles, variations in the condition of municipal and industrial production areas, cost of fuel, and so on.

The guidelines for assemblage and processing of AADT data was developed by the application of the Traffic Data Programs by the American Association of State Highways and Transport Officials (AASHTO) [8]. The association created the use of "average of averages" to produce an AADT without periodic or day-of-week bias. This is done by using a Monthly Average Day of the Week (MADW) data calculated monthly and weekly, indicating 84% coverage of the total periodic traffic record. The Annual Average Day of the Week (AADW) is calculated using the computed each day-of-week's MADW (7 per year). At last, the AADT is calculated from the AADWs. AADT is a vital parameter towards the layout of the highway structures and facilities, beginning from forecast study up to creating a highway design working document [9].

1.1 Gross Domestic Products (GDP)

Definition offered by the Department of Finance and Development 2019, Gross Domestic Product (GDP) is the sum total of all the economic, financial and monetary values of all the refined goods and services produced in a country's legal territories in a particular period of time. GDP is a signifying factor indicating the economic strength of any country, which also reflects the growth of traffic and general monetary performance of that nation as well [10]. GDP functions as a comprehensive yardstick of a nation's fiscal strength, being the extensive measure of the general home and industrial manufactured products. GDP computation is an annual process, though it can also be computed quarterly. According to [11], GDP values are affected by factors which can be easily evaluated. For example, as the population growth continues to rise, the working percentage of the populace will increase and consequently, the home and industrial manufactured product will be on the increase.

1.2. Population Density (PD).

Population Density (PD) can be explained as the number of people dwelling in an area per kilometer square. Population density is also population divided by total approximated land area or water volume [12]. As the population density changes, there is a simultaneous change in the movement pattern of the traffic [13]. This can lead to traffic congestion or decongestion as the type of population changes implied.

1.3. The effect of GDP and PD on AADT.

The national economic growth and the population density change the value AADT. However, these changes are mathematically analogous due to the non streamlined or indefinite changes on the economic and demographic factors. When there is economic boom, as a result of increased work force as a consequent of population density, there is a positive tendency of the increment in traffic record. The home and industrial products generated by the working population need to be transported from the point of production to the point of sale or usage. In the same vein, the surging human population sort for a way to provide safety and comfort during transportation of the human and material resources, resulting in purchase of more private and commercial vehicle that increases the AADT. Traffic is dependent on the sum total of automobiles willing to travel.

The economic and demographic factors on the traffic changes of an area are paramount determinant of the rate of development of the economy [14}. These factors can be used to access the contemporary changes and evaluation of AADT. Thus, it is important that the knowledge of a factor capable of predicting the value of AADT in relation to the economic and demographic factors be established for a particular highway to enhance a rapid determination of the future traffic which can aid in a suitable design and redesign of national and state highways [15]. This research will provide an obvious method for determination of the traffic growth on Onitsha - Owerri with regard to the variation of the economic and demographic factors. Some of the studies like [16] and [17] have used Gross Domestic Product (GDP) as the economic indicators in their various analyses of traffic assessments. But these parameters are only suitable for long-term predictions as their value does not change on a short-term basis. Selection of exogenous factors to be included in the modeling also depends upon the location and importance of the road. In this regard, special consideration has to be given to border transport which requires that the political and economic conditions of both connected cities should be taken into account. Some of the studies like [18] and [19] have used Gross Domestic Product (GDP) as the economic indicator in their models.

2.0. Methodology

2.1. The Study Area

Onitsha urban area is located in the Anambra State, southeastern Nigeria, between latitudes 6.1667^{0}N and longitudes 6.7833^{0}E. The urban area occupies about 51km^2.

The latitude of Owerri, Imo, Nigeria is 5.4833^{0}N**,** and the longitude is 7.0333^{0}E**.**

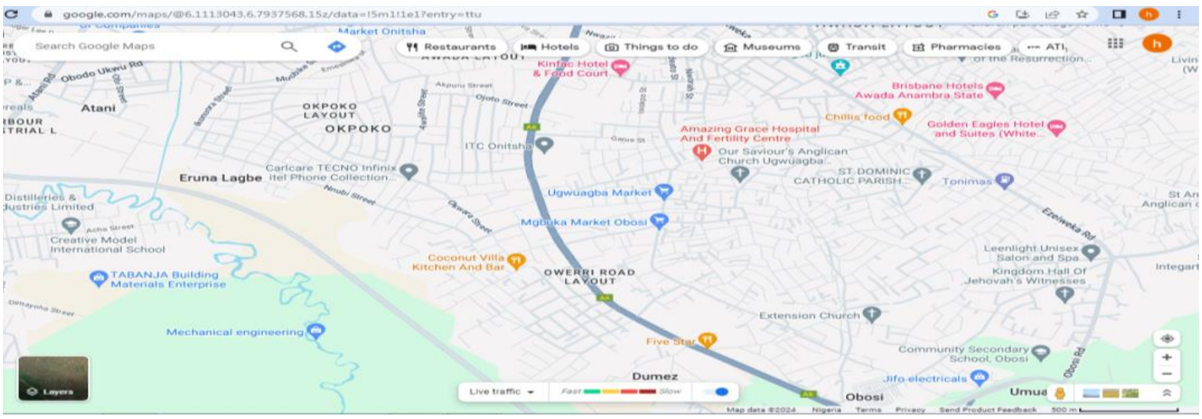

Figure 1. Map showing the location of Onitsha – Owerri road

2.1. Data Collection.

The 20 - year annual average daily traffic record was conducted along the highways under study using an Automatic Traffic Recorder (ATR), and Automatic Vehicle Classifier (AVC) in order to collect the categorized vehicle axle load. The ATR is a fixed type which automatically records the number of vehicles crossing a section of the road in a desired period. The working is caused by the effect of impulses generated by the traffic movements on the pneumatic hose placed across the roadway. In the electro – mechanical recorder, the count is actuated by the closing of the electric circuit by the passage of a vehicle. The automatic vehicle classifier is actuated by the interruptions of light beam falling on the photocell on the road side as the vehicle passes. The ATR and AVC were fixed independently just before Orba highway interchange. The traffic record was done on daily basis for a period of twenty (20) years. The vehicle count was conducted on daily basis and the volume of traffic recorded was period downloaded into a computer at the end of every week to enable an accurate analysis and also to provide enough memory for the ATR and AVC. The various categories of vehicle counted include:

1. Light weight vehicles,

2. Medium weight vehicles,

3. Heavy duty vehicles,

The traffic counts were done between 06:00 hrs – 06:00 hrs (6:00 AM – 6:00 AM) representing 24 hourly traffic count for one day. At the end of the year, the total of the categorized traffic counts was summed up and divided by 365 days. This gives the annual average daily traffic for that particular highway in each year.

The gross domestic products and the population density were obtained from the Ministry of Budget and Planning, Anambra State.

3.0. Results and Discussion

Table 1. Characterization of traffic, environmental and demographic factors for Onitsha – Owerri road

YEAR	Light Weight Vehicles (pcu=1.00)	Medium Weight Vehicles (pcu=2.00)	Heavy Duty Vehicles (pcu=3.00)	Total Traffic, T (pcu/day)	Gross Domestic Product, G (₦)	Population Density, P (people/sq.km)
2001	5,50,129	4,01,189	3,92,176	13,43,494	2,60,00,000	2,90,121
2002	6,14,429	3,82,095	3,73,518	13,70,042	2,10,00,000	4,09,233

2003	4,80,428	3,63,911	3,55,746	12,00,085	2,40,00,000	3,01,023
2004	5,48,047	3,46,592	3,90,123	12,84,762	2,50,00,000	3,90,410
2005	4,17,208	3,30,099	4,02,199	11,49,506	2,32,00,000	4,72,001
2006	3,87,837	3,14,390	3,44,100	10,46,327	2,63,40,000	4,23,197
2007	4,59,865	2,99,430	2,92,733	10,52,028	2,41,13,000	4,19,333
2008	3,33,225	2,85,182	2,78,809	8,97,216	3,09,10,000	4,88,001
2009	5,21,908	3,32,613	3,25,160	11,79,681	2,99,90,000	5,30,745
2010	5,12,090	3,80,844	3,72,296	12,65,230	3,21,02,300	7,00,271
2011	4,91,090	3,69,613	3,61,319	12,22,022	3,02,87,300	6,30,712
2012	4,80,198	3,27,186	3,19,856	11,27,240	3,42,88,000	7,01,491
2013	5,23,623	4,90,187	4,30,590	14,44,400	3,72,90,000	5,79,340
2014	6,12,099	5,01,998	4,76,834	15,90,931	4,12,09,000	6,33,020
2015	5,70,231	4,21,097	4,40,081	14,31,409	2,90,90,000	6,49,099
2016	7,01,023	5,12,098	4,71,044	16,84,165	3,12,30,000	5,00,239
2017	5,23,001	3,86,680	3,77,998	12,87,679	3,79,80,000	6,72,022
2018	5,29,001	4,43,371	4,33,401	14,05,773	4,10,98,000	7,11,038
2019	6,18,224	4,91,090	4,80,035	15,89,349	4,42,20,000	8,30,922
2020	6,76,012	4,68,514	4,57,972	16,02,498	4,79,00,000	7,90,641
TOTAL	1,05,49,668	78,48,179	77,75,990	2,61,73,837	63,72,47,600	1,11,22,859

Table 2. Computation chart for values of model parameters for Onitsha – Owerri road

YEAR	SAMPLE No.	$T = y_1$	$G = x_1$	$P = x_2$	$\ln T = y_2$
2001	1	13,43,494	2,60,00,000	2,90,121	14.11
2002	2	13,70,042	2,10,00,000	4,09,233	14.13
2003	3	12,00,085	2,40,00,000	3,01,023	14
2004	4	12,84,762	2,50,00,000	3,90,410	14.07
2005	5	11,49,506	2,32,00,000	4,72,001	13.95
2006	6	10,46,327	2,63,40,000	4,23,197	13.86
2007	7	10,52,028	2,41,13,000	4,19,333	13.87
2008	8	8,97,216	3,09,10,000	4,88,001	13.71
2009	9	11,79,681	2,99,90,000	5,30,745	13.98
2010	10	12,65,230	3,21,02,300	7,00,271	14.05
2011	11	12,22,022	3,02,87,300	6,30,712	14.02
2012	12	11,27,240	3,42,88,000	7,01,491	13.94
2013	13	14,44,400	3,72,90,000	5,79,340	14.18
2014	14	15,90,931	4,12,09,000	6,33,020	14.28
2015	15	14,31,409	2,90,90,000	6,49,099	14.17
2016	16	16,84,165	3,12,30,000	5,00,239	14.34
2017	17	12,87,679	3,79,80,000	6,72,022	14.07
2018	18	14,05,773	4,10,98,000	7,11,038	14.16
2019	19	15,89,349	4,42,20,000	8,30,922	14.28
2020	20	16,02,498	4,79,00,000	7,90,641	14.29

	SUMMATION ∑	2,61,73,837	63,72,47,600	1,11,22,859	281

Table 3. Computation chart for values of model parameters for Onitsha – Owerri road (contd)

SAMPLE No.	x_1^2	x_2^2	x_1x_2	x_1y	x_2y
1	6.76E+14	8.42E+10	7.54E+12	3.49E+13	3.90E+11
2	4.41E+14	1.67E+11	8.59E+12	2.88E+13	5.61E+11
3	5.76E+14	9.06E+10	7.22E+12	2.88E+13	3.61E+11
4	6.25E+14	1.52E+11	9.76E+12	3.21E+13	5.02E+11
5	5.38E+14	2.23E+11	1.10E+13	2.67E+13	5.43E+11
6	6.94E+14	1.79E+11	1.11E+13	2.76E+13	4.43E+11
7	5.81E+14	1.76E+11	1.01E+13	2.54E+13	4.41E+11
8	9.55E+14	2.38E+11	1.51E+13	2.77E+13	4.38E+11
9	8.99E+14	2.82E+11	1.59E+13	3.54E+13	6.26E+11
10	1.03E+15	4.90E+11	2.25E+13	4.06E+13	8.86E+11
11	9.17E+14	3.98E+11	1.91E+13	3.70E+13	7.71E+11
12	1.18E+15	4.92E+11	2.41E+13	3.87E+13	7.91E+11
13	1.39E+15	3.36E+11	2.16E+13	5.39E+13	8.37E+11
14	1.70E+15	4.01E+11	2.61E+13	6.56E+13	1.01E+12
15	8.46E+14	4.21E+11	1.89E+13	4.16E+13	9.29E+11
16	9.75E+14	2.50E+11	1.56E+13	5.26E+13	8.42E+11
17	1.44E+15	4.52E+11	2.55E+13	4.89E+13	8.65E+11
18	1.69E+15	5.06E+11	2.92E+13	5.78E+13	1.00E+12
19	1.96E+15	6.90E+11	3.67E+13	7.03E+13	1.32E+12
20	2.29E+15	6.25E+11	3.79E+13	7.68E+13	1.27E+12
SUMMATION ∑	2.14E+16	6.65E+12	3.74E+14	8.51E+14	1.48E+13

3.1. Linear Regression Equation

The annual average daily traffic, T, is the dependent variable; whiles the gross domestic product, G, and the population density, P, are the independent variable.

Let $T = f(G, P)$ (1)

Let $T = a_1 + a_2G + a_3P$ (2)

Applying the method of least square sum minimization to estimate the value of the regression constants, a_1, a_2, a_3. (Agunwamba, 2007)

Let,

$\overline{y_1} = \lambda_0 + \lambda_1 x_1 + \lambda_2 x_2$ (3)

Comparing equations 2 and 3

$\overline{y_1} = T$

$\lambda_0 = a_1$

$\lambda_1 = a_2$

$x_1 = G$

$\lambda_2 = a_3$

$x_2 = P$

Using the minimum value analysis;

$$S^2 = \sum(y - \overline{y_1})^2, \quad (4)$$

$$S^2 = \sum(y - \lambda_0 - \lambda_1 x_1 - \lambda_2 x_2)^2 = 0 \quad (5)$$

Using the partial derivatives of the sum of the minimized equation;

$$\frac{\partial S^2}{\partial \lambda_0} = -\sum(y - \lambda_0 - \lambda_1 x_1 - \lambda_2 x_2) = 0 \quad (6)$$

$$\frac{\partial S^2}{\partial \lambda_0} = -\sum y + \sum \lambda_0 + \sum \lambda_1 x_1 + \sum \lambda_2 x_2 = 0 \quad (7)$$

Where S^2 = sum of squares of deviation of points

$$\sum y = n\lambda_0 + \lambda_1 \sum x_1 + \lambda_2 \sum x_2 \quad (8)$$

Where $n = number\ of\ data\ points, in\ this\ study, n = 20 years\ (n = 20)$

$$\frac{\partial S^2}{\partial \lambda_1} = -\sum(y - \lambda_0 - \lambda_1 x_1 - \lambda_2 x_2)(x_1) \quad (9)$$

$$\frac{\partial S^2}{\partial \lambda_1} = -\sum y\, x_1 + \sum \lambda_0 x_1 + \sum \lambda_1 {x_1}^2 + \sum \lambda_2 x_2 = 0 \quad (10)$$

$$\sum x_1 y = \lambda_0 \sum x_1 + \lambda_1 \sum x_1^2 + \lambda_2 \sum x_1 x_2 = 0 \quad (11)$$

Similarly;

$$\frac{\partial S^2}{\partial \lambda_2} = -\sum(y - \lambda_0 - \lambda_1 x_1 - \lambda_2 x_2 - \lambda_3 x_3 - \lambda_4 x_4)(x_2) \quad (12)$$

$$\sum x_2\, y = \lambda_0 \sum x_2 + \lambda_1 \sum x_1 x_2 + \lambda_2 \sum x_2^2 = 0 \quad (13)$$

Solving the system of the simultaneous equations 8, 11, 13

Using Cramer’s Rule:

$$n\lambda_0 + \lambda_1 \sum x_1 + \lambda_2 \sum x_2 = \sum y_1$$

$$\lambda_0 \sum x_1 + \lambda_1 \sum x_1^2 + \lambda_2 \sum x_1 x_2 = \sum x_1 y_1$$

$$\lambda_0 \sum x_2 + \lambda_1 \sum x_1 x_2 + \lambda_2 \sum x_2^2 = \sum x_2\, y_1$$

From the systems of linear equations, we apply the use of Determinant Method (or Cramer's Rule) in MATLAB in solving for the unknown variables; λ_0, λ_1, λ_2

The MATLAB computation;

% AX = C (14)

% A = square matrix or coefficient matrix,

% X = solution vector,

% C = constant matrix or unhomogeneous vector

% column operations; replacing columns 1, 2, and 3 of matrix A by matrix C one after the other in linear regression equation.

$20\lambda_0 + 6.37x10^8\lambda_1 + 1.11x10^7\lambda_2 = 2.62x10^7$

$6.37x10^8\lambda_0 + 2.14x10^{16}\lambda_1 + 3.74x10^{14}\lambda_2 = 8.51x10^{14}$

$1.11x10^7\lambda_0 + 3.74x10^{14}\lambda_1 + 6.65x10^{12}\lambda_2 = 1.48x10^{13}$

Note: The coefficients of λ_0, λ_1, and λ_2 are written in MatLab coding format in multiples of 10^{16}, while the column vector C is written in multiples of 10^{14}

```
A = 1.0e+016 *

    0.0000    0.0000    0.0000

    0.0000    2.1400    0.0374

    0.0000    0.0374    0.0007

C = 1.0e+014 *

    0.0000

    8.5100

    0.1480

A1 = 1.0e+016 *(Obtained by replacing column 1 by C)

    0.0000    0.0000    0.0000

    0.0851    2.1400    0.0374

    0.0015    0.0374    0.0007

A2 = 1.0e+014 *(Obtained by replacing column 2 by C)

    0.0000    0.0000    0.0000
```

0.0000 8.5100 3.7400

0.0000 0.1480 0.066

A3 = 1.0e+016 *(Obtained by replacing column 3 by C)

0.0000 0.0000 0.0000

0.0000 2.1400 0.0851

0.0000 0.0374 0.0015

Computation of the determinants; A, A1, A2, A3;

ans = A = 2.5058e + 027

ans = A1 = 2.0640e + 033

ans = A2 = 5.5820e + 025

ans = A3 = −1.0079e + 027

% apply Cramer's Rule;

$$\lambda_0 = \frac{\det(A1)}{\det(A)} \quad (15)$$

$$\lambda_1 = \frac{\det(A2)}{\det(A)} \quad (16)$$

$$\lambda_2 = \frac{\det(A3)}{\det(A)} \quad (17)$$

λ_0 = 8.2373e+005

λ_1 = 0.0223

λ_2 = -0.4022

$f_\lambda = (\lambda_0, \lambda_1, \lambda_2) = (8.23x10^5, 0.02, -0.40)$

From calibrated equation 2

$T = a_1 + a_2 G + a_3 P$

But;

$\lambda_0 = a_1$

$\lambda_1 = a_2$

$\lambda_2 = a_3$

Therefore, the linear regression model equation for Onitsha – Owerri road becomes;

$$T = 8.23x10^5 + 0.02G - 0.4P \quad (18)$$

This is similar to the model equation proposed by [20], $\log e(P) = AO + A1 \log e\,(EI)$ (19)

Where P = traffic volume (of any vehicle type), EI = economic indicator (GDP/Population), AO = regression constant, A1 = regression coefficient (elasticity index). Though, the economic indicator is defined by a single parameter, EI, the separated form of the economic indicator in equation 18 is similar.

3.2. The Graphical Representation of the Effects of GDP Data on Annual Average Daily Traffic.

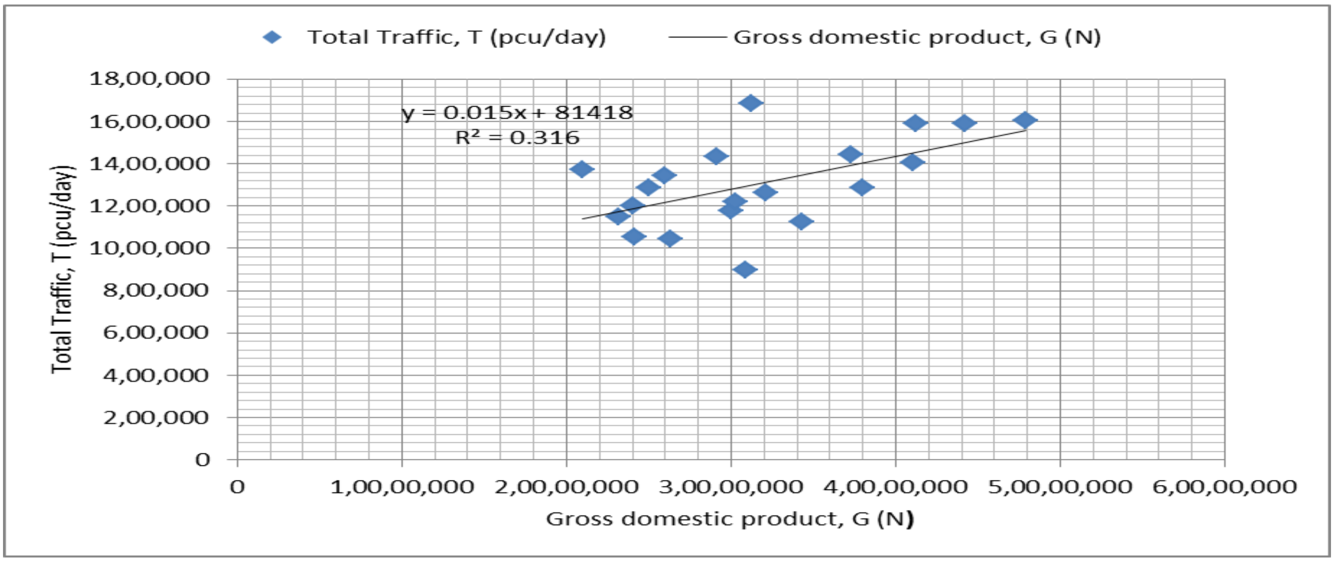

Figure 1: The relationship of annual average daily traffic with gross domestic product for Onitsha – Owerri road.

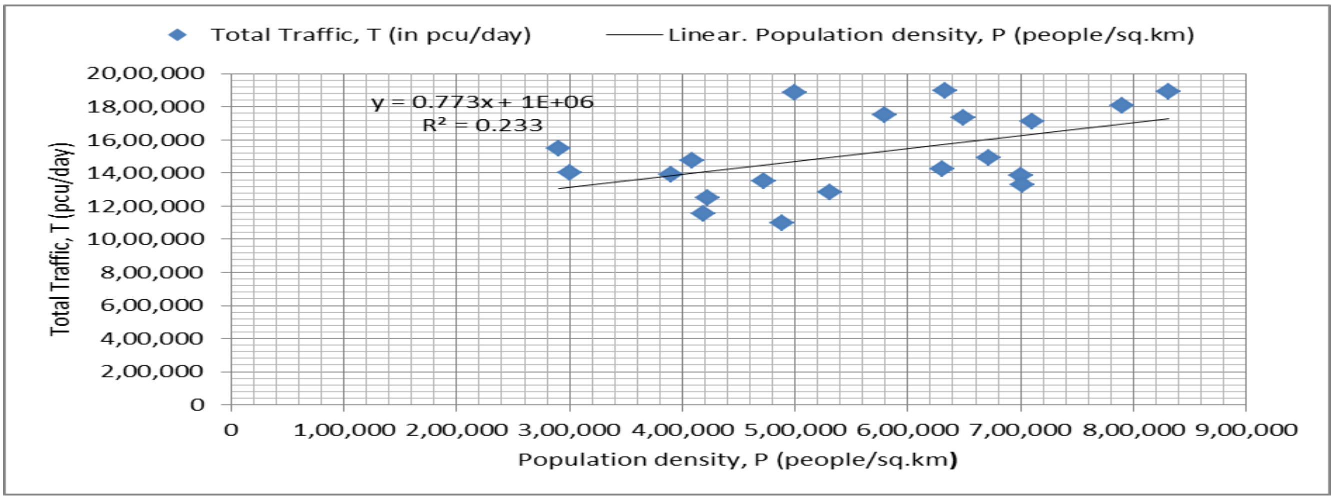

Figure 2: The relationship of annual average daily traffic with population density for Onitsha – Owerri road.

Table 1 shows the traffic, economic and demographic characteristics of Onitsha – Owerri road from 2001-2020, signifying a 20 – year data record. In 2016, maximum traffic volume was recorded as 1,684,165pcu/day, while the minimum traffic volume was recorded as 897,216pcu in 2008. The maximum gross domestic products occurred in 2020 at a figure of ₦47.9x10^6, and in 2002 at a figure of ₦21x10^6 as the minimum value recorded. The population growth along the highway is such that the maximum occurred in 2019 with a total of 830,922people/km^2, and the minimum was in 2001 at a total of 290,121people/km^2.

Tables 2 & 3 indicate the computation chats for the values of the mathematical model parameters. From the tables, the AADT (total traffic, T) is represented by the notation y_1, the GDP (G) is represented by x_1, and the PD is represented by x_2, while the natural logarithm of the AADT is represented by y_2. These notations are necessary for use in the mathematical handling of the various parameters. The figures in the tables are computed using the micro soft excel worksheet for more precise computation.

A 20 - point data entry was considered to make a good conclusive regression decision. From figure 1, the graphical relationship between the AADT and the GDP is shown. The equation relating AADT and GDP is given by $y = 0.015x + 81418$. (1)

Where, y = T, x = G.

Figure 2 shows the graphical relationship between AADT and the population density. The equation connecting the two variables is $y = 0.773x + 1X10^6$. (20)

Where y = T, x = P

The values of R indicate the degree of goodness of fit between the model and the measured parameters. When R is close to 1, it means that the equation represents the measured AADT values very well, and forecast of future values may be good as well.

The value of R from figure 1 is 0.316. This shows that the equation represents the measured value of AADT up to thirty percent (30%). It means that the improvement on the value of the home and industrial products manufactured from the area proximity to the Onitsha – Owerri road has a 30% influence in determining the positive increase in the value of annual average daily traffic.

Similarly, the value of R from figure 2 is 0.233. It indicates a relative low representation of the measured AADT by population density value for the highway under study.

There is a non-steady relationship between AADT, the GDP and the PD. Political and commercial disorderliness and disagreement has contributed to the deficit in the correlation value due to the fact that residences seek to take refuge elsewhere when the socio-political or communal conditions become unhealthy. There is the tendency of the human population to use alternative means of transportation like joining the limited commercial vehicles than procuring individual vehicles. This is due to the existence of unsteady socio-political serenity in the area close to the highway. The AADT also suffers the same fate caused by the gross domestic products improvement. Some finished products could not be transported to the places of demand due to anomalous security and political tensions generated along the areas close to the highway. Farming and lumbering activities which produces home industrial products have most of their outputs left in the thick forest due to the failed security situation existing in the area. All these contribute to the irregular values of AADT.

Table 4. Summary of regression and graphical model equations for the Onitsha – Owerri Road

AADT (T) relationship with:		
	Regression	**Graphical**
Gross domestic products, G	$T = 8.23x10^5 + 0.02G - 0.4P$	$T = 0.015G + 814188$
Population density, P	$T = 8.23x10^5 + 0.02G - 0.4P$	$T = 0.77P + 1x10^6$

Table 4 shows the various equations relating the AADT with G and P using different methods – by regression and graphical analyses. From the regression analysis equation, it implies that an increment in the value of G, means an increment in the value of T (AADT). In contrast, an increment in the value of P means a reduction in the value of T. This is as a result of the teeming population seeking alternative transportation means rather than providing individual vehicles. From the graphical assessment, both parameters increases the value of AADT However, the influence of P is more than the influence of G on the highway. This is as a result of the natural tendencies of the growing population in providing individual transportation means as the convention demands. When all the working individuals that engage in the generation of the GDP materials procure their private

4. Conclusion.

From the research, it can be observed that the economic and demographic changes within the environmental location of Onitsha – Owerri road have a great influence on the highway. An improvement on the GDP means a rise in the value of AADT. This is imperative due to the fact that the materials produced from the area demand the various vehicular means of transportation to move them from the point of production to the point of sales and demand. This natural phenomenon is limited to the fact that most of the items produced in the area (which are the GDP indicators) fail to be transported to the point of demand due to security problems, socio-political and communal instability. The land cover along Onitsha – Owerri road encompass mostly agrarian community who engages in farming and lumbering. Some communities in the area suffer from flooding and industrial waste disposal which affect their annual GDP value, hence affects the value of the AADT. The industrial productions existing in the area are also affected by the government policies and taxation on production priorities. Hence, to emancipate the GDP as a long-term predictor of AADT, there should be improvement of the security architecture in the adjoining communities, modification of some government policies and taxation. These will invariable produce a viable assessment and prediction of AADT.

From the regression analyses point of view, the population density tends to cause a reduction on the value of AADT. Actually, the growing working population can procure their individual vehicles, but some of the vehicles are not effectively in use - some are parked in their various residences. The ineffective use of these private vehicles is because of the poor pavement condition indices (PCI), lack of parking spaces, security instability, cost of fuel, and high vehicular maintenance cost (VMC).

Therefore, there should be emancipation of government policies to address the various factors militating against the provision of viable GDP and a healthy existence of the population which causes positive changes for the AADT prediction and assessment. This will go a long way in the formation of steady guide on the various highway maintenance schedules and transport infrastructure planning. The government agencies should mandate industrial production experts to design a system where the industrial waste are being neutralized safely without affecting the factors of the production of the gross domestic products and the human population. The ministry of transportation should also regularize the maintenance of the Onitsha – Owerri road and provide several alternative routes using the transportation infrastructure planning modalities. This will ease off traffic conflicts and minimize traffic congestion especially at the location proximity to the Upper-Iweka diamond interchange.

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