Observational Studies of Road Traffic Engineering Measures on Federal Capital Territory Roads in Abuja, Nigeria

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Abstract

The continuous increase in road traffic crashes on major intersections within the Nigeria's Federal Capital Territory, Abuja, prompted investigations into the causes and possible countermeasures. Traffic engineering measures such as the installation of speed bumps, warning signs and markings were considered most suitable for the nature of problems detected. Observational studies of the traffic situations on these sites, and the analysis of the "before" and "after" road crashes was conducted to evaluate the effectiveness of these countermeasures. The remarkable reduction in the road traffic crashes on these intersections made the consideration for the adoption of these measures on areas with similar problems eminent.

Résumé

Compte tenu d'augmentation des accidents de la circulation aux croisements dans la capitale fédérale du Nigéria ; une étude des causes et les remèdes s'est faite. Les remèdes telles que la mise en place des bosses ; les signalisations routières étaient considérées les solutions durables des problèmes. L'étude d'observation faite par rapport à la situation de la circulation des endroits en question et l'analyse ''d'Avant '' et l 'Après" accidents de la circulation c'était pour évaluer l'efficacité de ces contre- mesures mise en place. La diminution remarquable au domaine des accidents de la circulation surtout aux croisements a occasionné l'adoption de ces mesures aux endroits avec les problèmes semblables.

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INTRODUCTION

Abuja is the capital city of Nigeria. It is located in the centre of Nigeria in the Federal Capital Territory. Abuja is a planned city which was built mainly in the 1980s and officially became Nigeria's capital on 12 December 1991, replacing the role of the previous capital Lagos. The dominant structural element of the capital city is the high vehicular traffic and its beautiful road network.

Vehicular traffic when not effectively managed, results in congestions, dangerous conflict situations, and road crashes with various levels of severities. To forestall these, engineering measures are usually taken at the design stage or when safety problems are detected on existing roads.

Effective traffic management in Nigeria today, is faced with the critical issue of eroding basic traffic engineering measures on its roads. Successive road rehabilitation and new road projects pay little or no attention to these basic requirements for safe operations of traffic on the roads. In place where some of these measures are seen, they are mostly in bad condition or are defaced as it is with the road signs.

Despite the reasonable width of most of the roads in the FCT, and the clear site distance at intersections, they have continuously recorded high incidences of road crashes with various degrees of severity. This prompted an earlier study by the Federal Road Safety Corps, the Lead Agency in Traffic Management in Nigeria, the result of which led to the recommendation and installation of speed bumps, additional traffic warning signs and markings as the most suitable countermeasures for the observed deficiencies on some major road junctions within the city in August 2009. Research findings from experiments in other countries that attest to the effectiveness of these measures guided the choice.

The questions then were whether these measures would have similar effects considering the Nigeria's driving culture. If they are effective, what is the extent? If they are not, what modifications are required? This again prompted the decision of the Corps to embark on an evaluation study of the effectiveness of the measures, which culminated into this paper.

As suggested already by the background information, this paper aims at presenting the existing traffic situation, focusing particularly on traffic engineering measures in the FCT, as a representation of the Nigeria's situation; Nigeria's experience with selected measures and their effectiveness as a function of the general motoring public in the country. And make recommendations that will further enhance the effectiveness of these measures in the FCT and places with similar problems.

In carrying out this study, the methodological approach included the direct observations of the traffic situations on 10 randomly selected treated sites, and a simple 'Before – After' studies. The observe crash occurrence at the sites, and records of crash incidences provided estimates of the true crash frequencies, which were compared to reveal the level of safety.

The Road Traffic Situation within the FCT

The FCT has 4 major high density traffic routes that links it with other places. They include the Gwagwalada – Lokoja route, the Kubwa – Suleja – Kaduna route, Nyanya – Keffi, and the Gwagwa – Karimo route. The city experiences an Average Daily Traffic inflow of about 68,260 from these major routes, with peak periods between 0700hrs – 1100hrs towards the city, and between 1600hrs – 2200hrs going out of the city. Tables 1 – 2 shows the road traffic volume on two of these major routes.

	6-7	**7-8**	**8-9**	**9-10**	**10-11**	**11-12**	**12-1**	**1-2**	**2-3**	**3-4**	**4-5**	**5-6**	**TOTAL**
Mon	0	0	726	2143	734	0	0	2657	0	0	0	0	**6260**
Tue	1131	1050	1041	389	948	998	431	2566	2112	2086	2711	1987	**17450**
Wed	1434	1939	1455	2045	1529	1345	417	173	166	462	298	0	**11263**
Thur	1920	2161	2141	2118	3254	2278	1544	1581	1321	1502	1532	1395	**22747**
Fri	1085	2326	2400	1691	1475	2713	1303	1356	1728	1960	1300	757	**20094**
Sat	829	555	971	827	1217	1100	1227	1254	958	1317	1222	1426	**12903**
Sun	1736	1991	2034	2023	1804	1911	1775	1988	2061	1634	1959	2170	**23086**
Total	**8135**	**10022**	**10768**	**11236**	**10961**	**10345**	**6697**	**11575**	**8346**	**8961**	**9022**	**7735**	**113803**

Table 1: An In-bound Traffic Count Data of Kubwa Road

	6-7	**7-8**	**8-9**	**9-10**	**10-11**	**11-12**	**12-1**	**1-2**	**2-3**	**3-4**	**4-5**	**5-6**	**TOTAL**
Mon	1285	2599	3419	2106	2454	2573	0	1035	646	985	1270	1752	**20124**
Tue	2110	2402	1558	2429	1626	1327	706	1435	1246	2922	1933	1430	**21124**
Wed	2680	2304	2633	2541	2055	1172	1647	2510	1872	1266	1468	1274	**23422**
Thur	3485	2144	2655	2923	1843	1390	631	1719	2148	1452	1593	2785	**24768**
Fri	3312	2011	1580	1819	2307	1667	1458	1431	643	1582	1183	1477	**20470**
Sat	1889	1559	1387	1202	1391	1115	1349	1330	1691	1109	1379	1543	**16944**
Sun	2278	2312	3195	2889	1960	1347	953	1510	1422	1578	1662	1396	**22502**
Total	**17039**	**15331**	**16427**	**15909**	**13636**	**10591**	**6744**	**10970**	**9668**	**10894**	**10488**	**11657**	**149354**

Table 2: An In-bound Traffic Count Data on Nyanya Road

The result of this level of motorisation and high traffic, is the increasing congestion, long vehicular queues, delays, disregards to traffic regulations and dangerous manoeuvres, traffic conflicts, and in most cases road crashes witness on several of the nodes or junctions within and

outside the city. At day time, the situation discourages high speed at these nodes, but whenever the roads appears free and particularly at night, speed increases mostly above the specified limits without attention to other necessary road operating details and considerations.

General Status of Road Furniture on FCT Roads

Traffic management within the FCT appears to be faced with serious challenges, among which is the problem of inadequate basic road furniture meant to enhance the safe operation of the roads. However, a quick survey of the available road furniture on some roads within the city revealed a not very terrible situation.

Available on some of these roads are known road safety furniture that protects the vulnerable road users, which include pedestrian walk ways that separate them from the vehicular traffic flow, zebra crossing with few having facilities for disables, and other traffic calming devices. The status of the roads in terms of the availability of furniture is as presented in the result of a simple survey table 3 below, conducted on few roads in the FCT.

Routes	Tr. Signs		Tr. Lights		Round-Abouts		Rd. Markings		Tr. Calming		Ped. Crossing	
	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.
01	Yes	116	Yes	9	Yes	1	Yes	8	Yes	18	Yes	12
02	Yes	16	Yes	1	No		Yes	5	Yes	8	Yes	16
03	Yes	12	Yes	1	No		Yes	3	No		No	
04	Yes	11	Yes	2	No		Yes	8	Yes	6	No	
05	Yes	40	Yes	2	No		Yes	4	No		Yes	8
06	Yes	44	Yes	4	No		Yes	3	Yes	12	No	
07	No	-	Yes	2	No		Yes	4	No		Yes	4
08	Yes	8	Yes	2	No		No		No		Yes	1
09	Yes	6	Yes	2	No		No		No		No	
10	Yes	60	Yes	8	Yes	1	No		No		Yes	2
11	Yes	38	Yes	6	No		Yes	4	Yes	6	Yes	2
12	Yes	82	Yes	13	Yes	1	No		Yes	6	Yes	2
13	Yes	24	Yes	5	Yes	1	Yes	4	No		Yes	2

Source: FRSC,

Table 3: Availability of Road Furniture

KEY
Tr. Signs – Traffic Signs
Tr. Lights – Traffic Lights
Rd. Markings – Road Markings
Tr. Calming – Traffic Calming
Ped. Crossing – Pedestrian Crossing
Av. – Available
No. – Number Available

Though the survey shows the availability of road furniture such as road traffic signs, observations revealed that they are inadequate, some are defaced, or wrongly posted, to the extent that they make less meaning; the availability of traffic lights on most junctions is not supported by the required power supply to keep them functioning all through; the road markings obviously makes less meaning to drivers; pedestrians on the pedestrian crossing are not given any priority by drivers and are even not frequently used; and traffic calming devices such as rumble stripes which are still being run-over on high speeds. See figures 1 to 4 for some of the damaged and defaced road signs on roads in the FCT.

Figure 1 – Defaced road traffic sign at Sheu Yar'Adua Way, Abuja

Figure 2 – Defaced road traffic sign at N. Okonjo Iweala Way, Abuja

Figure 3: Defaced and damaged sign

Figure 4: A road sign covered by foliage

The Traffic Engineering Measures Adopted

In deciding on the appropriate measures to be adopted, the fact that the problems on these junctions were speed dependant played a key role. So the decision was to introduce speed calming devices alongside traffic signs and pavement markings. Speed cushions were more favoured. See figures 5 and 6 for diagrammatic illustration of the measures on some of the sites.

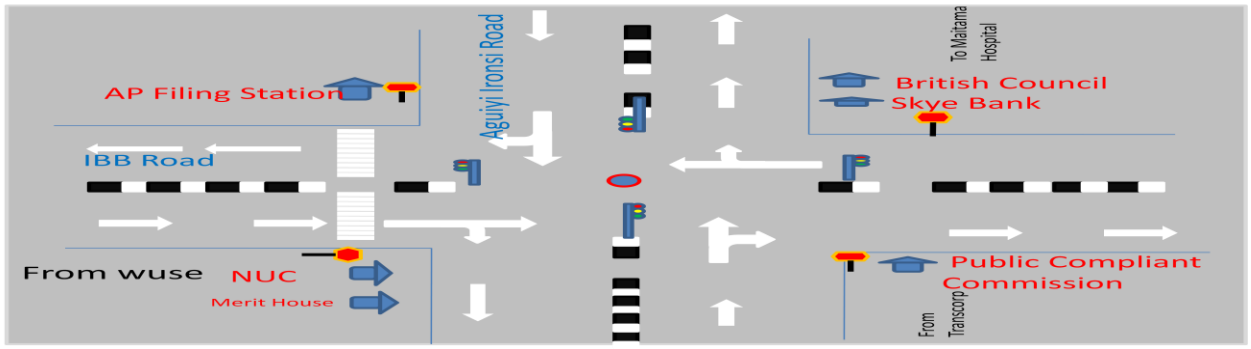

Figure 5 – IBB Road/Aguiyi Ironsi (NICON) Junction, Maitama before the provision of road traffic engineering measures.

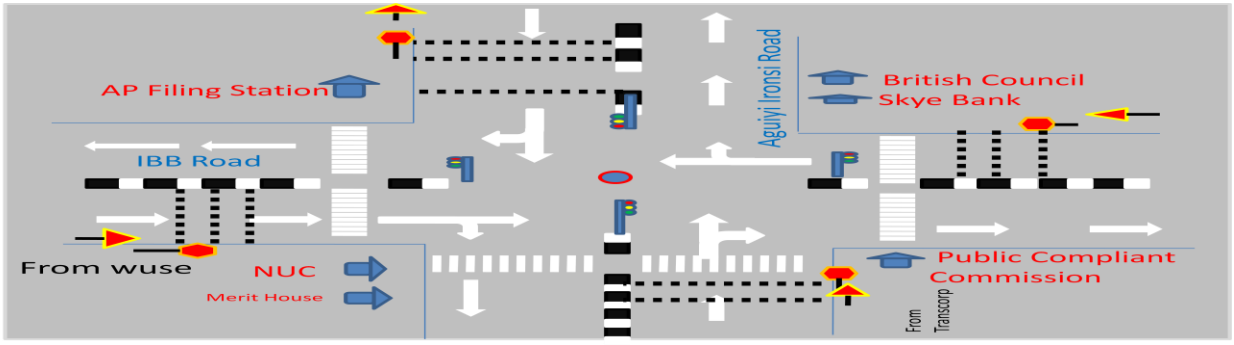

Figure 6 – IBB Road/Aguiyi Ironsi (NICON) Junction, Maitama after the installation of

NB: As shown in figures 5 above, warning signs such as 'T' junction signs, zebra crossing and speed bumps are missing on IBB Road/Aguiyi Ironsi Road (NICON Junction) before the introduction of the measures. Figure 6 also shows the installed recommended measures on site.

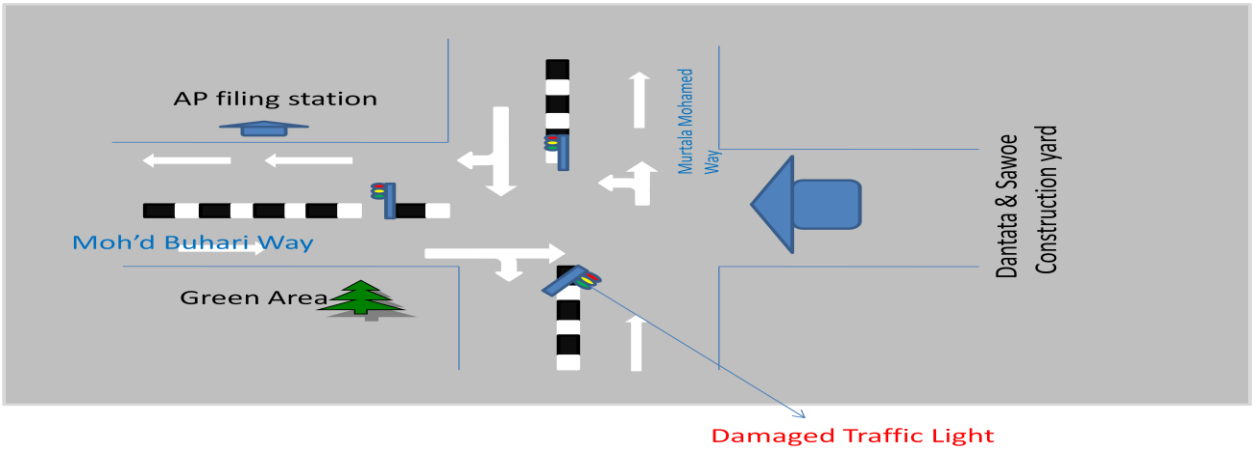

Figure 7 – Dantata Junction before the installation of the traffic engineering measures.

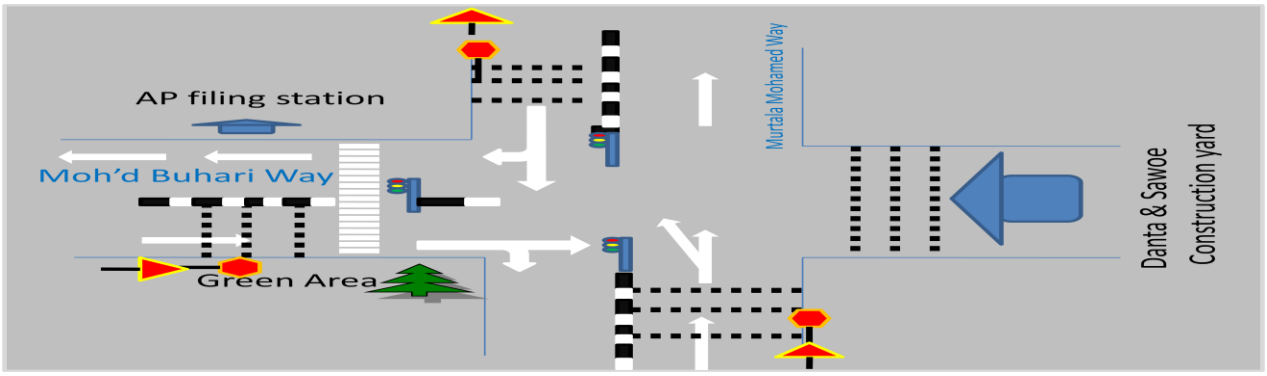

Figure 8 – Dantata Junction after the installation of the traffic engineering measures.

Before – After Evaluation of the Selected Traffic Engineering Measures on FCT Roads

This study method allows the opportunity to test the significance of difference in the reduction of road crash caused by the implementation of the selected countermeasures. The Chi-Square Test χ^2 was used. A comparison of the performance of the treated intersections (the "test") to all similar intersections in the city (the "control") was done. See tables 4 and 5 below for the ''Before and After'' road crash data on these treated sites and 10 similar untreated sites, and figure 9 showing graphically the Before and After crashes on the treated sites.

JUNCTIONS	Crash Frequency	
	BEFORE	AFTER
DANTATA	12	8
AIRPORT	8	5
J. BERGER	16	9
CHURCHGATE	13	6
DUTSE	18	6
NICON	15	8
MPAPE	10	4
DEEPER LIFE	14	11
NEW CBN	18	11
BOLINGO	11	6
TOTAL	**135**	**74**

Source: FRSC,

Table 4 – Before and After crash frequency on the 10 treated junctions

JUNCTIONS	Crash Frequency	
	BEFORE	AFTER
DANTATA	9	12
AIRPORT	7	9
J. BERGER	14	21
CHURCHGATE	8	7
DUTSE	13	18
NICON	12	16
MPAPE	9	8
DEEPER LIFE	12	15
NEW CBN	12	14
BOLINGO	8	10
TOTAL	**104**	**130**

Source: FRSC,

Table 5 – Before and After crash frequency 10 comparison junctions with similar traffic characteristics to the ones treated

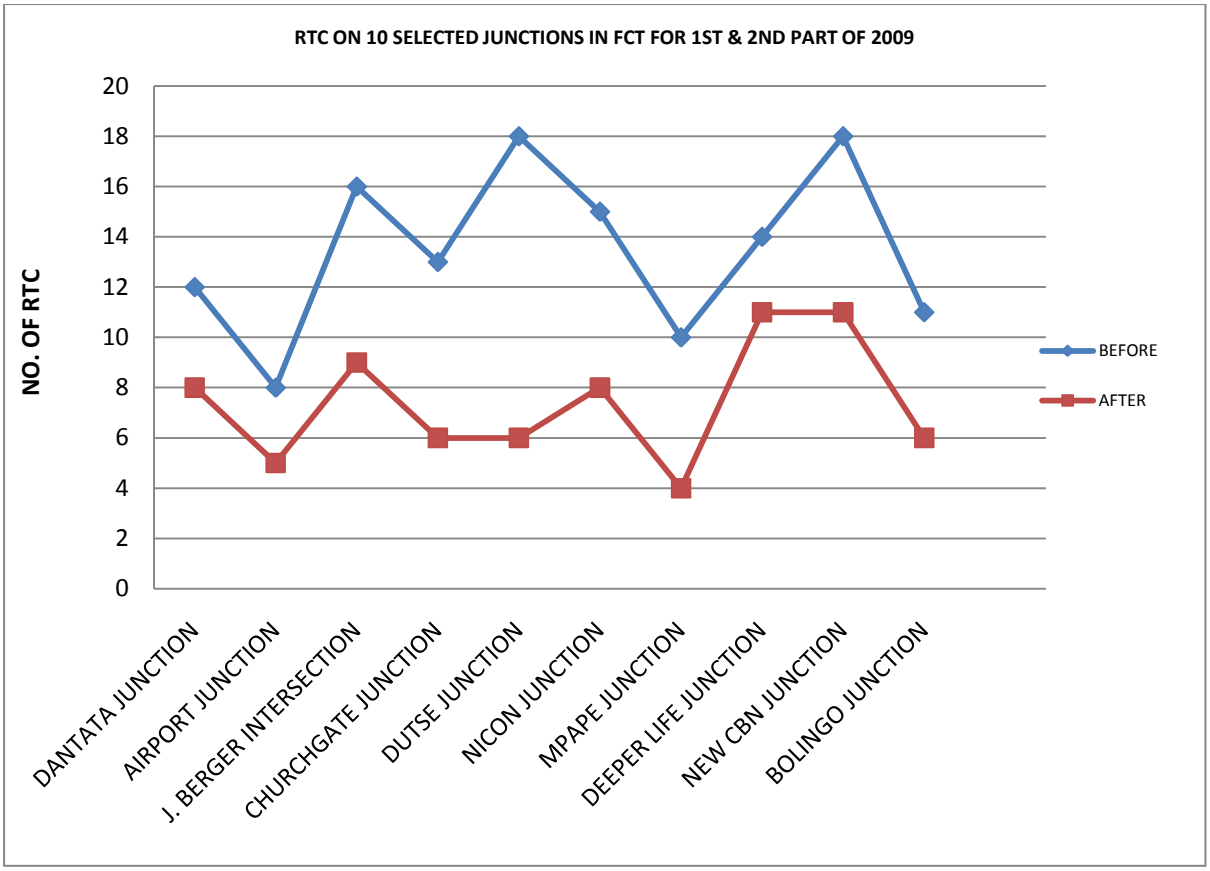

Figure 9: A Graphical Representation of the Before and After Crashes

Though a quick analysis of tables 6 and 7 ([135-74]/135) show a 45% reduction in the number of crashes on the treated sites. To confirm how significant this drop is in relation to the entire situation in the city, a control test analysis was conducted and subjected to a statistical test. Table 6 below, is a simple Before and After Analysis.

	Before	After	Totals
Treated site Comparison site	135 (a) 104 (c)	74 (b) 130(d)	209 (a+b) 234 (c+d)
Totals	239 (a+c)	204(b+d)	443 (n)

Table 6: Simple Before and After Analysis

The analysis shows that road crash on the treated sites went down by about 45%, while city wide crashes increased by 20%. A Chi-Square (χ^2) statistical test on the observed crash frequencies revealed that there is a significant difference in the change resulting from the implementation of the countermeasures on the treated sites as demonstrated using table 6 and the formula below:

$$\chi 2 = \frac{n(\mathrm{ad} - \mathrm{bc})2}{(a+b)(c+d)(a+c)(b+d)}$$

The test gave a calculated Chi (χ^2) value of 18.04, with a degree of freedom of 1 at 95% confidence level, the χ^2 value is 3.84. Since the calculated value appears greater than the critical value, it confirms that the treatment or the introduction of the countermeasures has caused a significant reduction in crashes.

Again, using values from table 6, the effectiveness of the treatment was determined using the Odds Ratio (OR) adopted from the work of Terek and Paul (2008), which is the ratio of change of crashes in the comparison sites to the change of crashes in the treated sites.

$$\mathrm{O.R} = \frac{\mathrm{c/d}}{a/b} = \frac{104/130}{135/74} = 0.44$$

The safety effect of the treatment is O.R – 1, i.e 1 – 0.44 which is 0.56. This means that the countermeasure is 56% effective in the reduction of crashes at the sites.

Summary of the Results

a. With about 68260 Daily Average Traffic inflow into the FCT, there is a high vehicular density within the city

b. The study revealed a traffic situation still characterised by congestions, long queues, dangerous driving manoeuvres, increased conflict situations, and high road crashes.

c. On relatively free traffic sections of the roads and particularly at night, there less regards for specified speed limits.

d. Of importance, is the fact that effective traffic management and control within the FCT, is being hampered by inadequacy of the basic traffic engineering measures. And where some of these measures are in place, some are damaged, defaced or not maintained, and worst still, the motorists and the other road users give less significance to their existence.

e. It revealed a 45% reduction in traffic crash after the implementation of the traffic measures on the selected sites, while the general crash situation on similar sites in the city went up by 20%.

f. Analytical result of the study confirmed the potency of the treatment as demonstrated by the Chi $\chi 2$ test result and that of the Odds Ratio which credited the measure with about 56% safety effective level.

CONCLUSION

Like in other developing countries, the high traffic volume and the accompanying problems within the FCT and other parts of the country, attest to the fact that road transport still remains the major means by which people and goods transit from place to place.

Effective traffic management within the FCT and indeed Nigeria as a country, is threatened not only by inadequacy of traffic engineering measures, but the poor road culture of the people. This does not allow many drivers and other road users to take note of existing measures, hence the obvious flagrant disregard of the safety measures.

In line with findings of studies conducted in other countries of the world as recorded in the Road Safety Handbook by Elvik and Vaa (2005), and the recent work of Sayed and deLeur (2008), though on rumble strips, speed bumps have proved to have great capacity for crash reduction.

However, like it is mostly the case, the observed sharp drop in road crash on the treated locations might be as a result of traffic diverting to alternative routes where speed bumps are not installed. This may have accounted for rise in the road crashes on these alternative routes.

Though lack of sufficient data has made it difficult for a detailed analysis of some important aspects of this study, the little information here can serve as a guide for decision-making and similar in-depth studies.

Certain challenges militating against the maintenance of safety on FCT roads have been sufficiently identified above. To mitigate these challenges, the following strategies are hereby suggested:

a. Road Safety Audits (RSA) and road assessment should be conducted on all major roads in FCT.

b. Advocacy, capacity development, result oriented public education, preventive road incidence enforcement, and post-crash assuages should be embarked upon by road traffic managers, enforcers and NGOs in the Federal Capital Territory.

c. Nigerian Government should muster the necessary political will to enforce road safety legislations that meet international best practices.

d. A stronger multi-sectoral collaboration on road safety should be encouraged amongst agencies and other Non-Governmental Organisations taking lead roles in activities and advocacy for reducing RTC.

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CERTIFICATION

I, Omidiji Adeyemi Ayodeji hereby certify that this manuscript has not been previously published and is not presently been considered for publication anywhere.

Signed Author
12 March, 2010