PETROLEUM SUBSIDY REMOVAL POLICY IMPACT ON TRANSPORTATION EXTERNALITIES AND CLIMATE CHANGE IN NIGERIA

BY

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Abstract.

Energy shortage, climate change, and economic downturn are the driving forces of governmental policies globally of which the automobile sector is a key culprit, and subsidies in all its forms is a tool for economic reinforcement. This study x-tray the effect of subsidy removal from petrol on road traffic flow and air pollution within FCT. Road traffic volumetric survey from the country's FRSC was collected as it affect park-and-ride, and Gray Wolf Toxic Gas Analyzer (Model: TG-500) was used to determine air pollutants concentration (NO2, SO2, and CO) along FCT entry road. The study revealed that a 53.5% increase in PMS between the year 2024 and 2025 brought about 39.48% reductions in vehicular flow on FCT major roads. CO concentration that is highest at 17.33ppm dropped to 13.84ppm along Keffi-Abuja road. It is therefore recommended that fossil fuel subsidies removals are panacea to green mobility and climate change mitigation.

Keywords: Air pollution; Climate change; Economic policy,; Fuel subsidy; FCT; Traffic flow.

1. Introduction

Before the discovery of petroleum deposit at Oloiribi in 1956, Nigeria pride in her agricultural produce like cocoa, coffee, cotton, groundnut, rubber, and other cash crops for foreign exchange. But petroleum is now more of a curse than blessing to the nation as it is the main driver of the country's economy amidst fail governance. For decades, Nigerians have been wallowing in the fluctuating journey of petroleum product prices, spanning from 6 kobo per litre in 1973 to a staggering 1,120 naira per litre in 2024. Nigeria has been known for the highest mortality burden and poor air quality in Africa and the 4th globally (Health Effects Institute, 2018), and was ranked 150th out of 180 countries with poor air quality environmental performance index (WHO, 2016c; Akinfolarin et al., 2017; Yale Center for Environmental law and Policy, 2018; and Edokpa & Ede, 2019). For decades, the UN in their various COPs have been signing series of agreements to cut down the emission of CO_2 and global temperature by 2.0 - 1.5% , but while countries like Kuwait are already planning for _life after oil', Nigeria with her teemed pollution is yet to take any tangible action on that

The dominance of auto-mobile traffic on roads in developing countries has becomes a major challenge because of its negative environmental and health implications (Zhao and Zhang,

2018; Shao, Zhang, Cao and Yang, 2022). Researchers like Redman, et al, (2016) in their studies, have revealed that factors like access to more income, education, social status and societal safety, levels of supply and satisfaction of public transport services have direct correlation with increase in car ownership in every society. In most African cities, including Lagos, traffic congestion has become a common feature (Otuoze, Hunt and Jefferson, 2021) due to poor public transportation and infrastructuree system.

Globally, the major air pollutants of concern, representing the US EPA criteria pollutants, include particulate matter (PM) in the size ranges of <2.5µm and <10 µm aerodynamic diameter (PM2.5, PM10 respectively), ozone (O3), carbon monoxide (CO), sulfur dioxide (SO2), nitrogen dioxide (NO2), and volatile organic compounds (VOC) like formaldehyde (HCHO). The threshold tolerant level established by US EPA is as shown in table 1.

Table 1. US EPA pollution standards

AQ1 Rating	PMtou g/m3	CO (ppm)	NO2 (ppm)	SO_2 (ppm)
Green - Good 0 - 50	0-50	0 - 2	0. -0.02	0 - 0.02
Yellow -Moderate 51 - 100	51 - 75	2.1 – 4.0	0.02 – 0.03	0.02 -0.03
Orange - poor for sensitive group 101 - 150	76 - 100	4.1 – 6.0	0.03 – 0.04	0.03-0.04
Red -Unhealthy 151 - 200	100 - 150	6.1 – 9.0	0.04 – 0.06	0.04-0.06
Maroon - Hazardous > 200	>150	>9.0	>0.06	>0.06

Source: USEPA 2014

More than 90% of the world's population lives in places where the air quality is above the WHO tolerance limits for Particulate Matter ($PM_{2.5}$ and PM_{10}), Ozone (O_3), Nitrogen dioxide (NO_2) and Sulphur dioxide (SO_2) as a leading pollutants with great health implications (USEPA, 2016a; WHO, 2016; Salami, et. al., 2020; Ioannis and Elivaset, 2020; WHO 2021). In the work of Ebeshi and Esemuze (2024), on the effect of particulate matter generation along Mararaba-Nyanya road FCT, Nigeria, Suspended Particulate Matter (SPM) was as high as 25.1 ±2.7 µg/m3 during peak traffic hours, and the mean concentration in the wet (p-value = 0.000<0.05) is significant. Frances et al (2020), submitted that fuel price, and stock of public transport vehicles have significant effects on automobile usage; but their prediction that vehicle ownership will increase to 48.7, 66.2, and 76.1 million in 2030, 2040, and 2050, respectively has being faulted by the present subsidy removal as people are now abandoning or selling their cars cheaply where there are buyers.

In terms of passenger modal choice, recent literature revealed that subjective determinants such as Comfort, Convenience, Safety and security, freedom, flexibility and psychological factors such as habits, lifestyle, beliefs, superstition and inter-modal transfer are formally considered as determinants of travel mode choice (Gonzalez & Suarez, 2013). More so, Thomas (2014) and Kaewkluengklom, Satiennam & Satiennam (2017) both opine that psychological issues are strong determinants of travel mode choice. While Frances et al (2020), submitted that fuel price, and stock of public transport vehicles have significant effects on automobile usage; but their prediction that vehicle ownership will increase to 48.7, 66.2, and 76.1 million in 2030, 2040, and 2050, respectively has being faulted by the present subsidy removal as people are now abandoning or selling their cars cheaply where there are buyers.

1.1. Energy subsidy and the intended national determine commitment (INDC)

Subsidies have a long history in all nations. The World Trade Organization defines subsidy as

―a financial contribution by a government, or agent of a government, that confers a benefit on its recipients‖ (Kojima and Koplow, 2015). The United Nations and International Energy Agency define an energy subsidy as ―any measure that keeps prices for consumers below market levels, or for producers above market levels, or that reduces costs for consumers and producers‖ (United Nations Environment Programme Division of Technology, 2002) In countries like Egypt, Jordan, and Yemen, energy subsidies expenditures was at a time far greater than those directed to health and education (El-Katiri and Fattouh, 2015)

Subsidies were institutionalized in Nigeria in 1977, following the Price Control Act that illegalizes the sales of some products (including petrol) above the regulated price. At the onset, the spirit behind subsidy was plausible and noble, but its administration has been plagued with gross corruption and mismanagement of fund for decades (Onyekwena et al 2017). According to Silva et al (2023), fuel subsidies is calculated by considering the marginal opportunity cost (MOC) between the export price that is Free on Board (FOB) and the import price that is Cost, Insurance, and Freight (CIF). The resultant effect of climate change impacts in the form of tsunami and heat waves had called for series of global summit on sustainable developments and national resolutions, and commitments.

Past studies like that of Benjamin (2017) and the International Energy Agency have opined that subsidy removal based on their methods, assumptions, and scope, would significantly cut greenhouse gas emissions Also Merrill et al. (2015) in aggregating a dozen separate studies confirmed that greenhouse gas emissions reductions from subsidy removal to range from 6.4% to 13% globally and from 1.3% to 9.3% for Asian countries like India and Thailand. In fact, as of November 2015, about 39 countries did submitted energy and fossil fuel subsidies impact as part of their intended nationally determined contributions (INDCs) in COP 21 at Paris, France (Terton et al. 2015). More so, this was the key focus at COP28 in Dubai as stressed by the Executive Secretary of UN Climate Change, Simon Stiell, there is therefore the need to get on track. The latest report of the UN‘s Intergovernmental Panel on Climate Change (IPCC) also reveals that greenhouse gas emissions need to be cut by 43% in 2030 with reference to 2019 levels.

1.1.1 Commuters travel mode choice

Generally, individuals make decision that appears to be rational to them based on their income levels, individual socio-demographic factor, spatial characteristics, socio- psychological factors, and social capital available to them (Witte et al., 2013). Where the existing mass transit appear to be disadvantage to them in terms of accessibility, they go into car-pooling where 4 to even 10 people can share a single vehicle. Car-pool vehicle system is where privately owned vehicles are collectively used for commuting and the operating costs is shared proportionately. In fact, some agencies and employers have subsidized van-pooling, ride sharing in 8 to 15 passenger vans provided by the sponsor. Passengers pay a monthly fee to the sponsor. Van pools are most successful for extremely long work trips to satellite towns.

2. Material and Method

2.1 The Study area

The federal capital territory (FCT) is located just north of the confluence of the Niger and Benue Rivers. It is bordered in the north-west by Niger State that is about 179 km away, In the north-east by Kaduna State about 156 km away, to the north-west by Nasarawa State to the east and south about 45 km, and by Kogi State to the south-west of about 217 km away. FCT lye between latitudes 8.25 and 9.20 north of the equator and between longitudes 6.45 and 7.39 east of Greenwich Meridian , see Fig. 1. Geographically, it is located at the middle Savannah belt of the country comprising of six area councils namely: Abaji, Abuja Municipal, Bwari, Gwagwalada, Kuje and Kwali with a total land area of approximately 7,290 km², and with an

estimated population of about 3 564 126 in 2016.

2.2 Data collection and analysis method

This study makes use of vehicular volumetric traffic survey and vehicular exhaust pollution data on selected routs within the federal capital territory (FCT) between the year 2023 and 2024 to determine the impact of the subsidy removal from premium motor spirit (PMS). The data were collected along 6 sampled roads linking the satellite towns and AMAC for 7days during the peak festive season through the federal road safety corps (FRSC) Abuja ccommand. While the PMS multi-temporal price trend between 1973 and 2025 were collected through Google search engine and secondary sources. For the air pollution change detection, the study employed Mobile handheld air quality monitoring equipment - Gray Wolf Toxic Gas Analyzer (Model: TG-500) for field detection and recordings of concentration levels of air pollutants (NO2, SO2, and CO); AQI was calculated by the equation given by the US. EPA (2017) as follows:

$$Index = \frac{Pollution\ Conentration}{Pollution\ standard} \times 100$$

Measurement of the air pollutants was carried out three times (morning, afternoon and evening) per day for 7 days in December 2024 and 2025, see table 2.Table 2. Location of Sampling Points

Survey Roads	**Node Coordinate**			**Location Description**			
Keffi - Abuja Road (north-axis)	**Node-1:** 9.02166 N 7.56820 E	**Node-2:** 9.02410 N 7.56125 E	**Node 3** :9.02745 N 7.55104 E	Nyanya Bridge	Karu Bridge	VI0 Auto-Centre (Kugbo).	AYA Roundabout).
Airport Road - City Gate (South axis)	**Node-4:** 9.02745 N 7.55137 E	**Node-5:** 8.98402 N 7.38873 E	**Node-6:** 8.99575 N 7.40676 E	Obasanjo Space center Lugbe).	International Cancer Center).	Kuchingoro, Army cemetery).	City Gate (adjacent Army post).
Suleja-Kubwa Road (West axis).	**Node-8:** 9.04884 N 7.53375 E	**Node-9:** 9.13778 N 7.35361 E	**Node-10:** 9.13781 N 7.35350 E	NIPCO, Kubwa second gate.	NEMA Ambulance bay. kubwa	Gvvarimpa gate, flyover bridge.	Katamkpe hill, SHEMA Pet.

Descriptive statistics and simple composite ogives curve graph theoretic indices were used to assess the level subsidy removal impact on vehicular traffic flow. The climate change impact of vehicular modal choice from automobile emission and greenhouse gas was assessed by subjecting measured traffic corridor vehicular exhaust pollution before and after the adoption of subsidy removal and park-and-ride public transport system.

3.0 **Results and Discussion**

3.1 Petrol price trend in Nigeria

Nigerians over the years have been subjected to continuous fuel prices fluctuations from just 6 kobo far back in 1973 to a crazy staggering price of between 1,200 and 970 naira per litre in 2025, (see figure 2). This price oscillation is not unconnected to the global market forces, IMF currency devaluation advice, political office holders‘ corruption that often have profound negative impact on the general economy and in the particular, the transport sector.

Due to the prolong fuel subsidy operation game in Nigeria, erection of petroleum filling stations has become proliferated in all cities and towns in the country (Dukiya, 2011, 2013). Within the country, there are three groups of filling stations based on their ownership and the source of their products which are: 1) the Nigerian National Petroleum Corporation (NNPC) who sell at government control prices, 2) The major marketers (like Oando, Mobile, Total, Agip) who sell at fairly moderated prices, and 3) the private individual marketers (often referred to as black marketers) who often take delight in hurdling petroleum products for abnormal profit.

Studies however have revealed that fuel subsidy in all its forms causes increasing air pollution and greenhouse gas emissions (Sweeney, 2020), road congestion (McCulloch, Moerenhout and Yang, 2021), Omitogun et al (2021) show that the removal of fuel subsidy might reduce the amount of carbon emission in the Nigerian economy. Similarly, Adekunle and Oseni (2021)

argue that fuel subsidy removal could reduce the growth in carbon emissions through low energy consumption. Ovaga and Okechukwu (2022) argue that fuel subsidy breeds corruption in Nigeria because a group of corrupt people have been working against the functioning of existing refineries so as to aid the continuous importation of refined fuel at global market price to justify their masqueraded fuel subsidy. Volumetric traffic flow change between 2023 and 2024

The volumetric road traffic survey carried out on the major corridors of FCT as revealed in table 2 shows that the 53.5% increase of the PMS between the year 2024 and 2025 brought more than 39.48% reduction in vehicular flow on the major roads. Along Keffi-Abuja rout, traffic drop from 10,627 to 7,902 on the average, on Airport-city rout, traffic drop from 8,865 to 6,492, and on Suleja-Kubwa rout, traffic drop from 9,823 to 7,258. The drop in vehicular traffic flow is in both private and commercial vehicles as many motorists couldn't breakeven in relation to their take-home salaries and maintenance of those vehicles. In another traffic survey carried out by the Federal Road Safety Corps (FRSC) along Kwali-Gwagbalada-Abuja rout, an average of six days survey from 6am to 6pm between December 2024 and January 2025 resulted in significant drop in traffic flow as revealed in fig 3 due the commencement of the PMS subsidy removal nationwide (Isa et al, 2015; Ali and Ngene, 2020).

3.1 Change in road corridor air pollution and petrol price

This study like many others revealed that apart from road traffic volumetric having two major peaks, (morning and evening peak), evening hours has the highest volumetric and pollution records on the average as indicated in table 2 and figure 4 where CO concentration is much more higher than other pollutants.

Table 2 Impact of PMS subsidy removal on vehicular traffic flow and air pollution in FCT

Survey Roads	Mean values for Dec. 2024				Mean values for Dec. 2025				Area location
	Traffic volume	NO_2 ppm	SO_2 ppm	CO ppm	Traffic volume	NO_2 ppm	SO_2 ppm	CO ppm	
Keffi - Abuja Road (north-axis)	10,627	1.72	0.12	17.33	7,902	1.38	0.10	13.84	AYA Roundabout).
Airport Road - City Gate (South axis)	8,865	1.51	1.72	5.62	6,492	1.21	1.38	4.45	City Gate (adjacent Army post).
Suleja-Kubwa Road (West axis).	9,823	1.42	1.91	12.5	7,258	1.14	1.53	10.0	Katamkpe hill, SHEMA Pet.

The evening CO concentration is highest at 21.4ppm and lowest with10.1ppm along Keffi-Abuja road, which is in agreement with the findings of Ishaya et al (2023) and Ogunseye et. al., (2018). The mean daily levels of SO2, NO2, CO along Keffi - Abuja road ranges between 1.3 - 1.85ppm, 0.12 - 0.14ppm and 1.71 - 17.57ppm before the subsidy removal, but now ranges between 0.89 – 1.39pmm, 0.07 – 0.13pmm, and 1.51 – 13.91pmm respectively. Although, the trend from March 2025 is on the increase due to the little downward adjustment in the PMS pump price.

4.0Conclusion

Energy subsidy removal is a complex and controversial issue globally especially in country like Nigeria where fuel subsidy management has been masqueraded for public fund embezzlement over the years. The journey of fuel price dynamics in Nigeria can be traced to ***Gen. Gowon's regime (1973-1976***, but it was the general economic down turn that forced the first democratic government of ***Pres. Obasanjo (2000-2003)*** to reduce the existing fuel subsidy thereby causing a 61.54% increases in pump price from 20 to 42 naira. ***President Buhari's regime (2015-2023)***

better described as the most miserable in the history of Nigeria governance witnessed a 124% increase in general prices. However, ***Tinubu regime (2023-2025)*** that is ill-informed, irrational, and capitalist oriented regime aggravated the trauma of the entire nation where PMS price shoal to between ₦900 to ₦1,200 per litter when he declared total fuel subsidy removal (Facts Figures, 2020).

The cost of PMS actually has negative impact on the nation's transport system and is the basis of the re-awakening of the informal park-and-ride transport system in the country. In Abuja for instance and many other major cities in the country, major organizations release their official buses to convey their employees to-and-fro satellite towns. While other workers in various neighbourhoods resort to bus and car pooling. In fact, to many, the idea of leisure driving and unsolicited visitations has being truncated without any legislation. The traffic flow pattern also has positive correlation with the air pollution as the traffic corridor pollution drop proportionately, thereby improving the ambient air quality of the FCT.

Although at the global level, various government and organizations like the G5 and G20, the International Energy Agency, and the Organization of Economic Cooperation and Development (OECD), are all dogged about phasing-out fossil fuel subsidies till-date. In fact, the International Monetary Fund (IMF 2015) reported that fossil fuels account for about 85 per cent of all global subsidies, and repealing these subsidies would lower global carbon emissions by more 28 per cent and fossil fuel air pollution deaths by 46 per cent, while increasing government revenue by over 5.8 per cent of GDP.

5. Recommendations

Based on afore going discussions, the following are recommended for the transport policy makers and other environmental managers:

i. That fuel subsidy removal should accepted in totality never to be revers as it advocated even by IMF and other researchers like Omitogun et al (2021) that fuel subsidy removal reduces carbon emission; while Adekunle and Oseni (2021) also argue that fuel subsidy removal reduce carbon emissions through low energy consumption.
ii. African governments and Nigeria in particular should start to plan for life-after-oil like Kuwait if they will not slum into deeper socioeconomic crises since many western world are already phasing out fossil fuel dependent automobiles by 2030.
iii. Nigeria and other similar African countries that are paying lip-service to e-bus service and green BRT should learn from Kenya, Ethiopia, and Egypt BRT project in collaboration with Institute for Transportation and Development Policy (ITDP), and the Global Green Growth Institute (GGGI).

iv. Integrated modal mass transport with modern park-and-ride systems at major transport corridors should be a priority every nations short and long transportation planning.
v. There should be proper surveillance and policy implementation on air pollution standards in terms of road worthiness of automobiles as observed by Ebeshi and Esemuze (2024),
vi. Incentives should be provided for non-motorized mobility in major urban centres in terms infrastructural design provision for better convenience and accessibility.

Conflict in Interest: I hereby declared that there is no conflict of interest in any form in the paper.

Funding: No funding was received from any organization

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