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# Determination of Road user Charges in South East Nigeria: An Empirical Survey

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## Abstract

The study was set out to determine road user charges (per/km). It carried out survey on different vehicle classifications (category) according to their average weights and converted them to an equivalent standard axle load (ESAL). This was utilized to determine the charges payable, the annual average daily traffic (AADT) and the cost component of a federal highway in the South-Eastern Nigeria on a yearly basis. The various needed data is collected especially the AADT. The charge per ESAL was obtained by dividing the annual roadway costs by aggregating the total number of the ESAL-Km it incurs on the 80.5km Onitsha-Owerri highway in a year. Furthermore, charge per vehicle was obtained by multiplying the individual ESALs by the charge per ESAL-Km. The study results show that road user charges (RUC) are directly proportional to the equivalent standard axle load (ESAL). This means that higher charges are paid by road users that cause more unit wear to the road. Hence the results: Tricycles and light passenger vehicle charges are negligible, Minibuses to pay ?0.98/km, Trucks and Buses to pay ?11.6/km, vehicles with multi-axles to pay ?17/km, and Heavy Construction Machinery and Earth Moving Equipment to pay ?41.59/km to recover the ?517 million computed as the annual roadway cost. Road user charges must serve the essential function of rationing the available supply among many possible demands.


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***Index terms***— road, user, charge, costing, highway and axle load.

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I. Background to the Study ransportation is one of the tools the civilized societies need to bring order out of chaos. In Nigeria, Ogwude (2011) asserted that only in the cities of Lagos and Abuja are conventional buses in use similar to what obtains in most cities worldwide. However in both cities the use of para-transit modes of transport is clearly dominant. For this reason, he said Nigeria remains the only country in the world where densely populated cities with over 6 million people do not have an organized urban transport system based on a combination of conventional buses and rail. Ugboaja and Ukpere (2011) established that transport systems provide mobility, access and other benefits as facilitating the productivity of other sectors of the economy. According to them, this contributes to several environmental pressures, namely atmospheric pollution, traffic accidents, congestion, resources depletion, waste accumulation and disruption of nature and cities. Urban transport pricing is currently one of the topical issues in different nations of the world. Pricing road use by time, place and distance of travel offers planners and politicians a powerful tool for reducing urban road traffic. An important goal when setting user fees is to achieve economic efficiency. The basic rule is for a price to be set equal to marginal cost. Consumers are only willing to purchase service that is at least as much as the price, so the rule says that consumers will get the service only when their benefits exceed the marginal cost of producing the service. The result is that marginal cost pricing maximizes social welfare. When the user charge is equal to marginal cost, the benefit of consuming the last unit of service equals its production cost (William and Edminton, 2000).

In 1985, about 23 percent of roads in Nigeria was in a bad state. This figure rose to 30 percent in 1991, and 50 percent in 2001 (Draft National Transport Policy, 2010). Unless roads and bridges are in good conditions, they cannot support the desired socioeconomic development of Nigeria and particularly in the South-East. This is why road pricing is important to prevent the rate of damage and to generate funds for maintenance and the provision of more facilities. User charges also have great potential for funding additional investment in public service infrastructure. Anderson (1987) demonstrated that if user charges increased the financial rate of return to public services infrastructure by 5 percent, enough revenues would be generated in sub-Saharan Africa to finance a 60 percent increase in annual investment. Some federal highways in the South-East of Nigeria include the Owerri-Umuahia, Enugu-Onitsha, Onitsha-Owerri, Abakaliki-Enugu, Enugu-Port Harcourt, Afikpo-Okigwe, etc. but more emphasis was on the Onitsha-Owerri federal road. South-East comprises the five states of Abia, Anambra, Ebonyi, Enugu and Imo with Owerri and Enugu as its geographical and regional capitals respectively. The South-East houses two major commercial cities; Aba and Onitsha which are of great contribution to the Gross Domestic Product (GDP). The presence of these markets has inflated the generated traffic on all the federal highways inter-linking all these ever-busy markets. Onolememen (2012) stated that the 80.84 km dual carriage Onitsha-Owerri highway as at 2012 has gulp the sum of ?19 billion in its construction cost representing 97% project completion. The loss of production hours before this time was enormous due to the high rise of externality factors arising from congestion, parking, and other environmental problems. The loss due to bad roads in Nigeria is valued at ?80 billion yearly, while additional vehicle operating cost resulting from bad roads is estimated at ?53.8 billion, bringing the total loss per annum to ?133.8 billion (Central Bank of ??igeria, 2003). This excludes the manhour losses in traffic due to bad roads and other emotional and physical trauma people go through on the road and the consequent loss of productivity.

Applying the 'cost causation principle,'a direct relation between traffic activity and resulting costs has to be made. Maintenance and some share of investment costs of surface layers are allocated accordingly by the 4th power of axle weights as recommended by the American Association of State Highway and Transport Officials (AASHTO) Road Test (Franziska, 2005). Therefore, determination of road user charges in South-East Nigeria will attempt to provide the unit charge payable by any road user in other to recover reasonably all the costs borne by the government in roadway costs. The questions we must ask are; which road user is responsible for the wear on the road? What cost was incurred to that effect? And on what basis is this allocated?

This paper would help the federal government make a good evaluation on how best to recover the cost of providing roadways, while increasing the budgetary allocation of the industrial sector vis-à-vis reducing the unemployment rate in the country at large. Therefore, is this method indeed a pathway to efficiency in road pricing in Nigeria? The aim of this paper is to determine road user charges as an empirical result by using the fourth power principle method of cost allocation to recover the capital and the maintenance cost per annum.

# 1 II. Methodology

The survey design was adopted for this study; this was due to the variability in capital and maintenance costs, and the traffic loads in different locations of the region. Traffic load depends on the rate of flow of road users measured in traffic volumes and the axle load measured in the Equivalent Standard Axle Load (ESAL).

A survey shows that the federal highways that go through the South-East includes; the Owerri-Umuahia, Enugu-Onitsha, Onitsha-Owerri, Abakaliki-Enugu, Enugu-Port Harcourt, Afikpo-Okigwe, etc. but more emphasis will be laid on the Onitsha-Owerri federal road and hence the study's sample size The paper presents the analysis of the survey on road user classification in South-Eastern Nigeria based on weight relevance. Various weights are converted to equivalent standard axle load (ESAL). It analyzed the results of the Annual Average Daily Traffic using the Average Daily Traffic (ADT) for seven-day volume counts. The Annual Vehicle Equivalent Standard Axle was computed, and the study estimated the road cost structure. The charge per different road user classification/category as calculated; hence, road user charges will then be determined.

# 2 III. RESULT AND DISCUSSION

# 3 a) Road user Classification in South-East Nigeria

Road user classification by vehicle weights in the South-Eastern Nigeria roads was shown according to the general classification of vehicles. This was done to avert the problem of lack of weigh-in-motion Bridge on our roads. Ordinarily, the 'Tricycles' is good component of the road users on this road but was neglected due to its insignificant weight to the ESAL and its short-distant journey purpose. Light private vehicles (LPV) which included passenger cars, jeep and vans and its weight category is from 1000 lbs to 6000 lbs, and this is the most frequent of the vehicle classification. Mini-buses are a very clear classification of road users in south-Eastern Nigeria; this forms the inter-city transport means in the region. It weighs between 6001 lbs to 14,000 lbs and the second traffic frequency.

Buses or trucks included all vehicles manufactured as traditional passenger-carrying buses and freight-carrying trucks with two axles to three axles and six tires. This includes; school buses, tippers. It weighs between 14,001 to 22,000 lbs. Trucks of multiaxles were used to categorize all trucks within the range of 22,001 lbs to 38,000 lbs. This group included the tippers that have 12,000 front axles and 17,500 rear axles, city bus which normally weighs from 25,000 lbs to 40,000 (25 to 60 passengers).The last group is the Heavy Construction Machinery and Earth-

Moving Equipment with an average weight of about 50,000 lbs. This included tankers, 1999 Mack (56,000lbs), 1999 Volvo trailer (52,000 lbs) etc. This classification is a typical developing nation's type adopted from India's practice, for many developed nations has over 600 different classifications. The data-collection periods consisted of 7 consecutive days; its average was taken and was converted into the annual ADT by multiplying each data by 365 representing the number of days in a year as shown Table 4. Figure **??** shows the traffic of different road user category based on the hours of the day, while Table 4 shows the representation of total road users' traffic. The annual roadway costs are divided by the ESAL-km (see table 5), the charge per ESAL-km is obtained. Therefore the road user charges were finally gotten by multiplying the charge per ESAL-km by the ESAL of individual road users as shown in Table 6. The results above are the empirical results for which this research was designed and expected to produce.

# 4 AADT by Road user Category

# 5 IV. Conclusion

This paper aimed at ascertaining the average weight of the road user classification converted into its equivalent standard axle of 80kN (18,000lbs) as provided by the fourth power principle. An AADT was obtained using the ADT data of a seven-day counting. The annual equivalent standard axle load on the sample road of individual road users' category was calculated and further divided the estimated roadway cost to ascertain the charge per ESAL-KM. The empirical results were determined by multiplying these charges per ESAL-KM and the individual ESALS. In spite of what is often seen as disadvantages of road pricing, charging for road use through the fourth power principle has shown clearly the damaging power of the axle loads regarding the charges, and road users with higher ESAL pay higher charges than those of lesser ESAL. In fact, the current situation of most of the South-Eastern Nigeria roads has led to more vehicle operating cost than the liabilities of these user charges and therefore has guaranteed minimal externality costs. [1] [2] [3]

*[Note: results: Tricycles and light passenger vehicle charges are negligible, Minibuses to pay ?0.98/km, Trucks and Buses to pay ?11.6/km, vehicles with multi-axles to pay ?17/km, and Heavy Construction Machinery and Earth Moving Equipment to pay ?41.59/km to recover the ?517 million computed as the annual roadway cost. Road user charges must serve the essential function of rationing the available supply among many possible demands.]*

Figure 1:

**1**

| Road user Classification | Weight Range (lbs) | Average Weight (lb |
|---|---|---|
| Light Private Vehicles | 0-6,000 | 3,000 |
| Mini-Buses | 6,001-14,000 | 10,000 |
| Trucks or Buses | 14,001-22,000 | 18,000 |
| Vehicles of Multi-axles | 22,001-38,000 | 30,000 |
| Heavy Construction Machinery and Earth Moving Equipment | 38,001-above | 50,000 |

b) Conversion to ESAL using the Fourth Power Principle Based on AASHO road test results, the most common approach is to convert wheel loads of various magnitudes to an equivalent number of "standard" or "equivalent" loads. The most commonly used loa Nigeria is the 18,000lbs (80kN or 8.16kips). This obtainable in many parts of the world.

Using the fourth power rule of thumb: ?????????? ?? = ? ?? ?? ??

A 30,000lbs road user will have an ESAL of ? 30,000 ? 4 / 18,000

Table 3 shows the load equivalency factor computed by the American Association of State Highways and Transport Officials (ASSHTO) to standardize it.

Figure 2: Table 1 :

**2**

| Road user Classification | Average Weight (lbs) | Description | ESAL |
|---|---|---|---|
| Light Private Vehicles | 3,000 | Single axle | 0.0003 |
| Mini-buses | 10,000 | Single axle | 0.118 |
| Trucks or buses | 20,000 | Single axle | 1.4 |
| Vehicles of Multi-axles | 40,000 | Tandem axle | 2.06 |
| Heavy Construction Machinery and Earth Moving Equipment | 50,000 | Tandem axle | 5.03 |

Figure 3: Table 2 :

**3**

| Axle Type (lbs) | Axle Load | | Load Equivalency Factor (LEF) | |
|---|---|---|---|---|
| | (KN) | (lbs.) | Flexible | Rigid |
| | 8.9 | 2,000 | 0.0003 | 0.0002 |
| | 44.5 | 10,000 | 0.118 | 0.082 |
| Single Axle | 62.3 80.0 | 14,000 18,000 | 0.399 1.000 | 0.341 1.000 |
| | 89.0 | 20,000 | 1.4 | 1.57 |
| | 133.4 | 30,000 | 7.9 | 8.28 |
| | 8.9 | 2,000 | 0.0001 | 0.0001 |
| | 44.5 | 10,000 | 0.011 | 0.013 |
| | 62.3 | 14,000 | 0.042 | 0.048 |
| | 80.0 | 18,000 | 0.109 | 0.133 |
| Tandem Axle | 89.0 | 20,000 | 0.162 | 0.206 |
| | 133.4 | 30,000 | 0.703 | 1.14 |
| | 151.2 | 34,000 | 1.11 | 1.92 |
| | 177.9 | 40,000 | 2.06 | 3.74 |
| | 222.4 | 50,000 | 5.03 | 9.07 |
| | | | | Source: Aashto 1993 |

Figure 4: Table 3 :

**4**

| Road user Classification | AADT (units) |
|---|---|
| Light Private Vehicles | 900,000 |
| Mini-buses | 300,000 |
| Trucks or buses | 200,000 |
| Vehicles of Multi-axles | 100,000 |
| Heavy Construction Machinery and Earth Moving Equipment | 50,000 |

Figure 5: Table 4 :

**1**

Year
4
Volume XVIII Issue II Version I ( )

Percent

Road users by Hour of the Day

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100% | | | | | | | | | | | | | | | | | |
| 90% | | | | | | | | | | | | | | | | | |
| 80% | | | | | | | | | | | | | | | | | |
| 70% | | | | | | | | | | | | | | | | | |
| 60% | | | | | | | | | | | | | | | | | |
| 50% | | | | | | | | | | | | | | | | | |
| 40% | | | | | | | | | | | | | | | | | |
| 30% | | | | | | | | | | | | | | | | | |
| 20% | | | | | | | | | | | | | | | | | |
| 10% | | | | | | | | | | | | | | | | | |
| 0% | 06.00-07.00 | 07.00-08.00 | 08.00-09.00 | 09.00-10.00 | 10.00-11.00 | 11.00-12.00 | 12.00-01.00 | 01.00-02.00 | 02.00-03.00 | 03.00-04.00 | 04.00-05.00 | 06.00-07.00 | 08.00-09.00 | 10.00-11.00 | 11.00-12.00 | 12.00-01.00 | |

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Figure 6: 1 :

**5**

| | | | | | |
|---|---|---|---|---|---|
| 10,00,000 | | | | | |
| 9,00,000 | | | | | |
| 8,00,000 | | | | | |
| 7,00,000 | | | | | |
| 6,00,000 | | | | | |
| 5,00,000 | | | | | |
| 4,00,000 | | | | | |
| 3,00,000 | | | | | |
| 2,00,000 | | | | | |
| 1,00,000 | | | | | |
| 0 | | | | | |
| Light Private Vehicle | Mini-Buses | Buses or Trucks | Multi-axled Trucks | Heavy Construc Machiner |

| Road Way Expenditure | Amount (?) |
|---|---|
| Depreciation of Capital Investment | 285,000,000 |
| Maintenance or Operation Cost | 19,100,000 |
| Highway Administration | 5,000,000 |
| Highway Patrol and Safety | 12,000,000 |
| Interest on Capital | 16,625,000 |
| Expenditure on Road Pricing | 165,000,000 |
| Other Externalities | 15,081,750 |
| Total | 517,806,750 |

Figure 7: Table 5 :

**6**

| Road User Classification | Road user Charges per Vehicle (?) |
| --- | --- |
| Light Private Vehicles | 0 |
| Mini-buses | 79 |
| Trucks or buses | 938 |
| Vehicles of Multi-axles | 1,380 |
| Heavy Const. Machinery Earth Moving Equipment | 3,369 |

Figure 8: Table 6 :

**7**

| Road User Classification | Road user Charges (?) per Km |
| --- | --- |
| Light Private Vehicles | Negligible |
| Mini-buses | 0.98 |
| Trucks or buses | 11.6 |
| Vehicles of Multi-axles | 17.0 |
| Heavy Const. Machinery Earth Moving Equipment | 41.59 |

Figure 9: Table 7 :

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[3]© 2018 Global JournalsDetermination of Road user Charges in South East Nigeria: An Empirical Survey

[Switzerland and Canada] , Transport Switzerland , Canada . www.tc.gc.ca

[Onolememen (2012)] *11 Road Projects Coast FG ?498b in 1 Year*, M Onolememen . www.nanngronline.com 2012. April 24. 2012. (NAN-H-80. Roads Abuja)

[Ogwude (2011)] 'Available online at www'. I C Ogwude . .transcampus.org/journals.www.ajol.info/journals/jorindon *Transport Infrastructure and Mobility in Nigeria. JORIND*, 2011. 2011 June. 9 p. .

[Ugboaja and Ukpere (2011)] 'Determining Economic Sustainability of Nigerian National Transport Policy'. P C Ugboaja , W I Ukpere . http://www.academicjournals.org/AJBMon *African Journal of Business Management* 1993-8233. 2011. 2011 March 1. 5 (8) p. .

[Draft National Transport Policy Federal Government of Nigeria ()] 'Draft National Transport Policy'. *Federal Government of Nigeria* 2010.

[Borer ()] *Study of Methods of Road Capital Cost Estimation and Allocation by Class of user in Austria*, Franziska Borer , Blindenbacher . 2005. Germany 55%.

[Anderson ()] *The Public revenue and economic Policy in African Countries*, Dennis Anderson . 1987. Washington, DC: World Bank. (World Bank Discussion Paper 19)

[William and Kelly ()] 'User Charge Financing of Urban Public Services Africa'. Fox William , Edminton Kelly . *Georgia: Andrew young School of Policy Studies* 2000.