# TRANSPORT AND VEHICLE CHARACTERISTICS IN THE CITY OF DAR ES SALAAM, TANZANIA

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## ABSTRACT

**Dar es Salaam city is the principal center of administration, social and economic activities in Tanzania. With a population of over 2.5 million people in total area of 1,300 square kilometres, Dar es Salaam city is among the most highly populated areas of Tanzania.**

**The city is believed to accommodate nearly half of the total road vehicles in the country. A government owned bus transporter (UDA) and a fleet of private operators commonly known as "Daladala" provide city public transport.**

**The city is served by approximately 1,150km of roads network system of a hierarchy of arterial, collector and local roads. The local roads comprise most of the network, constituting 81 percent of total classified roads. While all arterial roads are paved, the figure for collector and local roads is 80 percent and 39 percent respectively. The current efforts of road maintenance under assistance from the Japan International Cooperation Agency (JICA) will reduce the percentage of deteriorated roads to about 67 percent.**

**This paper describes the findings of a research that was carried out in the city of Dar es Salaam to obtain vehicle operating characteristics. The study involved 427 vehicles (105 cars, 140 buses, 142 trucks and 40 motor cycles).**

**Research findings established typical vehicle operating characteristics in cities of the developing world. Of important, the characteristics established include vehicle makes and conditions thereof, distance traveled per day, average fuel consumption per day, vehicle operating cost, roads condition and roads congestion, vehicle maintenance, drivers' behaviour and social aspects. The paper concludes by recommending ways to improve the negative characteristics.**

## 1. INTRODUCTION

Dar es Salaam city and region (Fig. 1) is the biggest city of Tanzania and the principal centre of administration, social and economic activities. The city lies off the Indian Ocean between longitude 39° and 39° 33´ east and between latitudes 6° 33´ to 7° 11´ south of the Equator. Total coverage area for Dar es Salaam is 1,350 square km and is occupied by over 2.5 million inhabitants.

Nearly half of road vehicles in Tanzania are based in the city of Dar es Salaam and they consume 42% and 35% of all petrol and diesel sold in the country respectively. The respective percentage share for the next biggest fuel consumer city, Arusha, is 9% and 7% respectively (TPDC, 1995).

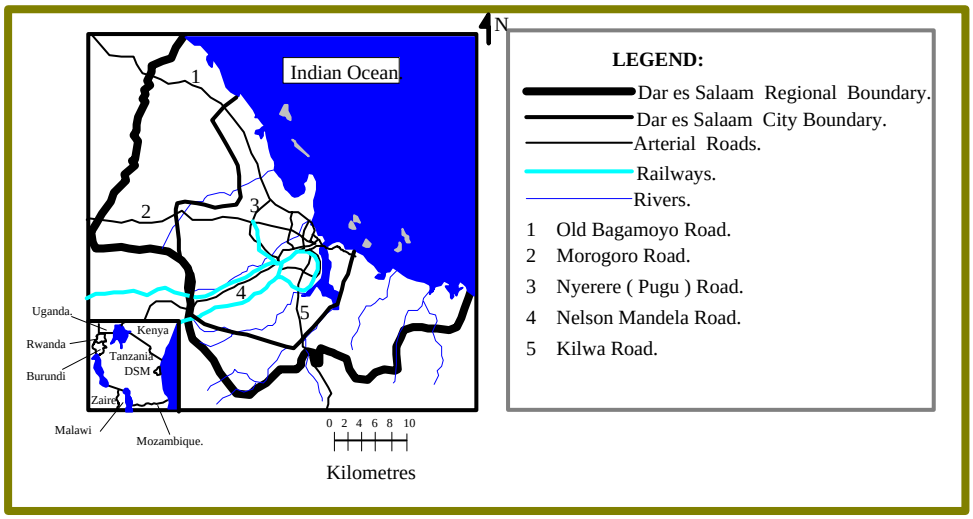


**Figure 1. Dar es Salaam city.**

Dar es Salaam city is served by approximately 1,150 km of roads network system of a hierarchy of arterial, collector and local roads (Table 1). Arterial roads occupy 13% of total classified roads while collector and local roads constitutes 6% and 81% respectively. The 148 km of arterial and 65 km of collector roads are paved while 61% of local roads are not paved. The current city roads maintenance and reconstruction project being executed in collaboration with the Japan International Cooperation Agency (JICA) will reduce the percentage of deteriorated roads from 80% to about 65%.

A government owned bus transporter (UDA) and a fleet of private operators commonly known as "Daladala" provide public transport. Other transport facilities for Dar es Salaam include Dar es Salaam International Airport; a port with container terminal; two railway lines: Tanzania Zambia Railway Authority (TAZARA) and Tanzania Railways Corporation (TRC); and a fleet of private buses. These facilities connect the city to upcountry regions and to neighbouring countries.

**Table 1. Existing classified roads in Dar es Salaam (JICA, 1990).**

| | CLASSIFICATION | LENGTH (KM) | % OF TOTAL |
|---|---|---|---|
| 1 | **Arterial roads** | 148 | **(13%)** |
| | 4 lane | 35 | 24% |
| | 2 lane | 113 | 76% |
| 2 | **Collector roads** | 65 | **6%** |
| | 2 lane paved | 52 | 80% |
| | 2 lane unpaved roads | 13 | 20% |
| 3 | **Local roads** | 933 | **(81%)** |
| | 2 lane paved | 251 | 39% |
| | Minor unpaved roads | 682 | 61% |
| | **TOTAL** | 1,146 | |
| | Paved roads | 451 | 39% |
| | Unpaved road | 695 | 61% |

## 2. RESEARCH METHODOLOGY

Two main research methods were applied in this study, statistical sampling and the use of questionnaires. The appropriateness of each method was determined by the area of application. In addition to these major research methods, observations and interviews were widely applied where necessary.

All research methods were applied to determine vehicle makes. Vehicle status, road condition and drivers' behavior was investigated using questionnaires and by observation. Statistical sampling was useful in determining the two proportions; the proportion of motor vehicles in Dar es Salaam and the proportion of diesel versus petrol propelled vehicles. The proportion of motor vehicles was obtained by statistical sampling. It was obtained using vehicles' particulars obtained at the Central Registry of Motor Vehicles (CRMV), National Insurance Corporation (NIC) and the Government internal revenue office. Proportion of type of fuel used for propulsion was obtained from the Central Registry of Motor Vehicles and from the National Insurance Corporation. It was decided to take a random sample of 300 vehicles (at a group of 100 vehicles each) from NIC and other 100 from CRMV, making a total of 400 sampled vehicles. The sample was further redistributed into smaller samples of 50. Sample averages of 50s joined to provide group mean of 100 and, the four groups providing the population proportion of motor vehicles. A total number of 500 questionnaires were distributed to stratas of each vehicle class forming a sample size of 50 questionnaires per each vehicle class. 426 questionnaires were collected (85%) with minimum and maximum collection being from taxis (33 questionnaires) and large buses/trucks (50 questionnaires), Table 2.

**Table 2. Questionnaire distribution and response.**

| NO | STRATA DESCRIPTION | DISTRIBUTED | COLLECTED |
|---|---|---|---|
| 1 | Motor cycles | 50 | 40 |
| 2.1 | Saloon cars | 50 | 34 |
| 2.2 | Commercial passenger cars (Taxis) | 50 | 33 |
| 2.3 | Station wagons | 50 | 38 |
| 3.1 | Large buses | 50 | 50 |
| 3.2 | Min-buses | 50 | 48 |
| 3.3 | Micro-buses | 50 | 42 |
| 4.1 | Heavy goods trucks | 50 | 50 |
| 4.2 | Medium goods trucks | 50 | 47 |
| 4.3 | Light goods trucks | 50 | 44 |
| **TOTAL** | | **500** | **426** |

## 3. RESEARCH FINDINGS AND DISCUSSIONS

Discussions to the research findings as contained in this section are based on the research design and methodology described in the previous sections.

3.1 Proportion of Motor Vehicles in Dar es Salaam

These proportions were obtained by averaging strata means from both the central Registry of Motor Vehicles and from the National Insurance Corporation. It was established that the proportion of diesel propelled vehicles was 55.32% whilst that for petrol was 44.68%.

The types and proportions of motor vehicles plying the roads of Dar es Salaam city were established. The percentage of cars was obtained to be 46.81% (with saloon cars being 26.39% and station wagons 20.42%); buses 7.94% (microbuses 5.75%, mini buses 2.5% and large buses 0.75% - as established from CRMV and NIC); goods trucks 29.17% (light goods trucks 19.25%, medium goods trunks 1.75% and heavy goods trucks 7.25%); motor cycles 10.80%; tractors/earth movers 2.71% and trailers 2.57%.

Of interest is the overwhelming number of private saloon cars (46.81%) against that of public transport buses 7.94%. Saloon cars for city transportation are not sustainable because they consume more energy and they emit more $CO_2$ per passenger-km, see Tables 3 and 4.

**Table 3. Energy consumption and carbon dioxide emissions by mode.**

| MODE OF TRANSPORT | ENERGY CONSUMPTION (MJ/PASSENGER-KM) | $CO_2$ EMISSION (g/PASSENGER-KM) |
|---|---|---|
| Car | 2.7 | 191 |
| Bus | 2.2 | 161 |
| Rail | 1.6 | 147 |
| Cycling | 0* | 0 |
| Walking | 0* | 0 |

(Richardson et al., 1993)
*Excluding renewable human energy.

**Table 4. Car pooling and modal energy requirements (Underwood, 1979).**

| MODE OF TRAVEL | AVERAGE NUMBER OF OCCUPANTS | MODAL ENERGY (kJ/PASSENGER-KM) |
|---|---|---|
| Single occupant vehicle | 1.0 | 8,900 |
| Average car | 1.4 | 6,400 |
| Car pool | 3.0 | 3,400 |
| Van pool | 9.0 | 1,500 |
| Dial-a-ride | 1.6 | 10,700 |
| Bus | 11.5 | 1,900 |

A shift to public transport or pooling (car pool or van pool) is desirable. Alternatively, people should be encouraged to move from their cars to buses. The encouragement can be done by removing the generally poor operating environment for buses so that they can run efficiently and at less cost to operators.

Of the 7.94% proportion of buses to total vehicles in Dar es Salaam microbuses takes 5.75% while mini buses and large buses take 2.50% and 0.75% respectively. Due to their small size and capacity microbuses can maneuver easily through congested roads and they have smaller waiting times at bus stops. However, microbuses pose a danger of worsening road congestion if they are not well managed and since they also need to be in larger numbers to serve a particular route.

3.2 Vehicle Makes

The trade liberalization that was introduced in Tanzania in early 90's saw various vehicles being imported from around the world. This study revealed that Japan is the major supplier with a percentage of 74 of all vehicles surveyed. The next major supplier being the United Kingdom (7.5%) followed by France (4.75%), Italy (2.75%), Korea (2%) and Germany (2%). The rest of motor vehicle suppliers sharing the remaining percentage.

The free importation of vehicles into Tanzania has drawbacks to their serviceability because after sales service is not assured. Contrary to original car dealers, most individual importers are not stocking spares and they lack the expertise to handle specialized maintenance.

About 54.76% of all motor vehicles under research were imported as new, 22.39% as used and 22.85% as reconditioned. Most motorcycles (95%) were imported in new condition. Very few microbuses and saloon cars were imported in new condition, 7.14% and 23.8% respectively. On the other hand, most heavy goods trucks (80%) and large buses (64%) were imported as new.

The imported condition statistics cited above shows that Tanzania becomes a market for cheap second hand vehicles. The situation arises, possibly, due to the low incomes in this city of the developing world. However, used vehicles are expensive in the long run because they consume more spares and fuel. The other major drawback of used cars is due to the fact that they miss

recently developed automotive technologies that are geared toward improved engine efficiency. Research findings supported this by revealing that 95% of the researched vehicles were having no single modern electronic computer controls in them.

3.3 Average Distance Traveled per Day and Average Fuel Consumption per Day

As shown in Table 5 it was found that saloon cars travels 51.38 km per day, station wagons 111.71 km, taxis 92.27 km, microbuses 176.31 km, minibuses 188.63 km, large buses 227.78 km, light goods trucks 125.48 km, medium goods trucks 94.38 km and heavy goods trucks 109.10 km. Motorcycles travel 55.40 km per day.

Average fuel consumption per day for saloon cars was 9.35 litres, station wagons 17.24 litres, and taxis 15.27 litres. The Consumption for microbuses, minibuses and large buses was 35.10 litres, 43.02 litres and 60.56 litres respectively. For light goods trucks, medium goods trucks and heavy goods trucks, average fuel consumption was found to be 16.61 litres, 22.11 litres and 42.16 litres respectively. Average fuel consumption per day for motorcycles was 3.01 litres.

The figures indicated for average distance traveled per day and that of average fuel consumption per day are just indicative because no actual measurement were taken. In some cases, for a particular mode of car there's no direct relationship between the figures established for distance and fuel consumption.

**Table 5. Average fuel consumption and average distance traveled per day.**

| Vehicle strata | Average Distance traveled per day [km] | Average fuel consumption per day [litres] |
|---|---|---|
| Saloon car | 51.38 | 9.35 |
| Station Wagons | 111.71 | 17.24 |
| Taxis | 92.27 | 15.27 |
| Micro buses | 176.31 | 35.10 |
| Mini buses | 188.63 | 43.02 |
| Large buses | 227.78 | 60.56 |
| Light trucks | 125.48 | 16.61 |
| Medium trucks | 94.38 | 22.11 |
| Heavy trucks | 109.10 | 42.16 |
| Motor cycles | 55.40 | 3.01 |

3.4 Roads Condition

A great portion of city roads is in poor condition and some suburb roads are impassable. Other road problems include missing road signs, malfunctioning traffic lights, no street lighting and impaired and or missing drainage system.

As shown by the response from vehicle operators the working environment to the vehicles is not optional. 7.48% of all interviewed operators reported that all distance traveled per day is of poor surface. 26.36% said that more than ½ of road traveled daily is of poor surface while 24.02%, 23.37% and 18.77% reported that poor surface condition constituted about ½, less than ¼ and none at all respectively.

There is a considerable number of operators who reported to travel on good road surface. It is either because they are appreciating the ongoing road repairs and improvement or they are restricting their vehicles on good roads only. The effects of poor roads surface to vehicles is through increased breakdown rates, increased rolling resistance and reduced speed of travel. In this situation vehicles consume more fuel and spares, consequently, vehicle's operating cost becomes high.

3.5 Road Congestion

Road congestion is on the increase in Dar es Salaam roads. 97.44% of interviewed operators agreed that roads congestion has some negative effects to them, 19.82% of all interviewed operators reported that roads congestion has negligible effects on fuel consumption. 17.76%, 16.01%, 33.94% and 12.47% felt the effects to be low, medium, high and very high respectively. The reported effects of roads congestion to increased time of travel was 9.79%, 6.58%, 23.27%, 39.46% and 20.91% for negligible, low, medium, high and very high respectively. The response shows that vehicle operators are highly affected by the existing road congestion.

Causes of the reported road congestion, arranged in decreased importance, were mentioned to be narrow roads, poor roads, driver behaviour, poor road surfaces, faulty traffic lights and inefficient traffic policemen.

Estimates of economic losses associated with traffic congestion are generally high. The direct effects being loses in productivity due to long commuting times are high transportation costs for goods. Furthermore, chaotic traffic conditions, more road accidents, low air quality and traffic noise are some social effects.

The solution to such transport problems in the cities is not simply to construct more freeways nor is it simply to construct new railways. But travel demand on the transport system must be managed [Richardson et. Al, 1993; Sathaye, 1994; Hutchinson and Black, 1978; Whitelegg, 1991; Ang, 1993]. Some transport management techniques that find useful application in decongestion measures include increasing roads capacity; linking traffic signal systems; improvement to the public transport systems; provision of one way streets; parking prohibition; control of vehicle population; staggering hours of activities and road pricing.

3.6 Drivers' Behaviour

Generally public bus drivers were characterized by high speed driving that was associated with frequent on-road stoppages. The study showed that about 12.82% of drivers preferred to drive at 30-50 km/hr speeds while 71.75%, 14.36% and 1.07% preferred 50-90 km/hr, 90 –120 km/hr and over 120 km/hr respectively.

3.7 Motor Vehicles Maintenance

This study showed that regular maintenance and planned maintenance was unpopular to many operators since most of them used breakdown maintenance policy. However, over 90% of all operators were prompt in changing engine oil and in general lubrication.

Since 79.33% of interviewed operators admitted that the cost of maintenance is either expensive or very expensive it shows that monetary constraint was the main cause of ineffective maintenance. Other reasons being unavailability of spare parts, ignorance and negligence. In such situations of poor maintenance it is difficult to find vehicles that operate at their designed characteristics.

About 15.17% operators used well-established garages and car dealers for overhaul and breakdown maintenance. Most operators claimed that these garages were bureaucratic in operation and that service charges were always inflated. Although specialized vehicle maintenance equipment is usually available from these well-established garages it is difficult to find that these vehicles are properly maintained. Without the use of specialized equipment the exactness of different timing settlings depend solely on the fitter’s experience.

3.8 Availability of Spare Parts

In general, most operators (58.55%) saw that spares for maintenance were readily available. However, 4.45% experienced scarcity. Unavailability of spare parts was noticed to some unique makes that had no dealers to import and provide after sales service to them.

3.9 Road Worthiness of Motor Vehicles

Dar es Salaam city authority, the Ministry of Communication and Transport and even the traffic police have set no effective legislation on roadworthiness. Obsolete designs are still operating; they are kept on the road depending on modified spare parts. Unroadworthy vehicles are major causes to environmental pollution and accidents.

Over all vehicle stratas observed, the percentage of defective vehicles for each strata ranged between 57.14% and 88.62%. Given that the judgement based on owners' experience without the use of special measuring equipment this is certainly a high rate of defectiveness. Contributing factors to this rate includes poor roads condition coupled with improper maintenance.

## 4. CONCLUSIONS AND RECOMMENDATIONS

A large proportion of Dar es Salaam roads needs maintenance or reconstruction. This should be done in such a manner that will improve sustainability of urban transport.

Second hand vehicles that are freely imported in Tanzania have some negative impacts to the environment and inflate vehicle operating cost. The Government should encourage importation of new vehicles through fiscal measures or should encourage local investments in automotive industry. Furthermore, roadworthiness registration, which will monitor the condition of vehicles, should be introduced.

Road management techniques should continue to be applied by Dar es Salaam city authority so as to decongest and to limit further congestion to city roads.

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