Acceptability of Sustainable Logistics Measures for Fuel Distribution by Tanker Trucks in Nigeria

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ARTICLE INFO
Keywords: Acceptability, Sustainable Logistics, Trucks, Fuel Distribution

ABSTRACT

Globally, greater attention is being paid to sustainable logistics practices due to the increasing negative impact of urban freight logistics on the environment. Urban logistics stakeholders are faced with the challenge to adopting measures to mitigate the negative impacts of freight logistics operations. This study evaluates the acceptability of sustainable logistics measures. This study adopted a cross-sectional and quantitative survey design. According to Creswell (2014), quantitative research involves the analysis of numerical data using statistical methods. This study used a purposive sampling technique for the distribution of 300 structured questionnaires to stakeholders in the oil industry including other road users in Lagos, Nigeria. The results from the analysis show that respondents accepted (are in support) all the sustainable freight logistics measures. The measures with the highest acceptability (strongest support) are the measures for traffic control, followed by the measures for traffic diversion, and lastly measures for traffic reduction.)

DOI: https://doi.org/10.59890/ijir.v2i5.1567
ISSN-E: 2988-2184
https://journal.multitechpublisher.com/index.php/ijir

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INTRODUCTION

Despite the significant contribution of urban freight logistics to the economy and functioning of a city, government and policymakers focus more on urban public transport (Rodrigues, 2006). Urban freight logistics has negative impacts on humans and the environment namely: congestion, accident, air and noise pollution, etc. (Zunder et al, 2016). Given the negative impacts, there is a need for greater attention toward sustainable freight logistics practices. The concept of sustainable freight logistics is aimed at implementing bundles of measures in order to optimize the positive and negative impacts of urban freight operation. The focus of this study is on sustainable freight logistics measures. To ensure economic growth and sustainable development, there is need for adoption of sustainable logistics practices for delivery of products most importantly in economies that rely heavily on fossil fuels. An inefficient freight logistics system has negative impacts on productivity, environment (congestion, air pollution etc.) and humans (accident etc.).

Nigeria has an average of about 5,000 tankers involved in wet cargo haulage, and 2,500 trailers in dry cargoes plying Nigeria’s roads daily. The consequence of the large numbers of freight vehicles is protracted urban transport problems of which Lagos State is the worst hit considering the astronomical increase in the numbers of both passengers and freight vehicles in the city (Olagunju, 2011). Nigeria has witnessed an increasing rate of tank truck explosions and accidents as a result of bad road, drunk driving, driver fatigue, poorly maintained trucks, axle load issues, poor load retention, speed, poor visibility and wrong parking of trucks on the highway. Tank truck crashes cause truck damage, loss of load, damage to property of third parties and present a risk to other road users.

According to FRSC (2018), the principal causes of fuel tanker crashes include: Non-adherence to road traffic safety practices, Inadequate driver’s training/certification and re-training leading to drivers’ errors, Inadequate provision of tanker/trailers parks across the country, Aging trucks and lack of fleet renewal programs, Security challenges and lack of clear-cut policy on tanker/truck transit in Nigeria, Non-adherence to standards by operators and by tank constructors, Alteration of original design value of truck heads and/or trailer, Bad state of the nation’s roads, Parking on unauthorized location along the road, Failure to install Speed limiting Device etc.

In recent years, governments all over the world have generated considerable interest in sustainable freight logistics measures. Adoption of more environmentally friendly and sustainable logistics measures is necessary for the mitigation of the negative impacts. (Eriksson et al, 2006). According to Boltze (1996) sustainable logistics measures can be categorised into: measures for traffic
reduction, measures for traffic diversion and measures for traffic control. Traffic reduction measures are targeted at reducing urban freight traffic (e.g. regulation on parking spaces to prevent disturbance due to freight delivery vehicles), while traffic diversion measures seek to influence spatial shift of traffic (i.e. destination choice of traffic), temporal shift of traffic (i.e. time choice/delivery time) and modal shift of traffic (i.e. from road to rail, from diesel to electric engine). Traffic control measures aim to influence route choice and driving behaviour such as implementation of truck routes, information and guidance system, speed limits, truck prioritization at signalised intersections, designation of truck only lanes, driver training for carriers etc.

However, there is a need to consider the acceptability of the sustainable logistics measures, because lack of acceptability is a barrier to implementation of the measures (Garling & Loukopoulos, 2007). The effectiveness of sustainable logistics measures in mitigating the negative impacts urban freight operations depends on acceptability of the measures (Schade, 2003). A thorough understanding of acceptability is essential in selecting appropriate sustainable logistics measures (Eriksson et al, 2008).

The acceptability of the measures by key stakeholder groups including the public, truck drivers, and owners is very critical for its success. This study aims to investigate the acceptability of sustainable logistics measures for fuel distribution by tanker trucks in Nigeria. Acceptability is referred to as the prospective evaluation of measures to be implemented in the future (Schade, 2017). Acceptability of sustainable logistics measures is the degree of evaluation of sustainable logistics measures that may be introduced in the future (Schade, 2003; Eriksson et al, 2006). Acceptability of sustainable logistics measures is an indication of readiness to act pro-environmentally (Eriksson et al, 2006).
LITERATURE REVIEW

Before the discovery of crude oil in Nigeria in 1956, agriculture was the main source of revenue. Presently, crude oil provides 95% of Nigeria’s foreign exchange earnings and 65% of Nigeria’s revenue (Akpongomeh & Badejo, 2006). It is estimated that 40 million liters of refined petroleum products are consumed daily in Nigeria (Eboh and Ejoh, 2014). In Nigeria, movement of fuel starts from the point of exploration to refineries, from refineries to storage depots and finally from depots to gas stations where they are sold to final consumers. Pipelines are used for the movement of crude oil from the point of exploration to the refineries and from the refineries to the storage depot, while the last mile delivery to the gas stations is done using tanker trucks (Adenikiju & Falobi, 2006; Aminu & Olawore, 2014). Due to the destruction of pipelines by vandals and breakdown of freight train, road has been the main mode of delivering petroleum products with the modal share of 82% with a heavy reliance on tanker trucks for fuel delivery. According to Obasanjo et al (2014), about 5000 tanker trucks are used to deliver 150 million liters of fuel to gas station daily. The tanker trucks have to move a long distance covering several kilometers on a bad road with poor infrastructure. Distribution of fuel by tank trucks is risky and expensive (Tordo et al, 2013). In Nigeria, an average tanker truck can carry a maximum of 33,000 liters of fuel. The capacity is quite limited compared to rail and pipeline modes (Moses, 2012). Fuel tanker trucks are faced with challenges such as bad roads, frequent accidents, breakdown of trucks on the highway, explosion and spilling of fuel on the road causing fire outbreak and death of other road users (Adenikiju & Folabi, 2006; Ehinomen & Adeleke, 2012) As such, many of the fuel trucks have been involved in road accidents most of which are fatal (Aminu & Olawore, 2014). Road accidents involving tanker trucks are caused by drunk driving, driver fatigue, poorly maintained trucks, axle load issues, poor load retention, speeding, poor visibility and wrong parking of trucks on the highway. Road accidents and crashes by tank trucks between 2007 and 2010 was 4,017 with 4,076 persons killed, 17,070 casualties, 12,994 people injured and 5,825 third party vehicles damaged or destroyed. According to the Nigeria Federal Road Safety Corps, the causes of tanker truck accidents and their frequencies are: dangerous driving (1038), speed violation (907).

Boltze et al (1996). The authors classified freight Transport Demand Management measures as: Measures for Traffic reduction: This involves regulation on parking spaces in land use plans to prevent disturbance due to delivery vehicles.

Measures for Traffic diversion: The measures seek to influence spatial shift of traffic (i.e. destination choice of traffic), temporal shift of traffic (i.e. time choice
delivery time) and modal shift of traffic (i.e. from road to rail, from diesel to electric engine).

Measures for Traffic control: This includes measures seeking to influence route choice and driving behavior such as implementation of truck routes, information and guidance system, speed limits, truck prioritization at signalized intersections, designation of truck only lanes, driver trainings for carriers.

To achieve sustainable urban freight logistics, sustainable logistics measures must be effective, acceptable and politically feasible (Garling and Schuitema, 2007). The importance of acceptability of sustainable logistics measures arises because the lack of acceptability is an obstacle to the introduction of the policy measures (Garling & Loukopoulous, 2007).

METHODOLOGY

This study adopted a cross-sectional and quantitative survey design. According to Creswell (2014), quantitative research involves the analysis of numerical data using statistical methods. This study used a purposive sampling technique for the distribution of 300 structured questionnaires to tanker truck drivers and owners, road safety officers, traffic management officials, Staff of the Nigerian National Petroleum Corporation, Fuel Depot workers and other stakeholders in the oil industry including other road users in Lagos, Nigeria.

The research instrument (questionnaire) for this study was developed using measurement scales identified from previous studies. Amendments were made to the selected items in order to fit into the context of this study. The questionnaire was divided into two sections. In the first section, the participants were asked to provide information about background data such as sex, age, income, educational qualification, employment status, employment type, marital status, number of children, number of cars and place of residence. The second section contained the items for each of the categories of sustainable logistics measures used in the research.

Before the full survey experiment, a pilot study was performed to examine the measurement instrument. The feedback from the respondents was taken and the instrument was refined for clarity and completeness. The pilot study received thirty responses. Using the data collected from the pilot study, a preliminary validity and reliability analysis was undertaken using SPSS software. The Cronbach’s alpha was calculated to examine the measurement reliability. The results of the data analysis revealed that all measurement items were loaded on the appropriate construct. Pretesting entails the use of few respondents to test the understanding and suitability of the questions to enable the researcher to make necessary amendments before sending the final questions to respondents (Sekaran & Bougie, 2016). The questionnaire was pretested for face validity using
transport researchers in Nigeria. The reliability test is used to evaluate the accuracy of the measurement items by accessing the internal stability and consistency of each item in each variable (Hair, Anderson, Black and Tatham, 1998). Cronbach’s alpha is a reliability coefficient that shows the extent of positive correlation among the items measuring a concept (Sekaran & Bougie, 2016). Alpha values range between zero (0.0) and one (1.0). The alpha value should be at least 0.70 or higher to retain an item to be used to measure intended concepts (Nunnally, 1978).

Data collected was analyzed using descriptive statistical analysis such as mean, standard deviation, frequencies, and percentages with the aid of data analysis software SPSS version 23.0. Sekaran & Bougie (2016) mention that survey questionnaire data can be reported using a descriptive statistical method such as frequency, percentage, mean, median, standard deviation and range.

The sustainable logistics measures used in this study are:

**Traffic reduction measures:**
- Regulation of tanker trucks parking to prevent disturbance of other vehicles and commuters

**Traffic diversion measures**
- Distribution of fuel using pipelines and freight trains
- Introduction of night delivery of fuel by tanker trucks
- Use of electric engine tanker trucks for fuel delivery
- Construction of more fuel depots to reduce the distance travelled by tanker trucks

**Improvement of security of fuel pipelines to prevent vandalism**

**Traffic control measures**
- Enforcement of the use of speed limiting devices by tanker trucks
- Enforcement of better loading and driving behaviour among fuel tanker drivers
- Ban on underage teenage tanker truck drivers
- Repair of bad road pavements to prevent tanker truck accidents
- Enforcement of the use of high grade materials for the construction of tanker trucks
- Enforcement of road worthiness certificates for fuel tanker trucks
Regarding the measurement of the sustainable logistics measures, the mean score for each of the three measures was used to determine the level of acceptability of the measures. A threshold of 3.0 was used based on the mean weights attached to the Likert response scales (Strongly Agree = 5, Agree = 4, Neutral = 3, Disagree = 2, Strongly Disagree = 1). If a particular measure has a mean value above the threshold of 3, it means the measure is acceptable. However, if a particular measure has a mean value below 3, it implies that the measure is unacceptable.

RESULTS

A summary of the characteristics of the study participants is presented in Table 4.1. The participants were adults with the majority (60%) aged between 35-54 years. In terms of Gender, 68% of the participants are male while 32% are females. Most of the respondents (66%) fall within the income category of N50,000.00 – N150,000.00. Regarding the level of education, most of the participants (52%) are holders of the first degree. In terms of employment status, 78% of the respondents are employed full time. Most of the participants (44%) work in the public sector, while 37% work in the private sector organisation. Concerning the marital status of participants, 84% of them are married, while 40% of them representing the majority have three (3) children in the household.

The results from the analysis show that respondents accepted (are in support) all the sustainable freight logistics measures. The measures with the highest acceptability (strongest support) are the measures for traffic control (mean: 3.78, standard deviation 1.095), followed by the measures for traffic diversion (mean: 3.765, standard deviation 1.494), and lastly measures for traffic reduction (mean: 2.895, standard deviation 1.305).
### Table 1. Descriptive Statistics of Measures

<table>
<thead>
<tr>
<th>Sustainable logistics measures</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
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<tbody>
<tr>
<td>Traffic control measures</td>
<td>3.78</td>
<td>1.095</td>
</tr>
<tr>
<td>Traffic diversion measures</td>
<td>3.765</td>
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</tr>
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<td>Traffic reduction measures</td>
<td>2.895</td>
<td>1.305</td>
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</tbody>
</table>

### DISCUSSION

Traffic reduction measures are targeted at reducing urban freight traffic (e.g. regulation on parking spaces to prevent disturbance due to freight delivery vehicles), while traffic diversion measures seek to influence spatial shift of traffic (i.e. destination choice of traffic), temporal shift of traffic (i.e. time choice / delivery time) and modal shift of traffic (i.e. from road to rail, from diesel to electric engine). Traffic control measures aim to influence route choice and driving behaviour such as implementation of truck routes, information and guidance system, speed limits, truck prioritization at signalised intersections, designation of truck only lanes, driver training for carriers etc.

### CONCLUSIONS AND RECOMMENDATIONS

In Nigeria and other developing countries of Africa, there are inherent challenges hindering the achievement of sustainable logistics practices. Some of the challenges identified in the literature included: Non-adherence to road traffic safety practices, Inadequate driver’s training/certification and re-training leading to drivers’ errors, Inadequate provision of tanker/trailers parks across the country, Aging trucks and lack of fleet renewal programs, Security challenges and lack of clear-cut policy on tanker/truck transit in Nigeria, Non-adherence to standards by operators and by tank constructors, Alteration of original design value of truck heads and/or trailer, Bad state of the nation’s roads, Parking on unauthorized location along the road, Failure to install Speed limiting Device etc. Based on the literature, sustainable logistics practices aimed at promoting environmental fuel tanker truck operation were classified into three viz: Traffic reduction measures, traffic diversion measures and traffic control measures.

This study examined the acceptability of sustainable logistics measures for fuel distribution by tanker trucks in Nigeria. The respondents expressed their
level of acceptability of measures for traffic control, traffic diversion, and traffic reduction. This study recommends that Government should consider the introduction of sustainable freight logistics measures starting with the measures for traffic control due to the high acceptability level.

**FURTHER STUDY**

This research still has limitations, so it is necessary to carry out further research related to the topic Acceptability of Sustainable Logistics Measures for Fuel Distribution. In order to perfect this research and increase insight for readers.

**REFERENCES**


