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Koozakar African Journal of Science Policy and Innovation Management OPEN ACCESS | PEER REVIEWED AJSPIM

An Exploratory Study of the Message System in the Public Transportation Sector in Nigeria: potentials as a low-carbon bottom-up social innovation

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Article information

https://doi.org/10.69798/01270122

2756 – 4118

ABSTRACT

Bottom-up social innovations are being used in the transportation sector with unintended outcomes for carbon emission reducing potentials. Activists and policy makers have called for studies on the potentials of such innovations in reducing carbon emissions to aid policy recommendations. This study explores the potentials of such an innovation in the transport sector in Nigeria of reducing carbon emissions. Called Message by users, this social innovation is used like an informal courier service to deliver items of trade, documents and medicine among others using the public transportation system. This social innovation saves users costs of transporting the items themselves using public or private transportation or formal courier services. Data on number of Messages sent was collected by personal observation at a public transport terminal for Ikeja bound passengers from Ile-Ife (towns in southwestern Nigeria) for seven days. Ninety-four Messages consisting of 106 items were observed to be sent at the terminal using the Message system during the period. Two scenarios that may lead to savings in carbon emissions were highlighted in the study; the first, if the sender boards a public transportation vehicle to deliver the item and the second, if private transportation was used rather than the Message system. The round-trip distance for the two options was estimated to be 400 Km. A six-passenger 2-litre engine public transportation vehicle which consumes an estimated 9L/100 Km was assumed for the study. The results showed that for the first scenario, 1,297.2 Kg CO2 will be produced and 7783.2 Kg CO2 for the second scenario if senders had used these alternatives other than the message system for the 94 Messages. The study concludes that the Message can be regarded as a Low-carbon Bottom-up social innovation and recommends public and/or private efforts to scale-up this innovation in other climes.

Keywords:
Bottom-up Social Innovations; Low-carbon Practices; Transportation Sector; Nigeria.

1. Introduction

The need for new approaches to providing mobility for the World's population has never been more urgent, challenging and complex.

Mobility is a major tool for achieving economic and social prosperity. It provides access to and facilitates spaces of economic activity, health care and education. Current models of mobility have however been found to be unsustainable. Air pollution from the transport sector accounts for over a quarter of carbon dioxide emissions. These emissions are not only the major cause of global warming, they are also responsible for deaths from respiratory diseases caused by traffic emissions. Existing mobility structures are also responsible for over a million road traffic fatalities each year. Most of these deaths have been reported to come from excluded groups in developing countries and they occur majorly among pedestrians, motor cyclists and mini-bus passengers. Another major challenge is that people living at the bottom-of-the-economic pyramid (especially women and children) have been majorly excluded from current mobility structures. Most developing countries are characterized by poor road network infrastructure and a high share of transport costs from household expenditure (Sustainable Mobility for All, 2019).

In addition, mobility structures in these countries have been modelled after those in developed countries, which mostly emphasize individualization of mobility. This model has further ostracized the poor from transport structures as most citizens from developing countries cannot afford vehicles of their own (Sustainable Mobility for All, 2019).

The dire need to provide solutions to these problems of mobility and access to excluded groups and reduce carbon emissions at the same time has called for innovative approaches. Technological solutions such as electric vehicles which have gained widespread recognition in developed countries have been found to be out-of-reach from people at the bottom of the economic pyramid in developing countries (Bergman, 2017). In addition, these innovations also encourage individualization of mobility. Scholars and policy experts have however called for more focus on social innovations or low-carbon social practices that aim to provide alternative means of mobility and access through reducing miles travelled by individuals and/or putting fewer cars on the road.

Social innovations have the capability to shift social structures towards more dynamic engagements with low-carbon social practices. Social innovations, especially those that evolve from informal settings usually develop to serve needs of excluded groups (Murray *et al*., 2010; Nuemeier, 2016). Low-carbon practices that develop in informal settings may however be less visible and even be at variance with the interests of existing power structures. This distance may cause a dearth of information, support and missed opportunities for developing policy mechanisms that may aid scaling these practices (Bergman *et al*., 2010; Murray *et al*., 2010; Qian and Zhou, 2021). It has been suggested that shifts or novelties in social orientation and governance structures may be the only viable means of providing access to sustainable mobility. These shifts highlight new social practices or innovations that may reduce carbon foot prints from human activities. As a matter of policy and focus of research, many countries and institutions have turned to social innovations to provide access to mobility structures.

Through social entrepreneurs, novel socio-cultural processes and political movements, social innovations have been developed, scaled and presented as solutions to reduce carbon emissions. A common example is Uber that provides access to ride sharing services. There is however other bottom-up social innovations in the transport sector whose original intention is not to reduce carbon emissions. The literature suggests that because of the locus and intention of their emergence, it may be necessary to examine their potentials as low-carbon practices by outcome (Bergman *et al*., 2010).

This study examines a wide spread bottom-up social innovation in Nigeria which has the potential of being used as a low-carbon social practice. Called the message (also the waybill in certain areas), this innovation is used like a courier service to deliver items of trade, documents and medicine among others using the public transportation system in Nigeria. An individual that wants to get a parcel, say a drug to a person in another town goes to the terminal where commercial vehicles that ply the route can be found. The sender simply hands over the parcel and phone number of the recipient to the driver of the vehicle. Once the price of transporting the parcel is agreed, the driver calls the recipient to agree on a point along the route where the recipient will receive the package. The call is repeated when the driver leaves the terminal with his full load of passengers and when approaching the agreed upon meeting point to ensure that recipient will be on hand to collect the package on time so as not to delay the progress of the vehicle and its passengers. This system, however crude and informal saves transport costs for users. The extent of its potential to reduce carbon emissions is however not known. This study aims to examine this potential.

2. Literature Review

Situating the *Message* in the social innovation literature

Social innovations have been found to hold great transformative potential. They can be new products, services or models that create social relationships and/or form new collaborations to address unmet social needs (Moulaert *et al*., 2017). They have also been described as new ideas motivated by social interactions that aim to provide solutions to meet social needs (Mulgan *et al*., 2007); change basic routines, resource flows and social systems (Westley and Antadze, 2010) and; transform legal, economic and policy regimes (Westley *et al*., 2014). This class of innovations has the potential to improve economic and social performance human capabilities and the efficient utilisation of assets and resources (Young Foundation, 2012).

The transformative potential of social innovations is borne from the fact that they can lead to the formation of new institutions, industries, policies, and forms of social interaction (Mumford and Moertl, 2003). Social innovations are now being used as a vehicle of socio-economic, -cultural, and -structural transformation. As a focus for policy and research, civil society, governments and business have turned to social innovations not only to provide social needs neglected by public and market mechanisms and dearth of inclusion in socioeconomic spaces and governance structures but also to address the negative environmental effects of technological advancement.

Low-carbon social innovation refers to new practices that contribute to reductions in carbon emissions. A social innovation can be defined as a low-carbon practice according to its intention by its promoters to be one or by its outcome. According to this view, new social activities intended to meet other unrelated social outcomes can be regarded as low-carbon practices if they end up reducing carbon emissions. Therefore low-carbon social innovations can be so delineated by the motivation or outcome (Markusson *et al*., 2010). Bottom-up low-carbon social innovation implies that the innovation is created by civil society rather than formalised private or public institutions and because of the locus of their emergence, formalising and scaling such innovations usually meets regulatory, institutional and resource barriers (Markusson *et al*., 2010).

Though the origins of the creation of the *Message* cannot be traced (and is not the purpose of this study), we deduce the social innovation to be a bottom-up social innovation created to reduce costs associated with logistics of moving people, items of trade and personal items and address challenges of inclusivity in mobility.

Background to Public Transportation in Nigeria

The public transportation system in Nigeria is controlled by two types of operators; the private operators and Government. The private operators can be further split in to two types, the private registered companies and those controlled by unions. Available data suggests that unions are estimated to control about 98% of all public transportation in Nigeria (Aderamo, 2010). The major unions are the National Union of Road Transport Workers, (NURTW), Luxury Bus Association of Nigeria (LUBAN) and Association of Commercial Motorcycle Riders of Nigeria (ACOMRN). Each of these unions has a different branch controlling a dedicated terminal where passengers board vehicles plying distinct routes between cities. The branch of union an individual belongs to is determined by the type of vehicle used for the transport business and the routes plied. Thus, an individual using a bus for transport will belong to a different branch of the union to one using a car or motorcycle even when plying the same route. As far as inter-city transportation is concerned, a branch of the Union controls the terminal from the point of departure while another branch manages the terminal at the city of destination (Aderamo, 2010).

3. Research Methodology

3.1. Data Collection

The study relied on primary data. The data was collected using observation techniques and interviews. The terminal chosen was for the Ile-Ife to Ikeja (Ojota terminal) route. Ile-Ife is a city located in Osun State in Southwestern Nigeria. It is about 200 km Northeast of Ikeja, the capital of Lagos. The coordinates of Ile-Ife are 7°28´N 4°34´E / 7.467°N 4.567°E and Ikeja's coordinates are 6°36´N 3°21´E / 6.60° N 3.35°E. Ile-Ife is the town of residence of the authors and the destination Ikeja, Lagos State was chosen because the State is the largest commercial hub in Nigeria. Data was collected at Lagos car transport service at Ile-Ife where passengers board 5/6-passenger vehicles to the Ojota terminal at Ikeja. One of the authors collected data at the Ile-Ife end of the route. Permission to collect data from the study was sought and obtained from the Chairman of the union of the Ile-Ife car passenger route. Data on the volume and types of items shipped was collected by observation. Since vehicles are loaded with passengers one after the other, the author recorded the number and types of items shipped by each vehicle by the *message* system. This data was collected for 7 days.

3.2. Framework for Carbon Footprint Calculation

The carbon footprint or carbon dioxide (CO_2) emissions in this study are characteristic of direct carbon emissions from fuel combustion by a vehicle used for public transportation. Thus, they are a function of vehicle footprints. Emission conversion factors facilitate the calculation of CO_2 emissions by multiplying them with activity data, expressed in their respective international units and converted into kilograms of carbon dioxide equivalent (kg CO_2e). CO_2e is the universal unit of measurement to indicate the global warming potential (GWP) of greenhouse gases (GHGs), expressed in terms of the GWP of one unit of carbon dioxide as seen below.

$$GHG\ Emissions = Activity\ data \times Emissions\ Conversion\ factor = kgCO_2e/l \ \ldots (1)$$

Calculating the direct vehicle emissions in this study entailed using an estimated vehicular fuel economy and CO_2 emissions of 2.3 kg per litre of petrol consumed on the trip (EPA.gov, 2023). To work out the travel footprint, distance travelled was multiplied by a carbon intensity for the cars used as represented in equation (2) below. The travel footprint of the study is a product of multiplying the direct emissions by the total annual distance travelled.

$$Travel\ Footprint = Distance\left(\frac{km}{yr}\right) \times EF\left(\frac{kgCO_2e}{km}\right) = Emissions\ kgCO_2e/yr \ \ldots (2)$$

4. Results

Data Collection

The results of data collection reveal that in 7 days (one week), ninety-four (94) *Messages* were recorded at Ile-Ife for vehicles leaving for the terminal in Ikeja. The ninety-four *Messages* consisting 106 items of fifty-three (53) envelops, thirty-nine (39) large parcels (made up of clothes and books), six (6) laptops, two (2) bags of rice, four (4) mobile phones, and two (2) 30 litre kegs of palm oil were observed to have been sent between the two locations.

Assumptions for the Study:

The carbon emission savings of the *Message* system is presumed to be the savings that would occur if the sender does not use the *Message* system. There are two options the sender may have to send the items.

Option one: The sender may decide to take a private car for the sole purpose of delivering the item

Option two: The sender may decide to board a 6-passenger vehicle for the same purpose.

These two scenarios were used to calculate the carbon emission savings of the system. The following assumptions are made for the study.

a) The public transport vehicle is assumed to be a 6-door Multi-Purpose Vehicle (MPV) with a 2.0 L petrol engine. This was the most common vehicle at the park
b) There will be 6 passengers per trip (excluding the driver)
c) The MPV is assumed to consume 9 Litres per 100 Km (Auto-abc, 2023)
d) 1 Litre of petrol produces 2.3 kg of CO_2
e) Individuals not using the *Message* system will either take the item using their personal car or board a similar 6-seater public transportation vehicle. It is assumed that

these individuals will make a round trip either by private car or 6-seater public transportation. That is, to deliver the item and go back to base

f) The personal vehicle of each individual *Message* owner is identical to the transport vehicle in fuel consumption.
g) The trips of the individuals not using the *Message* system will also terminate at the terminals

It is important to note that public transport vehicles in Nigeria do not embark on their journey unless the vehicle has its designated number of passengers. That is, a six-passenger car must have that number of passengers before it leaves the terminal. Therefore, the ultimate objective of the transport operators is the passengers and not whether there is a *Message* is going along or not. Consequent to this, it may be inferred that the message system is not responsible for carbon emissions or has zero carbon footprint.

Calculations for the Study

A. Estimation of Petrol Consumption:

The distance from the Ile-Ife terminal to Ojota (the Ikeja terminal) is 199.9 Km or approximately 200 Km. Round trip is therefore 400 Km

i. From Ife to Ojota, = $\frac{9\,L}{100\,Km}$ X 200 Km = 18 L

ii. Total Round trip Petrol Consumption is therefore = (18 + 18) L = 36 L

B. Estimation of CO_2 Emission:

i. From Ife to Ojota = 18 L X $\frac{2.3\,kg}{L}$ = 41.4 Kg CO_2

ii. Total CO_2 round trip Emissions, Ife – Ojota – Ife = (41.4 + 41.4) Kg = 82.8 Kg CO_2

Thus, carbon footprint for round trip = 82.8 Kg CO_2

C. CO_2 Emissions per passenger boarding a 6-Passenger Car:

This is

i. Petrol Consumption/Passenger, Ife to Ojota = $\frac{18\,L}{6}$ = 3 L

ii. Round trip Petrol Consumption/Passenger = $\frac{36\,L}{6}$ = 6 L

iii. CO_2 Emissions/Passenger, Ife to Ojota = $\frac{41.4\,kg}{6}$ = 6.9 Kg

iv. Round trip CO_2 Emissions/Passenger Ife-Ojota-Ife = 6.9 Kg x 2 = 13.8 Kg CO_2

Option One

Table 1 shows the carbon emission savings if the sender decides to take the item to Lagos using a personal vehicle rather than use the *Message* system. The estimated total petrol consumption for the round trip (Ife – Ojota – Ife) according to the assumptions would be 36 L, and estimated total CO_2 emissions (Ife – Ojota – Ife) at a distance of 400 Km would be 82.8 Kg (or carbon footprint = 82.8 Kg CO_2 e per return trip). At the observed 94 *Messages* per week, CO_2 emission savings will be 7,783.2 Kg CO_2 per week. If this data is projected on an annual scale, savings will be 404,726.4 Kg CO_2 if the *Message* system is used by individuals in Ife intending to send items to Lagos.

Option Two

Table 2 shows the carbon emission savings if the sender decides to take the item to Lagos by being a passenger in the public transport vehicle (i.e., being 1 out of the 6 passengers in the transport vehicle). As calculated above, estimated total round trip petrol consumption/passenger (Ife – Ojota – Ife) would be 6 L, and estimated total CO_2 emissions/passenger (Ife – Ojota – Ife) would be 13.8 Kg (or carbon footprint = 13.8 Kg CO_2 per return trip). Therefore, if individuals in Ife decide to use the message system rather than boarding a public transport vehicle to Lagos to deliver items, annual projected carbon emission savings will be 404,726.4 Kg CO_2

The *message* system in this study thus saves making 94 individual trips per week, over a distance of 37,600 Km, consumption of 3,384 litres of petrol and creating a carbon footprint of 7,783.2 kg (7.78 tons) CO_2. In a year, these figures are 4888 trips, over a distance of 1,955,200 Km, consuming 175,968 litres of petrol and creating a carbon footprint of 404,726.4 kg (404.73 tons) CO_2

Table 1: Annual Estimates in carbon savings if Individuals take the item with Personal Vehicles rather than use the Message System

Duration (weeks)	No of Messages	Distance: Ife – Ojota – Ife (km)	Petrol Consumption (L)	CO_2 Emission (Kg)
	1	400	36	82.8
1	94	37,600	3,384	7,783.2
52	4888	1,955,200	175,968	404,726.4

Table 2: Annual Estimates in carbon savings if individuals take the item in Public Transport rather than using the *message* system

Duration (weeks)	No. of Messages	Distance: Ife – Ojota – Ife (km)	Petrol Consumption (L)/ Passenger	CO_2 Emission (Kg)/ Passenger
	1	400	6	13.8
1	94	37,600	564	1,297.2
52	4888	1,955,200	29,328	67,454.4

Conclusion and Suggestions for Future Studies

As this study shows, significant carbon emission savings can be made by social innovations that can reduce the number of car trips and at the same time enhance inclusion in mobility structures. The study area of this research represents a very small portion of Nigeria's public transportation infrastructure (Nigeria's has a total length of 195,000 Km – World Data Info, 2023) and the likely extent of adoption of the *Message* system. Not only should future studies explore the benefits of this social innovation on a wider scale and for a longer period, studies can also be carried out at terminals where larger vehicle types that can carry between 10 and 30 passengers operate. Studies can also be carried out on risk factors involved in using this innovation and how public and private intervention may help alleviate these trust concerns in using the message system. Public and/or private intervention can also focus on scaling varieties of this innovation to other developing and even developed countries where this innovation can improve access to mobility infrastructure and reduce transport costs and carbon emissions at the same time.

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