Growth of informal transport in two Ghanaian cities

Implications for urban planning and policymaking

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Abstract: In sub-Saharan Africa, informal transport modes such as motorcycles, motor tricycles, minibus paratransit, and autorickshaws are preferred for first-and-last-mile trips. This has several socio-economic benefits but also contributes to traffic crashes, transport pollution, and congestion levels. These negative externality effects have direct correlations with the volume of informal transport in cities; therefore, projecting their growth dimensions is important for urban planning. However, no study has yet projected the growth trends of informal transport in African cities. This study uses the Gompertz time series model to estimate the growth of registered roadworthy vehicles and informal transport in Koforidua and Sunyani, Ghana, from 2019 to 2030. Results show that by 2030, informal transport comprising motorcycles, motor tricycles, and autorickshaws will dominate the vehicle fleet in both cities. This obligates strict enforcement of the requirements of vehicle roadworthiness, investments in sustainability-based smart transport infrastructures, traffic impact assessment, and bus rapid transit. It is imperative to foster stakeholder collaboration between urban planners and transport policymakers to improve smart micromobility solutions for sustainable cities.

Keywords: Ghana, informal transport, sustainable development goals, vehicle growth

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1 Introduction

Sub-Saharan Africa's (SSA) informal transport comprises motorcycles, motor tricycles, minibus paratransit, and autorickshaws. They are preferred for first-and-last-mile journeys (Ehebrecht et al., 2018). This is due to poor public transport, lower travel costs, poor road network, time-saving, employment creation, and availability (Diaz Olvera et al., 2016; Dumba, 2017; Ehebrecht et al., 2018; Onyango, 2018; Oteng-Ababio & Agyemang, 2012, 2015). However, these transport modes contribute to traffic crashes, congestion, and environmental pollution (Amegah & Agyei-Mensah, 2017). Campaigns to regulate the sector have been futile and where minimum success is achieved, they are often difficult to implement. Therefore, some countries such as Ghana and some states in Nigeria have proposed a complete ban on the sector. Nonetheless, such drastic measures will see a significant hike in private car ownership (Shao et al., 2022).

Globally, transport is characterized by congestion, air pollution, and traffic-related crashes. This situation is worsening in developing countries that have a high influx of informal transport in the traffic stream (Tomassetti et al., 2020) and increasing car culture. Despite the concerns, research on informal transport is limited specifically on evidence of growth in the sector. The sustainable development goals (SDGs) of the United Nations (2022) aim to build sustainable cities and communities (SDG 11). This requires cities to be safe, inclusive, resilient, and offer sustainable transportation. Therefore, a recommendation for improving the informal transport sector through effective control and regulation becomes imperative. Empirical studies should aim at understanding the growth implications of the sector to socio-economic policy nexus.

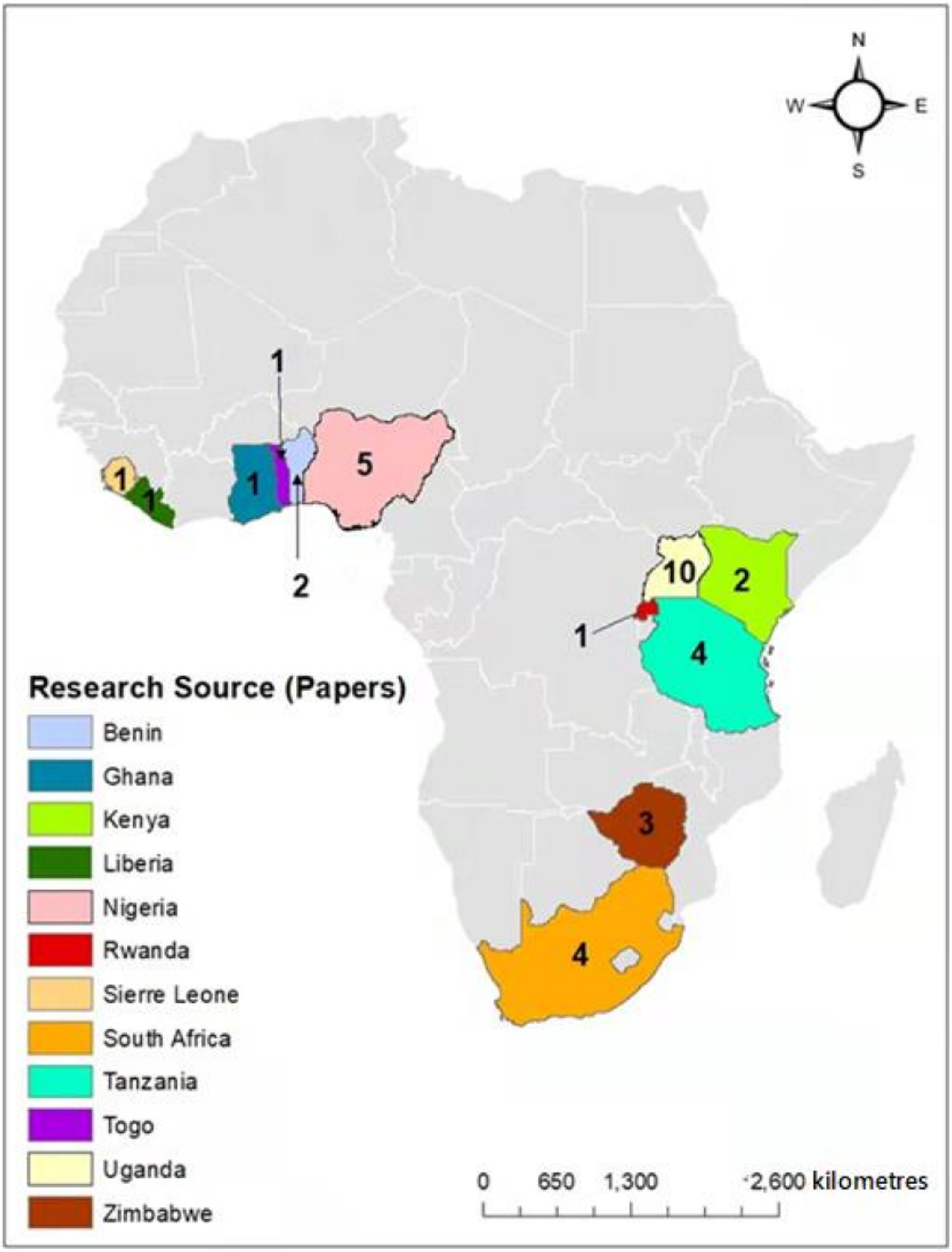
Rapid population growth in West African cities is associated with demand and ownership of motor vehicles ranging from personal vehicles to minibuses/paratransit (Imoro Musah et al., 2020). This car culture growth is no different in Ghana as statistics on vehicle registration and use are increasing. It was estimated that vehicular registration per annum grew at 33.6% as of May 2021 (Bank of Ghana, 2021). The rapid rise is attributed to the poor public transport system and the interest to own vehicles, which is considered 'prestigious and respectful' among many in society. Transport growth studies across Ghana are mainly focused on large cities; based on population and economic functions these are Accra (population and economic), Kumasi (population and economic), Tamale (population), and Takoradi (economic) (Dumba, 2017; Obiri-Yeboah et al., 2021; Oteng-Ababio & Agyemang, 2015). However, there is a paucity of research on the sector's growth in small cities despite the rapid hike in vehicles. According to OECD (2022), small cities have a population between 50,000 and 200,000.

Globally, several policies have been implemented to improve public transport. These include expanding the bus rapid transit (BRT) systems (Carrigan et al., 2013), encouraging shared and active mobility (Lin & Yang, 2019), and providing discount incentives for public transport users (Voon et al., 2017). However, these transport policies and strategies have received little focus in Ghana. To make effective policies, knowledge of growth trends of informal transport should be easily integrated into urban planning.

1.1 Informal transport sector research overview across SSA

In SSA, research on informal transport has largely focused on motorcycle taxis, with a few studies focusing on autorickshaws and motor tricycles. A search of English-language papers from SSA in the Web of Science core collection with a year limitation of 2010–21 found 35 papers. Figure 1 shows the originating countries of past contributions, exempting the review papers (not country-specific). Research activities are clustered in a few countries in SSA, whereas informal transport exists in several countries.

Figure 1: The country origin of past studies and the number of publications between 2010 and 2021



Source: Authors' own.

1.2 Ghana's informal transport sector and SDGs

One of the main influencing factors for the growth of informal transport is the insufficient public transport supply in SSA countries and the employment avenue that the informal transport has created. Given the high demand, finding the appropriate regulatory frameworks can enable SSA countries to improve informal transport services and operations. This would help to deal with problems regarding their regulation and driver safety. It was also found that in the urban road network, intersections and midblock sections have the most incidences of motorcycle taxi injuries (Dumba, 2017). Particularly, motorcycle taxis are also associated with fatal injuries (Kitara & Karlsson, 2020; Nabifo et al., 2021). Obiri-Yeboah et al. (2021) noted that, despite the positive attitude to maintenance, autorickshaw operators have a poor attitude to safety and traffic regulations, which has resulted in police harassment oftentimes. Effective policy control would also help modulate their emission control that has also been of concern (Ehebrecht et al., 2018; Lawin et al., 2016). These insights call for better urban planning and policies to regulate informal transport in SSA.

In line with the SDGs, planning and designing sustainable, safe, and inclusive transportation cannot be overemphasized. Transportation plays a significant role in achieving all the SDGs (May, 2013). Particularly, SGD 11 necessitates that all cities will have good transport infrastructure and enhanced safety. Reliable, safe, and clean transportation enhances subjective well-being and happiness in cities (Blais & El-Geneidy, 2014; Chatterjee et al., 2020). The informal economy is an equally important target under the SDGs (Hrelja et al., 2017), so making informal transport attractive and promoting orderly operation cannot be overemphasized. Achieving sustainable transport and resilient cities as part of SDG 11 is realistically based on the success of existing regulations and implementation. However, recent reports by the World Health Organization show that all the regulatory schemes and plans aimed at sustainable transport in Ghana are facing implementation lapses (Essel & Spadaro, 2020). These policies are noticeably started in larger cities like Accra and Kumasi. Ultimately, it is difficult to achieve SDG 11 under these implementation lapses. Perhaps, a new strategy that begins in small cities can be experimented. Although smaller cities have lower traffic densities, it is worth knowing the growth trends of informal transport to plan their station allocations, uniforms, and other formal/informal regulations and controls. For instance, traffic signal timing plans may vary in a city or give priority to a specific transport mode that is dominant in the traffic stream.

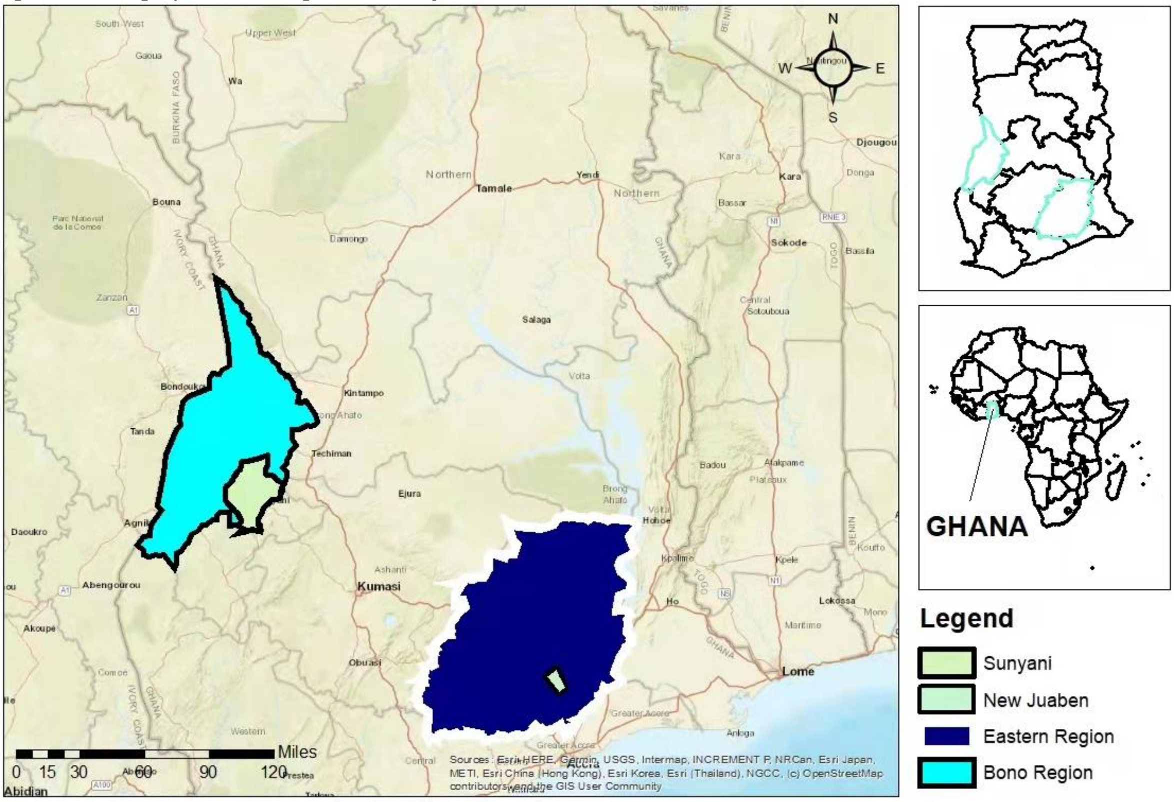
It is noteworthy that there is no previous projection of the growth dimensions of informal transport in smaller cities in the literature on informal transport from SSA. This lack of empirical findings inhibits effective urban planning, policymaking, and traffic control. Therefore, this study focused on projecting the growth of registered roadworthy vehicles between 2019 to 2030 in Koforidua and Sunyani, Ghana, to learn about the growth trends of informal transport. Gompertz time series model was used and the implications for policymakers and urban planners are discussed. This study enriches the literature on informal transport. It also elucidates the policy implications of the growth trends, which is relevant for public policymaking and urban planning in SSA. In addition, the growth trends can guide future economic growth and employment forecasts as well as the travel preferences of commuters.

2 Methodology

2.1 Case study cities

The study area is the Koforidua and Sunyani municipalities of Ghana, as shown in Figure 2. Koforidua is the regional capital of the eastern region, the third fastest-growing region of Ghana in terms of population. It comprises the New Juaben South municipal and New Juaben North municipal areas. The 2021 Ghana Population and Housing Census (PHC) reported a total population of 183,727 people in the city (GSS, 2021a). As a commercial centre for the eastern region it is home to many businesses, which makes it a highly mobile city. Sunyani lies in the Sunyani municipality of Ghana and is the capital city of the Bono region. It is located about 373 km from the national capital of Accra. There are five municipalities in the Bono region including Sunyani municipality. Sunyani covers a land area of roughly 506.7 km^2. Per the recent decennial 2021 PHC, the total population of the municipality is 193,595 people (49.8% men and 50.2% women) out of a regional population of about 1.2 million (GSS, 2021a).

Figure 2: Geographical setting of the study



Source: Authors' own.

These two cities were selected because they both have a good taxi market, which makes it easy to implement shared mobility strategies. Also, land ownership is vested in the state, which makes it relatively easier to implement any sustainable strategies that would require land acquisition. In the last decade, both regions have also experienced drastic population and economic growth, rapid urbanization, and increased human and vehicular mobility (GSS, 2021b, 2021c).

2.2 Data collection

Data were collected from the Driver and Vehicle Licensing Authority (DVLA) of Ghana. DVLA is the government agency responsible for the registration of vehicles and the issue of driver's licenses in Ghana. Therefore, the data are reliable and verifiable, with frequency and percentages in both cities shown in Table 1.

The data comprised records of annual registered vehicles in Koforidua and Sunyani from 2017 to 2019. A digitized vehicle registration and documentation process emerged in 2017 to optimize the vehicle licensing process, reduce errors, and make data accessible. The database contains the number of registered vehicles for 21 vehicle types, classified according to capacity and official name in Ghana.

Table 1: Overview of registered vehicles in the two cities

Vehicle type	Year 2017		Year 2018		Year 2019		Total
	Sunyani	Koforidua	Sunyani	Koforidua	Sunyani	Koforidua	
Motorcycle	818	597	810	630	812	1434	5,101
Tricycle (autorickshaw and motor tricycle)	537	9	1,460	90	1,708	498	4,302
Private motor vehicle <2,000 cubic capacity	437	406	366	417	333	380	2,339
Commercial motor vehicle <2,000 cubic capacity	292	213	283	322	364	361	1,835
Private motor vehicle >2,000 cubic capacity	300	259	207	318	198	216	1,498
Commercial motor vehicle >2,000 cubic capacity	30	3	17	11	6	4	71
Private buses and coaches	27	91	15	39	17	26	215
Commercial buses and coaches	41	164	58	152	42	141	598
Rigid cargo trucks <16 tonnes	6	18	13	4	7	26	74
Rigid cargo trucks 16–22 tonnes	6	15	5	10	10	7	53
Rigid cargo trucks >22 tonnes	4	3	2	11	5	7	32
Articulator trucks <24 tonnes	7	2	1	5	5	1	21
Articulator trucks 24–32 tonnes	1	1	1	4	6	1	14
Articulator trucks >32 tonnes	1		7		3	7	18
Articulator tipper truck	1		1		8	5	15
Construction equipment	3						3
Combine harvester					2		2
Agricultural equipment	2		2		9	3	16
Mining equipment					4		4
Particular identification mark					364		364
Special registration			7		55		62
Total	2,513	1,781	3,255	2,013	3,958	3,117	16,637

Source: Authors' own.

2.3 Data analysis and vehicle projection model

Descriptive analysis was computed to analyse the annual growth rate for the three-year duration in both cities. Consequently, the authors projected the volume of motorcycles, tricycles, private motor vehicles, commercial motor vehicles, and buses in both cities by 2030. Other vehicle types were excluded from the projections because they do not fall in travellers' modal split. For this study, the Gompertz time series model was used for projections. It represents the long-run relationship between vehicle ownership per 1,000 population and economic indicators such as income or gross domestic product (GDP) per capita. The model with the sigmoid function assumes that the growth rate starts slow and moves faster after some years, then slows down again when the end of the year being projected is approaching. This model has been used previously for vehicle ownership projections (Català et al., 2020; Kong, 2018; Satoh, 2021; Singh et al., 2020). The research team used the model calibrated by Singh et al. (2020) for projections in the present study. The generalized Gompertz model can be specified as in Equation 1:

$$V_{t,i} = Se^{\alpha e^{\beta y_{t,i}}} \qquad (1)$$

where $V_{t,i}$ denotes the long-run equilibrium level of on-road vehicles; S is the saturation level of vehicles (per 1,000 population); $y_{t,i}$ represents the GDP per capita; e is Euler's number

(e=2.71828), and parameters α and β indicate the negative growth rate of vehicle ownership over economic growth.

For projections in this study, the main parameters included the saturation level of the vehicles (vehicles per 1,000 capita), the GDP per capita, the average percentage increase in the number of registered vehicles, and the α and β parameters. The World Bank data on GDP per capita for Ghana in the year 2019 was used in the model (see World Bank, 2020). The saturation level (67), $\alpha(-7.488)$, and $\beta(-0.424)$ were adopted from Keshavarzian et al. (2012). An average growth rate of 1.5% was adopted for these small cities compared with 2.2% adopted for large cities in the Middle East (Keshavarzian et al., 2012). From Equation 1, since α and β are negative, $V_{t,i}$=S. Consequently, adjustments were made to the saturation level with the average annual growth rate of the vehicles registered in the candidate cities represented by θ resulting in Equation 2:

$$V_{t,i} = S\theta \tag{2}$$

By multiplying θ by the saturation level, the long-run equilibrium level of on-road vehicles ($V_{t,i}$) was derived and used to compound the growth of vehicles for the 11-year duration.

3 Results and discussion

The results (Table 2) indicate that tricycles, motorcycles, rigid cargo trucks (<16 tonnes), commercial motor vehicles (>2,000 cubic capacity), and articulator trucks (from 24 to 32 tonnes) had high annual growth rates for the three years in Koforidua. However, tricycles and articulator trucks seem to have high annual growth rates (>70 tonnes).

Table 2: Annual vehicular growth rate in the two cities

Vehicle type	Average growth rate (2017–2019)	
	Koforidua	Sunyani
Motorcycles	67	60
Tricycles	92	94.5
Private motor vehicles <2,000 cubic capacity	−3	−12.5
Private motor vehicles >2,000 cubic capacity	−4.5	−17.65
Commercial motor vehicles <2,000 cubic capacity	31.5	13
Commercial motor vehicles >2,000 cubic capacity	88	−54
Private buses and coaches	−45	−15.5
Commercial buses and coaches	−7	6.5
Rigid cargo trucks <16 tonnes	90	35.5
Rigid cargo trucks 16–22 tonnes	−31.5	41.5
Rigid cargo trucks >22 tonnes	5.5	50
Articulator trucks <24 tonnes	35	78
Articulator trucks 24–32 tonnes	83	86
Articulator trucks >32 tonnes	—	89
Articulator tipper truck	—	93
Agricultural equipment	—	61
Special registration	—	80
Total	34	26

Note: The empty cells (—) represent data unavailability.

Source: Authors' own.

By the estimations, tricycles and motorcycles will have the largest fleets if no major transport policies emerge as projected for both cities by 2030 for the selected vehicle types, as shown in Table 3. However, private motor vehicles, commercial motor vehicles, and buses are projected to increase marginally.

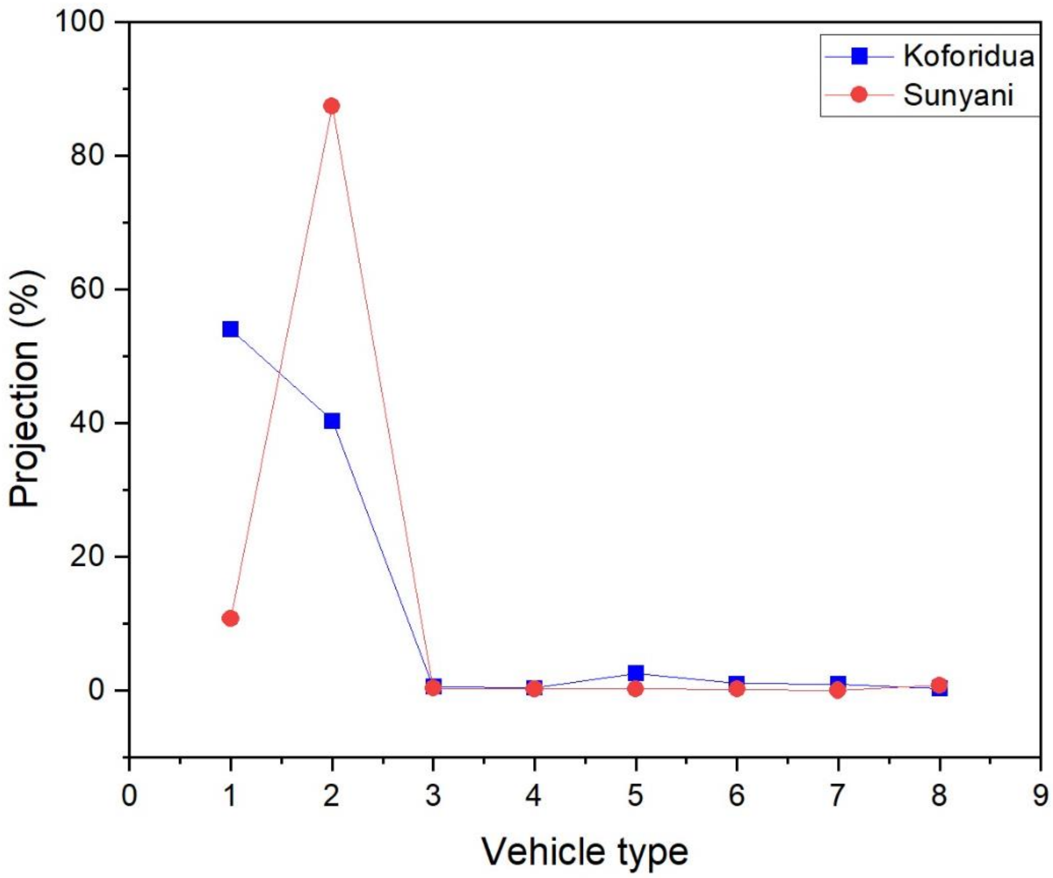
Table 3: Projected modal split of eight vehicle types by 2030

Index	Vehicle type	2030 Projection	
		Koforidua	Sunyani
1	Motorcycles	157,205	100,373
2	Tricycles	117,493	816,723
3	Private motor vehicles <2,000 cubic capacity	1,496	2,752
4	Private motor vehicles >2,000 cubic capacity	1,098	2,411
5	Commercial motor vehicles <2,000 cubic capacity	7,364	2,353
6	Commercial motor vehicles >2,000 cubic capacity	2,947	1,583
7	Private buses and coaches	2,796	175
8	Commercial buses and coaches	757	7,521

Source: Authors' own.

Additionally, the projected percentage of each vehicle type for the period from 2019 to 2030 is illustrated in Figure 3. Trends indicate that tricycle use is likely to dramatically increase over the 11-year analyses.

Figure 3: Projected percentage of each vehicle type (2019–30)



Source: Authors' own.

The general overview from the two Ghanian cities of Koforidua and Sunyani shows that motorcycles and tricycles commonly used as taxis and ride-sourcing services are growing at a fast rate and the travel patterns will require policy actions. These modes are prone to crashes and high fatality rates in Africa, and particularly in Ghana. Although vehicle ownership and travel decisions are derived from demand (Stanojević et al., 2020), and as this modal split trajectory continues to gain traction, dynamic optimization of intersection signal timing would be helpful in both cities. Traffic regulations are also required to be strictly enforced in situations of this nature (Ang et al., 2019; Oteng-Ababio & Agyemang, 2015). The traffic police must pay attention to speed, visibility, and motorcyclist alertness, which have been identified by past research as the main contributors to motorcycle crashes (Dodge & Halladay, 2008; Yousif et al., 2020). Furthermore, installing segregated lanes for motorcycles, at least at signalized intersections, will enhance safety because of their now increasing traffic volume (Cohen, 2013; Le Vu, 2016) and the threat posed to other road users.

The results revive an ongoing discussion about the regulation or ban of informal transport. Considering the growth projections, urban planners can consider formalizing their operations and integrating them with mainstream public transport. An outright ban will motivate people to own private vehicles (Shao et al., 2022) as mobility tools and consequentially increase congestion and pollution levels in Ghanaian and other African cities. However, this would require sufficient stakeholder engagement (Ehebrecht et al., 2018). It is imperative to create driver unions and make policies explicit on the allowable traffic zones for these modes. These include the distance individuals can travel within a city, the time of day the traffic zones can operate, and the use of safety tools such as helmets and reflector gadgets (Atubi & Ali, 2009; Bradbury, 2015; Ndadoum et al., 2016). Providing traffic segregation infrastructure and reducing huge first-and-last-mile accessibility shortfalls by public transport can offer not only equitable transport but also inclusive mobility outcomes (Acheampong & Asabere, 2022).

With the majority of vehicles in the study areas having a vehicle life/age of more than 10 years, the imposition of environmental taxes and incentives is seen as a plausible opportunity to limit the importation of overaged vehicles (Moonsammy et al., 2021; Pojani & Stead, 2015). Individuals and organizations importing overaged vehicles can be demotivated by high payment of import duties or payment of carbon emission levies, whereas persons and companies importing underage vehicles can have the benefit of accruing carbon emission levies over time.

It could be generally accepted that small-holder cities will have less public use vehicle systems based on the small population and convenience of travel. Therefore, the implementation of a generalized BRT system may not yield significant results in terms of reduction in cumulative transport-related emissions. Yet, with rigorous policy implementation to commence frequent and robust traffic impact assessment (TIA) studies, knowledge of road management could be obtained to find efficient and incentivized means to promote public bus transport within smaller cities (Lin & Yang, 2019). Alternative ways to reduce emissions are to encourage start-ups of emerging shared mobility systems and electric vehicle services and the use of active mobility (Voon et al., 2017). To significantly increase active transport rates in both cities, deliberate improvement in pedestrians and cycling infrastructure is paramount.

4 Conclusion

In this study, the Gompertz time series model was used to project the growth of registered roadworthy vehicles (2019–30) in two small cities in Ghana. The implications for policymaking and urban policy were discussed. This study contributes to the growing discussion on how to control and regulate informal transport in SSA. It is also relevant to enhance the well-being of residents in small cities. This rare case of small cities in literature provides a basis for future works. The results showed a high percentage of informal transport in the transport fleet of Koforidua and Sunyani. The projections show that assuming no urban planning decisions are made, and policymaking status quo remains, informal transport will dominate the traffic stream in these cities by 2030.

Improvement in active and shared mobility infrastructure and incentives are required to curtail the projected vehicle volumes of informal transport. The idea is to enhance the use of more sustainable transport modes. Other policies such as TIA, BRT systems, intersection signal optimization, subsidies on emission test kits, and strict enforcement of traffic regulations are proposed to improve well-being and safety in cities. In line with the SDGs, urban planners and transport policymakers in small cities can also form associations for the operators of these informal transport modes where they will be given adequate training and safety education. The strategy of giving free safety kits periodically can also be incorporated in planning decisions as validated in Tanzania (Sumner et al., 2014).

The present study had some limitations. The analyses used a limited dataset covering only three years. This is because the digitized registration of roadworthy vehicles started in 2017. Moreover, non-roadworthy vehicles were unaccounted for in the projections because they were not present in the vehicle register. Also, the projection covered informal transport modes such as motorcycles, autorickshaws, motor tricycles, and minibuses (paratransit) as these are the modes registered in Ghana. Other informal transport modes that may exist in other countries were excluded. Additionally, literature that discusses population growth, urbanization of other areas within Ghana, population shifts, demographic projection trends, electrification of the fleet, carbon dioxide targets worldwide, and general SDGs were excluded.

Therefore, future studies can explore further projection of informal transport in other cities of SSA. Studies can focus on non-roadworthy vehicles and empirically measure transport exhaust emissions. Besides, funded research can be directed at non-roadworthy and end-of-life vehicles (comprehensive life-cycle analysis) in SSA. Case studies can put more emphasis on small cities in SSA to help urban planners and policymakers. Considering the growth rate of motorcycles and tricycles, policy studies addressing the regulation of these modes would be beneficial.

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