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Article

Challenges to the sustainability of goods flows in the Greater Lomé Autonomous District (DAGL) in Togo

Djossou Kodjo[1,*], Dandonougbo Iléri[2], Barbara Lyonnet[3], Hicham Abbad[4]

[1] The Regional Centre of Excellence on Sustainable Cities in Africa, CERViDA-DOUNEDON, University of Lomé, Lomé 1515, Togo
[2] Laboratoire de Recherche sur Espaces, Echanges et Sécurité Humaine, LaREESH/Department of Geography, University of Lomé, Lomé 1515, Togo
[3] LEMNA, IAE Nantes-Economics and Management, Nantes University, 44300 Nantes, France
[4] LEMNA, Logistics and Transport Management, Nantes University, 44300 Nantes, France
*** Corresponding author:** Kodjo Djossou, kodjo.djo@gmail.com

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Abstract: The freight transport chain brings together several types of players, particularly upstream and downstream players, where it is connected to both nodal and linear logistics infrastructures. The territorial anchoring of the latter depends on a good level of collaboration between the various players. In addition to the flow of goods from various localities in the area, the Autonomous Port of Lomé generates major flows to and through the port city of Lomé, which raises questions about the sustainability of these various flows, which share the road with passenger transport flows. The aim of this study is to analyse the challenges associated with the sustainability of goods flows. The methodology is based on direct observations of incoming and outgoing flows in the Greater Lomé Autonomous District (DAGL) and semi-directive interviews with the main players in urban transport and logistics. The results show that the three main challenges to the sustainability of goods transport are congestion (28%), road deterioration (22%) and lack of parking space (18%).

Keywords: freight transport; traffic congestion; urban freight transport; sustainability; urban logistics; port city

1. Introduction

In support of industrial and commercial activities, the transport chain integrates several flows and players, from the supplier to the end consumer. Its organisation depends on logistics infrastructure, which is located mainly upstream and downstream, such as groupage platforms and ports. The latter are the load break points between sea and land. Most of them are located in urban areas or are being developed and later caught up in the city (Fousséni and Daoudou, 2002). These nodal infrastructures are invaluable links in the transport chain and exert economic, social and environmental influences on the towns and cities in which they are located.

On a continental scale, African Port cities are major sources of wealth and a magnet for foreign capital (Steck, 1997). This attraction is also demographic, particularly in West Africa, and is reflected in a major migratory flow and rural exodus, fuelling rapid growth in the urban population. Rapid population growth has led to urban sprawl, which increases dependence on cars (Nyassogbo, 1984). West African Port cities face a number of challenges, including the daily mobility of people and goods. This situation is exacerbated by the flow of goods generated by the port. Although the city's economic dynamics are heavily dependent on the flow of goods (Armand et al., 2013) these flows have a negative impact on urban life and the urban

environment if they are not organised efficiently (Tsonkov and Petrov, 2024). This poses a problem in terms of the sustainability of flows, particularly flows of goods in cities. Longly considered as a constraint (Trentini and Malhene, 2010) or a hindrance to people's mobility, urban goods transport has been neglected in favour of passenger mobility. In recent years, however, urban players and researchers have increasingly focused on the negative externalities of freight transport, such as traffic congestion, environmental pollution and social problems (Reisi et al., 2014). Issues related to the transport of goods and people in urban areas need to be addressed via an integrated, coordinated approach (Trentini and Malhene, 2010). Furthermore, the majority of studies devoted to urban transport generally consider only the mobility of people. Studies of urban freight transport often address only interurban flows. In the current context of rapid urban population growth in the DAGL, it is important to consider urban freight transport from a sustainable perspective. This raises the following question: What are the challenges linked to the sustainability of goods flows in the Greater Lomé Autonomous District (DAGL) in Togo?

The article is organized as follows. The next Section (2), presents a literature review on the sustainability of urban goods flows. Section 3 describes the materials and methods used for data collection. The results are presented in Section 4. The results are discussed in section 5, and section 6 presents the conclusion and recommendations.

2. Literature review

The drafting of this article was preceded by a literature review which examined the existing literature on the sustainability of urban transport in general and urban freight transport in particular. A literature review on the subject was presented as follows:

2.1. The concept of sustainable urban freight

According Rześny Cieplińska (2017) several concepts such as 'urban freight transport', 'urban logistics', 'urban freight...' are used to refer to urban freight transport. For the author, these different concepts vary only slightly depending on what is or is not taken into account. Urban goods transport encompasses the movement of goods or materials between economic establishments, household shopping trips and all other flows, particularly urban maintenance flows (Routhier, 2002). In addition to the organisation of activities that generate urban goods flows, urban logistics includes the development and location of transport and logistics infrastructures and the regulation of access to them (Albergel et al., 2006). According to Dablanc (2007), urban freight transport must be sustainable. The sustainability of urban freight aims to improve the environmental and social performance of freight flows while preserving the economic performance of urban centres. Several authors base sustainability in the transport and urban logistics sector on the triptych of sustainable development (Dablanc, 2007; Gonzalez-Feliu, 2016; Jouenne, 2010; Morana, 2014; Morana et al., 2014; Routhier, 2002). This approach is described by the authors as *'classic'* or *'traditional'*. In addition to the three traditional dimensions of the sustainability of urban freight (Ayadi et al., 2024), their work introduces indicators relating to two new

dimensions for assessing the sustainability of urban freight These are the political and spatial dimensions. For the authors, the spatial dimension refers to the accessibility of logistics and transport infrastructures. The political dimension, on the other hand, covers all the measures taken by the public authorities to reduce the negative externalities of urban freight and infrastructure funding policies. The indicators grouped within the different dimensions are often analysed across the board, since an economic indicator can have environmental or social impacts (Munier, 2011). Gonzalez-Feliu (2016) beyond the classic vision of sustainability and believes that the new vision, described as an alternative vision mainly linked to transport and based on what he calls 'the four capabilities', better meets the characteristics of a sustainable transport system. In his view, transport stakeholders need to develop four capacities for a sustainable transport system: '*the capacity to know and understand, the capacity to act and change, the capacity to avoid increasing nuisance and the capacity to anticipate'*. Indeed, knowledge of the challenges linked to the sustainability of urban goods flows enables stakeholders to become aware of the negative externalities involved and to act, either to limit or avoid them.

In this article, urban goods transport refers to the movement of goods between different points in an urban area. It includes supply flows to shops, whatever their origin, flows that circulate within the city and flows that cross the city. Urban management flows are not taken into account.

2.2. Measures to reduce the negative externalities of urban freight

The field of study of urban logistics covers the mobility of people and the organisation of urban freight. Although the mobility of people has long been at the centre of discussions, urban freight has only recently been taken into account in urban mobility planning (Gonzalez-Feliu and Routhier, 2013). Public authorities' interest in urban freight is mainly motivated by the negative externalities induced by commercial vehicles flows. Urban freight transport is a source of many negative externalities in environmental, social and economic terms. Congestion and parking management are major challenges for urban transport (Lee and Palliyani, 2017). Analysis of urban freight in the Lagos metropolitan area revealed that the main problems caused by urban freight are accidents, noise pollution, air pollution, road deterioration, traffic congestion and uncontrolled vehicle parking (Atomode, 2017). Gonzalez-Feliu and Routhier (2013), for their part, state that congestion remains the main negative effect of agglomeration economies, since it leads to an enormous loss of time in the daily mobility of people and goods. In addition to pollution and noise, it contributes to the deterioration of living and working conditions for city dwellers (Crainic et al., 2004). These authors point out that although urban freight transport contributes to the growth of the city's economy, it generates as much congestion as it suffers. For Crainic et al. (2009), urban freight represents both an opportunity for the urban economy and a challenge for local urban authorities and other road users. These challenges can be seen in the time lost in the movement of people and delays in the delivery of goods, air pollution which is a source of respiratory illnesses, increased delivery costs, noise and vibrations which disturb the peace and quiet of city dwellers in residential areas. A number of initiatives have therefore been taken by local authorities to minimise the

negative impacts of urban freight, through the introduction of a regulatory framework regulating the use of infrastructure during peak hours, the development of new infrastructure and the relocation of urban activities. To reduce the negative externalities of urban freight in Paris and London, the local authorities, in particular the mayors of the two cities, have taken almost similar measures, but with slightly different aspects (Browne et al., 2007). These measures, taken in collaboration with the various urban freight stakeholders, concern the regulation of access to urban space for commercial vehicles, parking management for the loading and unloading of goods, the professionalisation of the distribution sector, modal shift and the use of cleaner vehicles. For Muñuzuri and Van Duin (2014), the implementation of a regulatory framework for urban freight aims to ' *reduce the conflict between the interests of logistics companies and those of other stakeholders (residents, workers, traders, etc.) involved in urban mobility'*. However Morana et al. (2014) believe that, even if regulatory measures aim to reduce the negative externalities of urban freight, they should not penalise the supply of shops in urban centres. Lee and Palliyani (2017) in their work have shown that the level of congestion has been reduced by 20% in the past in Singapore following a regulation that imposes a payment at the level of urban tolls during peak hours. According to Kant et al. (2016), the urban landscape system is the key action for coordinating urban freight. The examples of London and Stockholm are cited by these authors as well-known success stories in Europe.

2.3. Stakeholder integration: a necessity for the sustainability of urban freight.

Minimising the negative externalities of urban freight involves integrating the players and processes involved in organizing urban logistics. The literature describes several types of stakeholders in urban freight. While some authors refer to them simply as actors (Gonzalez-Feliu, 2016), others prefer the term "stakeholders" (Armand et al., 2013). Two categories of stakeholders have been identified:

- The main stakeholders are the direct players in the transport chain (flow drivers, flow or infrastructure managers and flow regulators);
- Subsidiary stakeholders, such as trade unions, associations and consumers, are considered supporting players or defenders of the interests of a group.

Gonzalez-Feliu (2016) propose a classification scheme based on the actors' direct relationships with space and territory. According to this classification, the author also distinguishes between two groups of actors: space users and space organisers. The former have functions that have a direct impact on the occupation of space, whereas the latter are spatial planners and organisers. For an efficient urban freight system, a framework for collaboration between players is necessary. However, this framework must be coordinated by a single urban entity (Rześny Cieplińska, 2017). For this reason, the European Commission, in its report on urban logistics, states that "the objectives of urban logistics are quite difficult to achieve in terms of improving flows in urban areas, without them being coordinated by a specialised entity" (Chanut and Paché, 2014). The risk of urban infrastructure congestion increases in the absence of concerted collective action between the various players involved in its management. With respect to the advantages of integrating players in the supply chain, Roy et al.

(2006) state that integration means anticipating needs and better planning activities to respond effectively to customer demand. According to the authors, integration takes the form of a partnership or collaboration between the different players in the supply chain. This collaboration, they argue, produces beneficial effects such as "reduced costs, shorter lead times and improved quality". Following the same logic, Nagati et al. (2009) argue that an integrated system is more efficient and produces benefits for the various players involved. The benefits derived from the latter are greater than those achieved individually in a nonintegrated system (Simatupang and Sridharan, 2005). Although the benefits of an integrated urban transport and logistics system are no longer in doubt, the diversity of players involved in urban freight is a major challenge to its sustainability.

3. Materials and methods

The methodological approach adopted in this study involves both quantitative and qualitative approaches. The qualitative approach was adopted to gather the perceptions of the various stakeholders on the challenges linked to the sustainability of goods flows in Greater Lomé. This approach was complemented by a quantitative approach, which produces statistics on the contribution of each type of transport to traffic congestion by counting flows. Data related to the assessment of the various challenges of goods flows were also collected through surveys of drivers and traders. Following a detailed literature search, a field survey was conducted in the Greater Lomé Autonomous District.

3.1. Data collection

3.1.1. Participatory observation

The aim of participant observation was first to identify the key players in the goods transport chain and interview them. Second, it enables the location of the vehicle flow counting points following an observation of traffic on the main arteries, precisely at the junctions during peak hours. The main bypass road was chosen for the flow counts.

3.1.2. Questionnaire surveys

To obtain representative results, the purposive sampling technique was used.

The target population comprises three different groups of actors in the transport and urban logistics chain (shops, drivers attached to the autonomous port of Lomé and drivers attached to the main shopping centres). The questionnaires were adapted to the specific needs of each group, although some questions were common to all groups. The questionnaires were digitised in Kobotoolsbox software, and the links were sent to the 13 interviewers recruited for the study (one interviewer per commune).

A total of 541 stakeholders were interviewed. The results provided both qualitative and quantitative information.

3.1.3. Interviews

To gain a better understanding of certain transport problems in the study area, semi-structured interviews were also conducted with 16 players in the transport chain: union officials from the Union Nationale des Transporteurs Routiers du Togo (2); the

Union des routiers du Togo (2); the Bureau du Fret (1); wholesalers from the Grand Marché (5); the Direction de Transport aérien et ferroviaire (1); freight forwarders (2); the technical department of the town hall (2); drivers (5); and heads of departments at the port (5).

3.1.4. Manual flux counting

Manual counting was used to capture the proportion of each type of flow according to the means of transport used on the access roads to the port via the Autonomous District of Lomé. The counts were carried out over a period of three working days in Greater Lomé between 6 am and 6 pm, with count sheets organised at 15-minute intervals. Descriptive statistics were produced to analyse all the data, such as the graphic representation of flows by the hour and the average number of vehicles over the three days in both directions of traffic. All types of vehicles were counted, and the results were converted into passenger car units (PCUs), as shown in **Table 1**.

Table 1. Table of vehicle equivalence in passenger car units (PCUs).

Type of vehicle	Motorbikes	Tricycle	City taxis	Private cars	Mini bus	Light commercial vehicle (LCV)	Straight truck	Large Bus	Heavy goods vehicle (HGV)
PCU	0.5	0.75	1	1	1.5	1.5	2	2	3

The conversion into a PCU makes it possible to harmonise the analysis of counting data to understand the contribution of each type of transport to road congestion.

Kobo Collect, Excel and ArcGIS were used for data collection, data processing and map production, respectively.

3.2. Urban context of the Autonomous District of Greater Lomé (DAGL)

The Autonomous District of Greater Lomé (DAGL) has been the name adopted since 2019. (Togo-Loi-2019-06-decentralisation.pdf, s.d.) by the territory's administrative authorities to designate the Lomé conurbation, which is located in southwestern Togo. It is bordered to the south by the Atlantic Ocean, to the north by the Zio prefecture, to the east by the Lacs prefecture and to the west by the Aflao border and the Avé prefecture. Within the meaning of Article 324 of Law No. 2019--006 of 26 June 2019, the DAGL, as a territorial entity, comprises 13 communes and two prefectures as administrative subdivisions. It has 2,188,376 inhabitants spread over an area of 425.6 km² (RGPH 2022), i.e., a density of 514.19 hbts/ha. The configuration of the urban area reveals a centre (municipalities of Golfe 4, 3, 2 and 1, see **Figure 1**. below) that concentrates almost all administrative and economic activities, with a mainly residential periphery. As a result, there is a daily commuter flow, resulting in a high demand for mobility, particularly during the rush hour.

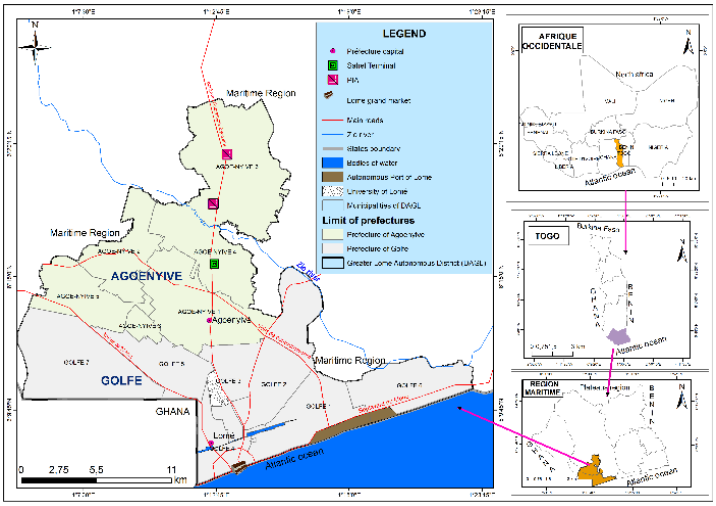

Figure 1. Map showing the location of DAGL and its major centres generating goods flows.

The largest goods transport hubs are located in the port area, around the large Market and in the city centre. Notably, each municipality has a commercial area, generally known as a "market". These are supplied by the flow of goods, mainly from the port area but also from other parts of the country (**Figure 2**).

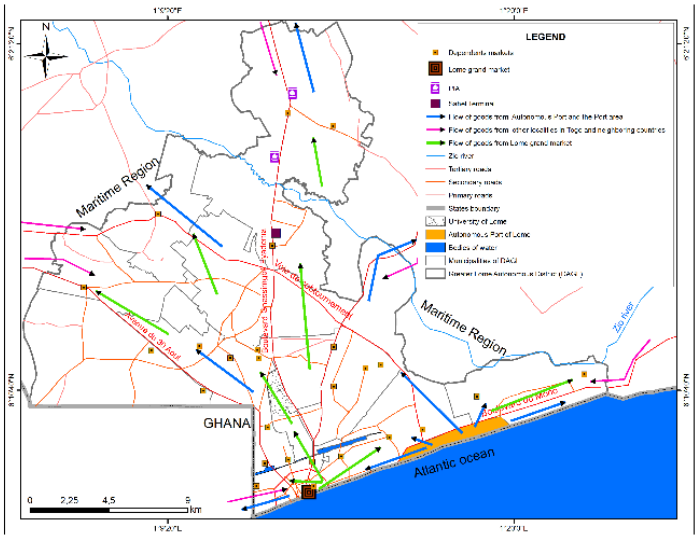

Figure 2. Map of goods flows in the DAGL to and from goods-generating centres.

4. Results and discussion

4.1. Organisational framework for urban goods transport and urban logistics in DAGL

This section presents the organisational framework of freight flows in the Grand Lomé urban area in order to analyse the interactions between the various players, their roles and the challenges involved in organising transport activities.

4.1.1. Locations of transport hubs and their impacts on the organisation of freight flows in the DAGL

A transport hub, as defined in this article, refers to any nodal transport, logistics or commercial infrastructure whose operation depends on significant movements of goods and people. The concentration of goods transport hubs in the same area of the country results in increased congestion on access routes. However, if they are well distributed, the various flows within the city can be better organised. The major centres generating goods are located mainly in the southern part of the Greater Lomé Autonomous District. These include the port and its port area, the Large Market and the Dekon shopping centre. Some logistics infrastructures, such as the "Terminal du Sahel" and the Plateforme Industrielle d'Adétikope (PIA), are located north of the city (**Figure 1**). The latter, operating since 2021, houses a dry port capable of handling up to 12,500 TEU containers and 800 trucks. The dry port handles containers destined for countries in the Sahel region, such as Mali, Burkina Faso and Niger, and relieves congestion in and around the Port Autonome de Lomé. The dry port, located on the Adétikopé industrial platform, also helps relieve congestion on the roads serving the port. According to the department in charge of managing lorry movements in and out of the autonomous port of Lomé, container transfers generally take place after 10 pm, when the flow of people travelling between home and work fade. Port statistics show that out of 20,7500 trucks leaving the autonomous port of Lomé, 6,488 were transferred to PIA, i.e., 3.12% in 2022, even though the platform was only operational for six months of the year. Improved collaboration between the industrial players attached to the platform has enabled production resources to be pooled to achieve economies of scale.

The port area is much in demand by economic operators whose activities are linked to the port. Almost all the national roads start from the city centre or the Autonomous Port of Lomé, described as the *"head of the line"* of the national transport system (Viményo, 2006). To take advantage of the port's accessibility and geographical proximity and achieve economies of scale, economic operators and transport professionals have set up warehouses in the municipalities of Golf 1, Golf 6 and Golf 4 (**Figure 1**). In these respective municipalities, a spatial recompositing is taking place as populations give way to economic activities and migrate to the outskirts. The results of the retail survey (**Table 2**) show that 95% of supplies to the communes of Greater Lomé come from the Large Market (62%), the Port and the port area (33%).

Table 2. Sources of supply for shops in the DAGL.

Origin	Frequency	Percentage
Grand Market	212	62%
Port area	76	22%
Port	37	11%
Other	11	3%
Airport	5	2%
Total	341	100%

As shown in **Table 3**, light commercial vehicles (LCVs) (34%) are the most commonly used vehicles for supplying DAGL stores, followed by tricycles (30%),

which are also LCVs, but have a low payload; straight trucks (23%) come third, followed by semi-trailers (10%) and other vehicles (3%).

Table 3. Means of transport used to supply shops in the DAGL**.**

Type of vehicle used	Frequency	Percentage
LCV	115	34%
Tricycle	102	30%
Straight truck	80	23%
Semi-trailer	34	10%
Other	10	3%
Total	341	100%

The importance of truck flows to and from municipalities located in the southern part of the DAGL is explained by the presence of the Port and the large market, which are the two main generators of goods.

4.1.2. Urban goods transport in the DAGL: an informal sector that is becoming more professional.

Two categories of players have been identified in the system for organising urban goods transport in the DAGL: public players and urban players.

Organisational system for urban goods transport and public players in Grand Lomé

Like other network industries, transport is a system organised in three layers, the main or basic layer of which is infrastructure. In the DAGL, government action in the urban transport subsector is most visible through financing the development and maintenance of transport infrastructure, whether linear or nodal. In the absence of an urban transport organising authority, government action in the sector is often carried out by the ministries responsible for transport. However, the organisation of transport services remains a monopoly of the private sector. The public authorities intervention is limited to the regulation of goods transport. Sometimes, this regulatory role is taken on by local authorities. However, the DAGL as institution, has no legal or financial powers to carry out infrastructure construction projects within its area of influence. The interviews with local authorities revealed that they have neither local urban transport plans nor legislation regulating urban transport in their areas of jurisdiction. This situation can be explained by the strong centralisation of the transport governance system and the weakness of the powers dedicated to it (Dowui and Ndiaye, 2023). In addition, the National Police is a key player in the organisation of urban goods transport in the DAGL. They report to the Ministry of Security and Civil Protection and are involved in regulating urban transport, generally during rush hour when traffic is often congested. It calls out to users if they fail to comply with the Highway Code and current urban transport regulations. Notably, the role of public authorities is to ensure that city dwellers enjoy a liveable urban environment, with equal access to public services in complete safety. However, goods flows are considered disruptive to urban traffic and are covered by regulations that restrict them in terms of time and urban space.

Organisation of the urban goods transport service layer in the DAGL: an activity heavily monopolised by private players in the transport chain

The goods transport service in Grand Lomé mobilises the private players that are the flow drivers (manufacturers, wholesalers, retailers, and end consumers) or goods transport organisers. They include haulers, drivers and forwarding agents. Considered to be the orchestral conductors of the goods transport organisation system in Grand Lomé, the unions constitute a pressure group facing public authorities.

The results show that the entire freight transport chain is organised around drivers and forwarding agents. Freight transport in Grand Lomé is fragmented, with the average fleet per haulier being fewer than 5 trucks. According to one of the leaders of the Union des routers du Togo, *"many truck owners are themselves drivers, and very few have more than 5 trucks". "Generally, you see someone who manages to buy a truck, gets behind the wheel and just like that becomes a driver transporter. If he's serious, after years of work, he saves up and buys a new truck and hands over the old one to another driver who will work for him,"* he concluded. The fieldwork revealed that two main unions are very active in the road haulage sector in Grand Lomé. These are the Union Nationale des Transporteurs Routiers du Togo (UNATROT), winch groups together truck owners or transporters, and the Union des Routiers du Togo (URT), winch groups together drivers (see **Figure 3**).

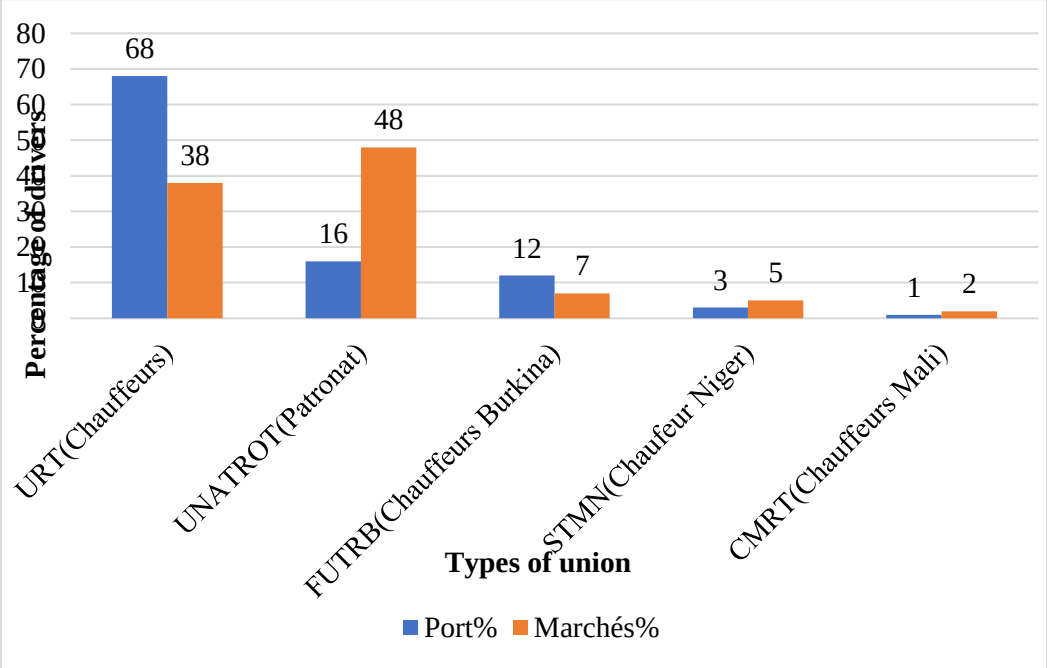

Figure 3. Union membership of drivers serving markets and the port.

The results in **Figure 3** show that the majority of drivers serving markets in the 13 Municipalities, belong to UNATROT (48%), and 38% belong to URT. However, the majority of drivers serving the port are members of URT (68%) and UNATROT (16%). This bears witness to the importance of these two syndicates in the organisation of goods flows in the Grand Lomé conurbation. On the one hand, this data shows that drivers serving the markets are for the most part owners of their trucks, whereas those serving the port mostly works for a haulier.

While UNATROT has set itself the objective of working towards the professionalisation of the road transport industry, URT aims to defend the rights and interests of drivers. The union is also represented by trade unions from Sahel countries, whose drivers transport goods to and from the autonomous port of Lomé. Under these rules, these drivers are not allowed to load goods unloaded at the port of Lomé for local consumption. In addition to UNATROT's specific role in distributing freight among Togolese hauliers, the role of all trade unions is to defend the interests of their members. They are thus grouped together within the faîtière patronale togolaise des transporteurs routiers (FPT2R), which sees itself as a framework for collaboration and a force for proposals to public players for the modernisation and professionalisation of the road haulage sector in Togo. Drivers, particularly those working for the port, work in collaboration with forwarding agents, who are often commissioned by direct flow actors to organise the transfer of their goods unloaded at the port to warehouses, which are generally located in town. The flow drivers or direct players in the transport and urban logistics chain in the Greater Lomé Autonomous District are manufacturers, economic operators whose activities consume or generate goods, and traders (wholesalers, semi-wholesalers and retailers). Their objective is purely economic, since the primary aim of their activities is to maximise profit by optimising the choice of means and route of transport to deliver goods within an optimum timeframe at a reasonable cost.

There is also a final category of stakeholders, namely, the beneficiaries of urban goods transport; those at the end of the chain, i.e., city dwellers; and the consumer or end customer who generates the purchase trip to supply the household. Even though the diversity of the players involved makes it difficult to work together in the search for a concerted logistics solution (Armand et al., 2013). It is possible to reconcile the interests of each group of players to create a collaborative framework that benefits everyone. In reality, the players share the urban space where each preserves its interests by playing its part to achieve its individual objectives. It is becoming necessary to realise that urban goods transport is a system whose malfunction would compromise the achievement of all the stakeholders' objectives. For example, economic operators want to see their goods delivered as quickly as possible to the right place at the lowest possible cost. To achieve this, roads need to be of the right size and access them properly to minimise congestion and optimise the speed of goods flows between the city's various economic centers.

The development of transport infrastructure and the regulation of access to it fall within the remit of the public authorities and local and regional authorities, who are urban public players. Their aim is to make the city economically competitive yet loveable for all its inhabitants. The search for the city's economic competitiveness becomes important when it is a port city. However, the existence of a regulatory framework that limits the negative externalities of logistics activities, particularly freight transport, on the lives of city dwellers and on the environment is one of the indicators of the sustainability of freight flows in an urban environment. The quest for sustainable goods flows in urban environments must mobilise the support of all the players in the urban system, whether public or private, and whether they drive or regulate flows. Therefore, what are the challenges involved in organising goods flows in Greater Lomé?

4.2. Urban freight transport, an industry facing enormous challenges to its sustainability

The urban dynamic of the Togolese capital has accentuated the sprawl of the city, mainly in northerly (over 25 km), easterly (over 12 km) and north-westerly (over 18 km) directions, forming the Greater Lomé Autonomous District (DAGL). Almost all of the outlying municipalities are residential, making them heavily dependent on the city centre for employment, services and supplies of goods.

According to the results of **Table 4** above, the top challenge mentioned by DAGL traders is traffic congestion (28%), which leads to delivery delays, followed by deteriorating road conditions (22%), parking problems (19%), regulations prohibiting the use of HGVs at peak times (17%), theft of goods (2%) and other challenges such as rising transport prices, which account for 3%.

According to HGV drivers, the challenges are broken down as shown in **Table 5** below

Table 4. The Urban goods transport challenges in Grand Lomé, according to traders.

Freight transport challenges	Frequency	Percentage
Delays due to congestion	96	28%
Deterioration of roads	76	22%
Lack of parking space	63	19%
Regulatory constraints	56	17%
Regularity of damage	32	9%
Other	11	3%
Theft of cargo	7	2%
Total	341	100%

Table 5. Urban freight transport challenges in Grand Lomé according to drivers serving markets and the port.

Urban freight challenges according to drivers	Drivers serving markets	Drivers serving the Port	Overage	Percentage
Lack of parking space	34	49	42	42%
Traffic congestion	32	18	25	25%
Poor quality of road	22	23	22	22%
Carelessness and failure of other road	12	10	11	11%
Total	100	100	100	100%

For both groups of drivers, the main challenges are parking problems (42%), traffic congestion (25%), poor road quality (22%), negligence and non-compliance with traffic regulations (11%).

4.2.1. Commercial vehicle parking management

Truck parking management is one of the major challenges for urban freight, with 72% of businesses surveyed having no spaces set aside for unloading trucks (**Figure 4**). They claim that for this activity, trucks park on the sidewalk in front of the store. This disrupts traffic flow, particularly on the generally undersized main roads. Truck parking on the pavement is the source of several accidents in the DAGL, especially at

night. What's more, around 78% of stores surveyed (**Figure 5**) has no parking facilities for customers. Customers often park their vehicles on the sidewalk to make purchases.

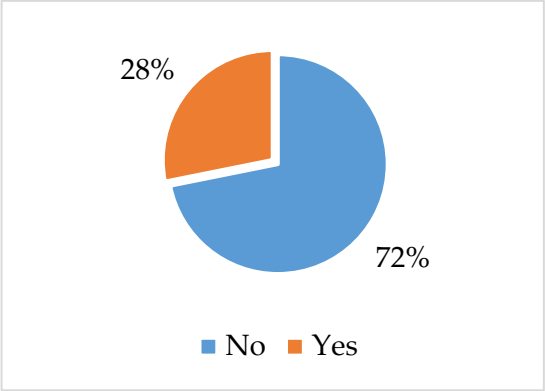

Figure 4. Proportion of stores with or without a space for unloading vehicles.

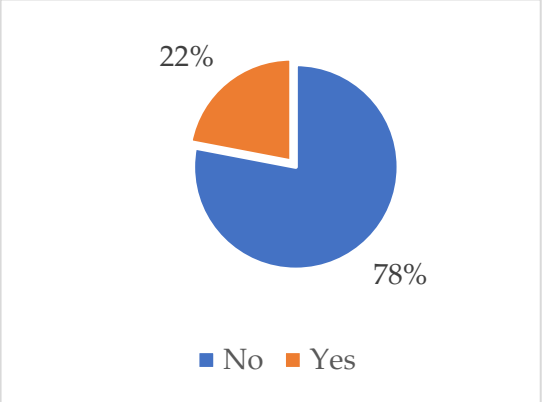

Figure 5. Proportion of stores with and without customer parking facilities.

4.2.2. Road conditions and cargo safety

One of the challenges facing the flow of goods in DAGL is the state of the roads, in particular the unpaved penetrating roads in the outlying districts. This challenge is cited by drivers and merchants alike. The deterioration of the roads means that businesses in these neighbourhoods are less accessible, especially during the rainy season, when most of the roads are impassable. Trucks often get bogged down because of their high Gross Vehicle Weight. Store owners in these neighbourhoods confirm the difficulties of supplying their stores during the rainy season. As one shopkeeper put it, *"drivers won't come here in the rain because of the state of the road. You can see for yourself, the water comes up here (pointing to the middle of a fence opposite) if it rains a lot. The lorry often unloads at the main road (paved roads), so I look for the handlers who carry sacks of rice and cans of oil here"*. 22% of businesses surveyed experience supply difficulties due to the state of the roads (**Table 4**) Some 718,712 m of the road out of a total of 975,482 m, or 74% of roads in the DAGL are in poor condition, according to data from the Direction Générale des Travaux Publics (DGTP) presented in **Table 6** below. The safety of goods has also been raised as a problem during deliveries. This concerns damage during handling, but also attacks by individuals, particularly when deliveries are made at night. One driver said, *"It's dangerous to unload at night in certain neighbourhoods, like here in Baguida. Once*

my truck broke down, and I left my apprentice with the truck until the repairman arrived. As he was sleeping under the truck, the thieves tore off the tarpaulin and took two bags of sugar".

Table 6. Types and conditions of roads in DAGL.

Type	**Status**			
	Good (m)	**Medium (m)**	**Poor (m)**	**Total (m)**
Asphalt roads	124,723	53,233	844	178,800
Paved roads	4900	7300	0	12,200
Earth roads	3918	62,696	717,868	784,482
Total	133,541	123,229	718,712	975,482

4.2.3. Road congestion: an indicator of traffic deterioration that contributes to an increase in pollutant emissions

Road traffic is considered congested when the volume of vehicles exceeds the capacity of the road, or when supply is less than demand for road use. When traffic becomes very dense, it comes to a standstill. This situation is often observed at certain junctions in the DAGL, notably the port traffic circle, where the exit of trucks from the port sometimes coincides with a large flow of vehicles on the coastal road, which is an interstate route. It often takes the intervention of the police to get things moving again. In the Autonomous District of Greater Lomé, as in most West African Port cities, demand for road use is high, especially in the port area.

To understand congestion and peak hours for each means of transport, we analyse in this section the results of the flow counts presented in **Figure 6** below. It should be noted that 39% of the drivers serving the port surveyed use the bypass (**Table 7**), which justifies its selection for the analysis of traffic in Greater Lomé.

Table 7. Truck routes from the port area.

Itinerary	**Frequency**	**Percentage**
Bypass Road to interchange	39	39%
Minor bypass road to Akpdésséwa	20	20%
Coastal Road to the Grand Marché	17	17%
Coastal Road to Baguida	12	12%
Minor bypass road to Hédzranawoé	7	7%
Coastal Road to Kodjoviakopé	4	4%
Other	1	1%
Total	100	100%

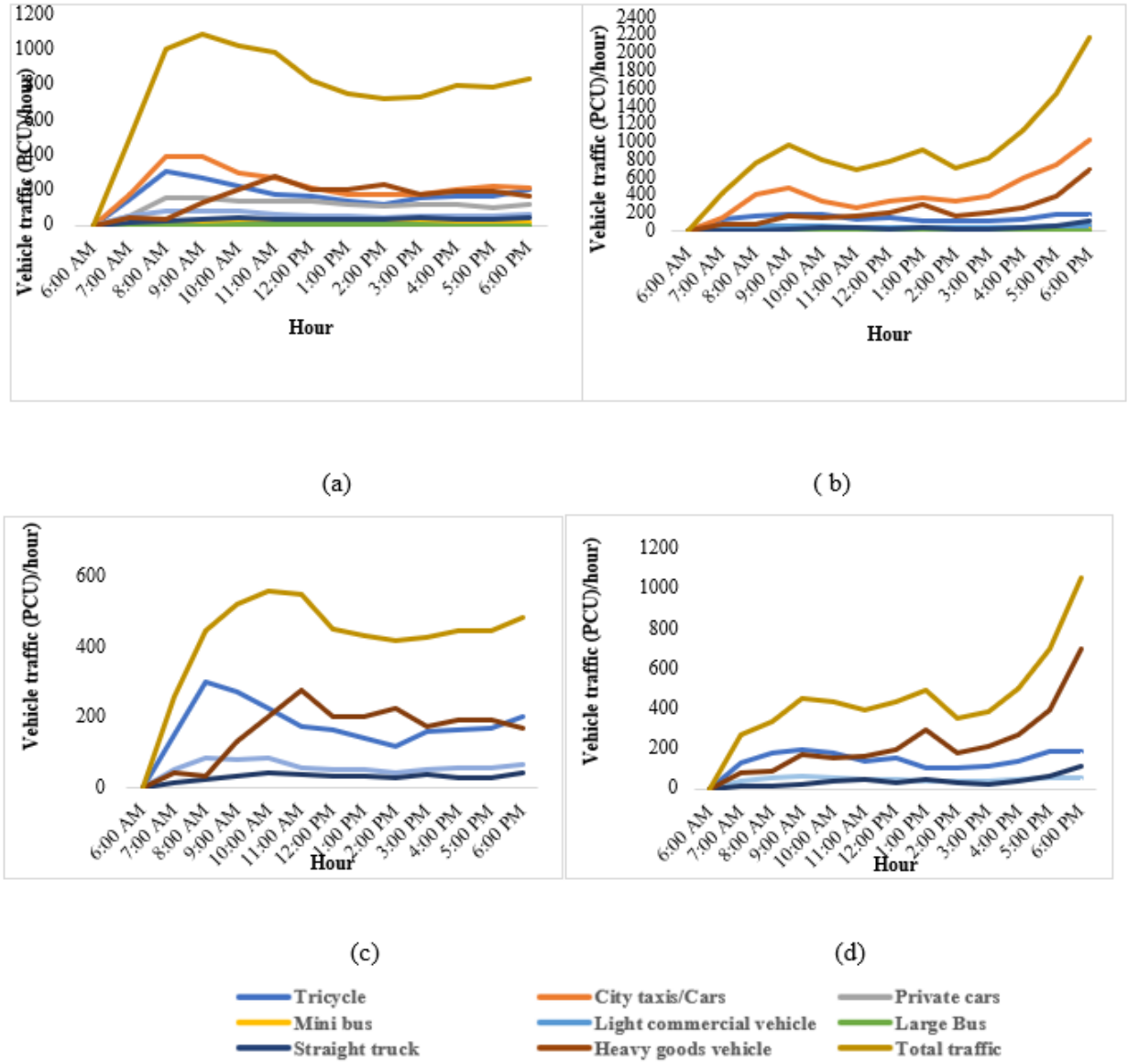

Figure 6. Results of flow counts on the Route du Grand Contournement: **(a)** All PCU vehicle flows to the port area as a proportion of total traffic; **(b)** All PCU vehicle flows from the port area as a proportion of total traffic; **(c)** All PCU goods flow to the port area as a proportion of total traffic; **(d)** PCU goods flow from the port area as a proportion of total traffic**.**

Analysis of **Figure 6a**,**b** shows that traffic on the Grand Contournement road is dominated by city taxis (38%), followed by heavy goods vehicles (23%), tricycles (19%), cars private or personal cars (8%), light commercial vehicles (6%), straight trucks (4%), minibuses (2%) and buses, which are virtually absent from the traffic. The number of goods vehicles in PCU on the Grand contournement road represents 52% of the total flow, which seems high for a conurbation. However, it should be noted that this road was built to drain the flow of goods to and from the port of Lomé.

Analysis of overall traffic (**Figure 6a**,**b**) reveals that the morning peak hour is between 8 and 10 a.m., with a peak at 9 a.m., when traffic reaches 1090 PCU per hour, or 11% of the total traffic (10036 PCU) recorded between the Agoè interchange and the port. A trader selling second-hand household appliances at the Zorobar market in

the port area confided to us: *"In general, if I don't have an appointment with a customer, I arrive here around half past eight or nine in the morning"*. This corresponds to the start of HGV traffic in the port area. "*We get back on the road between 8 and 11.30 a.m., after stopping at 5 a.m. It's the law and we have to respect it"*, explains one of the leaders of the Union des Routiers du Togo. Although the overall volume of traffic at 9 a.m. is driven mainly by city taxis and personal vehicles, the flow of goods, notably tricycles and heavy goods vehicles, also contributes to this volume (**Figure 6a**). Overall traffic increases in the afternoon from 4 to 6 p.m., when it peaks. This corresponds to the evening peak hour, when 2183 PCU per hour are recorded, or 19% of total traffic (11766 PCU) from the port to the Agoè interchange from 6 a.m. to 6 p.m. (**Figure 6b**). On the one hand, there is a variation in the flow of heavy goods vehicles, which follows the overall traffic trend. On the other hand, the flow of heavy goods vehicles recorded during the evening peak hour (699 PCU/h) is more than five times greater than that recorded during the morning peak hour (132 PCU/h). From these observations, we draw the following conclusions:

Traffic congestion occurs between 8 a.m. and 10 a.m., with a peak at 9 a.m., and in the evening between 4 p.m. and 7 p.m., with a peak at 6 p.m. (19% of total traffic and a high proportion of heavy goods vehicles). This reflects non-compliance with regulations banning heavy goods vehicle traffic at peak times, particularly in the evening, when flows increase between 5pm and 7pm (**Figure 6d**). According to the regulations, heavy goods vehicles are banned from the DAGL in the morning between 5am and 8am and between 11 :30am and 1pm. In the evening, they are also prohibited between 2 and 3 pm and between 5 and 7 pm. During our field surveys of drivers serving the port area and the Grand Marché de Lomé, 82% confirmed that they were aware of the regulations on traffic bans at peak times, while 18% said they were not informed. Nevertheless, those who were aware of the regulatory framework found it difficult to define the periods of the day during which their trucks were not authorised to circulate in the DAGL. This explains the inefficient flow of information between flow regulators and union officials, on the one hand, and between the latter and drivers affiliated to their unions, on the other. This situation is not conducive to the sustainability of flows, particularly goods flows in the DAGL, as the more congested traffic, the slower the vehicles travel and the more carbon they burn, resulting in the emission of atmospheric pollutants such as carbon monoxide (CO), nitrogen oxide (NOx), hydrocarbons, carbon dioxide (CO2), etc. The latter is responsible, on the one hand, for the high level of congestion and, on the other, for the high cost of transport. On the one hand, the latter is responsible for the greenhouse effect, which contributes to global warming, and on the other, these gases have harmful effects on human health.

5. Discussion

Analysis of the urban freight transport system in the DAGL through the prism of classic sustainability criteria reveals that freight flows face immense challenges that are not conducive to their sustainability. Poor Road quality, parking management difficulties, traffic congestion and no compliance with freight traffic regulations are the main challenges facing urban freight transport in the DAGL. These findings corroborate those of Lee and Palliyani (2017) in the Singapore example particularly

with regard to traffic congestion and parking management. French experience in urban goods transport has also shown, in the case of the city of Bordeaux, the importance of goods delivery vehicles in road congestion and the difficulties associated with parking management in an urban environment (Routhier, 2002).Several situations are at the root of these challenges, which have a negative impact on the sustainability of goods flows in the DAGL. For example, congestion is the result of a combination of factors, such as the location of the main centres generating flows of goods and people in the southern part of the city and the residential areas mainly to the north and north-west of the city. The failure to comply with HGV traffic regulations also contributes to traffic congestion. The poor condition of the streets is explained by two main factors: unpaved roads and overloaded lorries, and traffic density. These same factors were mentioned by Fousséni and Daoudou (2002) and Atomode (2017) as causes of traffic congestion and street deterioration in Cotonou and Lagos respectively. The challenge of truck parking in the DAGL is explained by the lack of provision of parking areas along streets and at some commercial junctions to accommodate trucks in loading and unloading operations. The study of the externalities of urban freight in Paris and London also revealed the extent of the disruptive parking caused by delivery lorries. The development of parking areas has been proposed by the Mayor of Paris as a solution (Browne et al., 2007) to make the flow of goods in the city efficient and sustainable.

Indeed, according to the work of Dablanc (2007), urban goods transport flows are considered sustainable when their organisation makes it possible to reduce pollutant and noise emissions, while improving the living and working conditions of drivers and other workers in the sector. However, the results reveal that goods flow in the DAGL evolve in a context of congested urban traffic, which contributes to an increase in polluting emissions. In addition, the social conditions of drivers are very difficult, as not only are they mostly paid on a trip-by-trip basis, but regulations limiting daily driving hours are not observed. This compromises the social sustainability of goods flows in the DAGL. However, the new vision of the sustainability of urban goods flows taken up by Gonzalez-Feliu (2016) in the form of the four capacities nevertheless allows us to identify progress towards sustainability in the organisation of goods flows in the DAGL.

Faced with the multiple externalities associated with urban goods transport, the various players have become aware of the increase in goods flows, and have anticipated this by building a first road, known as the “petit contournement”, to divert urban freight from the city center. In 2014, this road was replaced by the grand contournement, which offers greater capacity than the first. In addition, the Adétikopé dry port on the northern outskirts of Lomé also helps to relieve congestion in the port area by handling containers flows destined for the Sahel countries. It should be remembered that containers are transferred from the port to the dry port from 10 pm onwards, which benefits passenger flows that are often disrupted by truck. The capacity of public players has resulted in the introduction of a regulatory framework prohibiting the circulation of goods flows during peak hours. Although the implementation of certain actions, notably the transfer of containers to the dry port of Adétikopé, initially came up against opposition from certain players in the transport chain, such as container terminal operators, activities have resumed thanks to a

consensus between the players concerning the costs of container transfers. There has also been improved collaboration between urban goods transport organisers and flow generators, following the creation of the Togolese employers' association of road transporters, which aims to provide a framework for modernising the transport sector in Togo.

5. Conclusions and recommendations

The sustainability of goods flows in urban environments is mobilising more players in both research and urban management. Sustainable development indicators are used to assess the level of a sustainable transport system. Urban goods flows are considered sustainable when their organisation incorporates both environmental and social aspects as well as economic ones.

However, if all these aspects are considered, the many players in the transport and urban logistics chains need to be coordinated. Integrating the players in the transport and urban logistics chain therefore emerges as an efficient approach to the sustainability of goods flows in urban environments.

The results reveal that the organisation of goods flows in the DAGL faces a number of challenges that hamper its sustainability. For example, traffic congestion, which peaks at 9 am and 6 pm; no compliance with the current regulatory framework banning heavy goods vehicles from the roads during rush hour; difficulties in managing parking; carelessness on the part of drivers; and the poor state of the roads. However, analysis of the organisational system for urban goods transport through the prism of the four capacities reveals certain actions induced by the integration of the players. On the one hand, these actions stem from integration between direct or private players and, on the other hand, between the latter and public players and have a positive effect on the organisational system for urban freight.

6. Recommendations

6.1. Recommendations relating to transport infrastructure

The poor state of the roads was mentioned by both drivers and shopkeepers. For these two stakeholders, this situation is the cause of the difficulties in supplying the outlying districts, particularly during the rainy season. It often results in delivery delays, traffic accidents and unloading on the road, all of which increase damage and supply costs. In addition, the lack of spaces along the roads to accommodate lorries for unloading and loading at crossroads and commercial streets leads to illegal parking on the roads. This illegal parking contributes to traffic congestion at peak times and to traffic accidents, particularly at night.

In order to guarantee smooth and safe traffic flow for DAGL residents, the mayors and governor of the DAGL must undertake initiatives aimed at:

- rehabilitating degraded streets
- resurfacing unpaved streets in outlying districts,
- developing parking areas at commercial crossroads and streets to accommodate vehicles for unloading and loading operations,

- Authorising the construction of commercial buildings only when the construction plan includes a car park capable of accommodating customer vehicles,
- Considering modal shift to rail in the long term. In order to maintain the competitiveness of the autonomous port of Lomé, the transfer of containers from the port to the Adéticopé industrial platform could be organised by train, making the most of the old railways.

6.2. Recommendations for improving the regulatory framework for goods flows in the GLA

The only urban goods transport regulation in force in the DAGL relates to the restriction of HGV access to the city during peak hours. According to this regulatory framework, HGVs are authorised to drive in the DAGL in the morning from 8.00 am to 11.30 am and to resume driving in the afternoon during the following periods: 1.30 pm to 2.00 pm; 3.00 pm to 5.00 pm and 7.00 pm to 5.00 am. However, the results of the flow survey showed that lorries are on the road outside these hours, even though there are not many of them.

The DAGL local authorities must strengthen the regulatory framework for urban transport in general and goods transport in particular. These measures should include

- Forcing transport companies to respect HGV traffic hours. This action should start by raising awareness among union officials and drivers of the different periods when lorries are allowed to circulate in the DAGL. Awareness-raising should also cover the penalties for disobedience. In addition, the police must be made available to support the process of implementing the regulations,
- Reduce air pollution generated by HGVs by limiting the age of second-hand trucks imported and used to transport goods, as is the case in Côte d'Ivoire, where the age limit for imported trucks is between seven and ten years, according to the decree no. *D-2017-0792-FS.*, and in Senegal, where the age limit is between five and eight years,
- Limit parking time for loading or unloading goods in commercial streets and intersections,
- For actions to be sustainable, decisions must be taken with the support of all stakeholders.

6.3. Professionalising the urban freight sector

The urban freight sector in the DAGL is predominantly informal, which does not facilitate the application of regulatory measures.

The process of professionalising the sector, which has already been initiated by the State, must include the following aspects:

- Strengthening the role of the Togolese employers' association of road hauliers (FPT2R) and UNATROT in the professionalisation of the transport sector,
- Setting up an urban freight organising authority bringing together delegates from all the unions and managers from all the public and private organisations involved in urban freight transport,
- In addition to data on traffic accidents involving HGVs, set up a database to collect data on urban freight (the tonnages transported per year, the level of

polluting gas emissions by lorries, the number of decibels of noise generated by urban freight lorries in residential areas, etc.),

- Raise awareness among the various players and drivers of the need to limit the negative externalities of urban freight by limiting driving hours and complying with the Highway Code.

Implementing these measures will considerably improve urban freight traffic conditions in the DAGL by improving the living and working conditions of workers in the sector, but also by reducing the negative impact of urban freight on the environment and economic activities in the DAGL.

The results of this study will serve as a decision-making tool for local authorities and other stakeholders in urban freight transport, providing information on the various challenges facing urban freight. Implementing the various recommendations will improve the economic, environmental and social sustainability of urban freight in the DAGL. However, certain aspects of the work, such as the quantification of environmental nuisances such as air pollution and noise, and their impact on the health of the DAGL's population, deserve to be explored in greater depth in future articles. A strategy for implementing the various recommendations will also be proposed.

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