

weaknesses which tend to militate against effective agricultural development. Some of the existing land policies and the institutional arrangements have certain built-in inefficiencies that breed frustration. The existing legal and statutory arrangements are proving to be inadequate to meet current challenges. The approach to land policy design and implementation appears to be unco-ordinated. The general situation therefore seems to be one of conflicts, confusion, and chaos. These negative trends have created some fundamental problems with regard to effective agricultural development, and the structuring of realistic land policies.

The picture painted above calls for some measures to reduce the negative aspects of the management of our land as a resource. The measures should focus on:

- (a) The need for a review of our indigenous tenure arrangements in order to make land easily accessible and available for the private sector with respect to housing and agricultural development.
- (b) The importance of re-structuring the institutional arrangements for the management of our land resources in order to eliminate vested interests, waste and duplication. Such an arrangement should ensure the utilisation of land resources in such a manner as can benefit the present generation and those still unborn.
- (c) The reform of our land laws in order to ensure equity and social justice, without necessarily naturalising land.

- (d) The need for a national land use policy that is inter-sectoral both in structure, content and direction.
- (e) A system of agricultural land use possibilities, such as
  - i. A policy for integrated agriculture
  - ii. A policy for mechanised farming
  - iii. A policy for indigenous farming
  - iv. A policy for cattle ranching and dairy farming
  - v. A policy for integrated irrigation scheme that focuses on small irrigation mechanisms that can be delivered easily to farmers.
  - vi. A policy for production forestry
  - vii. A policy for protection forestry, etc.
- (f) A system of urban land use policy that ensures optimal use of land, and eliminates under-use, or misuse of land.
- (g) A co-ordinated policy for environmental protection, and
- (h) The need to examine the negative effects of compulsory powers of acquisition in order to eliminate landlessness, and to ensure that local wealth from the land is fairly distributed to the local community.

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## Parking of freight vehicles in Kumasi, Ghana

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### ABSTRACT

Kumasi is the second largest city in Ghana. It is also the only city on which national and international ground transportation routes converge, because of its location in the geographic centre of the country. By virtue of this Kumasi plays a unique role as an inland terminus for the collection and distribution of goods within and outside the country. The problem however, is that it appears the city does not have adequate facilities to accommodate and handle freight vehicles in the performance of its terminal and distribution functions. This article describes the findings of a study carried out to assess the extent and nature of the problems and their implications for public policy. The main method of study was by interviewing a random sample of parked vehicle operators and owners based on structured questionnaires.

The major finding of the study is that there are no adequate parking facilities for freight vehicles in Kumasi, but there is a potential market demand for such services. The study establishes that there is a need to build a freight terminal in Kumasi and run on a commercial basis by a limited liability company.

**Keywords:** freight vehicles, transportation, freight terminal, Kumasi

### INTRODUCTION

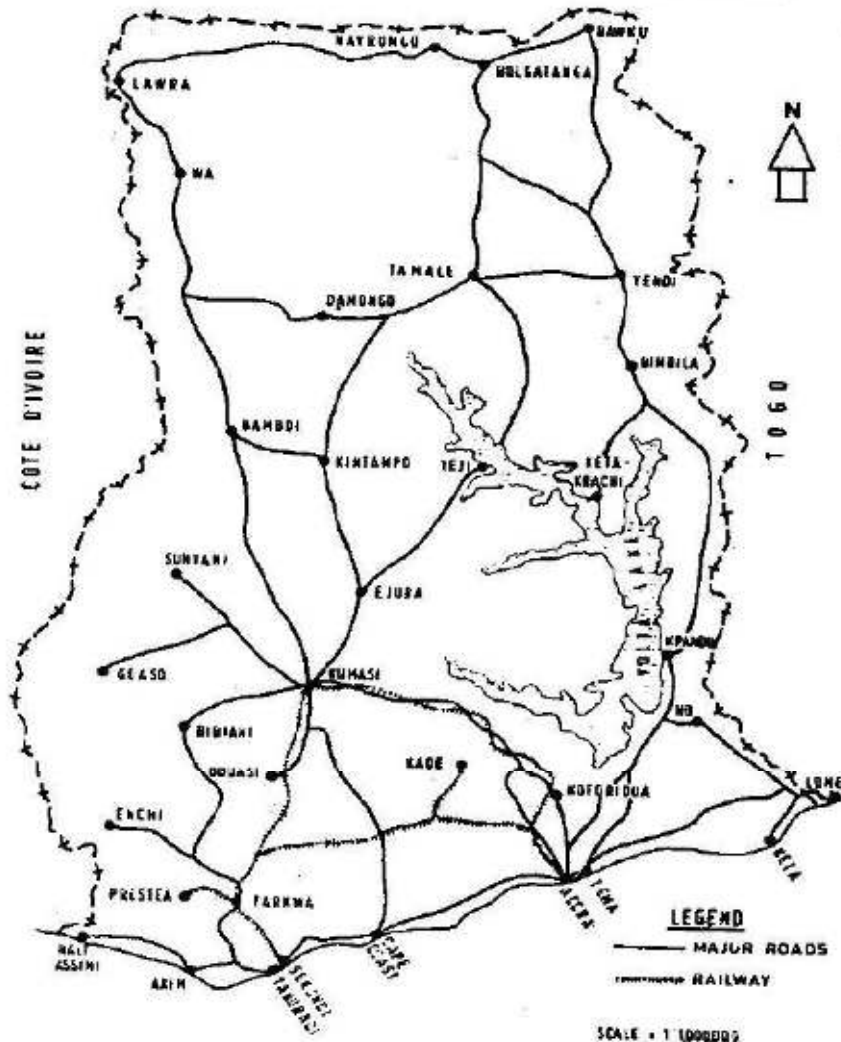
Kumasi is the second largest city with a population of about 500,000 located in the geographic centre of Ghana. It is the only city in Ghana on which national and international ground transportation routes converge (Figure 1). Consequently, the role of the city as an inland terminus for the collection and distribution of raw materials and manufactured goods within and outside the country cannot be over emphasised. The implication of this is that Kumasi generates and attracts a lot of freight traffic which is either destined to, or in transit through the city. However, very little is known about the traffic problems associated with the capacity of the city to adequately accommodate freight vehicles in the performance of its terminal and distribution functions. This paper describes the findings of a study carried out to assess the extent and nature of the problems and their implications for public policy. The main objectives of the study were:

1. to investigate the existing parking and related problems facing freight vehicle operators and owners in the city;
2. to assess the environmental problems created by freight vehicles parking in the city;
3. to determine the parking requirements for freight vehicles in Kumasi;
4. to determine whether there is a market demand for the provision of freight parking facilities in the city; and
5. to make appropriate recommendations to guide public policy in the provision of parking facilities for, as well as the regulation of freight vehicles in Kumasi.

### STUDY METHODOLOGY

The main approach adopted in the study was to collect data which were considered relevant to the identification of freight parking problems in the city, the type and scale of facilities required as well as the willingness to use and

FIG. 1: MAJOR TRANSPORTATION ROUTES IN GHANA



pay for such facilities if they are available. To this end, a freight terminal user survey was carried out in Kumasi in July 1987 by interviewing parked freight vehicle operators as well as freight vehicle owners of various transport associations throughout the city. The survey of vehicle operators which was carried out on four week-days (Tuesday to Friday) and a Saturday was based on structured questionnaires about the following main items.

1. Type and capacity of vehicle and goods carried;
2. Parking habits, characteristics and problems;
3. Origin and destination of vehicles;
4. Preferences for freight terminal location and facilities; and

5. Willingness to use and pay for facilities if provided.

#### SURVEY AND FIELDWORK

A reconnaissance survey revealed many locations where freight vehicles park on or off-street throughout the city. In all 40 major locations were identified as shown in Figure 2 and Table 1. These locations were classified into three main categories as "high", "medium" and "low" density parking areas by means of a ground count. On the basis of this classification a stratified sample representing about 55 per cent of the 40 locations was selected for interview of parked vehicle operators. In all 201 vehicle operators representing about 76 per cent of all



**TABLE 1: KEY TO FIGURE 2:  
IDENTIFIED PARKING PLACES FOR  
FREIGHT VEHICLES IN KUMASI**

1. U.S.T. Junction
2. Anloga Road (Carpenters' Site)
3. Anloga Junction (Mobil Filling Station)
4. Aboabo (Opposite Kotoko Cinema)
5. Aboabo (Aihaji Yakubu)
6. Aboabo Extension (School Park)
7. Sports Stadium (Car Park)
8. Adabia Commercial Institute (Mobil filling Station)
9. Central Mosque Area
10. Asawasi Market
11. Asawasi Reform Institute Park
12. Asawasi (Opposite Methodist Church)
13. Manhyia
14. New Tafo Lorry Park
15. Aboabo No.1 Station (Ghana Station)
16. Asem Boys School Park
17. Rex (B.P.)
18. Central Market (Boday)
19. Aflao Station
20. Asafo (GOIL) (24th February Road)
21. Railway Station (Cement Delivery Area)
22. Kejetia (GOIL)
23. Adum (Tarzan Transport Office)
24. Konadu Yidom School Park
25. New Tafo (MOBIL)
26. New Tafo (Atomic)
27. Suame Roundabout (MOBIL)
28. Suame Roundabout (TOTAL)
29. Abrepo Junction (B.P.)
30. Bantama Lorry Park
31. Sofollne
32. Kwadaso (MOBIL)
33. Asuoyeboah (B.P.)
34. Santasi Roundabout
35. Breman
36. Old Tafo (3 miles)
37. Old Tafo (Opposite Methodist Church)
38. Old Tafo (4 miles)
39. Top High (AGIP)
40. Amakom (SHELL)

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parked freight vehicle operators in the various locations at the time of the survey were interviewed. Table 2 shows a breakdown of the interview days, the station and the number of operators interviewed from each station.

It can be seen from Table 2 that the proportion of vehicle operators interviewed on each of the survey days ranged between 40 and 100 percentage points. Because of this high variable sample rate it was reasonably assumed that the data collected from vehicle operators could represent the typical parking characteristics of freight vehicles in Kumasi. In contrast, the number of freight vehicle owners interviewed was rather low. In all only 28 owners were interviewed. Even where the owners were contacted at their homes a number of call-backs had to be made to obtain fully completed questionnaires.

#### PARKING CHARACTERISTICS OF FREIGHT VEHICLES IN KUMASI

##### TYPES OF FREIGHT VEHICLES

The predominant type of freight vehicle identified in the city was the light goods vehicle with two axles and nominally six wheels. This constituted about 55 per cent of all freight vehicle operators interviewed. The next dominant type of freight vehicle was the heavy goods vehicles with four or more axles, which constituted about 34 per cent of the sampled freight vehicles. Medium goods vehicles with three axles, rigid or articulated, formed 11.0 per cent. Agricultural and construction vehicles constituted one per cent of all freight vehicles surveyed.

##### ORIGIN AND DESTINATION OF VEHICLES AND GOODS CARRIED

The survey results indicated that the origin and destination of the freight vehicles are Mali, Niger, Bourkina Faso, Takoradi and Accra-Tema. Most of these were the heavy goods vehicles carrying salt, food items, timber and manufactured goods.

Apart from the heavy goods vehicles there were also the medium goods vehicles which had both their origins and destinations in the country. Some operators transported plastic products, flour, sugar and manufactured products from Accra, Tema and Takoradi to destinations such as Kumasi, Sunyani, Berekum and areas beyond these. Other medium

Table 2: Ground Count of Parked Freight Vehicles and Number of Operators Interviewed at Each of the Parking Stations Selected for Interview

LOCATION	NUMBER OF STATIONS	DAY 1		DAY 2		DAY 3		DAY 4		DAY 5	
		NUMBER OF VEHICLES PARKED	PERCENTAGE OF VEHICLES INTERVIEWED	NUMBER OF VEHICLES PARKED	PERCENTAGE OF VEHICLES INTERVIEWED	NUMBER OF VEHICLES PARKED	PERCENTAGE OF VEHICLES INTERVIEWED	NUMBER OF VEHICLES PARKED	PERCENTAGE OF VEHICLES INTERVIEWED	NUMBER OF VEHICLES PARKED	PERCENTAGE OF VEHICLES INTERVIEWED
Old Tafo	3	-	-	-	-	-	-	22	10(91%)	-	-
New Tafo	3	-	-	-	-	28	23(82%)	-	-	-	-
Aboabo	3	23	21(91%)	25	20(80%)	-	-	-	-	-	-
Ghana Station	1	22	16(73%)	20	10(50%)	-	-	-	-	12	9(75%)
Boday	1	12	9(75%)	11	9(81%)	-	-	12	12(80%)	-	-
Asawasi	3	-	-	-	-	-	-	-	-	23	9(75%)
Rex	1	8	4(50%)	8	4(50%)	-	-	-	-	-	-
Suame											
Roundabout	2	-	-	-	-	8	8(100%)	-	-	-	-
Asafo Gail	1	5	5(100%)	-	-	-	-	-	-	-	-
Aflao Station	1	5	2(40%)	-	-	-	-	-	-	-	-
Kwadaso	1	-	-	-	-	-	-	9	4(55%)	-	-
Kejetia	1	-	-	-	-	-	-	8	5(62%)	-	-
UST Junction	1	-	-	-	-	-	-	-	-	1	1(100%)
<b>Total</b>	<b>22</b>	<b>75</b>	<b>57(76%)</b>	<b>64</b>	<b>43(65%)</b>	<b>36</b>	<b>31(86%)</b>	<b>54</b>	<b>41(76%)</b>	<b>36</b>	<b>29(80%)</b>

Figures in parentheses represent the percentages of Parked Vehicles Interviewed.

goods vehicles also brought in food-stuff from Techiman, Atebubu, Wenchi, Tamale and Yeji. This particular group of truckers usually spend the night at petrol filling stations in the proximity of the Central Market. On the other hand there were other vehicles which carried cement and building materials from the rail-head in Kumasi to destinations such as Techiman, Sunyani, Salaga and Bolgatanga. However, this formed a small proportion (15 per cent) of all freight vehicles most of which are usually not involved in the carriage of goods to the railways.

The foregoing groups of vehicles, especially those with either origins or destinations outside the city, and which stop overnight in transit in Kumasi, comprise a potential freight terminal market which can be captured if appropriate facilities are provided.

FREQUENCY OF TRIPS TO AND THROUGH THE CITY

The vehicle operators interviewed indicated that they undertook regular trips to and through Kumasi. Almost one half of these truckers, about 49 per cent, undertook the various trips described above once a week. Another 19 per cent undertook these trips twice a week and about 12 per cent made these trips on a monthly basis. It will be seen from Table 3 that most of the operators travelled to and through the city with a frequency of

either once or twice a week. When this is considered alongside the fact that about 65 per cent of these trips are external to Kumasi and last for at least two days, then the potential demand for parking facilities in the city can be appreciated. However, the nature of this demand may also be influenced by the parking habits of the freight vehicle operators under consideration.

PARKING HABITS OF FREIGHT VEHICLE OPERATORS IN KUMASI

VEHICLES WITH DESTINATIONS IN KUMASI

Because of the absence of a well organised public freight terminal facility in Kumasi, freight vehicles in transit or those that have their destinations in Kumasi are parked in a number of places scattered all over the city. Vehicles with destinations in Kumasi mostly park at Old Tafo and New Tafo, Asawasi and Aboabo. The other freight vehicles park in almost all the high density residential districts in the city (Table 4 and Figure 2). Within these neighbourhoods the freight vehicles park both on- and off-street including lorry parks, petrol filling stations, undeveloped open-spaces, school parks, lanes and the loading and unloading sections of various markets. Most of the freight vehicles that have their destinations in Kumasi (about 68 per cent) use the off-street parking spaces particularly the petrol filling stations. The others park on streets

Table 3: Frequency of Trips to and Through Kumasi

Frequency	Number of Operators	% of Total
Once a month	24	11.9
Twice a month	17	8.4
Thrice a month	8	4.0
Once a week	96	47.8
Twice a week	38	18.9
Thrice a week	10	5.0
Four times a week	1	0.5
Daily	2	1.0
Cannot determine	5	2.5
<b>Total</b>	<b>201</b>	<b>100.0</b>

**PARKING OF FREIGHT VEHICLES IN KUMASI, GHANA, E.K.A. TAMAKLOE, K.K. ADARKWA**

**Table 4: Location of Parking Places for Freight Vehicles with their Destination in Kumasi**

Location	Number of Vehicles Parked At Location	%
Ghana Station	13	7.4
Old Tafo	32	18.2
New Tafo	15	8.5
Suame	6	3.5
Suame Roundabout	2	1.1
Akwatia Line	6	3.4
Asawasi	14	8.0
Aboabo	19	10.8
Bantama	6	3.4
Dichemso	5	2.8
Ahinsan	4	2.3
Asukwa	2	1.1
Adum	5	2.8
Rex	10	5.7
Kejetia	4	2.3
Amakom	2	1.1
Sawaba	2	1.1
Asafo	4	2.3
Alabar	7	4.0
Asafo Market (Goil)	2	1.1
Kwadaso	2	1.1
Other Locations	14	8.0
<b>Total</b>	<b>176</b>	<b>100.0</b>

in front of the vehicle owner's house or any other residential street. This haphazard pattern of parking poses many environmental hazards of freight traffic congestion, noise, fumes, visual intrusion, pollution and the fear of safety for people living and working in the parking areas (Figures 3 - 6). This situation underscores the need for a unimodal (road/road) freight terminal in Kumasi.

About 46 per cent of the vehicle operators interviewed indicated that they experienced some parking problems in the areas where they park. The other 54 per cent indicated that they did not have any problems with parking. Most

of the operators' parking problems related to finding appropriate parking places either because the streets were too small for the freight vehicle or because they were congested. Some of the other problems were related to the exposure of goods in the vehicles to the vagaries of the weather, risks of theft, the difficulty of vehicle operators finding affordable resting places, and return payload within a short time.

**FREIGHT VEHICLES IN TRANSIT**

About 65 per cent of vehicle operators interviewed were identified as transit vehicles of which 79 per cent park in Kumasi while in transit. The popular

PARKING OF FREIGHT VEHICLES IN KUMASI, GHANA, E.K.A. TAMAKLOE, K.K. ADARKWA

Table 5: Location of Parking Places for Transit Vehicles

Location	Number of Vehicles Parked At The Location	%
Ghana Station	14	13.6
Old Tafo	11	10.7
New Tafo	14	13.6
Suame	6	5.8
Akwatia Line	5	4.8
Asawasi	12	11.7
Aboabo	11	10.7
Bantama	5	4.8
Dichemso	1	1.0
Ahodwo	1	1.0
Asukwa	1	1.0
Sepah	1	1.0
Asafo	1	1.0
Asafo Market(Goil)	4	3.9
Oforikrom	5	4.8
Odeon	6	5.8
Adukrom	1	1.0
Alabar	1	1.0
Other Locations	3	2.8
<b>Total</b>	<b>103</b>	<b>100.0</b>

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parking places include the "Ghana Station", New Tafo, Asawasi, Aboabo and Old Tafo (Table 5). The parking characteristics of these transit freight vehicles are very similar to those that have their destinations in Kumasi as described above.

The survey also revealed that the location of parking places for transit vehicles and resting places for their operators are quite different from those with destination in Kumasi. After parking their vehicles in convenient places the operators, and their assistants, usually find appropriate resting places either in the neighbourhood or in other nearby areas. Most of the operators usually spend the night in areas such as Aboabo and Old Tafo in their parked vehicles. Only about 2 per cent of vehicle operators spend the night in hotels. What this seems to indicate is the lack of overnight accommodation facilities for transit vehicle operators

in Kumasi. At the same time most of these operators cannot also afford the exorbitant cost of an overnight's stay in hotels. These are all pointers to the fact that there is the need for such facilities to be provided in a freight terminal complex in Kumasi at a reasonable cost to the operators.

**VEHICLE OPERATORS AND OWNERS  
PREFERENCES FOR PARKING FACILITIES**

Some of the facilities which vehicle operators and owners suggest they would like to have at a freight terminal in Kumasi included a parking area, warehouses, security services, fuel-station, guest rooms, a service workshop as well as services for mobilising, handling and forwarding of goods, amongst others. The rank order of equivalent facilities listed by vehicle operators and owners is summarised in Table 6.

Figure 3: FREIGHT VEHICLE PARKING STATION AT ABOABO (high density, low income residential area)



Figure 4: FREIGHT VEHICLES PARKED ON RESIDENTIAL ACCESS ROADS REDUCES EFFECTIVE WIDTH OF CARRIAGE WAYS FOR MANOEUVRABILITY

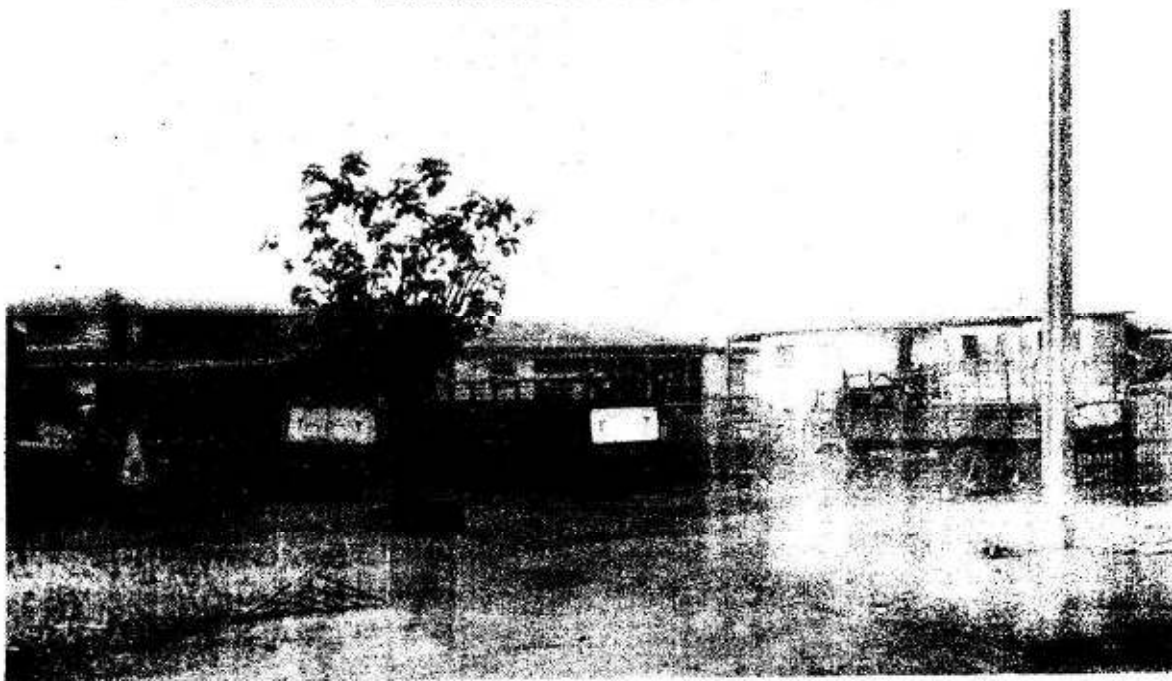


Figure 5: A SCHOOL PLAYGROUND INTRUDED BY FREIGHT VEHICLES IN TRANSIT

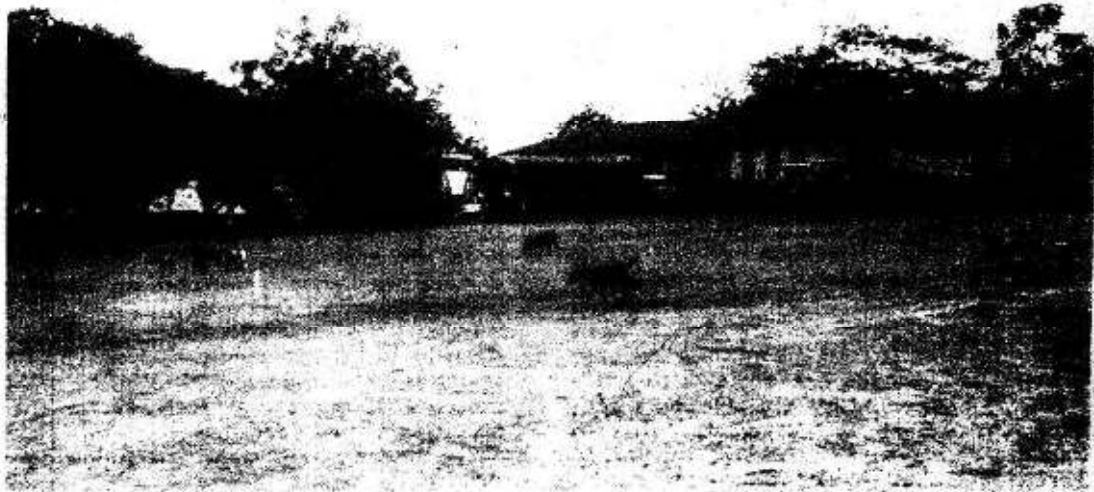


Figure 6: OFF-STREET PARKING OF FREIGHT VEHICLES IN OPEN SPACES WHICH ERUDE THE FREEDOM OF MOVEMENT OF PEDESTRAINS



Table 6: Prioritisation of Facilities by vehicle Operators and Owners

Facility	Score		Rank	
	Operators	Owners	Operators	Owners
Parking Area	887	176	1	2
Security Services	677	149	2	3
Guest Rooms	650	88	3	4
Workshop/Vehicle Repair	325	54	4	6
Fuel Station	298	63	5	5
Warehouse	249	181	6	1

Vehicle operators listed more facilities such as canteen, mosque, clinic, public bath and toilet as well as facilities for washing vehicles, which vehicle owners did not consider necessary. It is seen from Table 6 that the rankings by operators and owners are quite different. This is confirmed by a Spearman's rank correlation test. For example, whereas operators would want to see the parking area developed first the owners would want the warehouse developed first. Both groups of people seem to put roughly the same premium on security. The pattern of prioritisation depicted in Table 6 is, perhaps, a reflection of the inherent interests that operators and owners have in various aspects of a freight terminal facility. For example, while vehicle owners are concerned more about the goods carried, vehicle operators are concerned more about their convenience, the condition of the vehicles they operate and the security of goods carried. What is re-assuring, however, is the fact that no matter how these figures are interpreted they still indicate the existence of a potential demand for certain vital facilities for a freight terminal in Kumasi. The foregoing is further reinforced by the fact that about 88 per cent of the operators expressed their willingness to use the facilities for which they showed their preferences. In addition to this, all the vehicle owners also indicated their willingness to instruct their operators to use such facilities if they are provided.

**DEMAND FOR FREIGHT TERMINAL FACILITIES**

As indicated above the preferences of vehicle operators and owners for

terminal facilities include a parking area, drivers' guest rooms (hostel), a service workshop, fuel station, canteen, warehouses and cargo mobilisation bureau. An estimation of the future demand for these services, however, depends on the projected volumes of parkers willing to use and pay for the facilities if provided.

To estimate this demand the following procedure was used:

1. A linear projection of freight traffic through the city over a plan period of ten years was estimated with an annual growth factor of 2.5 per cent using 1987 as the base year. Projection up to 1992 is shown in Table 7. The 2.5 per cent constant growth rate of freight traffic was based on parameters of the national economy under the momentum of Ghana's Economic Recovery Programme.
2. Various factors of willingness to use and pay for terminal facilities if provided were derived from the parking user survey.
3. The following formula was used to estimate the stock of vehicles willing to use terminal facilities in a given year.

$$T_{rj} = \frac{1}{2}((V_{rj} F_r) + (W_{rj} K_r))$$

where  $T_{rj}$  = Average weekly stock of vehicle parkers on a given route  $r$  willing to use terminal facilities in a given year  $j$

$V_{rj}$  = The weekly volume of traffic entering the city on a particular route  $r$  in year  $j$

Table 2: Ground Count of Parked Freight Vehicles and Number of Operators Interviewed at Each of the Parking Stations Selected for Interview

LOCATION	NUMBER OF STATIONS	DAY 1		DAY 2		DAY 3		DAY 4		DAY 5	
		NUMBER OF VEHICLES PARKED	PERCENTAGE OF VEHICLES INTERVIEWED	NUMBER OF VEHICLES PARKED	PERCENTAGE OF VEHICLES INTERVIEWED	NUMBER OF VEHICLES PARKED	PERCENTAGE OF VEHICLES INTERVIEWED	NUMBER OF VEHICLES PARKED	PERCENTAGE OF VEHICLES INTERVIEWED	NUMBER OF VEHICLES PARKED	PERCENTAGE OF VEHICLES INTERVIEWED
Old Tafo	3	-	-	-	-	-	-	22	10(91%)	-	-
New Tafo	3	-	-	-	-	28	23(82%)	-	-	-	-
Aboabo	3	23	21(91%)	25	20(80%)	-	-	-	-	-	-
Ghana Station	1	22	16(73%)	20	10(50%)	-	-	-	-	12	9(75%)
Boday	1	12	9(75%)	11	9(81%)	-	-	12	12(80%)	-	-
Asawasi	3	-	-	-	-	-	-	-	-	23	9(75%)
Rex	1	8	4(50%)	8	4(50%)	-	-	-	-	-	-
Suame Roundabout	2	-	-	-	-	8	8(100%)	-	-	-	-
Asafo Goll	1	5	5(100%)	-	-	-	-	-	-	-	-
Aflao Station	1	5	2(40%)	-	-	-	-	-	-	-	-
Kwadaso	1	-	-	-	-	-	-	9	4(55%)	-	-
Kejetia	1	-	-	-	-	-	-	8	5(62%)	-	-
UST Junction	1	-	-	-	-	-	-	-	-	1	1(100%)
<b>Total</b>	<b>22</b>	<b>75</b>	<b>57(76%)</b>	<b>64</b>	<b>43(65%)</b>	<b>36</b>	<b>31(86%)</b>	<b>54</b>	<b>41(76%)</b>	<b>36</b>	<b>29(80%)</b>

Figures in parentheses represent the percentages of Parked Vehicles interviewed.

Table 7: Linear Projection of Freight Traffic Through Terminal Area by Year

Artery/Route	1987		1988		1989		1990		1991		1992	
	IN(V <sub>rj</sub> )	OUT(W <sub>rj</sub> )	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
Kumasi - Sunyani	726	743	744	762	763	781	782	801	802	821	822	842
Kumasi - Mampong	938	1000	962	1025	986	1051	1011	1077	1036	1104	1062	1132
Kumasi - Techiman	1203	862	1233	884	1264	906	1296	929	1328	956	1361	980
Kumasi - Accra	998	956	1023	980	1049	1005	1075	1030	1102	1056	1130	1082
Kumasi - Bekwai	529	434	542	445	556	456	540	467	584	479	599	491

$F_r$  = The proportion of traffic entering the city on route  $r$  willing to use the terminal facilities

$W_{rj}$  = The weekly volume of traffic leaving Kumasi on route  $r$  willing to use terminal facility in year  $j$

$K_r$  = The proportion of traffic leaving the city on route  $r$  willing to use terminal facility

The  $F_r$  and  $K_r$  were empirically derived from the parking user survey and are shown in Table 8. The  $V_{rj}$  and  $W_{rj}$  were estimated weekly traffic flows based on ground count of freight vehicles passing through Kumasi on the main routes [1]. The factor of 0.5 was introduced to eliminate double counting on each route.

The result of the above analysis is shown in Table 9 for all routes from 1987 to 1992. The average daily demand for terminal facilities was estimated by dividing the weekly figures by a factor of 5, being the number of days of the survey. These weekly and daily estimates of vehicle parkers willing to use terminal facilities constitute the basis for calculating the space requirements for a public road/road or unimodal freight terminal in Kumasi. The detailed procedure for estimating space requirements for parking is described below.

SPACE REQUIREMENTS FOR PARKING AND ANCILLARY SERVICES

Using the projected levels of user demand for terminal facilities in Table 9 and the composition of traffic from the parking survey, the dimensions of various vehicle sizes were determined. Based on this composition, an average vehicle sizes of 12.2m (40ft) in length and 2.2m (7.2ft) in width was estimated. Using vehicle dimensions derived from the empirical data the length and width of a parking stall to accommodate such a vehicle was estimated to be 12.2m (40ft) and 4.3m (14ft) respectively. An apron space (width) of 12.8m (42ft) was also estimated for ease of manoeuvrability. Thus, the area required by an articulated vehicle for parking works out to be about 107.5m<sup>2</sup> (1148 ft<sup>2</sup>).

Table 8: Proportion of Freight Traffic Stopping Through Kumasi and Willing to Use Terminal Facilities

Route	Direction	
	IN(F <sub>r</sub> )	OUT(K <sub>r</sub> )
Kumasi - Sunyani	.033	.047
Kumasi - Mampong	.288	.062
Kumasi - Techiman	.224	.344
Kumasi - Accra	.274	.360
Kumasi - Bekwai	.046	.094

Table 9: Average Weekly and Daily Stock of Parkers Willing to use Facility

Routes	1987	1988	1989	1990	1991	1992
Kumasi - Mampong	30	31	31	32	33	34
Kumasi - Mampong	166	171	175	179	183	188
Kumasi - Techiman	283	290	298	305	313	321
Kumasi - Accra	309	317	323	333	341	350
Kumasi - Bekwai	33	34	35	35	36	37
Average Weekly Demand	<u>164</u>	<u>169</u>	<u>172</u>	<u>177</u>	<u>181</u>	<u>186</u>

Table 10: Summary of Land Requirements for Kumasi Freight Terminal

Facility	Land Requirements
Parking	3.35 ha (8.27 ac)
Guest Rooms	0.40 ha (1.00 ac)
Warehousing	0.20 ha (0.50 ac)
Ancillary Facilities	
Canteen	0.10 ha (0.25 ac)
Auto Repair Services and Washing Bay	0.61 ha (1.50 ac)
Fuel Station	0.20 ha (0.50 ac)
Office Accommodation	1.22 ha (3.00 ac)
<b>TOTAL</b>	<b>6.08 ha (15.02 ac.)</b>

If at the end of the plan period (1997) 209 freight vehicles are expected to park on a daily basis then at maximum capacity utilisation the land requirement for parking will be about 22,467.5m<sup>2</sup> (239,932ft<sup>2</sup>) or 2.23 hectares (5.5 acres). However, it was estimated from empirical data that the parking load at the terminal on the average will be about 1.5 days per vehicle. If this factor is applied then 3.35 hectares (8.27 acres) of land will be required for parking purposes. This works out to be about 26 vehicles per acre and compares favourably with a minimum parking density standard of 30 vehicles per acre recommended for British conditions[2]. The space requirements for other uses are summarised in Table 10.

ESTIMATE OF POTENTIAL REVENUE

Estimates of potential revenue from the use of terminal facilities were based on the market demand or the willingness of parkers to pay for these services. Thus, the study identified three major sources of revenue. These are, parking, guest rooms and mobilisation, forwarding and handling of goods which attract a commission. From data based on the willingness of parkers to pay for various services, it was possible to derive demand curves for certain vital facilities. These are parking facilities for empty and loaded vehicles as well as vehicle operators guest rooms. All the functions which were derived using least square regression analysis exhibit hyperbolic curves with price elasticity of demand. The main equations with their co-efficients of determination (r<sup>2</sup>) and number of observations (n) are stated as follows:

Parking Empty:  $Q_m = 125026P^{-1.799}$ ,  
 $r^2 = .93, n = 176$

Parking Loaded:  $Q_w = 36433P^{-1.4645}$ ,  
 $r^2 = .80, n = 176$

Guest Rooms:  $Q_g = 254794P^{-1.6667}$ ,  
 $r^2 = .82, n = 168$

Where in all cases Q represents an absolute number of parkers willing to use a particular facility and P is the price in cedis at which parkers are willing to use the facilities. With reference to the parking demand, it was

not possible to disaggregate demand by vehicle type or size because of the relatively small number of observations.

REVENUE FROM PARKING

Expected revenue from parking for a given year i was estimated as follows:  
 $E_i = ((1.5 \times P_e \times 52)(V_{iw} + 2V_{if} + 3V_{ig})) + ((1.5 \times P_d \times 52)(S_{iw} + 2S_{if} + 3S_{ig}))$

where E<sub>i</sub> = expected revenue from parking for a given year i

P<sub>e</sub>, P<sub>d</sub> = daily parking rents for empty and loaded vehicles respectively.

V<sub>iw</sub>, V<sub>if</sub> and V<sub>ig</sub> = number of potential vehicles parking empty once, twice and thrice a week respectively

S<sub>iw</sub>, S<sub>if</sub> and S<sub>ig</sub> = number of potential vehicles parking loaded once, twice and thrice a week respectively

The constants 52 and 1.5 respectively represent assumed number of weeks in the year for operating the terminal and the average parking duration per vehicle per week.

REVENUE FROM GUEST ROOMS

The expected revenue from the use of guest rooms by operators and assistants is outlined as follows:

$$R_i = ((1.5 \times P_h \times 52)(Y_{ia} + Y_{ib} + Y_{ic})) + ((T_{ia} + 2T_{ib} + 3T_{ic}))$$

where R<sub>i</sub> = expected revenue from the hostel in a given year i

P<sub>h</sub> = accommodation rent per head

Y<sub>ia</sub>, Y<sub>ib</sub> and Y<sub>ic</sub> = number of potential vehicle operators parking empty vehicles, who need accommodation once, twice and thrice a week respectively

T<sub>ia</sub>, T<sub>ib</sub> and T<sub>ic</sub> = number of potential vehicle operators parking empty vehicles, who need accommodation once, twice and a week respectively

The above equation was also used in estimating potential revenue from guest rooms used by drivers assistants, with a variation in rent and an assumption of two assistants per parked vehicle

REVENUE FROM MOBILISATION,  
HANDLING AND FORWARDING OF CARGO

The assumptions underlying the estimation of revenue from the above service are implied in the following formula:

$$M_i = 52 \text{ scr} \sum_j (Q_i F_j D_j W_j)$$

where  $M_i$  = expected revenue for a given year  $i$

$Q_i$  = number of vehicle operators requesting (registering) for return payload in a year  $i$

$F_j$  = the frequency of trips on route  $j$  by destination

$D_j$  = distance between Kumasi and destination  $j$  of return payload

$W_j$  = mean weight of cargo carried on route  $j$  by destination

s, c, and r = constants respectively representing a supply factor of 33 per cent, a commission of 10 per cent and a freight rate of £0.01 kg/km

The results of the revenue analysis are summarised in Table 11. It can be seen that on the average about US \$850,000 can be generated every year from the operations of the terminal excluding revenue from ancillary services such as fuel sales, canteen and vehicle servicing. These values are based on a conversion rate of US \$=180.

CONCLUSIONS

The major conclusions drawn from the study are outlined as follows:

1. There are no adequate parking facilities for freight vehicles in Kumasi, neither are there any well organised distribution facilities for transshipment of cargo, which constitutes one of the major urban functions of the city. The result of all this is that freight vehicles park indiscriminately and haphazardly during the day and night at places unsuited for heavy vehicles, particularly in high density residential areas, leading to loss of amenity to people living in such areas. On-street parking of freight vehicles also poses danger to other road users including the pedestrian whose view is obstructed by the scale of these vehicles.

Table 11: Estimated Undiscounted Revenue (US Dollars)

SOURCE	Y E A R									
	1	2	3	4	5	6	7	8	9	10
Mobilisation, Forwarding and Handling	583,084	507,974	612,974	629,110	645,304	661,563	677,822	694,106	707,589	721,071
Parking	37,024	37,847	38,809	39,780	40,837	41,903	42,961	44,027	45,959	46,286
Guest Rooms	141,266	144,308	147,984	151,884	155,784	159,900	164,016	167,916	175,950	178,534
Total	761,374	780,129	799,767	820,774	841,925	863,366	884,799	906,049	929,498	945,891

Another aspect of the problem is that freight vehicle operators complain about lack of accommodation facilities and long delays in obtaining return payloads leading to the loss of revenue to transport owners.

2. There is a potential market demand for freight parking facilities including parking areas, accommodation for vehicle operators, haulage bureau for mobilising and transhipment of cargo with ancillary services such as canteen, fuelling, vehicle servicing and warehouses. The average demand for such facilities was estimated to be about 170 vehicles per day.
3. Based on the demand for various facilities, it was estimated that a minimum area of 15 acres will be required for the development of such facilities in Kumasi. About 8 acres of this will be used for parking of vehicles and 7 acres for other terminal ancillary services.
4. The development of the freight terminal has a high revenue generation potential with parking, accommodation for vehicle operators and haulage bureau as the major sources.

### RECOMMENDATIONS

On the basis of the above findings it has been recommended that subject to financial feasibility, a unimodal freight terminal complex comprising the elements identified above should be built in Kumasi. To ensure successful management and operation of the terminal, it is recommended that the terminal be developed and run by a limited liability company on commercial basis. The unimodal terminal could serve as an initial phase of a fully integrated intermodal (road/rail) terminal or an inland port in Kumasi. For this purpose, and

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taking into consideration factors of accessibility and location away from high density residential areas, a site at the railway crossing on the Kumasi-Accra road near Fumesua (Figure 2) has been recommended. The development of this site into a freight terminal complex in Kumasi will not only promote the control of environmental intrusion of freight vehicles in Kumasi but also the collection and distribution functions of the city. Government has responded positively to these recommendations.

### REFERENCES

1. Industrial and Management Services Limited (IMAS) Freight Terminal Study (Final Report), Accra. IMAS 1987, p.152
2. Lorries and the Environment Committee, Freight Complexes: An Appraisal of the Role of Freight Complexes and Possible Approaches to Development of a Number of Complexes in the U.K., July 1977 p.4

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