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Performance of private companies involved in urban solid waste management: Evidence from three cities in Ghana

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An assessment of performance of service providers involved in solid waste management was conducted to provide understanding of the performance drivers, constraints and challenges. A survey of 15 private companies was conducted in Accra, Tema and Kumasi to assess the solid waste vehicle productivity and utilisation, and the factors that influence vehicle productivity and utilisation. The vehicle productivity and utilisation of seven out of the 15 companies were below the average of 21 tonnes per day per vehicle and 61% respectively. The study suggests a non-linear relationship between utilisation and size of company. The performance implications are that companies with less than 15 vehicles will perform better in terms of vehicle productivity and utilisation than those with more than 15 vehicles. The factors that seem to influence the performance are route planning, supervision of vehicle operations and maintenance.

Introduction

The objective of this study was to assess the performance of the private companies involved in solid waste management. In this study, the performance of service providers was assessed in terms of market share of companies, productive efficiency (productivity) and utilisation of waste collection vehicles. The productive efficiency is defined as the ratio of outcomes or outputs (waste collected in tonnes) to input (vehicle). The factors which are likely to influence performance are the size of company (number of vehicles), service charges and payment, vehicle maintenance, and solid waste collection planning and supervision. Performance of organisations is assessed in term of efficiency (productivity) and effectiveness (quality of service or products) (Carter, Klein, and Day, 1992: Kessey, 1995; Cointreau-Levine and Coad, 2000; Lusthaus et al., 2002). Organizational performance assessment approaches focus on efficiency and effectiveness, but there are inherent difficulties in measuring effectiveness or quality of many outputs if relevant benchmarks are not established (Boston, 2000). Performance assessment of solid waste service delivery establishes the basis for monitoring and evaluating the efficiency and effectiveness of the service delivery.

The performance assessment is essential for understanding the relationships in contractual arrangements. In a conventional contract, the contractual agreement between principal and agent (service provider) usually defines the performance measures by which the performance of the service provider is assessed and the sanctions for each failure or poor performance. Public choice theory suggests that conventional contract and performance monitoring increase efficiency and improve service quality (Awortwi. 2003). However, relational contracting theory suggests that rigorous contract performance monitoring is not always good; rather aspects such as mutual trust and shared values, and cooperation between the principal and agent explain contract performance better (Fernandez, 2005). The relevance of assessing performance of service providers involved in solid waste management in developing countries is an emerging issue. There are no well defined performance targets or standards for assessing performance of urban solid waste providers, and therefore different approaches are used by researchers. This study seeks to apply performance assessment methods used in other fields of study to assess performance in solid waste management.

Methodology

Data collection

Three large cities (Accra, Kumasi and Tema) in Ghana were chosen for the study. The population figures of the cities and number of private companies are presented in Table 1. A sample of 15 companies out of 34 in the three cities was selected for the study.

Table 1. Population of cities and sample size			
City	**Population**	**Number of companies**	**Sample size**
Accra	1,658,937	18	5
Kumasi	1,170,436	6	6
Tema	506,400	8	4
Total		34	15

Table 2 presents the framework for data collection and analysis. Performance data were collected from the disposal sites (secondary data) and companies. Data on vehicle types, quantities of waste collected, number of trips, maintenance schedules, service charges, type of contracts and company staff were collected.

Table 2. Structure of data collection			
Aspects of the study	**Indicators**	**Variables**	**Definitions of variables**
Performance of companies	Efficiency	Vehicle productivity	Ratio of wasted collected (tonnes) to vehicles
		Vehicle utilisation	Ratio of actual waste collected to company capacity or expected output
	Size of the market	Market share	Ratio of quantity of waste collected by a company to the total waste collected in the city
Determinants of performance	Capacity	Size of company	Number of vehicles on road
	Physical resource management	Mode of collection planning and supervision	Rational route plan for vehicles, Vehicles operation supervision
		Vehicles maintenance	In-house maintenance, Maintenance schedule available
	Cost recovery	Level of service charges	User charge and unit price of service contract

Mode of solid waste services

The main type of collection service in the three cities are the communal collection and house-to-house. Communal collection is a system for solid waste collection in which individuals bring their solid waste directly to communal skip containers at secondary collection points, from where the waste is collected and transported to the disposal site by the companies. The communal solid waste collection services are provided under service contract arrangements between the Municipal Authority and the private companies. The Municipal Authorities pay the companies for the services delivered.

House-to-house collection is a method of collecting domestic solid waste in which the individuals place the bins full of waste outside their houses at the curb side or roadside on the specific days for collection. The residents served by the house-to-house waste collection use standard bins (120 or 240 litres). The house-to-house service is rendered to residents in the high and middle income areas. Another form of house-to-house collection called 'block collection' is a predominant mode of solid waste collection in Tema. The house-to-house solid waste collection services are provided under franchise contract arrangements between the Municipal Authorities and the private companies. Under the franchise contract the companies collect revenue from the users and subsidy from the Municipal Authorities for some areas.

Results and discussions

Vehicle productivity

Vehicle productivity is defined as the actual output per vehicle per day. Figure 1 shows the relationship between vehicle productivity and the market share. The market share is the ratio of the quantity of waste collected by a company to the total waste collected in the city. The average productivity was 21 tonnes per day per vehicle and seven companies had values below this average. The productivity increases with increasing market share but declines as the market share exceeds 30% (Figure 1). The relationship between productivity and market share is non-linear. The analysis of performance of private companies showed that the productivity of a particular vehicle type varied from company to company. Productivity depends on how the companies organise their operations to utilise the vehicles in terms of the number of trips made in a day

and the vehicle load. The maximum productivity is achieved by ensuring that each vehicle load is full and maximum number of trips per day is made. Figure 2 shows the relationship between vehicle productivity and the size of company. The number of vehicles on road was used as a measure of the size of company. The companies with productivities above the average of 21 tonnes per day per vehicle have varied number of vehicles (from two to 22 vehicles).

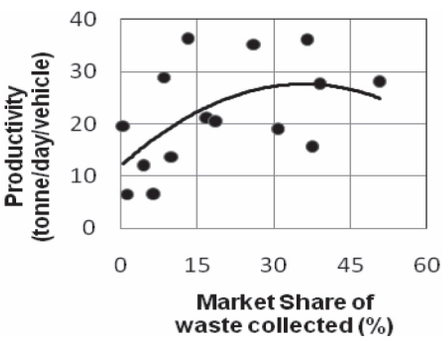

Figure 1. Relationship between vehicle productivity and the market share

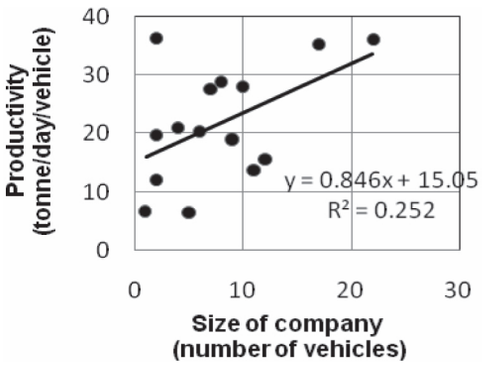

Figure 2. Relationship between vehicle productivity and the number of vehicles on road

To maximise productivity the companies have to plan their collection routes for the drivers and do not have to allow the drivers to use their discretions as to which route to take. Whether the companies have workers with ability to plan their routes requires further assessment.

Vehicle utilisation

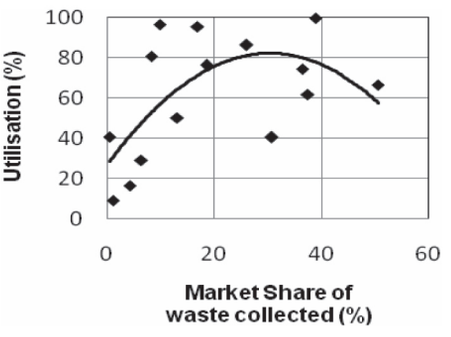

Figure 3. Relationship between utilisation and the market share

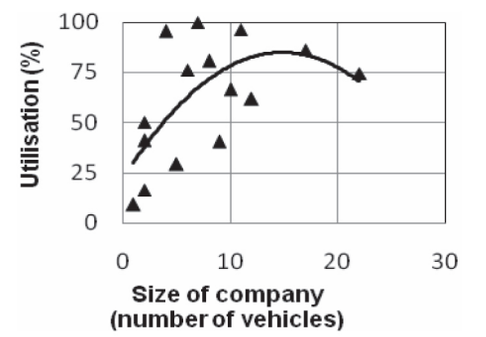

Figure 4. Relationship between utilisation and the number of vehicles

Figure 3 shows the relationship between vehicle utilisation and the market share for the 15 companies in the three cities. Vehicle utilisation is the ratio of the actual waste collected by each vehicle to the expected output of the vehicle. In other words, vehicle utilisation measures the actual output of vehicles as against the expected vehicle output for a period of time. The number of trips and waste collected by each vehicle were used to determine the actual outputs for all the companies. The expected output was computed using the maximum number of trips each type of vehicle could make based on historical records and the nominal quantities of waste that could be disposed of by the various types of collection vehicles. For example, a compactor truck with nominal weight of 12 tonnes per trip could make two round trips a day and therefore

the expected output would be 24 tonnes per day. Vehicle utilization gives indication of the extent to which the companies make use of their waste collection vehicles. The results show that the average utilisation value was 61% and seven companies were below this average. The utilisation values increase with increasing market share but begin to decline as the market share exceeds 30% (Figure 3). There is a non-linear relationship between vehicle utilisation and the market share. Figure 4 shows a relationship between vehicle utilisation and the size of the company. The utilisation values increase with increasing number of vehicles but decline as the number of vehicles exceeds 15. There is direct non-linear relationship between the size of the company and the vehicle utilisation.

The decline in utilisation may be attributed to irrational route planning and how the companies organise their vehicles operations.

Performance drivers: Factors affecting performance

Table 3 presents a Pearson correlation matrix for the performance variables (productivity, utilisation and market share) and some of the variables that affect the performance variables. There is positive correlation (0.55; $p < 0.05$) between the productivity and utilisation. The size of company has influence on market share (correlation of 0.62; $p < 0.05$) and actual waste collected (correlation of 0.93; $p < 0.01$), but do not significantly influence productivity and utilisation. Increasing the number of vehicles owned (size of company) may not significantly increase productivity and utilisation if the internal management is weak.

The internal management of operations appears to be a crucial factor in attaining a reasonable high productivity and utilisation, because company's productivity and utilisation largely depend on internal management such as supervision of operations, motivation of workers, vehicle maintenance, rational route planning and vehicle scheduling. Further analysis is required to understand the relationships and the effects of some of these factors on productivity and utilisation. Some of the factors that may explain the differences in productivity and utilisation are the levels of service charges, payment of service contracts, and internal management.

Table 3. Correlation matrix

Variables	1	2	3	4	5	6
1. Vehicle productivity						
2. Vehicle utilisation	0.55(*)					
3. Market share	0.48	0.45				
4. Actual waste collected	0.68(**)	0.45	0.56(*)			
5. Size of company	0.50	0.50	0.62(*)	0.93(**)		
6. Level of user fee charges	-0.08	-0.40	0.19	-0.31	-0.39	
7. In-house Maintenance	-0.26	-0.41	-0.03	-0.09	0.04	0.25

* Correlation is significant at the 0.05 level (p<0.05), ** Correlation is significant at the 0.01 level (p<0.01)

This study reveals that it is not only investment in vehicles that are needed in the solid waste sector but also capacity building of the private sector on how to make maximum use of the physical resources. For example, if all the private companies in Kumasi attain 90% vehicle utilisation, all the waste generated in Kumasi will be disposed of to achieve 100% collection rate.

Service charges and payments

Table 4 shows the differences in the service charges for communal service contracts and the house-to-house service in the cities. The house-to-house service charges, ranging from GH¢ 2.00 to GH¢12.00 per month per bin, are based on the level of income and vary from city to city. There are three levels of income: low, middle and high. Businesses such as banks and restaurants in the central business districts serviced by companies pay GH¢12.00/month/bin in Kumasi. Currently, communal waste collection service in Accra and Kumasi are rendered free of charge to the communities, most of which are in the low income zones. The Local Government (Municipal Assembly) in Tema collects GH¢ 0.80 as user fee from residents served with communal waste collection service.

Table 4. Service charges by companies				
City	House-to-house service (GH¢/month/bin)			Communal service (GH¢/tonne)
	Low	Medium	High	
Kumasi	2.00	2.50	4.00	9.00
Accra	2.50	6.00	10.00-12.00	10.00
Tema	2.00	2.40	6.00-11.00	6.00-10.00
US$1 = GH¢0.92				

Figures 5, 6, and 7 show the relationships between the level of vehicle utilisation and the house-to-house user charges in Accra, Tema and Kumasi respectively. The user charges vary from city to city and also vary within the same city because of the income levels of the people. Five companies in Kumasi have utilisation values above the average of 61% but charge lower fees (GH¢2.2 - 3.5) compared to Accra and Tema. Figure 5 shows that within Accra four companies with utilisation values below the average of 61% charge different fees (above GH¢5) depending on the areas they serve. The differences in the levels of the user fees and the mix of house-to-house service (franchise contract) and communal service (service contract) may indirectly affect productivity and utilisation. Further analysis of these differences will provide better understanding of the effect of user charge on productivity and utilisation.

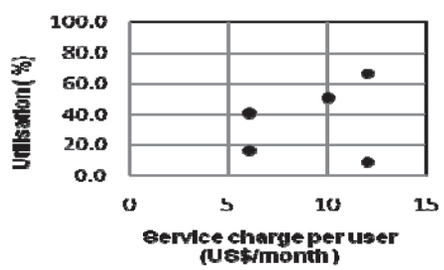

Figure 5. Relationship between utilisation and the service charges for 5 companies in Accra

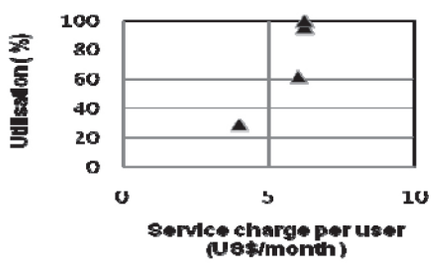

Figure 6. Relationship between utilisation and the service charges for 4 companies in Tema

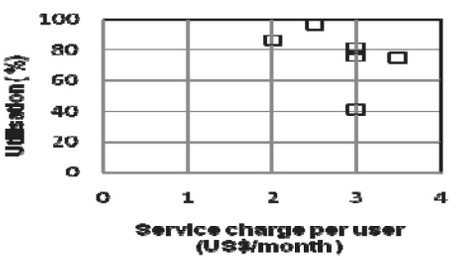

Figure 7. Relationship between utilisation and the service charges for 6 companies in Kumasi

The following constraints affect performance of the companies:

- The communal users do not pay for the communal service. The local governments delay payments for communal service rendered by the companies.
- The house-to-house service charges for some zones are insufficient to ensure recovery of capital and operation and maintenance costs. Some of the house-to-house users also default in paying their service charge under the franchise arrangements. Apart from the level of user fee, the revenue collection ef-

ficiency (percentage of total bill which is collected) of the franchise contract and the amount in arrears may affect cash flow.

- Inadequate private finance reflects in the use of over aged vehicles (above 10 years). This results in poor coverage and low quality services due to frequent vehicle breakdown. Incentives such as reduction in import tax on solid waste vehicles should be provided for the companies.

The main challenges in the solid waste service are financing investments and how to maintain cost effectiveness of operations.

Maintenance of collection vehicles

Table 5 summarises the vehicle maintenance activities of the 15 companies. Utilisation of vehicles depends on operations supervision, regular maintenance and response to faults and breakdown of vehicles. Data on vehicle maintenance schedules and service were obtained from the questionnaire survey. For efficient operation, vehicle maintenance is required. Eleven out of the 15 companies have in-house maintenance workshops and maintenance schedule, and handle both major and minor works; however six of these companies have utilisation values below 61%. The four other companies depend on external workshops for vehicle repairs and maintenance. The vehicle utilisation of one of these companies was 40% but the others have values above 86%. Inadequate maintenance and vehicle breakdowns (as a result of old age vehicles) may be some of the causes of low vehicle utilisation, since the availability of in-house maintenance does not significantly influence utilisation (correlation of -0.41 in Table 3).

Table 5. Summary of vehicle maintenance practices of the 15 companies

Aspect of maintenance	Variable	Frequency
Company has in-house maintenance workshop	Yes NO	11 4
Company has maintenance schedule	Yes NO	12 3
Frequency of maintenance	Bi-weekly Monthly As and when faults develop	5 7 3
Seek external maintenance services	Yes NO	6 9

Collection planning and supervision of field operations

The route planning, collection scheduling and supervision of field operations tasks by the companies were assessed. The modes of collection planning and vehicle supervision are presented in the Table 6. All companies have collection schedules and employ supervisors to check the work of drivers and the collection crew. The drivers in twelve companies use daily log-books for recording details of the vehicles' operations but as to whether the data are analysed is questionable. Twelve of the companies did not have route maps and the drivers use their discretion as to which route to take during waste collection. To achieve high quality of service, rational route planning and supervision are essential.

Table 6. Mode of planning and supervision of vehicle operations

Operations	Variable	Frequency
Rational route planning	Daily log-book for drivers Map showing routes No route maps	12 3 12
Mode of Supervision and monitoring of collection services	Field visit and inspection Communication (phone calls) Liaise with community leaders	15 8 1

One company with utilisation of 80% has seen the importance of route planning and supervision and therefore has taken steps in negotiating with an information technology company to provide global positioning and radio service to monitor their vehicles to ensure high utilisation of its vehicles.

Conclusions

The performance implications of this research are important for understanding the solid waste management issues in Ghana. The productivity and vehicle utilisation of seven out of the 15 companies were below the average of 21 tonnes per day per vehicle and 61% respectively. Five companies in Kumasi had utilisation values above the average of 61% despite the lower user charge compared to the other cities. The performance implications are that companies with less than 15 vehicles will perform better in terms of vehicle productivity and utilisation than those with more than 15 vehicles. The study also reveals that it is not only investment in vehicles that are needed in the solid waste sector but also capacity building of the private sector on how to make maximum use of the physical resources. Route planning, supervision of vehicle operations and maintenance, and the mix of house-to-house service (franchise contract) and communal service (service contract) may account for the differences in performance.

Recommendations

Some recommendations are drawn from the study. First, the capacity building of the private companies should be encouraged to help increase vehicle utilisation and productivity. Secondly, the private companies should attach importance to the analysis of vehicle operations, rational route planning and supervision of vehicles. Thirdly, the user charges should be reviewed to reflect the cost of services to ensure financial cost recovery of the solid waste services. Finally, incentives such as reduction in import tax on solid waste vehicle could encourage private finance for solid waste management.

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