

APPRAISAL OF SOLID WASTE COLLECTION EFFECTIVENESS FOLLOWING THE INTRODUCTION OF CITY-WIDE WASTE COLLECTION LEVY SCHEME IN KUMASI, GHANA

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ABSTRACT: In Ghana, solid waste collection and disposal services over the years have become the bane of Metropolitan and Municipal Assemblies. Among the obstacles to effective solid waste management in Ghana, inadequate and unsustainable financing have been identified to be the most important. To help provide a sustainable means of financing solid waste management in the Kumasi Metropolis, the metropolis has instituted a Pay As You Throw system (PAYT), dubbed City-Wide Solid Waste Collection Levy Scheme. This paper therefore examines the impact of this program on solid waste collection effectiveness. The indicators used were money generated from communities, and solid waste handling since the introduction of the program. It was found that there has been an improvement in the handling of solid waste, and also the program had resulted in increase in revenue stream and a reduction of cost on the central government.

KEYWORDS: Solid waste management, Kumasi, pay-as-you-throw scheme, Zoomlion, communal waste collection.

1 INTRODUCTION

Among the basic services that are currently receiving wide attention in the urban agenda of many developing countries is solid waste management [1], [2]. Reference [3] says 9 out of every 10 African cities are facing serious waste collection and disposal problems. This has resulted in piles of waste which blocks drains and roads. Also the smell of rotting refuse and of smoke from burning waste are well noticed in many urban cities. The increasing number of flies, mosquitoes and rodents due to this waste is raising concerns of public health experts. The urban poor have been identified as those who are mostly faced with these conditions, because they are given the lowest priority in the allocation of waste collection resources [4].

1.1 SOLID WASTE MANAGEMENT IN GHANA

Waste is defined as a left-over or a redundant material of little or no value to its owner and which the owner wants to discard [5]. This implies that being 'waste' is not an inherent property of an item or product but depends on how the owner values the item. Solid waste is therefore a waste that is not water or airborne. Solid waste is defined to include refuse from households, non-hazardous solid waste from industrial and commercial establishments, refuse from institutions market waste, yard waste, and street sweepings. Management is also defined as the process of controlling or dealing with things or people. Therefore solid waste management can be defined as the process of collecting, transporting, processing or disposal of garbage so as to reduce their effect on human health, the environment or aesthetics [5],[6].

In Ghana urban sanitation is a duty of local governments. General waste management is conferred in the Ministry of Local Government and Rural Development (MLGRD) which oversees the Metropolitan, Municipal and District Assemblies (MMDAs). The MMDAs are in charge of the collection and final disposal of solid waste through their Waste Management Department (WMDs). All MMDAs have developed waste management and environmental health plans to help solve the numerous sanitation problems [7]. However, like most developing countries, Ghana still faces lots of challenges in terms of proper solid wastes management. These challenges have resulted in poor solid waste management, the consequences of which include, illegal disposal of waste which subsequently chokes drainage canals and storm sewers, and increases breeding places for disease causing parasites such as mosquitoes. The next section elaborates some of the major challenges faced by solid waste management in Ghana.

1.2 CONSTRAINTS TO IMPROVEMENT OF ENVIRONMENTAL SANITATION IN GHANA

The rapid rate of uncontrolled and unplanned urbanization in most of the developing world, especially in Africa, which is mostly caused by rural-urban migration, natural population increase and engulfing of peripheral rural settlement has been identified to be one of the factors militating against solid waste management in Ghana [8],[9]. This contributes to an increase in waste generation per capita, which government and private waste contractor are not able to keep up with. The result is environmental degradation. Also, a positive correlation has been identified to exist between urban population size and percentage of waste moved, and also the number of households that benefit from regular waste collection [8]. This implies that population size is a very important factor that influence solid waste management.

In addition to rapid urbanization, weak institutional arrangement have been identified as a constraint to solid waste management in the country [10]. Increase in urban population in the Kumasi Metropolis is controllable or amendable by a designated institution. Therefore, it is concluded that institutional weakness is the thriving force behind indiscriminate disposal of solid waste faced in the city [10]. In his studies, he found that residents of the metropolis were willing to stop throwing waste about if the city's waste department provide bins. However, for a long time the Waste Management department of the Kumasi Metropolis has not provided any other options for waste disposal. Therefore, without any other adequate choices, all the law enforcement in the city, especially laws against indiscriminate disposal of solid waste cannot be effective.

Although weak institutional arrangement provides a constraint to proper solid waste management, the lack of innovative ways to finance waste management in Ghana has also been identified as a factor that hinders efficient waste management services delivery, which eventually causes systemic environmental pollution and deterioration. Waste management needs an intense capital investment; therefore its financing deserves a sustained investment plan. However, the main sources of funds for waste management activities in Ghana include; revenue generated at the District/Municipal Assembly level, the State Government levels, the Central/Federal Government budgetary allocation and external donor support [11]. Therefore, in this period of decreasing aid and shrinking central government budgets, the country must find new and innovative ways to draw upon local capital markets for financing waste management. In support of this argument, a study conducted in the Kumasi Metropolis established that lack of financial capacities makes it very difficult for city authorizes in Kumasi to collect all waste generated in the city for final disposal [12]. This results in door-to-door collection been limited to the high and some middle income areas. This inequality of waste collection in the city had led to indiscriminate disposal of waste in drains, streams and canals, resulting in poor environmental situations in the cities.

1.3 ATTEMPT TO SOLVE SOLID WASTE MANAGEMENT PROBLEMS IN GHANA

Although improving solid waste management implies making waste collection and disposal systems more efficient, raising public awareness and enforcing environmental solid waste management laws, the Ghana government have found that a prerequisite for all of these factors is a well-organized management, operating in an enabling institutional framework, and capable of generating the financial resources required to meet operation, maintenance and investment cost [12]. Therefore, having recognized institutional structures and arrangements which are incapable of generating a sustained financial resources required to deliver an acceptable level of service as one major constraint to the improvement of environmental sanitation in Ghana, the National Environmental Sanitation Policy (NESP) was developed. The NESP which was prepared in 1999 and revised in 2010 defines a systematic approach and institutional framework within which to handle the nation's sanitation problem. The objectives of the policy that were derived from the challenges facing the sector include; capacity building, Information, Education and communication; legal and regulatory issues; Level of service; sustainable Financing and Cost of Recovery; Research and development; monitoring and Evaluation [7]. The policy identified that the challenges that are encountered by sustained financing and cost recovery were due to; the attempts to transfer to the Assemblies environmental sanitation functions performed by the ministries and the central government agencies without transferring the accompanying budget; the inadequate allocation of resources for environmental sanitation services, both at the national and district level, and unsustain financing services with increasing burden on the public sources. Therefore, the policy directs the assemblies to encourage private sector service providers to participate in solid waste management, and also to apply direct cost recovery from beneficiaries. Again, the policy emphasizes that full commercial price covering waste management operations and capital cost should be applied wherever possible, and where full direct cost is impossible, the cost of any service that is not charged would be subsidized by the assembly.

A study conducted to assess the impact of this policy on solid waste management in the Kumasi metropolis concluded that the implementation of the policy had led to changes in the organizational structure for solid waste management in the city. One change which was identified is that solid waste collection was now contracted out to private companies. This had led to efficiency in terms of amount of solid waste that is been collected to the final disposal site, and also in cost recovery.

Solid waste collection had seen an increased from about 50% in 1999 to 87.4% in between 2000 and 2004. The amount of money collected from beneficiaries of house-to-house collection services also increased from 26.5% in 2001 to 68.6% in 2004 [12].

1.4 SOLID WASTE COLLECTION SYSTEMS IN KUMASI METROPOLIS

There are two types of solid waste collection system in the Kumasi metropolis: door-to-door and communal. In the door-to-door collection system, a compactor truck moves from one house to the other collecting solid waste. Beneficiaries are then charged a monthly fee which ranges from GH¢ 10.0 to GH¢ 15.0 (USD 2.52 – USD 3.78). For the communal collection system, skip containers are located at vantage points within each community, and when full picked by skip loaders at a determined frequency to the final disposal site.

The Kumasi Metropolitan Assembly traditionally was not charging beneficiaries of communal waste collection services [13]. Private contractors were paid GH¢ 10.0 (USD 3.78) by the Kumasi Metropolitan Assembly for a ton of waste carried to the final disposal site. However, the assembly realized that government subsidy for these services were not very prompt. This led to inadequate funds for the private contractors. To help solve this problem, the department decided to introduce a system dubbed City-wide Solid waste collection levy Scheme. Under this program which is sometimes referred to as pay-as-you-throw (PAYT) system, residents are required to pay a minimum of GH¢ 0.1 (USD 0.03) directly to representatives of solid waste contractors located near all the communal central disposal containers. This system operates similar to the Variable-rate solid waste disposal system which is presently being practiced in most parts of the United States.

1.5 TYPES AND BENEFITS OF PAY-AS-YOU-THROW

There are many forms of pay-as-you-throw solid waste programs, however, the most common types are bag programs, can programs, tag and sticker programs, hybrid programs and the weight-based rates [15]. The weight-based rate which is the method employed by the Kumasi metropolitan assembly, charges customers based on the weight of their waste. It has the advantage of providing a flexible way of recycling. This is because customers would save on the little waste they remove from their garbage. According to the US Environmental Protection Agency this approach to solid waste management incorporates three interrelated components that are important to successful community programs: environmental sustainability, economic sustainability and equity. Communities with PAYT program have seen significant increase in recycling and reduction in waste, this has resulted in a significant reduction in municipal solid waste management expenses. Finally, the program has brought about equity which was not realized in the previous way of managing trash through taxes or flat rate [15].

Although the PAYT program had won some support and recognition in developed countries, it did not do well in the greater Accra region of Ghana when it was introduced some years back. The Accra Metropolitan Assembly's intention to re-introduce the PAYT program to help solve solid waste collection problem in the metropolis met a lot of oppositions by the members of the Environmental Services Providers Association (ESPA). The ESPA called on the Assembly to introduce Polluter-Pay Principle (PPP) instead of PAYT. They argue that unlike the PAYT system that puts the cost of waste management on the beneficiaries, under the PPP system levies are put on all items that are imported or produced locally. These levies can then be used to pay for the disposal of the items after their lifespan. They also believe that since the first PAYT system did not work out well, it would never work again [16].

The situation is however different in the Kumasi metropolis. The PAYT system was introduced in the metropolis in 2009 and it still functions [13]. The director of the waste management department in the metropolis revealed that the system had rescued Kumasi from filth, and that his department is looking forward to improving the system [17]. The purpose of this study therefore is to examine the impact of the City-Wide Waste collection levy scheme on solid waste management effectiveness in the metropolis.

2 MATERIALS AND METHODS

The study adopted the case study method of qualitative research and semi structured interview and questionnaires were used as data gathering instruments. The study involved waste management departments and households within six (6) sub-metros, namely Bantama, Asokwa, Nhyiaso, Asawase, Oforikrom and Kwadaso.

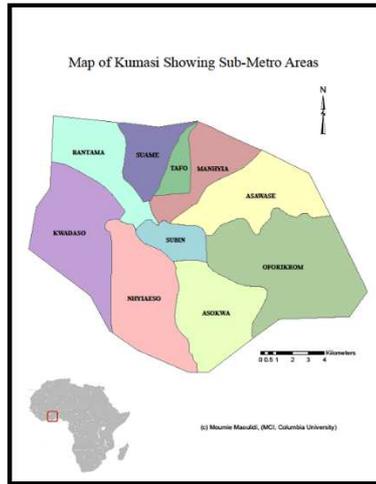


Figure 1: Map of Kumasi

Fig. 1 shows the map of Kumasi with labels of all the sub metros.

All the five (5) private waste collection contractors, with the exception of Zoomlion Ghana Limited were responsible for communal collection of solid waste within just one sub-metro. However, Zoomlion Ghana Limited was responsible for three of the ten sub-metros. Therefore, one out of the three sub-metros under Zoomlion’s jurisdiction was randomly selected for this study. The sub-metros within which data were collected as indicated in Table 1 are Bantama sub-metro (under Mesk World Ltd.), Asokwa sub-metro (under Sac-M jurisdiction), Nhyiaso sub-metro (under KWML jurisdiction), Asawase sub-metro (by Zoomlion Ghana Ltd.), Oforikrom sub-metro (under ABC waste company), and Kwadaso sub-metro (under Waste group).

Table 1: Areas visited in Kumasi

SUB METRO	SUBURBS VISITED				
	Bantam	Cambridge	Sofoline	Bantama	Abrebo
Asokwa	Asokwa	Ahinsan	Atonsus S-Line	Dompoase	Gyinase
Nhyiaso	Fankyenebra	Ahodwo	Adiembra	Dakwadwo	Sokoban
Asawase	Adukrom	Abuabo	Asawase	Asabi	
Oforikrom	Boadi	Kotei	Ayeduase	Ayegya	
Kwadaso	Asuyeboah	Odeneho Wadaso	Nzema	Tanoso	Kokode

The semi structured interviews were conducted with the six (6) private solid waste contractors and two staff from the Kumasi Waste Management Department. The interviews with the contractors were aimed at determining the locations for the central waste containers within each sub-metro, determining the contractors knowledge and awareness of the levy scheme, and finally to know if the levy scheme had helped them to meet some of their operational cost.

To test for the improvement or otherwise of the determinants of solid waste handling in this study, four hundred (400) questionnaires were distributed to four hundred households within six (6) sub-metros of the city. The questionnaires were designed to access the solid waste handling before and after the inception of the program. There were a hundred percent (100%) responses from the household survey; however, forty (40) responses were removed from the analysis because respondents were new in the metropolis and so could not state the solid waste management conditions before the introduction of the program.

In determining if there has been an increase in revenue stream, an estimation of the average minimum, average median and average maximum of profit each contractor makes in the six sub-metros were calculated. To calculate for the profit or loss made by the contractor, the money respondent claimed they pay before depositing their waste in each sub-metro were determined during a household survey. The average minimum, average median and average maximum of these monies were calculated for each sub-metro. The number of people in each sub-metro was projected from the study sample using the average household size and the average number of households per a house in the metropolis. The average household size in Kumasi is 5.1 persons, and there is an average of 3.4 households per a house [18]. The number of respondent who claimed

they dispose of their waste in the central disposal container, and the average of the money paid at the containers were used to calculate the actual money contractors make within each sub-metro.

2.1 STATISTICS OF RESPONDENTS

Two hundred and fifty-nine (259) representing seventy-two percent (72%) of the respondents were females, while one hundred and one (101) representing twenty eight percent (28%) were males. 71 (29.7%) of the respondents fall within the age bracket of 10-20 years, 130 (36.1) were between ages 21-30. The number of respondents whose ages were 31 – 40, and above 41, were 75 (20.8%) each. The minimum, median and maximum number of years respondents have stayed in their community were three, ten and fifty years respectively.

A statistical test - Fisher's exact test - was then applied to the proportion of responses collated from the respondents before and after the introduction of the levy scheme and p-values <0.05 were considered as being statistically significant.

3 RESULTS

3.1 INCREASED REVENUE STREAM AND REDUCE COST TO GOVERNMENT

Table 4 shows the estimated amount of money generated through the city-wide waste collection levy scheme within the six (6) sub-metros.

3.2 IMPROVEMENT MADE TO SOLID WASTE HANDLING

Summary of information about the disposal of solid waste in the selected sub-metros and conditions at the disposal site before the introduction of the City-Wide Solid Waste Collection levy Scheme are shown in Tables 2.

Table 2: Municipal Solid waste handling before the introduction of the program

Suburbs	Bantama	Asokwa	Nhyiaso	Asawase	Oforikrom	Kwadaso	TOTAL
Number of respondents	80	67	50	76	42	45	360
Where solid waste is disposed							
<i>central waste container</i>	53(66.3)	47(70.1)	35(70)	76(100.0)	38(90.5)	37(82.2)	286(79.4)
<i>other places</i>	27(33.8)	20(29.9)	15(30)	0(0.0)	4(9.5)	7(15.6)	73(20.3)
Frequency of waste disposal							
<i>everyday</i>	69(86.3)	50(74.6)	32(64.0)	41(53.9)	29(69.0)	31(68.9)	252(70.0)
<i>once in a week</i>	0(0.0)	2(3.0)	1(2.0)	7(9.2)	1(2.4)	0(0.0)	11(3.1)
<i>twice in a week</i>	8(10.0)	12(17.9)	14(28.0)	15(19.7)	4(9.5)	12(26.7)	65(18.1)
<i>other</i>	2(2.5)	3(4.5)	2(4.0)	13(17.1)	7(16.7)	2(4.4)	29(8.1)
Condition at the waste disposal site							
<i>the container never spilled over</i>	5(6.3)	12(17.9)	10(20.0)	18(23.7)	15(35.7)	5(11.1)	65(18.1)
<i>the container over spilled</i>	48(60.0)	34(50.7)	30(60.0)	54(71.1)	23(54.8)	33(73.3)	222(61.7)
<i>there was no container</i>	0(0.0)	9(13.4)	2(4.0)	0(0.0)	0(0.0)	1(2.2)	12(3.3)
<i>do not know</i>	13(16.3)	12(17.9)	6(12.0)	4(5.3)	2(4.8)	3(6.7)	40(11.1)
Knowledge of how often container was carried away							
Yes	10(12.5)	20(29.9)	25(50.0)	28(36.8)	7(16.7)	18(40.0)	108(30.0)
<i>everyday</i>	0(0.0)	0(0.0)	0(0.0)	2(2.6)	0(0.0)	3(6.7)	5(4.6)
<i>once in a week</i>	3(3.8)	4(6.0)	6(12.0)	8(10.5)	4(9.5)	3(6.7)	28(25.9)
<i>twice in a week</i>	6(7.5)	0(0.0)	4(8.0)	9(11.8)	0(0.0)	4(8.9)	23(21.3)
<i>once in a month</i>	1(1.3)	6(9.0)	3(6.0)	2(2.6)	0(0.0)	5(11.1)	17(15.7)
<i>other</i>	0(0.0)	10(14.9)	12(24.0)	7(9.2)	3(7.1)	3(6.7)	35(32.4)
No	47(58.8)	39(58.2)	22(44.0)	48(63.2)	32(76.2)	23(51.1)	211(58.6)

Table 3. Solid waste handling after the introduction of the program

Suburbs	Bantama	Asokwa	Nhyiaso	Asawase	Oforikrom	Kwadaso	TOTAL
Number of respondents	80	67	50	76	42	45	360
<i>Where solid waste is disposed</i>							
central waste container	80(100)	66(98.5)	48(96.0)	74(97.4)	41(97.6)	45(100.0)	354(98.3)
other places	0(0.0)	1(1.5)	1(2.0)	0(0.0)	0(0.0)	0(0.0)	2(0.6)
<i>Frequency of waste disposal</i>							
everyday	46(57.5)	37(55.2)	33(66.0)	19(25.0)	29(69.0)	30(66.7)	194(53.9)
once in a week	2(2.5)	4(6.0)	2(4.0)	12(15.8)	2 (4.8)	0(0.0)	22(6.1)
twice in a week	23(28.8)	20(29.9)	13(26.0)	34(44.7)	4(9.5)	14(31.1)	108(30.0)
other	9(11.3)	6(9.0)	1(2.0)	9(11.8)	5(11.9)	1(2.2)	31(8.6)
<i>Condition at the disposal site</i>							
the container never spilled over	31(38.8)	45(67.2)	20(40.0)	35(46.1)	19(45.2)	17(37.8)	167(46.4)
the container over spilled	49(61.3)	18(26.9)	28(56.0)	32(42.1)	20(47.6)	25(55.6)	172(47.8)
do not know	0(0.0)	2(3.0)	1(2.0)	6(7.9)	1(2.4)	3(6.7)	13(3.6)
<i>Knowledge of how often container was carried away</i>							
Yes	28(35.0)	33(49.3)	40(80.0)	28(36.8)	7(16.7)	25(55.6)	161(44.4)
everyday	2(2.5)	13(19.4)	5(10.0)	10(13.2)	2(4.8)	7(15.6)	39(24.2)
once in a week	8(10.0)	5(7.5)	1(2.0)	11(14.5)	2(4.8)	1(2.2)	28(17.4)
twice in a week	12(15.0)	6(9.0)	6(12.0)	5(6.6)	2(4.8)	8(17.8)	39(24.2)
once in a month	0(0.0)	0(0.0)	1(2.0)	0(0.0)	0(0.0)	0(0.0)	1(0.6)
other	6(7.5)	9(13.4)	27(54.0)	2(2.6)	1(2.4)	9(20.0)	54(33.5)
No	52(65.0)	33(49.3)	9(18.0)	43(56.6)	33(78.6)	20(44.4)	190(52.8)

There is a marked difference in the areas where people disposed their waste before and after the introduction of the scheme. After the introduction (Table 3), 98.3% (354/360) of the respondents used the central waste container as opposed to 79.4% (286/360) who used it previously (Table 2). People who disposed waste in other areas after the introduction constituted only 0.6% (2/360) as compared to 20.3% (73/360) previously. A look at the other areas of disposal captured as other places in Tables 2 indicates that 63% use available refuse dumps, 5.5% burn their solid waste and another 5.5% bury their solid waste in holes, 1.4% dispose their solid waste in the main drain and another 1.4% in the river with the remaining 23.3% disposing their solid waste in the bush. Four (4) out of the 360 respondents gave no answer to this question.

Also, there was a major disparities on frequency of waste disposal before and after the scheme was introduced. 53.9% (194/360) claimed they dispose their solid waste every day, 6.1% (22/360) claimed they dispose their waste once in a week, 30.0% claimed it was twice in a week and 8.6% claimed their frequency of solid waste disposal did not follow any special schedule as stated after the inception of the program (Table 3). Five (5) out of the total of 360 respondents gave no answer to this particular question. However, before the scheme it was observed that 70.0% (252/360) of the respondents dispose their solid waste every day, 3.1% (11/360) dispose their solid waste once in a week, 18.1% (65/360) dispose their waste twice in a week and the remaining 8.1% (29/360) dispose their waste on occasions other than the three stated above (Table 2). Three (3) respondents did not provide any information on the frequency with which they dispose of their solid waste.

Again, there was a clear and noticeable difference on the conditions at the disposal sites. After the scheme was introduced (Table 3), 46.4% (167/360) claimed the central disposal container never spilled over, 47.8% (172/360) claimed the disposal container over spilled and 3.6% (13/360) claimed they had no knowledge about the conditions at the disposal site. Eight (8) out of the total respondents numbering 360 gave no answers to this question on their questionnaires. But 18.1% (65/360) claimed the central disposal container never spilled over, 61.7% (222/360) claimed the container spills over, 3.3% (12/360) claimed there was no disposal container, and with the remaining 11.1% saying they virtually have no knowledge on the conditions at the disposal sites before the introduction of the scheme (Table 2). Twenty-one (21) out of the 360 respondents did not provide any information on the conditions at the disposal sites.

Table 4: Projected Revenue from the scheme

Variables	SUB-METROS					
	Asawase	Bantama	Nhyiaso	Asuyeboah	Oforikrom	Asokwa
No. of times a skip gets full	4	2	6	1	2	6
Expected money contractors get from communities	112.5	72.7	166.1	20.8	67.5	166.1
Money contractors get if community pays minimum fee (GH¢)	116	332	277	332	208	308
Money contractors get if community pays median fee (GH¢)	332	332	471	498	291	534
Money contractors get if community pays maximum fee (GH¢)	1661	498	1080	1163	747	1044
Minimum profit (GH¢)	54	260	111	311	140	142
Median Profit (GH¢)	220	260	304	477	223	368
Maximum Profit (GH¢)	1548	426	913	1142	680	878

4 CONCLUSION

4.1 SUSTAINED FINANCING

The estimated amount of money contractors get from beneficiaries of the communal services are much above the projected money that the waste department estimated that they would get. For example, if all the beneficiaries in the Asokwa sub-metro were to pay the minimum fee of GH¢ 0.2 (USD 0.05), then the contractor would make a profit of GH¢ 142.0 (USD 35.80) as shown in Table 4. Therefore, the system is one that can sustain itself. The minimum, median and maximum amount of money respondent pay each time put their solid waste into the central bin were ten pesewas, thirty pesewas and 100 pesewas respectively.

4.2 SOLID WASTE HANDLING

After the introduction of the program, comparison of the choice of areas for waste disposal showed that respondents were 15 times (95% CI: 6.6 – 35.6, $p < 0.0001$) more likely to dispose their solid waste in the central waste container compared to the 46 times likelihood of choosing other places other than the central waste container prior to the introduction of PAYT. This shows that there has been an improvement in disposal of solid waste at legal places since the introduction of the program.

Also, before the introduction of PAYT there was a 2 times (95% CI: 1.3 – 2.4, $p = 0.0002$) likelihood that the central waste container would spill over and the odds of not finding a container at the disposal site was 26 times (95% CI: 1.5 – 439). Above all, there was a significant chance that respondents will not know anything about conditions at the disposal site (OR=3, 95% CI: 1.8 – 6.4, $p = 0.0002$). Significant improvements were however, observed in the trends after the introduction of PAYT where there was 4 times likelihood (95% CI: 2.8 – 5.5, $p < 0.0001$) that the central waste container will never spill over.

Finally, before the program was introduced, study respondents were 2 times (95% CI: 1.5 – 2.7, $p < 0.0001$) more likely to dispose of solid waste every day. After the program's introduction however, the trend shifted to a 2 times (95% CI: 1.4 – 2.8) tendency of disposing solid waste twice in a week. Comparisons for waste disposal once a week and at other times out of these regular schedules showed no statistically significant differences ($p > 0.05$).

5 RECOMMENDATION

The Kumasi Metropolitan Assembly should reach out to the inhabitants who are currently not using the central bins so that indiscriminate dumping of solid waste in gutters, streams and river bodies will cease.

The scheme has so far been successful in dealing with waste to an appreciable limit as well as generating income for the Waste Management Contractors hence the scheme could be replicated in other District and Metropolitan areas which have similar solid waste disposal challenges.

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