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Assessment of Public Private Partnership Model of Solid Waste Management System in the

La Dade - Kotopon Municipality

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Abstract

Municipal solid waste management (MSWM) continues to be a challenge in cities and towns of Ghana due to inadequate logistics and financial burden. The study assesses the Privatization (PPP) model of solid waste management and health impacts of sanitation diseases in the La Dade-Kotopon Municipality. Field visits, structured questionnaires and key informant interviews were used to collect data from 156 resident participants, including two (2) service providers. Waste collection service quality was categorized as very poor, poor, fair, good and very good. Health impact of sanitation diseases was assessed using hospital data on Disability Adjusted Life Years (DALY) of residents due to poor sanitation over a five-year period. The study found out 103 (64%) of respondents indicated that sanitation practices were better to aftermath of the PPP arrangement while 44 (26%) rated service quality as fair. Residents of low-income suburbs who cannot afford service fees illegally dump theirs in public spaces and drains especially during the raining seasons. Survey response on challenges faced by service providers included delays in service payments by the Municipal Assembly, inaccessible household routes and long transportation distances, traffic and dump sites within catchment areas. The study concluded that although the Municipal Authority has instituted mechanisms and much efforts into SWM, little improvement occurred.

Key Words: *Solid Waste Management, Cost, Collection Service Reliability*

Introduction

Solid waste management services delivery in Ghana remains a major challenge to Metropolitan, Municipal and District Authorities with Annual budgetary allocations costing 50 to 70% and completion from other social and economic sectors such as education, health and social protection programs in Ghana (Lissah et al, 2021). Having to deal with budgetary constraints and the financial resources available for solid waste management, the Municipal Authorities are also faced with indiscriminate dumping of solid waste in open public spaces and drainage systems which poses health implications of disease outbreaks such as Cholera, Malaria and Dysentry (United Nations- Habitat, 2010).

By 2050, waste production will be 73 percent higher than it was in 2020. The trajectory for this will grow from 2.24 billion tons in 2020 to nearly 3.88 billion tons by 2050. Currently, 33% of waste is managed through burning or open dumping (World Bank, October 2021). For example, it is expected Kenya's amount of solid waste generation will increase from 2000 to10,171 tonnes per day by 2025 (Kyere et al, 2019). Moreover, at the global, regional and local levels, waste is continually becoming a rising problem due to volumes of generation.

Waste management systems in developing economies are still insufficient and, in some cases, cause environmental problems because the waste tends to be unseparated and disposed of in open landfill sites (Arenas et al, 2019:01). Addaney and Oppong states, Ghana like other developing countries has over the years had difficulties in municipal solid waste management (MSWM) due to infrastructure and technical inefficiencies. In regard, governments have attempted to decentralize SWM services delivery to deal with issue.

However, bridging the gap provides for management governance to national and local authorities as well as practitioners with case studies which includes, creating right institutional structures, finance for investment, sustained operational funds and incentives for

change, organizational models of service delivery in local markets, informal sector planning and service delivery and advancement in policy instruments aligned with waste hierarchy towards circular economy (World Bank, October 2021).

In Ghana, despite numerous policy reforms and programs, there still remains challenges in the solid waste management sector (Kyere et al, 2019). The La Township is no exception since solid waste management services delivery remains an uphill task for the Municipal Authority due to inadequate logistics and financial burden coupled with uneven waste collection, waste overflow from skip bins and communal containers, insufficient storage containers and disposal of waste in unapproved spaces. In contrast, the La Municipal Authority in 2012 adopted the Privatization model of solid waste management as a benchmark from neighbouring Municipal Authorities to deal with the issue but invariably, there still remain challenges to having a 100% clean La Township (LaDMA, 2020). Currently, the Municipal Authority has signed an MOU with Green Africa Youth Organization (GAYO) as an intervention measure to develop a solid waste management strategy towards zero waste in La (LaDMA, 2021).

Consequently, the La Township and its residents suffer from the effects of improper solid waste disposal. The resulting effect being health risks to humans while degrading the environmental aesthetics of communities. Inefficient sanitation services are a result of weak institutions, national planning and low political will (Watkins, 2006). Data from the Ghana Health Service indicate that six (6) out of the top ten (10) diseases in Ghana are linked to poor environmental sanitation with malaria, diarrhoea and typhoid fever jointly constituting 70–85% of out-patient cases at health facilities (Kyere et al, 2019). Health problems such as cholera, malaria, diarrhoea and typhoid among other sanitation diseases in Ghana costs the country $290 million yearly represented by 1.6% of the country's Gross Domestic Product (O' Neill, 2021).

In the year 2015, a total of 618 cases of cholera with 6 deaths (a case fatality rate (CFR) of 1.0%) were reported from 29 districts in 8 regions as of 14 June 2015 in Ghana. Greater Accra Region was the epicenter of the outbreak which recorded 291 cases with 5 deaths (WHO, June 2015). Within the Accra Metropolis, a total of 14 cases were recorded with 1 death. The La Municipality recorded 5 cases.

The study assesses privatization model of solid waste management, the quality of solid waste collection services and health impacts of sanitation diseases in the La Township.

Materials and Methods

Procedures
Study design and primary data engaged 156 participants consisting of residents, stakeholders and waste management experts through structured questionnaires from July to November 2020.

Primary reference point of survey questions included demographics of study participants, quality of solid waste collection services, sanitation practices before and after privation and health impact and economic significance of poor solid waste services delivery of the study.

Demographics recorded for study participants included age, gender, marital status, educational level and household size. Quality of solid waste collection services included frequency of collection, availability of dustbins, skips and waste storage types for households. Sanitation practices prior and post situations recorded disposal practices, communal container management and uncontrolled dumpsites. Health impacts of poor sanitation included hospital data on related and enteric sanitation diseases outbreak of Diarrhoea, Intestinal worms, Typhoid fever and Cholera for periods 2016 – 2020. Health data for the period 2016 – 2019 and year 2020 was chosen allowing a 3 year adequate space for assessment of the PPP model of solid waste management, which was rolled out based on fees and performance based evaluations in 2012 by the La Municipal Authority. Interview by structured questionnaires employed systematic sampling by stratification. The study area was categorized into High, Middle and Low class areas (Song sore et al, 2005). Location and stratification of study areas is defined in Table 1 and Fig.1.

Household stratification and interview was fifteenth (15th) house of ten (10) respondents aged Eighteen (18) years and above. Sample frame was 51, 154 total household population (GSS, 2010 PHC). Sample size is determined using empirical sampling as stated in equation 1 below (Gomez and Jones, 2010).

Equation 1: $n = N/ (1+N (a)^2)$

Where n = Sample size, N = Sample Frame and ***a*** represents a margin of error of (0.08) with a confidence level of 92%.

Sample distribution by stratification and sampled number of houses were 250, 100, 60, 40, 90, 100 and 50 for classification of stratified areas for survey interview.

Table 1: Social classification of Selected Areas

High Class Areas	Middle Class Areas	Low Class Areas
Cantonments	South La	La Township
East Cantonments		
Airport		
Burma Camp		
North Labone		

Fig. 1. Map of study indicating areas of Stratification

Results on the enteric infections outbreak of Diarrhoea, Intestinal worms, Typhoid fever and Cholera for periods 2016 – 2019 and year 2020 of study respectively were analyzed employing Disability Adjusted Life Years (DALY) parameters according to the World Health Organization; Salomon et al, 2013. DALY Mathematical parameters (WHO; Salomon et al, 2013) is given as;

DALY = YLD + YLL:

Where;

YLD = I x DW x L or YLD = P = DW

I = Number of Incident Cases

DW = Disability Weight

L = Average Duration of Case until Remission or Death

P = Number of Prevalent Cases and;

YLL = N x L:

Where;

N = Number of Deaths

L = Standard Life Expectancy at Age of Death.

Standard life expectancy for DALY parameters is 80 for men and 82.5 for women. Scale measurements are from 0 for full health to 1which is equivalent to death. Averagely, life expectancy for both genders is (80 + 82.5/2 = 81.25) (WHO; Salomon et al., 2013). Data Analysis

All analyses were conducted using Minitab software, Statistical Package for Social Scientists Software (SPSS version 25) and Microsoft Excel. Descriptive statistics were used for primary data analysis.

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All analyses were conducted using Minitab software, Statistical Package for Social Scientists Software (SPSS version 25) and Microsoft Excel. Descriptive statistics were used for primary data analysis.

Assessment of Quality of solid waste collection services

Structured and oral interviews with residents benefiting from waste collection services, two (2) private waste collection service providers, waste management unit and attendants at Communal Container Management sites with field visits was conducted in an assessment of quality of waste collection for the study.

Assessment of sanitation practices for prior and post Privatization model of solid waste management

Structured survey interview with residents was conducted in the La Township to assess prior and post sanitation situation in the Municipality with cross – examinations of cleanliness of constructed drains and gutters and environmental aesthetics as parameters for fields visits.

Health Impacts of Sanitation Diseases in La Township

Data was collected on reported sanitation diseases from a health facility (La Polyclinic) relative to poor sanitation practices and trend analysis presented in graphs analyzed, using Minitab software. Descriptive statistics employed SPSS software while computations on Disability Adjusted Life Years (**DALY**) relied on (WHO; Solomon ***et al***, 2013) parameters.

RESULTS AND DISCUSSIONS

Quality of solid waste collection services

Table 2: Demographics of Respondents

Gender of respondents:

Male (%)	Female (%)
44 (%)	56 (%)

Age in years (n):

18-30	31-40	41-50	51-60	61 and above
n= 43	n =50	n =36	n =19	n =13

Educational level (n):

Primary	Junior High	Senior High	Tertiary
n =16	n = 14	n =56	n =75

Table 3: Measure of Quality Waste Collection Services to Resident Beneficiaries

Household Waste Storage n (%)		
Do your household have	Yes n (%)	No n (%)
a waste bin?	69 (42.9)	92 (57.1)
If no, mode of waste storage?	N (%)	
Polythene	20 (21.3%)	
Jute Sacks	44 (46.8%)	
Rubber Containers	30 (31.9%)	
Total	94 (100)	

Waste Collection Frequency n (%)						
How often is your waste collected?	N (%)					
Daily	33 (21.7%)					
Weekly	76 (50.0)					
Bi-weekly	43 (28.3%)					
	Poor	Very Poor	Fair	Fairly-Good	Good	Very Good
	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
How would you rate solid	40 (25%)	40 (25%)	44 (26%)	21 (13%)	17 (11%)	5 (5%)
waste collection services						
received by your household?						

Results revealed by participants posited fairly 26% (n **=** 44) an appreciation measure of solid waste collection services after privatization model within stratified areas in the La Township. A percentile measure (55%) of respondents gave a fair to very good solid waste collection services.
Sanitation Practices before and after Introduction of PPP

Table 4: Assessment of sanitation practices on prior and post privatization model

Condition	Before	n (%)	After n (%)
	Better/Good	103 (64.0%)	
What was the sanitation situation	Bad/Worse	39 (24.2%)	
Before PPP?	Before PPP?	1 (0.6%)	

	20 (21.3%)		
What is your assessment now?	Better/Good		41 (25.5%)
	Bad/Worse		51 (31.7%)
	No Improvement		69 (42.9%)
Total		161 (100.0)	161(100.0)

Survey study posits sanitation practices for prior privatization model as better n = 103 (64.0%) and minimal improvement aftermath n = 69 (42.9%).

Health Impacts of Sanitation Diseases

Health impacts of study relied on hospital data on the Disability Adjusted Life Years (WHO; Salomon ***et al***, 2013) of residents due to poor sanitation for the period 2016 to 2019 and 2020. Reported enteric infections of Diarrhoea, Intestinal worm, Typhoid fever and Cholera were diseases of focus with descriptive statistics analysis.

DALY *= YLD + YLL:*

Where;

YLD = I x DW x L or YLD = P = DW

I = Number of Incident Cases

DW = Disability Weight

L = Average Duration of Case until Remission or Death

P = Number of Prevalent Cases and;

YLL = N x L:

Where;

N = Number of Deaths

L = Standard Life Expectancy at Age of Death.

By Disability adjusted life years computation parameters, the data posited the following for all four enteric infections of focus (Diarrhoea, Intestinal Worm Typhoid fever and Cholera);

Daly for the enteric infection of Diarrhoea cases for male and female (2016 – 2019) and 2020:

Daly (2016 – 2019) = YLD = *I x DW x L or YLD = P = DW* + YLL = *N x L*

YLD + YLL = 3703 x 0.281 x 4 + 0 x 81.25 = 4162

Daly (2020) = YLD = *I x DW x L or YLD = P = DW* ***+ YLL =*** *N x L*

***YLD + YLL = 374 x 0.281 x 1 + 0 x 81.25 =* 105**

Fig. 2 shows trend analysis of diarrhoea cases. The y axis indicates case counts (C 1) and the respective years on the x axis. Based on data, the highest case was recorded in 2016 while the least record occurs the subsequent year. After attaining the minimum record, there was a surge in 2018 and a sharp decline the following year. DALY for Diarrhoea cases of both males and females from period 2016 – 2019 was **4162** and period 2020 was **105**.

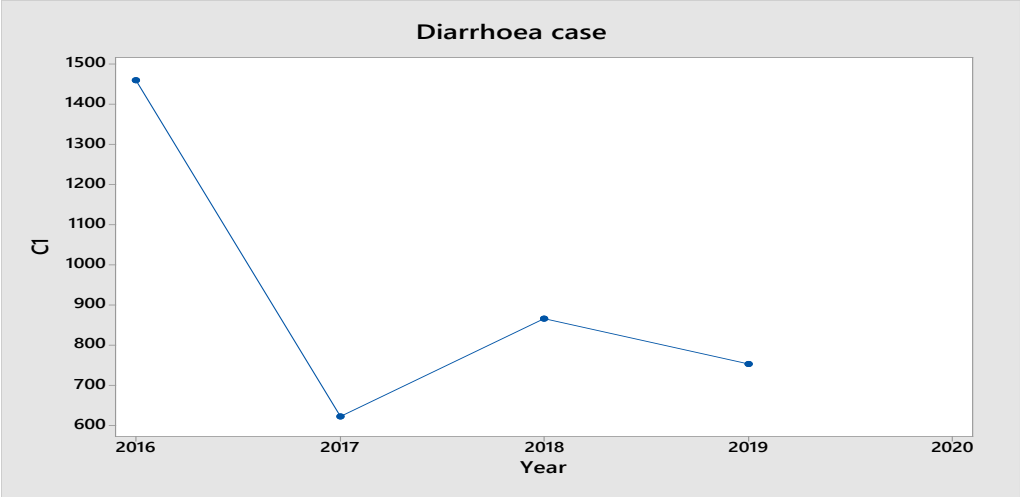

Fig. 2 Trend analysis of Diarrhoea

Daly for Intestinal worms cases for male and female (2016 – 2019) and year 2020;

Daly (2016 – 2019) = YLD = *I x DW x L or YLD = P = DW* ***+ YLL =*** *N x L*

***YLD + YLL = 81 x 0.030 x 4 + 0 x 81.25 =* 9.72**

Daly (2020) = YLD = *I x DW x L or YLD = P = DW* ***+ YLL =*** *N x L*

***YLD + YLL = 4 x 0.030 x 1 + 0 x 81.25 =* 0.12**

Fig. 3 gives account of the trend analysis of intestinal worm. On the y axis indicates case counts (C 2) and the respective years on the x axis. In 2016, the minimum number of intestinal worms was recorded and a minute increase the following year. Sporadically, there was an increase in 2018 (highest recorded case) over the last four years. In 2019, the number of intestinal worms' cases dropped significantly, approximately to the minimum case count.
DALY for both males and females from periods 2016 to 2019 totalled **9.72** and period 2020 was **0.12**.

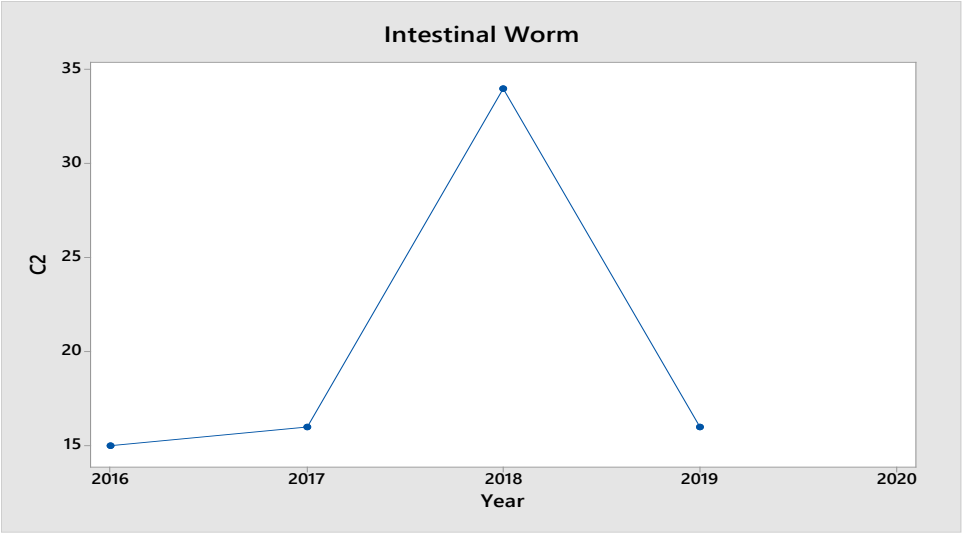

Fig. 3 Trend analysis of Intestinal worm

Daly for Typhoid fever cases for male and female (2016 – 2019) and year 2020;

Daly (2016 – 2019) = YLD *= I x DW x L or YLD = P = DW* ***+ YLL =*** *N x L*

YLD + YLL = 346 x 0.210 x 4 + 0 x 81.25 = **291**

Daly (2020) = YLD *= I x DW x L or YLD = P = DW* ***+ YLL =*** *N x L*

YLD + YLL = 8 x 0.210 x 1 + 0 x 81.25 = **1.68**

Fig. 4 statistically on the y axis indicates case counts (C 3) and the respective years on the x axis for intestinal worms gave fluctuating case counts. Since the highest occurrence recorded in 2016 there was subsequently a sharp decline in the 2017. Case counts increased in 2018 and declined in 2019. Years 2017 and 2019 recorded minimum count cases for the four year period. DALY analysis for both males and females from 2016 – 2019 totalled **291** and year 2020 was **1.68**.

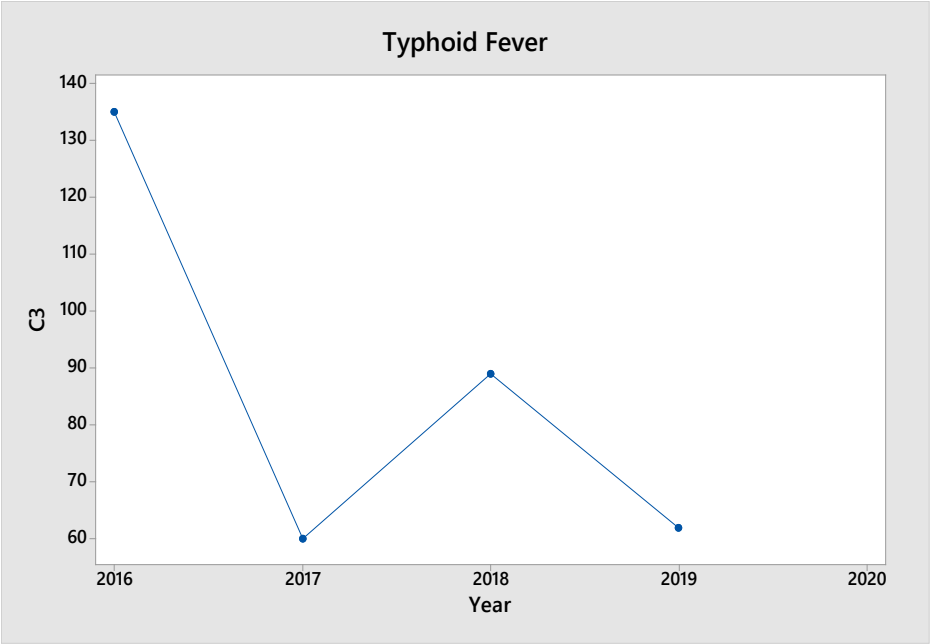

Fig. 4: Trend analysis of typhoid fever

Daly for Cholera cases for male and female (2016 – 2019) and year 2020;

Daly (2016 – 2019) = YLD *= I x DW x L or YLD = P = DW* ***+ YLL =*** *N x L*

YLD + YLL = 47 x 0.210 x 4 + 0 x 81.25 = **39.5**

Daly (2020) = YLD *= I x DW x L or YLD = P = DW* ***+ YLL =*** *N x L*

YLD + YLL = 0 x 0.210 x 1 + 0 x 81.25 = **0**

The study assessed case counts of cholera indicated on the y axis as case counts (C 4) and the respective years on the x axis. Based on the data, cholera cases only occurred in 2016 and none was recorded for years 2017 – 2019 periods. DALY analysis for males and females from periods 2016 – 2019 totaled **39.5** and year 2020 was **0**.

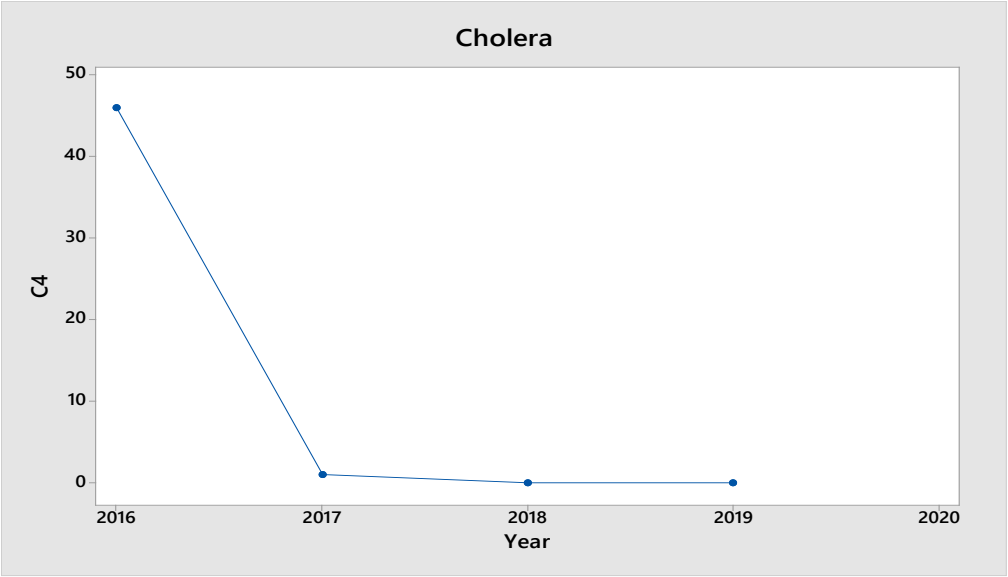

Fig. 5 Trend analysis of Cholera

Descriptive Statistics on Enteric Diseases outbreak of study for periods 2016 – 2019

Descriptive statistics of observation, mean, standard deviation and standard error mean on reported case counts of diarrhoea, intestinal worms and typhoid fever was conducted. Details on the descriptive statistics for the diseases of focus are presented in Table 4, 5 and 6.

Diarrhoea

Table 2: Descriptive statistics of Diarrhoea, Intestinal worms,

Diarrhoea	Obs	Mean	Std Dev	Std Err Mean
2016				
Male	610	107.5311	61.57844	2.49324
Female	850	114.2800	60.32196	2.06903
2017				
Male	264	45.2879	30.59872	1.88322

Female	359	50.3538	29.11469	1.53661
2018				
Male	385	83.4831	56.86072	2.89789
Female	482	71.3195	38.32156	1.74550
2019				
Male	310	70.4645	48.12965	2.73358
Female	415	64.9373	39.48015	1.93800

Intestinal worm

Table 3: Descriptive statistics of Intestinal worm

Intestinal Worm	Obs	Mean	Std Dev	Std Err Mean
2016				
Male	9	2.1111	0.78174	0.26058
Female	6	1.6667	0.51640	0.21082
2017				
Male	6	2.3333	0.81650	0.33333
Female	10	2.0000	0.81650	0.25820
2018				
Male	16	3.7500	2.11345	0.52836
Female	18	4.2222	2.48657	0.58609
2019				
Male	5	2.6000	0.54772	0.24495
Female	11	1.3636	0.50452	0.15212

Typhoid Fever

Table 4: Descriptive statistics of Typhoid Fever

Typhoid Fever	Obs	Mean	Std Dev	Std Err Mean
2016				
Male	53	19.7170	7.70708	1.05865
Female	82	20.6341	10.85540	1.19878
2017				
Male	21	5.0952	2.60585	0.56864
Female	39	8.2821	4.16090	0.66628
2018				
Male	40	10.6500	5.39967	0.85376
Female	49	11.0816	5.41155	0.77308
2019				
Male	30	6.7333	3.78685	0.69138
Female	32	6.6875	3.07369	0.54336

Quality of solid waste collection services

Survey results showed a fair appreciation on measure of solid waste collection services received by beneficiaries. On the percentile assessment of fair to very good, respondents reported a good sanitation situation of the study scope. This was accounted for by keen mechanisms of solid waste management and efforts by the La Municipal Assembly.

Sanitation practices for prior and post Privatization model of solid waste management

Study survey showed prior sanitation practices as better and little improvement aftermath. From the study, the sanitation situation remains better with the privatization scheme since the High class suburbs revealed good sanitation practices and solid waste management results.

Health impacts of sanitation diseases in the La Township.

Health impacts of enteric infections were assessed using hospital data by Disability Adjusted Life Years (DALY) parameters on residents (aged 0 to 60 years and above) of stratified areas due to poor sanitation practices for periods 2016 to 2019 and 2020. Diarrhoea, Intestinal worm, Typhoid fever and Cholera were enteric diseases of focus. From the study, diarrhoea cases was the highest, followed by typhoid fever, cholera and intestinal worms the least for periods 2016 to 2019 while year 2020 recorded better results (decline in figures) on enteric infections relative to previous years

from the study results. Descriptive statistics on enteric infections from the study implied more females got infected than males. Majority of persons who contracted the enteric diseases were within the middle and low class suburbs. The result of this was due to poor hygiene (food vendors selling) by choked constructed drains and gutters with solid and decomposing organic waste and open public spaces which serves as ambient parameters for breeding of house flies, mosquitoes and other vermin pets. However, study results revealed a different situation for the High class suburbs showing good sanitation practices following the PPP arrangements.

Conclusion

Quality of waste collection services to beneficiary households by contracted companies on behalf of the Municipal Authority had 55% of respondents rating them fair, fairly good, good and very good. 45% of respondents rated the services as poor or very poor. Survey reveals residents were satisfied with the service collection measure of solid waste within their vicinities.

Survey responses on sanitation practices for prior and post implementation of the privatization model of solid waste management was rated better to aftermath of little improvement (64% of respondents gave this assertion) while 42.9% gave no improvement. Invariably, this means the sanitation situation remains better following the PPP arrangements in 2012 and further, can be improved.

Hospital data descriptively on enteric infections of poor hygiene and sanitation services in the La Township revealed more females recording higher prevalence than the male counterparts and better results (decline in infection) on Daly figures in year 2020.

The study alludes the PPP arrangements has positive health effects, augmenting efforts of the Municipal Authority on solid waste management of the study scope. Relatively, the Municipal Authority with the following measures can further improve on the PPP model; prompt service payments to private contracted waste companies for municipal solid waste (road/pavement sweepings, drainage/gutter cleanings, civic amenities/waste from public schools, clinics, hospitals and communal container waste collections), routine sanitation guards and strict enforcement of sanitation bye – laws, regularization of informal waste collectors, regular education and sensitization on proper solid waste disposal especially in middle and low class suburbs.

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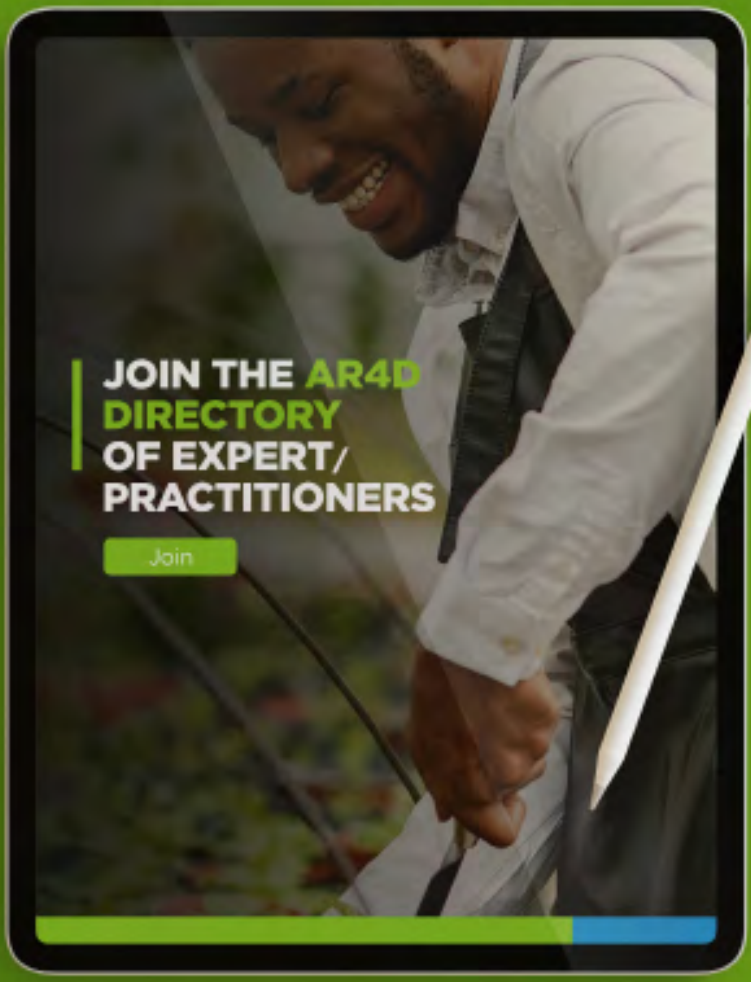

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