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The contribution of participatory engagement strategies to reliable data gathering and inclusive policies in developing countries: Municipal solid waste management data in the Greater Accra Metropolitan Area of Ghana

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The absence of participatory engagement strategies in the collection of solid waste management data in most developing countries affects reliability and deprives professional staff and local authorities of any clear basis for system modernization. This article addresses these challenges in the Greater Accra Metropolitan Area of Ghana, by using participatory action research and systems analysis approaches, to engage a working group of relevant stakeholders to map material flows, assess socio-economic contributions, and chart a sustainable pathway towards informal waste sector integration. The data collected were analyzed statistically and the result is a seemingly simple statement: 1618 informal service providers and 646 informal recycling entrepreneurs are collecting 1370 tonnes per day, which is equivalent to 46% of municipal solid waste. In total they are recovering 85,653 tonnes of recyclables annually; achieving a 6.4% recycling rate, and saving the municipalities an estimated US\$20 million in annual solid waste operations costs. Despite the critical mass of pointers to the benefits of this activity, integration of the informal sector remains a complex issue; and the fear of losing access to clients and materials remains a challenge to the sector. In response to the assessment, the working group has worked together with municipal officials and the related policy institution to elaborate recommendations for integration of the informal waste sector. The assessment suggests that the next step for decision-makers is to institutionalize inclusive waste and recycling policies, and to continue to collaborate with stakeholders to support the informal waste sector to sustain reliable data flows and to unleash their full potential as valued contributors to urban waste management.

Keywords: data, Ghana, inclusive waste management policies, informal waste recycling, integration

Introduction

This article reports on how a participatory engagement strategy has proved useful in an attempt to close the municipal solid waste (MSW) and recycling data gaps in the Greater Accra Metropolitan Area of Ghana ('the GAMA'), as part of prerequisites for the development of action plans and inclusive governance policies towards working with the informal waste sector in both the service and value chains.

The Informal Waste Sector (IWS) refer to private individuals and micro-enterprises involved in solid waste management and recycling activities, but that are not necessarily acknowledged or supported by the formal waste authorities (Scheinberg, Simpson, and Gupta 2010). They are categorized into two groups: informal recyclable collectors (IRCs) working within the value chain and informal service providers (ISPs) working within the service chain.

In most cities and regions in emerging economies, this sector is responsible for almost all of the recycling that occurs (Scheinberg, Wilson, and Rodić 2010; Wilson, Velis, and Rodić 2013). In Ghana, ISPs have been widely reported to offer user-friendly and reliable services at affordable rates to their waste collection clients (Oduro-Appiah et al. 2017b, 2019), while informal recyclable collectors (IRCs) are the main extractors of valuable recyclables (Oteng-Ababio 2012; Rockson et al. 2013). Through their activities, IRCs supply secondary (recycled) materials to intermediate processors and end-user

manufacturing industries. The activities of the IWS contribute to supporting their families, to savings in municipal budgets, to extension of useful landfill life, to achieving the requirements of the SDGs (Valencia 2019), to energy benefits and to subsequent CO₂ footprint reduction (Linzner and Lange 2013; Ayodele, Alao, and Ogunjuyigbe 2018).

Reliable data and inclusive governance are considered essential components of a well-functioning solid waste management (SWM) system (World Bank Group 2018). Data on the performance and contribution of the IWS support local authorities in policymaking, planning of MSWM systems, and provides a baseline upon which support systems for the IWS can be designed (Linzner and Lange 2013; Soós, Whiteman, and Wilson 2017; UNEP 2018). But almost by definition, there is little reliable data and information in informal operations, especially where their operations are defined as belonging to the 'grey economy.' The performance of informal recycling and re-use is therefore usually absent in statistics on recycling rates, and the number of informal entrepreneurs and workers in the service and value chains does not appear in official registers of professions or occupations. And while the informal sector is a real factor in what happens on the ground in cities, its existence and functioning are seldom part of decision-making. Could the lack of participatory engagement methodologies for collecting reliable data and the absence of information on the activities and socio-

economic contribution of the ISPs and IRCs be contributing factors?

As the Sustainable Development Goals (SDGs) become more important, finding modalities for working with the micro private waste sector in developing countries assumes a higher priority (Velis 2018; Valencia 2019).

Understanding what recyclables and organics have value – specifically what can be valorized and marketed to the value chains – requires more accurate information than can be found in ‘the usual data sources,’ which often consist of 10- to 20-year-old desktop studies that estimate the waste by counting the discharges of vehicles at formal dumpsites. To plan for the circular economy, a completely different approach is needed, that engages a range of stakeholders in measuring, evaluating, and estimating various solid waste and recycling factors (Diaz 2017). In Ghana, a multi-year initiative between researchers and the municipality of Accra, has shown how inclusive and participatory processes can make a real contribution to improving information and data in public waste management organizations (Oduro-Appiah et al. 2019).

The research to this article has engaged a 14-member working group of researchers, informal waste actors, development planners, waste managers and policymakers for 11 months to use the participatory action research method to comprehensively map the material flow, assess the contributions of informal actors to the overall MSWM system within all the 25 lower middle-income municipalities of the GAMA, and recommend the actions likely to lead to a successful integration of the informal waste and recycling sector. Participatory action research (PAR) is a research approach that supports stakeholders to collaborate and collectively work together towards a common goal (McIntyre 2007). It opens up governance and planning processes to both professionals and non-professionals; empowering them in the process to form, articulate and own their opinions towards reliable data gathering, inclusive intervention development and decision-making (IJgosse, Anschütz, and Scheinberg 2004).

Strategically, this process of documentation is important because it provides a platform for modelling, valuating, and communicating the positive contributions of informal entrepreneurial activity in the service- and value-chains which, in turn, informs policy and practice in institutionalizing the system.

Following the introduction, this article has been organized further into five sections: Section two provides an overview of the informal waste sector and the relationships between participatory engagement strategies, reliable data on the IWS, and inclusive waste management governance in developing countries. This is followed by a brief description of the study area, the greater Accra Metropolitan Area of Ghana. The methodological interventions for a systems analysis approach to facts-based data collection, and the strategic results of the assessment of the roles and contributions of the informal waste sector form section four. Section five concludes the paper with discussions on how integration of the IWS can sustain

reliable data flows for planning purposes; with recommendations on a pathway likely to drive decision-makers commitment towards ideal integration processes within the GAMA and other similar cities in developing economies.

The informal waste sector, data and information gathering, participatory action research and inclusive solid waste management and recycling in developing countries

Despite best efforts and the strong support of development partners and international financial institutions to modernize waste systems in lower middle-income countries, the neo-liberal promise of formal private sector participation (conceived and promoted as an antidote to inefficient public services) has proved disappointing in the waste sector (Obirih-Opareh and Post 2002; Achankeng 2003). The wisdom and much of the scholarly literature ascribes weak governance characterized by limited financial resources; low cost recovery mechanisms, low technical and human resource capacities; and the absence of strategic plans and regulatory frameworks for such failures (Asase et al. 2009; Guerrero, Maas, and Hogland 2013; Oduro-Kwarteng and van Dijk 2013; Leal Filho et al. 2016; Mmereki, Baldwin, and Li 2016; Oduro-Appiah et al. 2020). This lack of well-functioning, robust formal waste management and recycling systems has created opportunities for a large and growing informal waste sector to supplement services and fill gaps; creating significant numbers of livelihoods in the process.

Collecting baseline solid waste data from the IWS in developing countries is no easy task. Unlike their formal counterparts, they lack the requisite capacity and may remain under no obligation to record, document and report their activities (Linzner and Lange 2013). Where they willingly provide data, their desire to work as free riders raises doubts about the authenticity and reliability of such data. Municipal authorities in most lower middle-income countries like Ghana, are thus confronting challenges to build, maintain, and institutionalize inclusive MSWM and recycling systems (Oteng-Ababio, Arguello, and Gabbay 2013, 2017). The lack of basic MSW data and information, that is the basis for planning and developing appropriate interventions and support systems towards inclusive system modernization is lacking (UNEP 2018). Even where there appears to be information, its usefulness and reliability is limited in a number of (predictable) ways (Scheinberg, Wilson, and Rodić 2010):

- (1) The information has been collected by external consultants working under time pressure for donors or development banks, and is therefore likely to consist only of the most obvious and available information on formal activities.
- (2) It is based on and extrapolated from global or regional data sets that have not been validated in the field, and therefore are likely to miss key locally relevant factors and site-specific information.
- (3) It is in most cases more than 10 years old.
- (4) It has mostly been gathered in relation to planning a facility, and is likely to be inflated for a number of

institutional reasons, such as the fear of not building sufficient capacity or to capture the maximum amount of donor funding for the project.

The research for this article has used the Participatory Action Research (PAR) method to improve data collection and inclusive governance in the GAMA. The PAR is considered suitable for research work that is committed to co-develop interventions and programmes with people rather than the conventional research approach that engage consultants and experts to develop solutions for people (Chambers 1992, 1994; Van de Klundert, Anschütz, and Scheinberg 2001; McIntyre 2007). McIntyre (2007, 1), identifies four main underlying tenets of the PAR process:

(a) the collective commitment to investigate an issue or a problem, (b) a desire to engage in self- and collective reflection to gain clarity about the issue under investigation, (c) a joint decision to engage in individual and/or collective action that leads to a useful solution that benefits the people involved, and (d) the building of alliances between researchers and participants in the planning, implementation, and dissemination of the research process.

We adopted the PAR approach based on three main reasons:

- (1) The experiences of the authors and their colleagues with the MSWM system of the GAMA and the resulting realization that the conventional systems for data collection, system assessment and intervention development have for far too long failed to provide validated and reliable data to support planning and inclusive decision-making.
- (2) The availability and 'open source' framework of the integrated sustainable waste management (ISWM) concept for system modernization to which participatory processes are considered central to allow managing authorities to open governance and planning to both professionals and non-professionals.
- (3) The unique desire and understanding of the authors to collaborate with municipalities to: strengthen capacities, close existing data gaps in IWS operations, and chart a plausible path for IWS integration into the formal MSWM system.

The PRA approach promotes cooperation and transparency among stakeholders, empower and build capacities of working group members in addition to creating a wide ownership of results (Ijgosse, Anschütz, and Scheinberg 2004). The process lends itself to a better understanding of the concerns of the target group (the IWS) and a higher probability of developing locally appropriate and systematic interventions towards inclusive waste management systems.

In the GAMA, the working group chose PRA as the engagement strategy to assess the contributions of the ISPs and IRCs with the objectives to build consensus on what works and to identify challenges and opportunities to drive decision-makers' commitment at charting a sustainable pathway towards inclusive MSWM systems. The choice to use PRA was and remains above all a practical one: conventional data sources are simply inadequate

to support this kind of co-operative process and achieve useful and affordable results.

The greater Accra metropolitan area

The Greater Accra Metropolitan Area ('the GAMA') lies along the South-Eastern coast of Ghana and covers an area of 1453.53 km². It consists of 25 municipalities (see Figure 1) and it is home to the capital city (Accra) and the industrial hub (Tema) of the country. The GAMA is home to an estimated 4.6 million residents and contributes about 25% of the gross national income of Ghana (Government of Ghana 2017). It is considered the 11th largest metropolitan area in Africa and generates an estimated 3293 metric tonnes of MSW daily. With the exception of the two metropolitan cities of Accra and Tema (0.71 kg), the daily average per capita MSW generation is estimated at 0.50 kg. Biodegradable waste including grass cuttings (45–61%), plastics (14%), paper and cardboard (5%) and metals (2–5%) form the four major constituents of MSW (Miezah et al. 2015; Oduro-Appiah et al. 2017a). Formal separation of MSW is non-existent although a few individuals separate glass bottles and high-density polyethylene pouches used for water packaging at the household level to sell to itinerant buyers. We selected the GAMA because it represents the largest (about 90%) hub of IWS activities within the country.

Key methodological interventions and strategic results

The research to this article has used a participatory engagement strategy (the PAR) to identify and mobilize relevant stakeholders together to collect verifiable, real time practical data on the informal waste sector and assess their socio-economic contributions to the MSWM system of the GAMA. The objective was to allow these stakeholders to:

- freely articulate their opinions and perceptions of the IWS
- gain a comprehensive understanding of the activities, contributions and challenges of the IWS
- promote trust and transparency towards reliable data and information gathering
- build competencies and further improve upon inclusive decision-making.

The main data collection approach of the working group includes a combination of structured surveys and semi-structured interviews, discussions, field observations and measurements, and mapping of material paths. Unlike the conventional method of data collection, the point of departure in the use of PAR was that, the target group of study (the IWS) were the protagonists in control of a process that actively engaged them in data collection and decision-making, rather than objects for study and passive recipients of information (Ijgosse, Anschütz, and Scheinberg 2004). The working group, which had a reasonable representation of the IWS collectively developed a checklist of questions and survey instruments to meet the data requirements. The Cochran's formula was used to estimate the sample size (234 for the waste

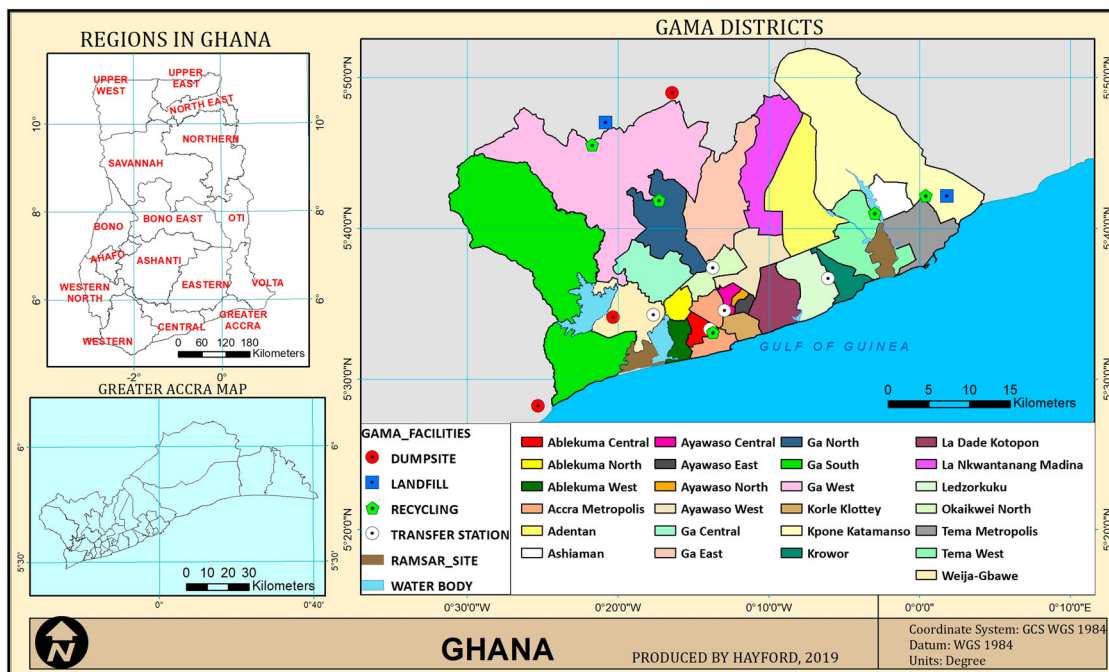


Figure 1: The Greater Accra Metropolitan Area showing the 25 municipalities and MSWM facilities. Source: The authors, 2019

pickers and 320 for the ISPs) for the study (Cochran 1977). But the dynamics and complexities of the activities of the IWS, especially with the waste pickers, called for a careful approach to the use of these conventional sample sizes. Based on the varied nature of material quantities collected and salvaged, and the wide dispersal of the IWS within the GAMA, the working group came to the conclusion to increase the sample size of the waste pickers and the ISPS to 330 and 700 respectively. In addition to this, all informal waste sector actors were counted. The IBM statistical package for social scientists, version 24 and the subSTance flow ANalysis (STAN) software, version 2.6, were used for data analysis and the drawing of waste flow diagrams. In the following sub-sections, the specific instruments used to collect the various data and the results obtained are discussed.

Census of the informal waste and recycling sector within the GAMA

The census data of the ISPs and the IRCs (waste pickers, buyers and junk dealers) were collected using face-to-face questionnaires. This was followed by a random sample survey covering 330 out of 600 waste pickers, 35 out of 46 buyers and junk dealers, and 700 out of 1618 ISPs. The questionnaire administration was done by 12 members of the working group in six different languages including English and French. Snowball research sampling approaches allowed researchers to reach the junk dealers who operated outside of the traditional processing locations. The questionnaires were pretested earlier on 40 people to test validity and reliability. The questions were limited to name, sex, age, marital status, household size, contact address, highest education level

Table 1: Demographic characteristics of the IWS within the GAMA.

Characteristics	Category	ISPs (n = 700) %	IRCs		
			Pickers (n = 330) %	Buyers (n = 24) %	Junk dealers (n = 11) %
Sex	Male	99	85	98	100
	Female	1	15	2	0
Age	<18	4	3	0	0
	18–27	45	43	12	15
	28–37	36	32	52	38
	38–47	12	14	28	32
	48–57	3	6	8	15
	>57	1	3	0	0
Education	None	42	52	9	8
	Primary	20	33	66	77
	Secondary	37	14	22	15
	Tertiary	1	1	3	0
Nationality	Ghanaian	93	53	54	77
	Nigerien	5	35	42	23
	Nigerian	2	9	4	0
	Togolese	0	3	0	0

Source: The authors, 2019

and registration or otherwise to national health insurance and pension schemes. The working group had to visit all bulk transport, final disposal and processing sites for six consecutive weeks to engage with the informal operators, create a rapport, build alliances, and assure the ISPs and the IRCs of confidentiality. This was necessary to pave way for mutual trust and understanding towards reliable data. The responses to the survey were coded manually, entered, and analyzed by means of the statistical package for social sciences (SPSS), version 24.0. Descriptive statistical tools were used to explore and interpret the findings.

Results of the census

The census results are shown in [Table 1](#). The total number of IRCs within the GAMA is 646. The 15% female workforce of the waste pickers represents a slight increase when compared with the 90% male and 10% females reported earlier (Rockson et al. 2013). With an average household size of four, the waste pickers are composed of 53% Ghanaians, 35% Nigeriens, 9% Nigerians and 3% Togolese; confirming the involvement of immigrants in waste salvaging for survival purposes (Gerdes and Gunsilius 2010). The ISPs, 1618 in number ([Table 2](#)), however, are predominantly Ghanaians (93%) with only 7% from the neighbouring countries. Unlike the IRCs and partly because of societal perceptions, only four females (1%) are involved in informal MSW collection. A significant number (more than 75%) of both the IRCs and ISPs are youth between 18 and 37 years with no formal education; putting them at extremely low odds to formal employment opportunities. The 1% of respondents with tertiary education are mostly from deprived regions of the country who join the sector during vacations to raise funds to support their education.

Developing data and information on the activities and material balance of the informal waste sector

The material and process flow diagrams ([Figures 2 and 3](#)) are based on data from structured interviews and questionnaire administration among the randomly selected ISPs and IRCs and validated amongst managers of MSWM and recycling facilities, in combination with observations, photos (which did not include identifiable individuals), and mapping. The questions focused on the types and quantities of valuable materials picked separately by the IRCs and collected as part of MSW by the ISPs. It also included the disposal and processing paths of the collected and recovered materials. Additional questions addressed working schedules and specific challenges. Data collected were validated among managers of MSWM and recycling facilities.

The survey began with trust-building actions, including a series of meetings between the working group and the ISPs and IRCs. The working group presented themselves to answer and clarify pertinent questions, assure confidentiality of economic-related data and information, and agree to a work plan and to respect a checklist of do's and don'ts of the ISPs and the IRCs. To validate quantitative information, materials collected by the IRCs and the ISPs were weighed at the end of each week for four

consecutive weeks – with the permission of, and in the presence of the waste picker, the buyer and two members of the working group. The data collected per ISP and IRC were analyzed and averages were computed for the total number of ISPs, waste pickers, buyers and junk dealers. The computed tonnages were then used to estimate the informal recycling rate within the GAMA as a percentage of the total MSW generated. A process and material flow diagram was developed by tracking the flow and quantities of recovered waste streams within the value chain.

Results: activities and material balance of the informal service providers

The material flow diagram of the ISPs ([Figure 2](#)) is intended to assist stakeholders and decision-makers to understand the linkages between informal and formal activities within the service-chain (Scheinberg et al. 2011). Through healthy price-value relationships and reliable services, the ISPs have attracted a large customer base and are collecting daily, an average of 1370 metric tonnes (46%) of all collected MSW within the GAMA. Whilst they recover 37 tonnes of metals and plastics daily for sale to junk dealers, intermediate buyers operating as micro-enterprises collect 20 tonnes of paper mostly from institutions and commercial centres to sell to paper recycling industries. Depending on proximity, the ISPs dispose all collected MSW directly or via designated bulk transport stations to landfills and dumpsites. Two round trips per day is the norm for each operator, but delays at the disposal sites (deliberately created as a counter-measure to compel municipalities to pay debts owed to the management of the landfills) has reduced it to one; greatly affecting their turnovers. A significant number of the ISPs work six days a week with average collection frequencies of three times per week per client.

Results: activities and material balance of the informal recyclable collectors

The flow of materials of the IRCs is shown in [Figure 3](#). Preferred materials of the IRCs are:

- Polyethylene Terephthalate (PET)
- High-Density Polyethylene (HDPE)
- Low-Density Polyethylene (LDPE)
- Polypropylene (PP)
- Ferrous metals
- Non-ferrous metals, mostly aluminium and copper

The number of waste pickers, the quantities of the various MSW components they recover and the amount per tonne at which the recovered materials are sold to intermediate buyers and junk dealers are shown in [Table 3](#). Most waste pickers pick more than one stream of recyclables; the minimum being three per collector. The 600 waste pickers, who constitute the base of the network, recover 68,053 tonnes (6.4%) of the total annual MSW (1,065,194.25 tonnes) arriving at the landfills and dumpsites ([Figure 3](#)). Depending on storage space, type of recovered waste stream and the requirements of local buyers, most pickers accumulate their waste for at least a week before selling.

Table 2: The number of informal service providers (ISPs) collecting MSW from within the GAMA.

No.	Municipalities	Area (Km ²)	Population	No. of ISPs	MSWM facilities
1	Accra Metropolis	23.50	568,172	150	Integrated Recycling and Composting Plant Korle Klottey Ecological Rehabilitation Project (KLERP) Transfer Station
2	Ablekuma West	12.47		48	
3	Ablekuma North	10.77	246,838	251	
4	Ablekuma Central	9.10	336,088	59	
5	Ayawaso East	3.71	230,538	45	
6	Ayawaso North	2.13		35	
7	Ayawaso West	35.19	88,918	11	
8	Ayawaso Central	6.04	178,478	121	Kokomlemle Mini Transfer Station
9	Okaikwei North	20.86	285,903	85	Zoom Pak Transfer Station, Achimota
10	Korle Klottey	11.88	152,733	29	
11	Ga Central	41.33	141,070	25	
12	Ga East	82.89	179,107	100	
13	Ga West	247.40	268,557	45	Accra Compost and Recycling Plant (ACARP)
14	Ga North	58.29		40	City Waste Recycling
15	Ga South	262.55	521,162	43	
16	Weija-Gbawe	43.46		28	Weija Dumpsite Tidy-Up Mini Transfer Station Zoom Pak Transfer Station, Teshie
17	Ledzokuku	37.05	275,239	33	
18	Krowor	18.38		55	
19	La Dade-Kotopon	35.97	221,284	62	
20	La Nkwantanang Madina	67.80	134,837	135	
21	Adentan	82.24	93,158	50	
22	Tema Metropolis	42.31	353,086	4	Safi Sana Recycling Plant
23	Tema West	51.63		11	
24	Ashaiman	20.29	231,096	151	
25	Kpone Katamanso	226.27	132,070	22	Kpone Landfill and Blowplast Recycling Ltd.
Total		1453.51	4,638,334	1,618	

Source: The authors, 2019

The ISPs recover 13,468 tonnes (3%) of the waste collected and this together with the contributions of itinerant buyers are sold to junk dealers and intermediate processors for further processing. Together with the contribution of some selected municipalities, the Accra Composting and Recycling Plant (ACARP) and the intermediate buyers, the annual quantity (102,033 tonnes) of materials recovered for recycling amounts to 8.5% of the total MSW generated (1,198,652 tonnes) within the GAMA.

With an estimated recycling efficiency rate of 75%, only 76,524.75 tonnes of the total recovered materials are recycled into useful products; bringing the actual recycling rate within the GAMA to 6.4%. The rest are returned to landfills as rejects. Of the 600 waste pickers identified,

only 250, mostly Ghanaians, on the Kpone landfill site are well organized with a well-structured leadership hierarchy; partly because of strict rules from the management of the controlled landfill and partly due to the effort of Women in Informal Employment Globalizing and Organizing (WIEGO), who provide support through education and demonstration of best practices.

The socio-economic contribution of the informal service providers and the informal recyclers

The activities of the informal solid waste sector supports livelihoods of most urban poor in addition to creating social and indirect economic benefits to the cities they work in (Scheinberg, Simpson, and Gupt 2010).

Table 3: Average quantities and selling prices of MSW streams recovered weekly by the waste pickers.

Waste stream	No. of waste pickers	Average recovery/person/week (Kg)	Total recovery/week (Kg)	Price/tonne US\$	Total price/tonne US\$
PET	333	2000	666000	120.00	79,920.00
HDPE	515	60	30900	240.00	7,416.00
HDPE (Pouches)	178	150	26700	160.00	4,272.00
LDPE	128	600	76,800	260.00	19,968.00
PP	327	800	261600	200.00	52,320
Metal	447	500	223500	140.00	31,290.00
Copper	72	3	216	3400.00	734.40
Aluminium	460	50	23000	240.00	5,520.00
Total		4163	1308716		201,440.40

Source: The authors, 2019; US\$1.00 = GHC5.00

Legend: IRCs: Informal recyclable collectors; PET: Polyethylene Terephthalate; HDPE: High-Density Polyethylene; LDPE: Low-Density Polyethylene; PP: Polypropylene.

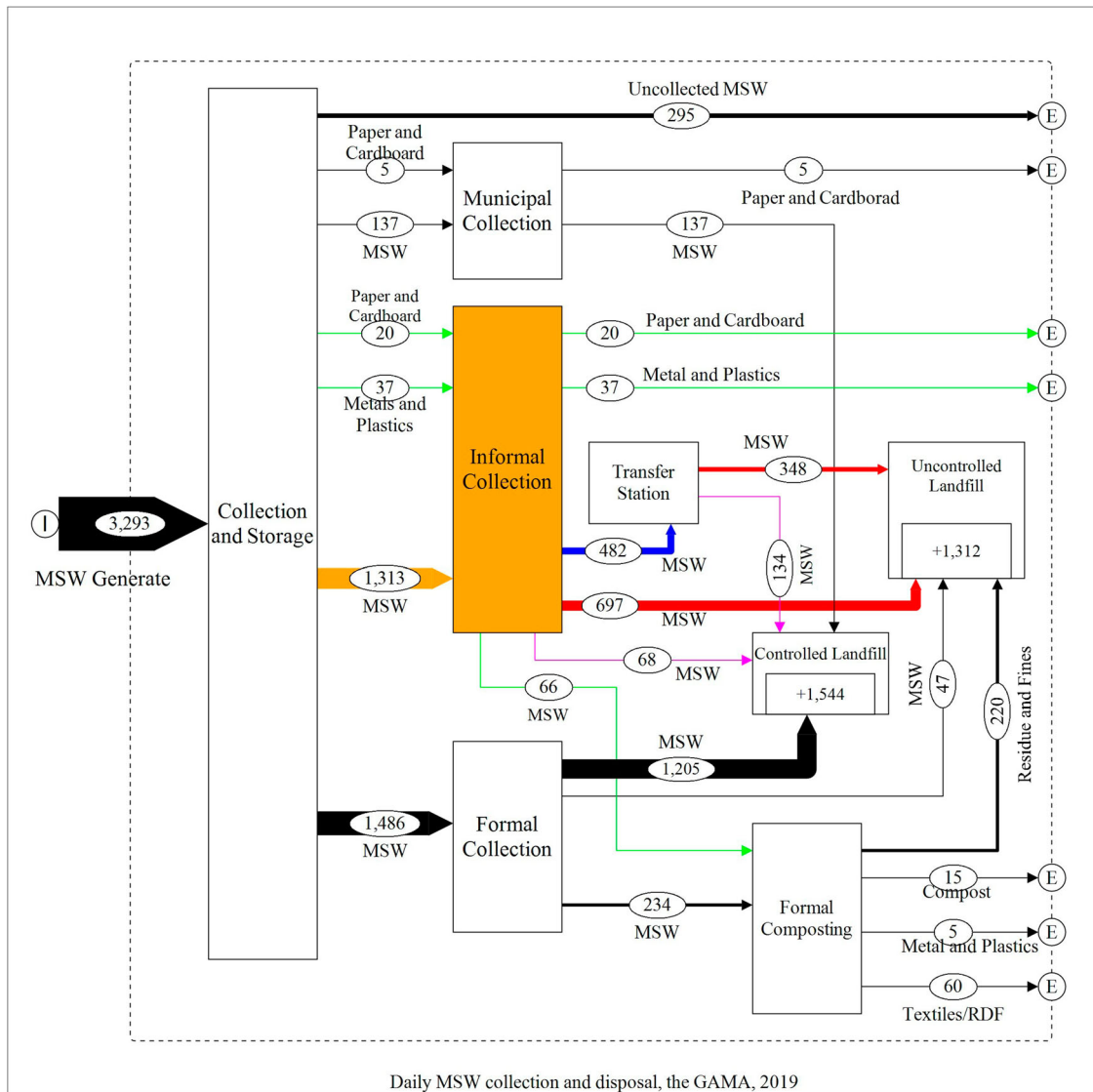


Figure 2: Sankey-type material flow diagram for MSW collection and disposal within the GAMA, Ghana. The thickness of the flow corresponds to the weight of the waste (tonnes per day). *Source:* The authors, 2019. Developed using STAN 2.6[©] (Institute for Water Quality Resources and Waste Management, TU-Wien, Austria). Legend: ISPs: Informal Service Providers; MSW: Municipal Solid Waste; RDF: Refuse Derived Fuels.

The economic benefits of the activities of the ISPs to the municipalities within the GAMA has been estimated based on their cost of operation and turnover (Table 4). Relevant data was obtained as part of the interviews and the day-to-day field monitoring processes of the activities of the ISPs and the IRCs. In relation to the ISPs, the working group made an inventory of the source of their equipment (motorized tricycles), maintenance schedules, breakdown frequencies, in addition to the daily amounts paid for equipment usage. Their economic contribution to the system was estimated by computing the average frequency and average quantity of waste brought to the sites by each operator, the amount raised per day minus the expenditures on fuel, disposal, maintenance and depreciation. The economic contribution of the IRCs was estimated by computing the economic value of the void space saved from their activities; in addition to computing the tonnages and related prices of the various waste streams recovered, weighed and sold to local buyers and junk dealers.

Service users pay a relatively lower average cost of US \$8.00 for three times a week MSW collection by the ISPs, compared to US\$12.00 for once a week collection by formal service providers. This in addition to service reliability and client friendliness justifies the relatively strong preference of clients to the services of the ISPs. On average, an ISP realizes US\$40.00 upon collecting a full tricycle (1.2 tonnes) of MSW from 100 households (Table 4). Out of this, US\$22.00 is spent on fuel, maintenance and servicing of equipment parts, disposal, and depreciation for operators who own the tricycles or as daily returns to the individuals who rent out the tricycles. The rest, US\$18.00, is considered as turnover, which provides livelihood to household members.

The ISPs indirectly contribute to saving the municipalities an amount of US\$20,192,640.00 (Table 4) annually in MSW collection and disposal cost. If not for the three times collection frequency per week and reliable services, the US\$40.00 collection and disposal cost for a 1.2 tonne of MSW by the ISPs would have been higher than the

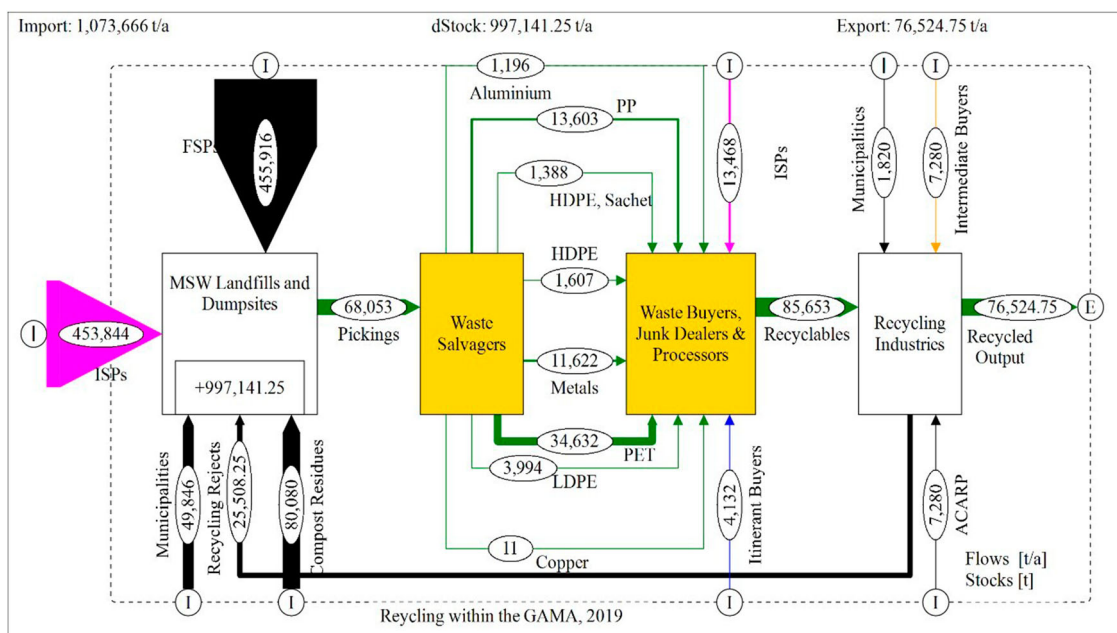


Figure 3: Process flow diagram for MSW recycling within the GAMA, Ghana. The thickness of the flow corresponds to the weight of the waste (tonnes per year). **Source:** The authors, 2019. Legend: ACARP: Accra Composting and Recycling Plant; FSPs: Formal Service Providers; HDPE: High-Density Polyethylene; ISPs: Informal Service Providers; LDPE: Low-Density Polyethylene; MSW: Municipal Solid Waste. PET: Polyethylene Terephthalate; PP: Polypropylene.

estimated average of US\$30.00 per tonne of MSW collected and disposed in lower middle-income countries (Coffey and Coad 2010; Kaza, Yao, and Bhada-Tata 2018). In reality, the ISPs are offering quality services at a highly reduced cost to the municipalities. For example, the municipality of Accra, in 2015, is reported to have collected 21216 tonnes of MSW at approximately US\$3.6 million minus labour cost (Oduro-Appiah et al. 2017a). The ISPs would have collected the same at just 13% of the cost based on the computations of Table 4.

Each waste picker earns on average US\$300.00 per month, and collectively these micro-entrepreneurs sustain 2400 dependents. Although lower than their ISP counterparts, this amounts to a daily turnover of US \$12.50 (which is still 6 times higher than Ghana’s minimum wage of US\$2.00). Local buyers and junk dealers earn on average US\$ 400.00 and US\$1000.00 per month respectively. Each of 195 workers (mostly women) employed by the junk dealers to wash, cut, dry and pre-process recovered materials earn an average of US\$4.00 a day. The IRCs and the ISPs contribute to save the GAMA 387,902 m³ of void space and US \$856,530.00 in annual landfill operational expenses (Kusi, Nyarko, and Boamah 2016; Aledu and Amfo-Otu 2018).

Sustaining reliable data flows and inclusive governance within the GAMA and Sub-Saharan Africa through IWS integration

The IWS within the GAMA contribute to 84% of recycling compared to the formal sector. This in addition to their economic contribution to useful landfill life extension and savings in MSW operational expenditures provides strong evidence for their integration into the formal solid waste management system. But local authorities and decision-makers of MSWM in most lower-middle income cities of Sub-Saharan Africa seem not to recognize such form of inclusive private sector participation to be beneficial to the cause of MSWM modernization (Oteng-Ababio, Owusu-Sekyere, and Amoah 2017; Sandhu, Burton, and Dedekorkut-Howes 2017).

Neither the existence of analytical and recycling frameworks (Velis, Wilson, and Rocca 2012; Scheinberg and Simpson 2015; Fei et al. 2016), examples of best practices of the International Labour Organization (ILO) towards informal inclusiveness and integration in East Africa (Ishengoma and Toole 2003), nor recent attempts by WIEGO and other non-governmental organizations (NGOs) to strengthen informal recyclable collectors (Ezeah, Fazakerley, and Roberts 2013), have been able to drive commitment of local and national authorities

Table 4: Estimated cost of service provision by the informal service providers within the GAMA.

Item No.	Expenses category	No. of ISPs	Cost of service provision in US\$	
			Daily	Annually
1	Fuel	1618	4.00	2,019,264.00
2	Maintenance cost		2.00	1,009,632.00
3	Disposal cost		6.00	3,028,896.00
4	Depreciation>Returns		10.00	5,048,160.00
5	Average turnover		18.00	9,086,688.00
	Total		40.00	20,192,640.00

towards IWS inclusiveness across Sub-Saharan Africa (UNEP 2018). With the exception of South Africa, Uganda, Kenya, Tanzania, and Madagascar (Aparcana 2017; Godfrey and Oelofse 2017; Andrianisa et al. 2018), where the scholarly literature provides evidence of policy development and practical attempts at integration for the IWS in selected cities, all other Sub-Saharan Africa countries, including Ghana, have yet to demonstrate commitment both at policy and legislative levels towards informal waste sector integration (Oteng-Ababio, Owusu-Sekyere, and Amoah 2017; Ayodele, Alao, and Ogunjuyigbe 2018). This apparent lack of recognition for the contribution of the IWS does not only prevent them from unleashing their full potential towards MSW system modernization in the region, but leaves them also in constant fear of losing their means of employment and survival at any time.

However, the participatory approach to this article and recent projects in Accra have made a convincing case that collaboration and structural cooperation between researchers, municipalities and other relevant stakeholders can prove a good approach to close apparent gaps in MSW data and drive decision-makers commitment towards inclusive governance and MSW system modernization within the GAMA (Oduro-Appiah et al. 2017a, 2019). Integration of the IWS may not only open up opportunities for local government support, but will provide the necessary path to sustain reliable MSW data flows for continuous planning and inclusive decision-making.

The municipalities within the GAMA stands further to benefit immensely from the experiences of Latin American and Asian cities in countries like Brazil, Columbia, Chile, Mexico, Peru, China, India, Indonesia, Bangladesh, and the Philippines, where policies and legal frameworks towards formalization and integration of the informal waste sector have been translated into successful organizing, often of co-operatives, and sometimes business associations or waste picker unions (Medina 2000; Paul et al. 2012; Silva de Souza Lima and Mancini 2017). Modest success in organizing, combined with some form of external impulse and donor support, suggest that integration is a win-win and sustainable MSWM delivery system.

Recommendation for informal sector integration within the GAMA

Recommending a pathway for integration of the IWS within the GAMA and other Sub-Saharan regions to address the outlined challenges and sustain reliable MSW data flows is necessary but requires cautiousness. A one-fits-all solution may definitely not be the way to go. Based on the experiences and the findings of this study, we support the continuous collaboration and participatory development of action plans based on building on what works for each particular location. Nonetheless, the process within the GAMA and best practices of other developing cities (especially in Latin America) suggest that any attempt at successful integration should be municipality and local government driven with the support of academia, research institutions and NGOs; but also maintaining private actors' value-chain control (Scheinberg

2012; Navarrete-Hernandez and Navarrete-Hernandez 2018; Oduro-Appiah et al. 2019).

We recommend the following steps towards the integration of the IWS within the GAMA:

- (1) Engagement of the sector through registration of active IWS members.
- (2) Organization of new and strengthening of existing IWS associations.
- (3) Provision of training and capacity building support.
- (4) Development of a stakeholder platform with significant representation of the IWS sector actors.
- (5) Assigning low-income service zones (where the formal service providers are known to be failing in service delivery) to the IWS in future franchise agreements.
- (6) Provision of unhindered access to MSW to the IWS from within their working zones and on the landfill sites to enable them continue with their collection services and value-chain recovery activities.
- (7) Continuous gathering of data and monitoring of the activities of the sector to drive advocacy and societal support towards the enactment of policies for their integration.

A careful balance between the repercussions of an integrated IWS with the full potential to maximize collection coverage and recycling rates, and the probable legal and economic effects on the existing formal service providers needs further research and deliberations to prevent conflicts, promote cooperation and harmonize user fees where necessary (Gerdes and Gunsilius 2010). The potential possibilities of creating markets for recyclables, improving the bargaining power and working conditions of the IRCs and tapping the experiences of the ISPs and IRCs towards household and central MSW separation systems, (Scheinberg 2012) should remain subjects of research interest to be introduced systematically after trust and some significant measure of system sustainability has been achieved.

Conclusion

Contrary to the conventional approach to data gathering, especially with regard to the informal waste sector in developing countries, this study has made the case that structural cooperation and stakeholder consultation, based on inclusive planning and participatory action research methods, create a reliable pathway to baseline data and information gathering for inclusive decision-making.

The process has provided evidence to support the significant role and socio-economic contribution of the ISPs and IRCs to the MSWM system within the GAMA, Ghana. The detailed process and material flow diagrams provide a comprehensive overview of the movement of materials handled by the ISPs and the IRCs and are intended to enable stakeholders to identify points of entry for support provision and development of locally appropriate action plans towards a sustainable integration process within the GAMA.

The informal waste and recycling sector within the GAMA contributes to substantial savings for the 25

municipalities in MSWM operation costs in addition to increasing the useful life of the region's scarce landfills. Despite their efforts, the sector still lacks official recognition and has been facing difficulties with occupational safety and health, harassment and a related threat of being refused to continue with their choice of employment (Boampong and Tachie 2017). The challenge for the municipalities is to optimize the benefits that the informal sector provides, through positive engagement, support and integration into the formal waste economy (Diaz 2017).

The working group, with support from the municipalities and the new ministry of Sanitation and Water Resources, has come to appreciate the partnership linkages in addition to the need to mobilize various types of capital, among them human, financial, social, physical, and public infrastructure capital, in order to ensure sustainable integration (Sembiring and Nitivattananon 2010). The working group members are cooperating with other stakeholders to develop the action plans and policies which will be systematically implemented to engage, register, organize, and integrate the informal waste sector as part of a comprehensive programme that seeks to modernize and sustain the MSWM and recycling systems in the 25 municipalities. Although the content of the information gathered will differ in other developing countries, the methodology, the process flows and the process recommendations in this study, and their capacity to leverage locally responsive informal waste and recycling sector integration are likely to result in closing of data gaps and integration of the sector in similar developing economies.

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