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Working with the Informal Service Chain as a Locally Appropriate Strategy for Sustainable Modernization of Municipal Solid Waste Management Systems in Lower-Middle Income Cities: Lessons from Accra, Ghana

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Abstract: Twenty years of formal private sector participation in solid waste management in Ghana has failed to deliver an increase in collection coverage and recycling rates. This article shares lessons and experiences from Accra, Ghana, a middle-income city where researchers and municipal solid waste managers have collaborated to modernize the municipal solid waste management system by working together to develop a locally appropriate response to the informal waste service sector. Stakeholders have used inclusive decision-making and participatory research methods to bring formal service providers to work in partnership with their informal counterparts to improve collection and recycling. The Wasteaware benchmark indicator framework has been used to assess and compare the improvements in the physical and governance aspects of the municipal solid waste management system, supplemented by statistical analysis of responses to a survey on the socio-economic contribution of the informal service providers in the city. Within two years of their inclusion, the number of informal service providers has increased by 71 percent, from 350 to 600, creating new livelihoods and contributing to poverty reduction. The informal service providers have been able to increase collection coverage from 75% to 90%, waste capture from 53% to 90%, and recycling rates from 5% to 18%, saving the municipality US$5,460,000.00 in annual operational costs. The results have influenced the decision-makers to move towards structural integration of the informal service providers into the formal waste service system. The shift towards practical, locally responsive interventions in Accra provides a positive example of sustainable waste management modernization, and key lessons for cities in similar economies.

Keywords: informal service providers; inclusive urban services; participatory planning; municipal solid waste management; modernization; emerging economies; Accra; Ghana

1. Introduction

Despite the progress in high-income counties in modernizing municipal solid waste management (MSWM) in the last three decades, the same cannot be said of emerging economies, especially in Sub-Saharan Africa. In Western Europe and North America, a combination of technological innovation, collaboration between academia and industry, and political and social commitment has contributed to

strategies that deliver sustainable, equitable and resource-efficient MSWM, characterized by a near 100% collection coverage, state-of-the-art disposal, and moderately high recycling rates [1,2].

In contrast, the MSWM system of most middle-income economies is characterized by low to moderate levels of collection coverage with significant amounts of uncollected waste on illegal dumps and beaches [3,4]. The solid waste generated by households on poor urban settlements is rarely collected, even though the waste collection service consumes more than 50% of municipal budgets [5]. Rather than building on what is working and exploring truly local solutions, municipal authorities and national politicians tend to choose donor-financed and technology- and capital-intensive management models modeled on MSWM in the developed worlds, as a path to system improvement [6,7]. Such approaches may appear to represent a rapid solution but are seldom sustainable [1,7].

For this reason, decision-makers in countries like Ghana tend to dismiss opportunities to recognize, integrate and support informal waste collectors (referred to here as informal service providers (ISPs), to distinguish them from informal waste pickers or recyclers, who are valorizing recyclables) into their formal systems [7,8]. Interventions geared at recognition and formalization of the informal waste sector (IWS) have been proven to increase collection coverage, raise recycling rates and create employment opportunities for the urban poor, many of whom are unable to find employment in the formal system [9–11].

The joint United Nations Human Settlement Programme (UN-Habitat) and United Nations Environment Programme (UNEP) sustainable cities program in Dar es Salaam, Tanzania, supported by the International Labour Organisation (ILO), served as one of the first innovative micro-privatization models in Sub-Saharan Africa which institutionalized, organized and monitored the integration of ISPs to promote poverty eradication and improve waste collection [12–14].

Although ISPs often do not pay taxes nor work in the formal financial sectors of a city; they offer their clients personalized services, simple technologies, and affordable user charges, most of which are lacking in formal waste collection systems found in lower middle-income cities. Despite their local knowledge, healthy price–value relationship and broad acceptability to system users, authorities charged with managing municipal solid waste (MSW) have been reluctant to recognize the ISPs as an integral and valuable part of the system [8]. At best, their contribution is considered a nuisance, unhygienic and crime-related; even though they do a better job than their formal counterparts [15].

Why are municipal authorities so reluctant? Research interests, technical capacity, commitment, stakeholder inclusivity and an understanding of the local politics and waste system dynamics are widely understood to be paramount to delivering an integrated sustainable waste management (ISWM) system [16–18], but city authorities in emerging economies tend to focus more on donor investment [1,19]. This article presents the lessons and achievements in ISWM, of a collaborative working group of researchers, politicians, MSW managers and service providers; who have developed and implemented locally appropriate interventions to increase MSW collection coverage and recycling rates in Accra. The work is based on the hypothesis that ISWM improves the chances of sustainable and positive outcomes, by promoting structural co-operation between researchers, municipalities and relevant stakeholders. Such collaborations raise capacities to assess the MSWM system in a participatory and transparent manner, and facilitate co-operation at all levels.

The concrete objective of the ISWM assessment was to support city authorities to collect relevant data, transparently assess their systems, identify challenges, correct and encourage each other, and to explore the potential improvements that simple technologies and locally responsive interventions can bring about. The current paper represents one aspect of the collaborative approach to socialize the assessment of the socio-economic contribution of the ISPs, as part of a deliberate strategy to create a pathway and prepare the formal authorities to organize and integrate them into the formal MSWM system. This paper has a secondary objective to share lessons and experiences of the collaborative process of intervention development and implementation.

Following the introduction, this paper has five additional parts. Section 2 provides an overview of the definition and the theoretical framework that governs the informal waste sector. Section 3

summarizes the history of the evolution of formal and informal MSW collection in Accra. This is followed by the interventions that were designed and implemented in the framework of action research; the methods that were adopted to assess the socio-economic contribution of the ISPs to the MSWM system; and the framework that was used to map system improvements, all in Section 4. Section 5 discusses the intervention outcomes and the related contributions to MSWM system modernization. The lessons learnt along with new interventions for a continuous improvement strategy in MSWM service delivery form part of the Section 6.

2. Theoretical Framework, the Politics of the Informal Waste Sector

The informal solid waste sector (IWS) consists of private individuals, groups and micro-enterprises who are involved in solid waste collection, recovery and recycling but without the express support or recognition of the formal waste managers, putting them at risk of being considered to be in violation or in competition to formal contracting processes [20]. The IWS, a segment of the wider informal economy in developing countries, has been growing since the 1990s, partly due to the limitations in the creation of formal jobs, and partly due to the mismatch between the capacities and skills of the sector and the requirements and expectations of the formal sector [21]. Based on their modes of operation, the IWS is classified into two distinct groups: informal recyclers (IRs) in the value chain (recycling industry) and informal service providers (ISPs) in the service chain (formal solid waste management system) [20].

The policy debates about the informal economy and by extension the IWS have been governed by four main theories for decades: dualist, voluntarist, structuralist, and legalist [21]. A recent addition is the co-production theory upon which this study is based. The dualist perspective considers the emergence and upsurge in IWS activities in developing countries as a consequence of limited economic growth and the lack of formal employment creation. According to the dualist school of thought, IWS activity is deliberately chosen as the sustainable and inevitable option by the marginalized in society because of a lack of skills and capacities to compete for formal employment. According to the dualist, IWS activities, which become more pronounced during times of economic crisis; are detrimental to the economic growth of a country, with the consequence that the focus of the policy should be to criminalize or eliminate the IWS and create more formal jobs. The MSW collection privatization concepts of the World Bank and the micro-privatization models of the ILO from the beginning of 1990s, especially in Sub-Saharan Africa, are seen as products of the dualist school of thought [22,23].

The voluntarist approach frames the informal economy as belonging to one end of the labor continuum in which IWS actors deliberately seek to work within the informal economy as free riders: they have a base from which to make gains but avoid taxes and regulations. Voluntarists vilify the IWS and use pejorative language to describe them as tax evaders that create unfair competition for their formal counterparts. They thus argue for all informal enterprises and individuals to be under formal regulatory control as a means for society to increase its tax base [23].

The structuralist, in contrast to the dualist, believes that informality arises at a particular developmental stage of capitalism. According to this view, the informal economy is subordinate to the formal economy [24], and is working for formal institutions. Structuralists see the informal sector as an integral part of the formal economy; they understand that informality drives competition between formal enterprises through direct and indirect linkages in provision of low cost inputs, materials, and services. The informal supply chain picking recyclables from dumpsites and selling them at low prices to formal recycling companies is considered by structuralists as proving the validity of their points of view. The linkage is considered exploitative to the informal sector since the formal enterprises are believed to set the rules for the transactions, which enables them to increase profit margins to the disadvantage of the waste pickers. Structuralists promote the organization of informal sector entrepreneurs—almost always referred to as "workers", into solidarity unions and cooperatives to strengthen the informal economy to negotiate for recognition, the right to work, better working conditions and better prices for their goods and services [25]. The vision of the structuralists

corresponds most closely to the situation in Latin America, while in other emerging economies the local realities contradict this position.

The legalist school of thought posits that the informal economy comes into being in response to hostile legal and labor requirements and obstacles to formalization such as registering of a business, registration for income, value added tax (VAT) and other taxes, the need for licenses or permits, legal conditions for hiring employees, requirements for workers insurance, complying with legal and labor laws, etc. Legalists tend to favor interventions which aim to introduce simplified bureaucratic procedures to encourage informal enterprises to legalize their operations [26].

The scholarly literature on the IWS to the MSWM system in developing countries has revolved around the role and contribution of the informal value chains, and has to a large extent embraced the dualist and the structuralist schools of thought [27,28]. This paper, in contrast, takes as its point of departure, the theory of co-production, which in turn is linked with the use of combinations of state and non-state actors in public service delivery [29,30]. Co-production advocates the use of formal–informal linkages as effective answers to the failures of the kinds of state-based and privatized models of service provision [31] found in the MSWM systems of many cities in emerging economies.

A complex mix of factors including weak governance, lack of political will, moderate capacities in both the private and public sectors, exacerbated by rigid financing and budgeting systems, has contributed to the failure of the privatization and public–private participation (PPP) management models in most developing countries. The result is a gap between user economic and social demand for waste services on the one hand, and informal providers offering these services to a system which rejects them as illegitimate [23].

This was the baseline situation at the time the initiative behind this paper began, in 2015. The ISPs in Accra were contributing to the city's ability to meet performance targets, at a time when formal service providers were failing, creating a situation that was favorable for the development of new compromises that would allow the informal entrepreneurs to unleash their full potential and contribute to system modernization and sustainability [32].

The co-production literature also emphasizes the coordination that is possible through formal–informal linkages and multi-stakeholders arrangements to bridge institutional and resource gaps [31]. The use of a team of researchers, politicians, solid waste managers and other relevant stakeholders to develop and implement the interventions within this study was deliberately designed to enable synergies that will continuously and systematically build the capacities of municipal officials and also encourage local authorities to lead the process of recognizing, integrating and organizing the ISPs as part of the MSWM system of the city to improve their efficiency.

3. Evolution of Solid Waste Collection Service Delivery in Accra

Solid waste collection service delivery in Accra until 1999 was publicly managed [33,34]. Prior to that time, the system was based on a network of secondary collection sites where residents were allowed to discharge their waste. Each site had at least one communal container—initially drawn by mules and later hoisted by skips—that was transported to municipal dumpsites for disposal [35]. Due to the lack of access routes in low-income areas, service was limited mostly to high- and middle-income areas. The cost of the service was largely borne by the central government with more than 80% of residents and commercial enterprises, mostly within middle- to low-income areas enjoying free services [36]. Residents of high-income areas, who benefited from house-to-house collection services offered by ISPs paid privately and directly to the service providers.

3.1. Public–Private Partnerships and the Evolution of the Formal System

In 1999, local authorities in Accra were confronted with inflows of persons from rural–urban migration and high population growth. These, in addition to low revenue collection, undermined the autonomy of the system. Local and national authorities were neither politically nor administratively able (nor willing) to raise revenue sufficient to sustain the MSWM system. Rather than taking political

risks, they took the path of choice of many decision-makers in emerging economy cities to enter into formal public–private partnerships (PPP); ostensibly with the objective to increase collection efficiency and coverage, but in practice to avoid taking responsibility for raising fees [33], as well as to comply with donor recommendations. Whatever the real reason for the PPP policy, it did not arise from any observable interest in what the private sector had to offer [37], and so it was not surprising that the "PPP arrangement" failed. It did not improve collection coverage in densely populated areas nor fix the problems with revenue collection. As a result, the municipality incurred a debt to private solid waste contractors of US$8,400,000.00 [33] for collection and disposal charges between 2000 and 2007. The resultant legal and political unrest pushed decision-makers to rethink the role of the private sector providers and service users in the city [38].

In 2008, in the course of the World Bank's Second Urban Environmental Sanitation Project [39], city authorities took the initiative to introduce the "polluter pays principle" with the aim to shift the cost of MSW collection to system users. The polluter pays principle ultimately led to the introduction of the fee- and performance-based MSW collection strategy in 2011 [38]. The performance-based strategy had three major features:

- to offer the formal private sector the opportunity to bid competitively to participate in a five-year franchise agreement;
- to increase collection coverage, and
- to assign the responsibility of service fee collection to the franchise-holders.

The city acting on behalf of the public retained for itself some regulatory and monitoring responsibilities:

- to set user charges;
- to enforce obligations, and
- to have the right to abrogate contracts for non-performance.

Despite the expected improvements, the system was in a downward spiral, and five years after the implementation of the strategy, coverage under formal service provision chains had dropped from 60% to 55% [36]. During the same period, ISPs increased their client base and by 2016 were collecting more than a third of all MSW generated in the city, such that their activities had increased the overall collection coverage to 75% [3].

3.2. Evolution of Informal Service Provision in Accra

The activities of the informal MSW service providers, working in parallel to the formal system, were first documented in the literature in 2002 [34]. These activities continued during the period of the PPPs, with its emphasis on formal private sector participation in service delivery [40]. In this, Accra is not unique: there are many examples of micro-enterprises in the informal sector providing or supplementing formal service delivery, especially in emerging economies [22,41–43]. ISPs are not, unfortunately, a solution to all of Accra's MSWM problems: the reach and effectiveness of micro-service providers is constrained by limitations in financial management capacity, professional skills, ability to mobilize investment in vehicles, and other problems faced by bottom-of-the-pyramid entrepreneurs.

Despite such limitations, in Accra, the current generation of ISPs has evolved from cart-pushers to motorized tricycle operators (Figure 1). They work primarily in low-income areas, and have experienced significant growth in the last 20 years. ISPs, partially in support of their own interests, have been the main advocates of equitable MSW collection. Their reliable and friendly services have given users a sharp contrast with unreliable and costly formal waste collection. Lean operations, affordable user charges and simple technologies have allowed this sector to essentially whip their formal sector competitors. However, their operations are not perfect: they have been criticized for disposing of the collected waste in heaps or semi-formal dumping sites, rather than paying to discharge

it at formal disposal facilities. They collect fees directly from the users and are reported not to pay taxes on this income [44].

Figure 1. Motorized tricycles in a queue to dispose collected municipal solid waste (MSW) at one of the bulk transport stations (Zoom Pak) in Accra. Photos: The authors, 2018.

The implementation of the fee- and performance-based MSW collection strategy in 2011 had both a positive and a negative impact on the ISPs. It brought their activities to the attention of city officials and donors, but the nature of the franchise agreements between the municipality and formal service providers gave the formal sector a nominal monopoly, in effect criminalizing ISP operations and meaning that ISPs could no longer work within the zonal monopolies of their formal counterparts. Their activities were thus confined to the (less profitable) slums and low income areas of the city, where the formal providers had failed to increase collection coverage. In 2014, the ISPs were formally recognized by the environmental service providers association, an association of formal MSW collectors. Partly as a result of this, between 2013 and 2016, the number of ISP units grew from 52 to 350 members. They are currently registered under the Ghana "Bola" Taxi Union with chapters in each of the ten recognized zones of the city (Figure 2), and were found in 2016 to be providing as much as 28% of waste collection in the city [3].

Despite the documented benefits of informal service provision coupled with the existence of frameworks for their integration into the formal system [15,45–47], those charged with MSWM in the city have been reluctant to integrate and regulate their activities. During a participatory assessment of the MSWM system in Accra, stakeholders identified two perverse effects of the inaction of local authorities on the ISPs. First, the market and survival orientation of the informal business has pushed collectors to set their user charges too low, creating "unfair" competition with their formal counterparts whose earning models depend on economies of scale. Secondly, the lack of recognition has created data gaps in the MSWM system since their activities are largely unreported and therefore unaccounted for [48]. Through a participatory review of the fee- and performance-based MSW collection strategy, working groups decided to develop and implement inclusive and participatory interventions to improve the physical components and also harmonize the MSWM service delivery field [44].

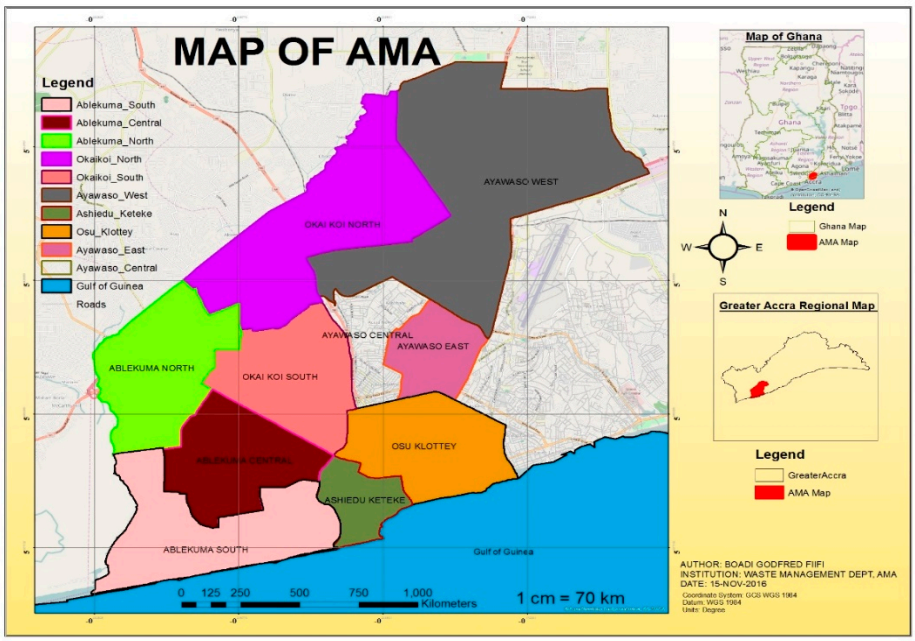

Figure 2. Formal collection zones of the Accra metropolitan assembly (AMA). Source: Waste management department of the AMA, 2016. Six new district assemblies have been carved out of the 10 zones of the AMA by a legislative instrument since March 2018 but all are still being nurtured by the AMA until 2019.

4. Materials and Methods

4.1. Action Research and Intervention Development

This article reports on three years of participatory action research with the objective to understand the problems in the MSWM system and work in a participative way to modernize MSWM delivery in Accra. In this process, a working group of researchers, stakeholders and staff of the municipality have:

1. assessed the physical components and governance aspects of the MSWM system in line with the concept of ISWM [3];
2. reviewed an existing collection strategy and developed a new five-year fee- and performance-based MSW collection franchise agreement that supports ISPs to work as legalized entities within franchised monopolies of formal service providers to increase collection coverage [44];
3. negotiated with formal service providers to support their informal counterparts with motorized tricycles at hire purchase to increase their efficiency and turnover [44];
4. recommended and developed an action plan for the integration of the ISPs as a locally appropriate and sustainable path to improve the physical indicators of collection, disposal and resource value [3];
5. recommended and supported the closure of unofficial dumpsites patronized by 350 ISPs and stimulated subsequent construction of two bulk transport stations to improve the cost and time efficiency of waste transfer activities [49].

4.2. Survey and Registration of Informal Service Providers

The survey and registration of the ISPs were carried out for fourteen consecutive weeks between May and August 2018 from 8:00 a.m. to 5:30 p.m. at the transfer stations (bulk transport stations) where the ISPs dispose of collected waste. Data was collected using a structured questionnaire (see supplementary material, Tables S1 and S2) administered by 12 members of the working group, two of which were representatives of the association of ISPs. The consent and participation of the ISPs to the process were sought through their leaders and also through national print and broadcast media [50,51]. All 600 ISPs were registered and provided with identification stickers for their tricycles. A total of

234 out of these 600 participants were randomly selected for the interview. Participants were asked for the source of acquisition of their equipment (tricycles), maintenance schedules, durability and breakdown frequencies in addition to the daily amounts paid for equipment usage to enable the municipality to comprehend their working environments and challenges. The economic contribution of the ISPs to the system was estimated by computing the average amount of waste brought to the sites by each operator, the money raised per day vis-a-vis the expenditures on fuel, disposal and maintenance. The health and work safety of participants were assessed by soliciting the routines on the acquisition and use of safety gears. Level of education, marital status, evidence of valid driving license, road worthiness of equipment and participants' registration to national health insurance and pension schemes were asked to enable the municipality to formulate realistic plans towards their education and support. The earnings of participants were analyzed in line with their dependents to determine ways through which they can be supported to increase their turnover. Each respondent was allowed to share work-related challenges and their expectation of support from the city. Quantitative data was validated after the survey through face-to-face interviews with two operations managers of the bulk transport stations where the ISPs are mandated to dispose of their waste, using the standardized semi-structured interview guide (see supplementary material, Table S3). The responses to the survey were coded manually, entered, and analyzed by means of the statistical package for social scientists (SPSS), version 24.0. Descriptive statistics were used to explore and interpret the findings. The registration data, however, was entered into a Microsoft access database for use by the municipality.

4.3. Wasteaware Indicators—Basis for Benchmarking

The Wasteaware benchmark indicators and the immediate incubator: the 2010 UN-Habitat publication 'Solid Waste Management in the World's Cities' [18] have become a model framework that supports cities to assess the performance of their MSWM system with other cities [52]. The indicators have proved versatile and responsive to the global community's need for an all-inclusive quantitative and multi-attribute qualitative assessment tool [52,53]; and since 2010, it has been used to assess and compare the MSWM of more than 40 cities [52].

Based on the concept of integrated sustainable waste management (ISWM), the indicators evaluate a city's MSWM system on two overlapping components: the physical systems and the governance aspects. The physical systems and their 'hardware' refer to collection as a measure of public health; treatment and disposal based on transfer, processing, landfilling, and incineration as a measure of environmental protection; and resource management, referring to reduction, re-use and recycling and organic waste valorization as a measure of resource value. Operational openings for user and provider inclusivity, financial sustainability, and sound institutions and proactive policies form the backbone of the governance "software" aspects. The accompanying traffic light symbolism is an indication of the performance of the city's MSWM system in each indicator; where red, orange, and green signify low, medium and high performances respectively.

The outcome of the action research interventions and the contribution of the ISPs to collection coverage and recycling throughout the period were documented and entered into the automated Microsoft Excel sheets of the Wasteaware benchmark indicators to compute aggregate scores and assess improvements in the physical components and governance aspects of the city's MSWM system [52]. The Wasteaware indicators were chosen to benchmark the improvements in the MSWM system of Accra because of its global applicability across all income levels, broad usage and coverage, and the existence of a detailed user manual and automated Excel sheets to guide users in its application [52,53].

In the following sections, we present the interventions' outcomes and how they have affected the physical and governance aspects of the city's MSWM system. Particular emphasis is put on the cost of the services to the municipality, the system users and the ISPs. Lessons learnt are also discussed.

5. Interventions Outcomes and System Modernization

5.1. Benchmarking the Improvements in the Municipal Solid Waste Management System

The authors, with support from local authorities, implemented locally responsive interventions that focused on the inclusion of informal service providers. In the process, the number of ISPs in Accra increased from 350 in 2016 to 600 in 2018 [3]. The increase is attributable to three factors:

1. the agreement of the formal service providers to support and allow informal counterparts to work in their franchised zones;
2. the persistent inefficiencies in the formal service delivery of the city; and
3. the inability or unwillingness of the informal collectors to find alternative sources of livelihood.

Within two years of intervention implementation, the ISPs daily contribution to MSW collection increased from 385 tons [3] to 720 tons, and their overall contribution to MSW collection improved from 28% in 2016 to 47% in 2018 (Table 1). Paradoxically, the contribution of formal service providers dropped in percentage points from 55% in 2016 to 48% in 2018 (Table 1). The performance and improvement in the MSWM system of the city throughout the intervention period (2016–2018) is shown in Table 2. The quantitative physical indicators of collection, environmental protection, and resource recovery are represented by the numbers 1.1 and 1.2, 2 and 3 respectively. The number and letter combinations of 1C, 2E, and 3R are representative of the qualitative physical indicators. The combinations 4U and 4P, 5F, and (6N and 6L) represent the 'qualitative governance indicators of user and provider inclusivity, financial sustainability, and sound institutions and proactive policies respectively. The performance of the city in the indicators is represented as Low (L), Low/Medium (L/M), Medium (M), Medium/High (M/H) and High (H); depicted by the colors Red, Red/Orange, Orange, Orange/Green, and Green, respectively. Selected background and waste-related information of the city are represented by the letters B1 through B3 and W1, respectively.

At least partly due to the increased activity of the ISPs, the documented rate of collection coverage (1.1) increased from 75% to 90% (Table 2). Since 2017, the city has closed all known unofficial dumpsites and the private sector has been empowered to construct two new bulk transport facilities of a daily capacity of 1800 tons to receive MSW from the ISPs [49]. Consequently, the volume of waste captured (1.2) for controlled disposal (2) and valorization increased significantly from 2016 figures (Table 2). The quality of disposal expressed by the indicator 2E (Table 2) did not increase significantly throughout the period, but the closure of the dumpsites provides a greater opportunity to improve health in the communities where they were located. The ISPs, the informal waste pickers and recyclers, and the municipality contributed to somewhat higher recycling rates (3)—an increase from 5% in 2016 to 18% in 2018—through recovery and diversion of valuable materials from disposal to valorization. However, the quality of recycling performance (3R) remains low since a significant part of the recovered materials is not separated at source but picked from the landfill after they have been contaminated with food waste.

Despite a lack of robust participation by system users (4U) in decision-making, provider inclusivity (4P) has improved significantly as a result of efforts by the municipality and formal service providers to recognize the ISPs and bring them into the formal MSWM system (Table 2). There has also been some marginal gain in the financial sustainability indicator due to the construction of the two transfer (bulk transport) stations and attempts to recover the full cost of disposal through a declining subsidy scheme in a new franchise agreement [44]. Moreover, activity-based budgeting is slowly becoming more common, so that the total cost of MSWM will be clear in the near future. There has been improved cooperation among municipalities to build adequate disposal capacity in the region and the national government has established a new ministry dedicated to sanitation, waste management and water resources and when these are fully functioning, there should be a significant improvement in the institutional and policy indicators (6N and 6L).

Table 1. Daily collection amounts (tons) of MSW in Accra (AMA) between 2016 and 2018.

Year	FSPs (tons)	ISPs (tons)	WMD (tons)	Total (tons)
2016	718	385	68	1171
2017	682	600	70	1352
2018	734	720	81	1535
percentage increase	2%	87%	19%	31%
percentage contribution	48%	47%	5%	

Source: The authors, 2018. Legend: AMA: Accra metropolitan assembly; FSPs: Formal service providers; ISPs: Informal service providers; WMD: Waste management department.

Table 2. Wasteaware benchmark indicators of MSWM in Accra before and after intervention implementation.

No.	Category	Indicator		Results		
		City/Country Year of assessment		2016	Accra/Ghana 2017	2018
		Background information				
B1	Income level	WB income category GNI capita^{-1}		$1390	Lower middle $1490	-
B2	Population	City population Transient population		1,936,836	1,983,320 500,000	2,030,919
B3	Waste generation	MSW generation (tons year^{-1})		631,506	643,552	655,888
		Key MSW-related data				
W1	Waste capita^{-1}	MSW capita^{-1}	Kg year^{-1} Kg day^{-1}		259 0.71	
		Physical components				
1.1	Public health—waste collection	Waste collection coverage		75% (M)	81% (M)	90% (M/H)
1.2		Waste captured by the system		53% (L/M)	77% (M)	90% (M/H)
1C		Quality of waste collection		M (42%)	M (58%)	M/H (63%)
2	Environmental control—waste treatment and disposal	Controlled treatment and disposal		62% (L/M)	77% (M)	87% (M/H)
2E		Degree of environmental protection in waste treatment and disposal		M (60%)	M (60%)	M/H (65%)
3	Resource management	Recycling rate		5% (L)	10% (L/M)	18% (L/M)
3R		Quality of the 3Rs-Reduce, reuse, recycle—provision		L/M (38%)	M (42%)	M (46%)
		Governance aspects				
4U	Inclusivity	User inclusivity		L/M (33%)	L/M (38%)	M (46%)
4P		Provider inclusivity		M (50%)	M (60%)	M/H (75%)
5F	Financial sustainability	Financial sustainability		L/M 38%	M (42%)	M (50%)
6N	Sound institutions, proactive policies	Adequacy of national SWM framework		M 50%	M (50%)	M (54%)
6L		Local institutional coherence		L/M 33%	L/M (38%)	M (42%)

Source: The authors, 2018. Legend: Performance levels in physical and governance indicators and corresponding color codes: low performance (L)-red; low/medium performance (L/M)-red/orange; medium performance (M)-orange, medium/high performance (M/H)-orange/green; and high performance (H)-green. GNI: Gross national income; MSW: Municipal solid waste; WB: World Bank.

5.2. Financial Sustainability

The full cost of MSWM in Accra is not known but the available data between 2013 and 2017 suggests that the city has been spending more than 100% of previous budgets [3] for each of those years. This might be partly due to the absence of a systematic program of implementation and the lack of activity-based budgeting procedures. Having privatized MSW collection services, the municipality's financial commitment to MSWM is through subsidies in disposal and supplemental collection actions—such as liquidating illegal dumps—that serve to compensate for non-performing aspects of the formal system. Until 2016, the full cost of disposal was borne by the municipality. As part

of measures to attain financial sustainability, the working group and the municipality developed and are implementing an intervention related to the new five-year franchise agreement that serves to shift the full cost of collection and disposal to users in a declining subsidy arrangement.

The MSWM system currently uses a cross-subsidization approach to subsidize service user charges for low-income users. Currently, resident-users living in high-income neighborhoods pay their formal concessionaire US$20.00 for four-times-a-month collection of a 240-L bin of co-mingled MSW. Middle- and low-income counterparts officially pay US$12.00 and US$4.00 respectively, to their formal providers. In practice, they pay what they can through semi-formal arrangements with their formal service providers, who accept the partial payments as being fair, considering the chronic inefficiencies in the formal service delivery system [44].

Informal service providers fill in the gaps and offer reliable service, negotiable fees, and personalized services. Collection frequencies of 10 times a month among the ISPs are not uncommon, and each tricycle full of MSW (1.2 tons) collects from an average of 100 households per round trip. Two round trips per day is the practice but delays in offloading at the bulk transport stations have reduced it to one round trip—this, of course, affects their turnover. On average, collectors realize US$35.00 with a full tricycle of MSW, with a daily turnover of US$15.00. The rest constitutes daily expenses on disposal charges, fuel, maintenance and depreciation. Service users pay, on average, US$4.00 for a 240-L bin of MSW collected by the ISPs. The 600 ISPs through their contribution are improving upon the living standards of 3000 dependents and are saving the city US$3,120,000.00 in annual collection and disposal cost.

6. Lessons Learnt and New Interventions for System Sustainability

After more than three decades of MSW challenges, and nearly 20 years of interventions through formal private sector participation, the research team was facing a poorly performing system at the beginning of their intervention. Collection coverage along formal service provision was dropping, and had declined from 60% in 2011 to 55% in 2016, a rate lower than the 88% average for Wasteaware benchmarking of lower-middle income cities [3,54]. The city was facing inadequate public and environmental health and perennial outbreaks of cholera and flooding [55]. A participatory benchmarking exercise in 2016—using the Wasteaware benchmark indicators—was seen as an initial step to establish a baseline and analyze system performance [3]. Instead, it turned out to be an engine of positive change, confirming the observation that the peculiar dynamics of the MSWM system in cities of developing countries call for a different approach towards modernization. Training and assistance that support municipal staff to map their own MSWM challenges and elaborate ideas towards responsive and affordable solutions works better than having consultants make decisions in a politico-social vacuum [6,56]. In place of complex technologies promising quick fixes, which have proved to be unsustainable [6,7], an innovative collaboration between academia and municipal authorities has shown itself to be a working and effective tool for change: the authors in collaboration with system stakeholders have taken only three years to shift the thinking of municipal staff and decision-makers from technology- and capital-intensive models of MSWM modernization to identify what works for the city.

A basic lesson of this article is that participatory research appraisal (PRA) of the MSWM systems of cities in developing and emerging economies, conducted in accordance with the ISWM concept and in collaboration with research institutions and or academia, has the potential to stimulate locally appropriate interventions that succeed in modernizing the system. The primary goal advanced by ISWM is that there are no fixed solutions to MSWM, but modernization has to be developed and tailored to local needs and conditions to preserve what is working and improve what is failing after a critical assessment of the physical and governance aspects of the system [17].

Accra's commitment to embrace such collaborative efforts at almost no cost to the city has led to the systematic improvement in the physical and governance indicators since they were first measured in 2016 (Table 2). The collaborative research team has enjoyed support from different political regimes

and is continuously working to develop new interventions to address and improve the MSWM system. The working group has drawn action plans to integrate the ISPs into the formal system, with the aim to regulate their activities and also reduce urban poverty. The focus also is to seek support for them to increase collection coverage and recycling rates further.

Despite the significance of PRA as a sustainable methodology, most emerging economies fail to involve all relevant stakeholders during the planning of MSWM systems [57], creating major gaps in ownership and the implementation of plans and interventions [58]. Accra adopted PRA methods to bring together relevant stakeholders as working groups to assess and plan interventions together. The system opened itself to transparency and accountability, which has provided opportunities for trust, understanding and cooperation among stakeholders. A positive outcome which has set a chain reaction for the integration of the ISPs and the improvement of the physical systems of the city's MSWM system has been the unusual agreement in 2016 in which formal service providers engaged their informal counterparts to further support them with loan schemes through high purchase of motorized tricycles to increase collection coverage and turnover [44]. In addition, the participatory process has contributed significantly to the generation of reliable data for future planning purposes. Currently, the authors, the municipality and service users are leading the process of forming the city's first ever stakeholder platform in MSWM to develop modalities to sustain the integration of the informal sector into the formal system.

The collaboration has also yielded positive but marginal improvement in the governance aspects of the city's MSWM system. Working groups have kept faith to support and improve the system through continuous and participatory development of locally appropriate interventions. The city has shown further commitment to the process by implementing the outcome and recommendations of the process.

In Accra, the resource recovery rate is driven solely by the informal sector and has been poor [3] compared to other emerging economies [17,54]. Subsidy schemes, especially those related to landfilling, indirectly contribute to low scores in two-ways: first, they prevent service providers from leading the initiative of diversion of recyclables from disposal and separation of waste at source, measures that would eventually lead to higher valorization amounts. Secondly, full cost accounting of MSWM is not achieved, coupled with the fact that the municipality is unable to sustain such subsidies. We have developed a declining subsidy scheme since 2016 to shift the full cost of collection, transportation and disposal to system users as a sustainable measure to eventually suspend subsidies and promote full-cost recovery in the city's MSWM system.

A bigger challenge in policy formulation, regulation and monitoring for MSWM in Accra has been the overlap of responsibilities among ministries and departments, a practice which has created huge gaps in policy implementation and enforcement. Fortunately, the political commitment in the establishment of the new ministry of Sanitation and Water Resources in 2017 and the engagement of stakeholders in planning and implementation of interventions are targeted at addressing such issues. Although yet to be experimented, we recommend the movement of the ministry towards the establishment of democratic MSWM departments towards good governance.

7. Conclusions

In Accra, Ghana, there has been significant improvement in the physical and governance indicators of MSWM after researchers and municipal staff deliberately developed interventions to involve informal waste collectors in service delivery. Within two years of engaging the informal service providers (ISPs), collection coverage increased by 20%, waste capture by 70%, recycling rates by 260%, and the municipality is making substantial savings in annual collection and dumping cost. The apparent improvement underscores the importance of collaboration, cooperation and commitment among researchers, politicians and local authorities in identifying what works for lower-income cities of the world, especially in Sub-Saharan Africa. In addition to developing and implementing new and locally appropriate interventions towards system improvement, the collaboration has led to capacity

building of municipal staff in MSWM assessment, intervention development, advocacy, and monitoring and evaluation. The process has established the potential of the informal waste sector to fill the gaps created by their formal counterparts in service delivery. The process has provided the opportunity for the generation of new and relevant data for future planning purposes. Even before their integration into the formal system, the increase in the number of ISPs throughout the intervention period serves a significant contribution to urban poverty reduction. The working group is still developing policy initiatives to improve further the governance indicators of financial sustainability and sound policies and proactive institutions. Although progress on the two governance indicators has been slow and expected, the authors are optimistic to see systematic improvements because of the continuous support and commitment of local and national authorities towards the process. The ministry, the municipality and the researchers need to intensify efforts geared to developing action plans to formally recognize, regulate and support the ISPs in the formal MSWM system of the city. It is essential for cities with similar peculiarities and dynamics to Accra to find a practical guide to modernizing their own systems.

Supplementary Materials: The following are available online at http://www.mdpi.com/2079-9276/8/1/12/s1, Table S1: The survey questionnaire used to assess the socio-economic contribution of the informal service providers in Accra; Table S2: The questionnaire used to register the informal service providers in Accra; Table S3: The semi-structured interview guide used to collect data from the facility (bulk transport stations) operations managers to validate data from the survey.

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