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Social Life-Cycle Assessment of Household Waste Management System in Kabul City

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Abstract: The present study constitutes the first social life cycle assessment (SLCA) study in Afghanistan and aims at assessing the social performance of the waste management system (WMS) of Kabul city. The system boundary considered includes households generating the waste, the sanitation department of Kabul city, scavengers, recycling shops, the recycling factory, and the local community living in its vicinity. Compared to previous SLCA studies that consider one stakeholder per organization, we distinguished between the manager and the worker level for each organization. In total, eight stakeholders, 90 inventory indicators, and 20 impact subcategories were investigated. Results show three main social issues: the overwork of scavengers, recycling shop owners and recycling factories' workers and managers, the absence of communication and implication of the local community, and the poor cleanliness of the surroundings of the recycling factory and collection points. At the sanitation department, managers were found facing more psychological stress and overwork than workers, demonstrating the current isolation of the department inside Kabul's local government. It seems nonetheless possible to improve Kabul's WMS by redesigning the location of garbage bins and conducting communication campaigns towards consumers and the local community. That would help to minimize the nuisances associated with the handling of waste and to integrate better waste management activities into the socio-economy of Kabul city.

Keywords: Kabul city; social life cycle assessment (S-LCA); social sustainability; UNEP/SETACT guidelines; waste management

1. Introduction

Low management of urban wastes can lead to the contamination of surface water, groundwater, soil, and the atmosphere. Ma et al. showed for example that infrastructure restructuring of open dumps could reduce the CO_2 emission of the municipal solid waste (MSW) by one third [1], whereas Di nardo et al. emphasized the issue of odor emissions in solid waste landfill [2]. The issue of urban wastes and the importance of waste solid waste management (SWM) is particularly important in economically developing countries marked by the rapid urbanization process. Further, though allocating 20%–80% of municipal revenues to SWM [3], open dumping and open burning remain a widespread activity in economically developing countries and collection rates are as low as 30%–60% of total generated waste. In Kabul, the capital city of Afghanistan, a low-income country, only 25% of waste is currently collected [4]. The poor performance of Kabul's waste management system (WMS) can be attributed to the current focus of local government on economic aspects and to a lesser extent environmental aspects to the detriment of a social approach of WMS. Finnveden et al. [5] emphasized the importance of considering social issues for holistic waste management policies because it can help to design practical and achievable policies. WMS has indeed the characteristic that consumers are also the waste generators, meaning that policies targeting waste reduction, waste separation, and proper handling of waste are

difficult to enforce if one disregards the social dimension [5]. Similarly, Salvia et al. [6] demonstrated stakeholder engagement and behavior-changing targeted measures as critical elements of successful urban planning and resource efficiency policies. Li et al. [7] evaluated composting, waste-to-energy, and material recovery technologies in the context of Chinese WMS considering environmental effectiveness, economic productivity, and social health safety, and concluded that simultaneous environmental, economic and social approaches are necessary for building sustainable WMS.

Social life cycle assessment (S-LCA) is a recent research field aiming at capturing the social aspects of products of the organization comprehensively along their life cycle. Many studies have specifically examined methodological aspects of S-LCA [8–11], but no general consensus exists on the data collection process, the selection of social indicators, or the characterization model to aggregate the inventory indicators into social impacts [12]. These methodological shortcomings have led to less practical studies than those using other more established methods of life cycle costing (LCC) and environmental life cycle assessment (E-LCA). More than 35% of economic/environmental evaluation studies have been conducted via LCC and E-LCA vs. 17% for the evaluation of social aspects through S-LCA [13]. An important milestone in the S-CA literature was the publication of the UNEP/SETAC guidelines which, although incomplete, constitute a basic framework for S-LCA.

The present study assesses social impacts of the existing WMS in Kabul based on the S-LCA technique. The case of Kabul is particularly relevant to address the situation of WMS in low-income countries. First, the city is marked by an increase in its population from 1.5 million inhabitants in 2001 to 4.9 million inhabitants in 2015 [14] leading to an increase in the amount of wastes generated. Second, the current collection rate is very low and open dumps are responsible for contamination of the air and water. According to Rahimi [15], there have been 3000 deaths a year as a consequence of pollution in Kabul, of which the poor waste management system appears the main driver. Third, the municipality of Kabul has little knowledge on the structure of the waste management system focusing only on waste collection, waste transportation, and landfill management. Local government misses an integrated approach of waste management and a clear knowledge of the situation of all formal and informal actors involved in the Kabul's waste management system. In this context, the systemic approach of S-LCA appears particularly relevant to identify the social hotspots along with the waste flow management from waste generation at households to landfill or recycling facilities. Compared to earlier S-LCA studies reported in the literature, the number of stakeholders considered is enhanced in consideration of all formal and informal actors of WMS. Distinctions between worker and manager levels are also implemented and new S-LCA indicators and subcategories specific to the context of Kabul and WMS are developed.

2. Materials and Methods

A case study methodology was followed according to UNEP/SETAC guidelines 2009. This study consists of the following stages: 1—goal and scope definition, 2—inventory analysis, 3—impact assessment, and 4—interpretation [16].

2.1. Goal and Scope Definition

The goal of the study is to assess and compare the social impacts of involved stakeholders for the existing WMS in Kabul city. The scope comprises waste collection, separation, recycling, and landfilling processes (Figure 1).

In S-LCA, the researchers have mainly framed their goal based on two approaches: process-based and company (organization) conduct [17]. Schmidt et al. [18] and Muthu [19] highlighted analyses of social impacts according to unit processes, which is similar to environmental life cycle assessment (E-LCA), whereas UNEP [16] and Dreyer et al. [19] laid emphasis on the consideration of the conduct of companies, organizations, and actors in the studied system. Many scholars have adopted the latter approach [19,20], except for some direct occupational health related impacts, because social impacts (e.g., child labor) are mostly independent of physical input or output of the processes [21–23]. The company (organization) conduct approach was adopted for the present study.

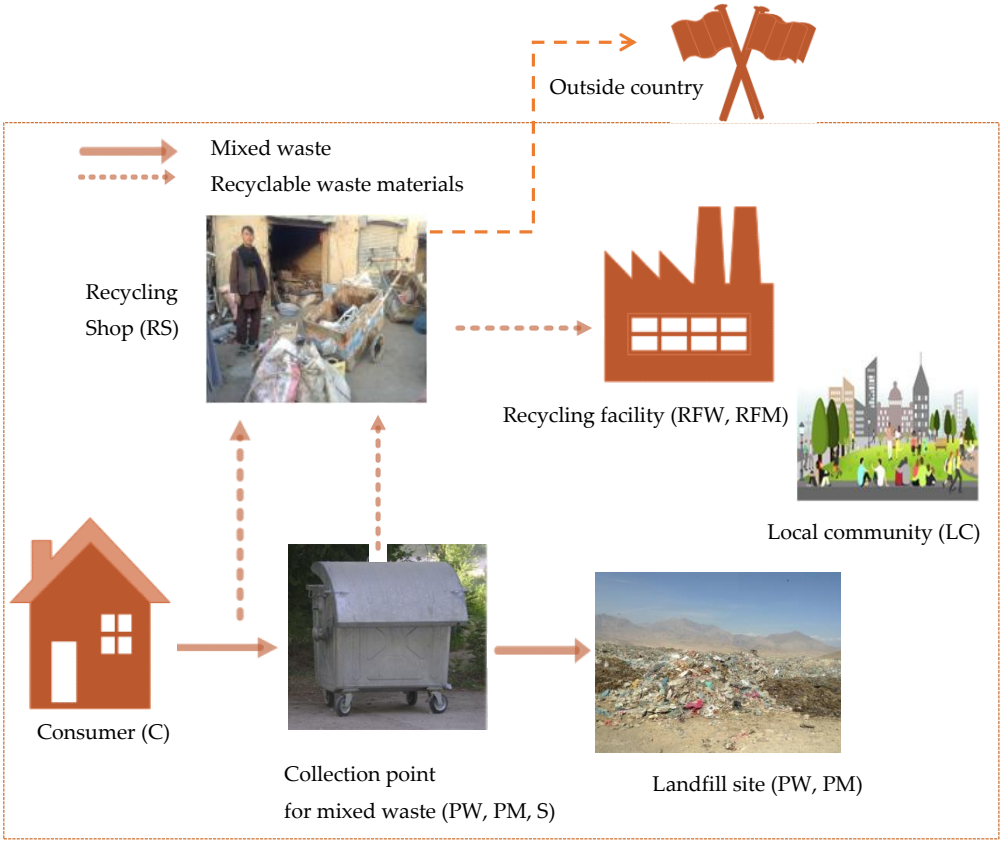


Figure 1. System boundary. C, consumer; PM, public managers; PW, public workers; S, scavengers; RS, recycling shops; RFM, recycling facility managers; RFW, recycling facility workers; LC, local community.

To date, UNEP guidelines include a list of 31 impact subcategories classified based on five stakeholder groups (workers, consumers, local community, society and valued chain actors), which is not comprehensive or complete and which requires the development of additional categories [17].

The present study examines the eight stakeholders presented in Table 1. Stakeholders are considered not only to cover both informal and formal workers of WMS, but also to differentiate between worker and manager levels.

Table 1. Targeted stakeholders with associated numbers of people surveyed.

Stakeholder Groups	Description	Surveyed
Consumers (C)	People receiving waste management services (WMS)	302
Public managers (PM)	Individuals working at managerial levels in public solid waste management departments	10
Public workers (PW)	Individuals working at operational levels in public solid waste management departments	30
Scavengers (S)	Informal workers collecting recyclable materials from households and/or collection points	30
Recycling shops (RS)	Individuals receiving recyclable materials from scavengers and selling them to recycling facilities	20
Recycling facility managers (RFM)	Individuals working at managerial levels in recycling facilities	10
Recycling facility workers (RFW)	Individuals working at operational levels in recycling facilities	10
Local community (LC)	People living near recycling facilities	40

The identification of impact categories and inventory indicators was done by following the four steps presented in Figure 2. First, an extensive literature review of international, national sustainability reports, and norms was conducted to identify the social aspects and issues of WMS in economically developing countries with an emphasis on Afghanistan. In the second step, studies using S-LCA methodology were reviewed and classified according to the UNEP/SETAC guidelines to assess the compatibility of social aspects identified in step 1 with S-LCA study [12]. In total, Table A1, 55 documents were considered, of which 48 could be classified within the UNEP/SETAC framework (see Appendix A). Among these documents, 5 were related to UNEP guidelines, 14 to other S-LCA guidelines, 10 to waste management case studies, and 19 to case studies related to other economic sectors. As many as 27 documents reported the use of at least one impact subcategory not present in UNEP/SETAC guidelines such as job satisfaction. In the third step, the list of impact subcategories established in step 2 was presented to an expert and official and the WMS stakeholders of Kabul city interviewed during a field trip. Finally, a short list of inventory and impact subcategory was established considering data availability and reliability. In conclusion, 20 subcategories and 90 inventory indicators were identified to assess the social impacts of waste management for involved stakeholders. Table 2 shows the 20 impact subcategories and related indicators for each of the eight stakeholders. Details of inventory indicators are presented (see Appendix B).

Table 2. Number of indicators per stakeholder and impact subcategories.

			Number of Indicators Per Stakeholder							
Impact Subcategories	**Source**	**TOT**	**C**	**PM**	**PW**	**S**	**RS**	**RFM**	**RFW**	**LC**
Community engagement	UNEP	2								2
Feedback mechanism	UNEP	8	4							4
Local employment	UNEP	1								1
Education/training	Own	6	1	3	2	3	4	3	2	1
Waste management planning	Own	4	2							2
Waste management quality	Own	15	7							8
Health and safety	UNEP	24	6	12	12	12	12	12	12	6
child labor	UNEP	3		3	3	3	3	3	3	
Equal opportunities/discrimination	UNEP	3		3	3	3	3	3	3	
Fair income	UNEP	3		3	3	3	3	3	3	
Working hours	UNEP	2		2	2	2	2	2	2	
Physical working conditions	Own	2		2	2	2	2	2	2	
Psychological working conditions	Own	2		2	2	2	1	1	1	
Job satisfaction	Own	1		1	1	1	1	1	1	
Job security	Own	1		1	1	1	1	1	1	
contribution to economic development	UNEP	2		2			2	2		
Job creation	Own	2			2	2			2	
Technology development	UNEP	3		3				3		
end of life responsibility	UNEP	2		2			2	2		
stakeholder relationships	Own	4		2		2	3	3		
		90	20	41	33	36	39	41	32	24

C, consumer; PM, public managers; PW, public workers; S, scavengers; RS, recycling shops; RFM, recycling facility managers; RFW, recycling facility workers; LC, local community.

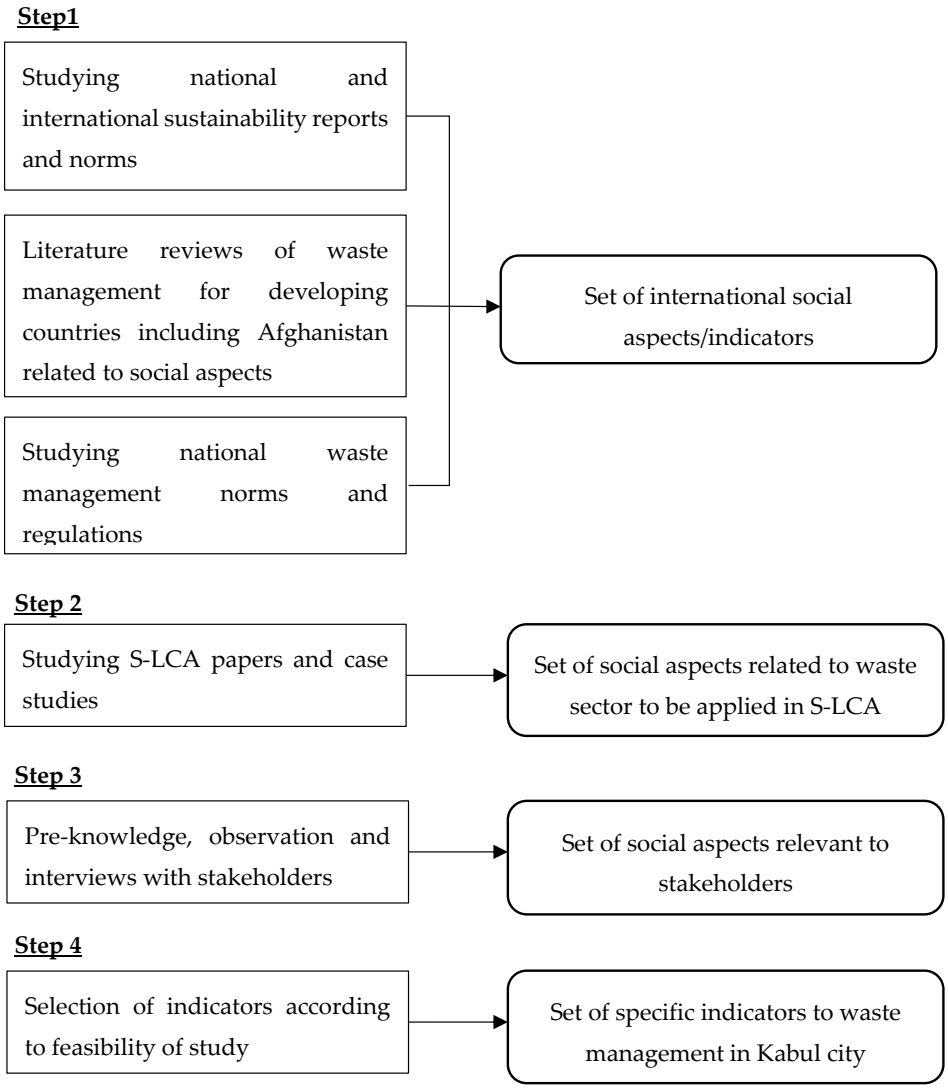


Figure 2. Steps for the selection of specific social subcategories and inventory indicators (adapted from Siebert et al. [24]).

2.2. Study Sample Size

Kabul city has 22 districts and is very diverse in terms of ethnic groups and safety issues. Therefore, the overall population is not known exactly, and figures vary from 3,543,700 inhabitants [25] to 6,000,000 Inhabitants [26]. The Sanitation department of Kabul is situated in the 4th district of Kabul, one of the safest districts and the most populated one as it represents 15% of the total population [4]. For security and practical reasons (see Section 2.3), the analysis was restricted to this district. In this district, the number of recycling shops is estimated to 25–30 and the number of scavengers to 1000. Thus, the sample size can be estimated to 67%–80% for the recycling shop and 3% for scavengers. The number of recycling facilities is not known exactly but is less than recycling shops meaning sample size may represent as much as 50% of the total. The number of workers (technicians, drivers) and administrative staff (managers, officers, cleaners) in the sanitation department are 3625 and 127, respectively. These individuals working on three main sections: sewerage, solid waste, and cleanliness of the city, and we do not have the exact data related to the staff working both as workers and managers in solid waste management. So, it might be difficult to derive a percentage out of that. In addition, the population in the 4th district is estimated to 330,115, according to the central static office (CSO) of Afghanistan, and the sample size is 0.09%. For the local community, we have 60,000 inhabitants and sample size constitutes 0.06%.

2.3. Inventory Data Collection

As there were few reports, publications, statistical data, or company records available for assessing Afghanistan and Kabul's WMS, basically, the inventory data collection process was administered through face-to-face interviews with stakeholders along with field observations in order to crosscheck the reliability and consistency of information. This process was, in fact, the most challenging and time-demanding in terms of validity, reliability, accessibility, and relevance. The presence of violence, crimes and conflict zones between government and terrorist groups as well as ethnicity and language barriers were the critical issues to reach the target plan. Besides, low education, illiteracy and lack of awareness of interviewees, especially scavengers, public, and recycling facility workers, and lengthy questionnaire as some of them complained about—these might have resulted in some inconsistent responses although I made every effort to restrict it—could be mentioned as obstacles. Along with that, the unwillingness of stakeholders because of lack of trust and the benefits of the research for themselves; cultural problems, for instance, it would be unsecure to conduct interviews with women while they are available than men, particularly during the weekdays; gain access to the area; difficulty reaching officials from recycling facilities and government, and finally geographical constraints, such as traveling long distances to access participants, added further challenges to the process.

For the analysis of the study, we conducted a survey questionnaire on 452 respondents from eight stakeholder groups, as shown in Table 1. The questionnaire consisted of 76 five-scale Likert type questions, 11 yes/no questions, and 3 open-ended questions. Likert scale questions were employed to assess subjective data (i.e., personal feelings or satisfaction levels), although yes/no and open-ended questions were used to collect objective data. Most data collected were either qualitative or semi-quantitative (see Appendix B. Indeed, Papong et al. [27] demonstrated the difficulty of using quantitative data in S-LCA and showed that almost all social impacts determined in S-LCA case studies were assessed in terms of qualitative and/or semi-quantitative data.

2.4. Impact Assessment

Impact assessment is made in two steps. First, answers to the indicator survey are converted into inventory scores through a characterization method. Second, the inventory scores are aggregated into impact scores considering the purposes and importance of the respective questions. Characterization is based on a scoring system supporting the comparison of individuals' answers to the indicator survey [16]. Performance reference points (PRPs) such as international and national accepted standards or best practices are used to define a scale from worst to best social condition or practice. The scoring systems used in the literature are very diverse, showing the current lack of consensus on characterization methodology. Spillemaeckers et al. [28] applied a binary scale (0 or 1) to assess the fulfillment of social indicators, whereas Umair et al. [29] characterized data are either negative (−) or positive (+). Blom and Solmar [30] used a 1, 0, −1 scale, where −1 represents a positive social impact and 0 denotes the absence of social issues or data. The same scoring system was employed by Wan [31] with −1 referring to negative social effect instead. Hsu et al. [32] suggested the characterization of the quantitative and qualitative indicators differently. Company data over PRP ratio were used for quantitative data to classify company performance on a nine-scale interval (1, 1.5, . . . , 5) whereas efforts made by a company on social performance (qualitative indicator) was characterized either as non-implemented (0), partially (0.5), or completely (1) implemented. Ciroth and Franze [33] proposed a six-scale scoring system classifying company social performance from very poor performance to very good performance. However, as presented by Foolmaun et al. [17]. Ciroth and Franze's scoring system is based on expert judgment, which might be difficult to assess. Foolmaun et al. [17] proposed instead a logical scoring system based on the conversion of indicator results into percentages (e.g., % of workers satisfied with their job) and calculated percentages into five score categories: 0%–20% (1), 20%–40% (2), 40%–60% (3), 60%–80% (4), and 80%–100% (5).

The scoring system used in the present study is a five-scale system. For the 5-scale Likert-type questions, 1 was assigned to the lowest social performance and 5 to the highest one. For yes/no

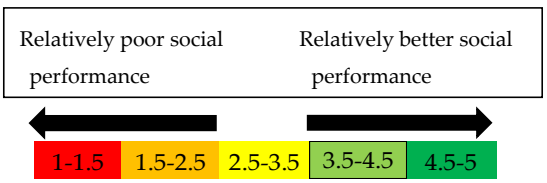
questions, the methodology developed by Foolmaun et al. [17] was used. Finally, for open questions, percentages for each surveyed individual were first calculated by dividing the answers by the highest answer value given by all stakeholders. Then, the five score categories developed by Foolmaun et al. [17] were used. For example, the highest number of baths taken per month by stakeholders was reported as once a day or 30 times a month. Therefore, individuals taking a bath once a week or four times a month were assigned a score of 2 because 4/30 = 13% belongs to interval 0%–20%. All indicators were considered with the same weight. Aggregation of scores from inventory to impact subcategories was done by taking the average score for each stakeholder group.

3. Results and Discussion

Table 3 presents the impact subcategory scores for each stakeholder. The color is used to characterize social performance: very poor [red] (1–1.5), poor [orange] (1.5–2.5), fair [yellow] (2.5–3.5), good [light green] (3.5–4.5), and very good [green] (4.5–5). Each impact subcategory result is discussed hereinafter.

Table 3. Impact subcategory scores for stakeholders.

		C	PM	PW	S	RS	RFM	RFW	LC
Consumers and local community	Community engagement								1.00
	Feedback mechanism	2.31							1.12
	Local employment								1.00
	Education/training	1.74							1.00
	Waste management planning	3.08							2.03
	Waste management quality	2.39							2.63
	Health and safety	2.95							1.68
Workers	child labor		5.00	5.00	1.91	1.53	5.00	4.57	
	Equal opportunities/discrimination		3.40	3.78	3.50	2.83	3.67	3.67	
	Fair income		5.00	5.00	3.44	3.60	5.00	5.00	
	Education/training		3.27	3.00	2.13	2.55	3.73	5.00	
	Health and safety		2.57	2.40	2.18	2.34	3.17	2.29	
	Working hours		1.80	3.23	1.05	1.00	1.00	1.00	
	Physical working conditions		3.26		2.52	3.40	3.75		
	Psychological working conditions		2.10	2.72	2.63	2.90	2.80	2.70	
	Job satisfaction		3.10	3.87	2.40	3.90	4.60	2.80	
	Job security		3.60	4.77	4.30	3.70	3.80	2.80	
System approach of WMS	contribution to economic development		2.20			4.10	1.55		
	Job creation			1.50	3.30			1.90	
	Technology development		1.80				3.93		
	end of life responsibility		2.60			1.40	1.50		
	stakeholder relationships		1.45		1.33	1.67	2.13		



3.1. Situation of Consumers and Local Community

3.1.1. Community Engagement, Feedback Mechanism, Local Employment, Education, and Training

Community engagement is non-existent. The interviewees indeed reported no Corporate Social Responsibility (CSR) fund or direct investment made by the local community. The recycling facility does not hire local people, does not provide any feedback about their activities to local community or any environmental awareness campaign. Relations with the local government are not better: 100% of the surveyed people of the local community stated their lack of satisfaction with the way government handles their complaints, although 20% reported that local government sometimes listens to their concerns about waste management. By contrast, 55% of consumers reported that

government listens at least sometimes to their concerns, while 53% reported their satisfaction with the way government handles them afterwards. Also, 49% agreed that local government groups are affected by a feedback mechanism. However, 81% reported that their opinions are not considered at all for waste management planning. Finally, 20% of consumers reported receiving information from government about waste handling.

3.1.2. Waste Management Planning and Quality

Waste management planning relates to waste collection schedule and the location of garbage bins for consumers and working schedules and locations of recycling factories for the local community. In fact, 85% of consumers are satisfied with the waste collection schedule, but only 50% are satisfied about the locations of garbage bins. The situation is worse for the local community, with only 48% agreeing with the working schedules of the recycling factory and 25% with its location. Interviews revealed that consumers mainly complained about the access distance to garbage bins from their home as they feel entitled to a maximum distance of 250 m. Local community people complained about the proximity of recycling facilities and long evening working hours that disturb their tranquility. This is to be related to waste management quality, which is related to the cleanliness of the waste management services and its associated disturbances. Of consumers, 59% report overflowing of waste containers, probably because consumers overload the nearest bins. The issue of dustbin location leads also to littering of waste, which is reported by 81% of consumers. Consequences are the presence of flies and mosquitoes (67%), of animals gathering around collection points (85%), and of unpleasant smells (93%). As a result, 54% of consumers have a poor image of the monitoring system of waste management by local government. Regarding recycling factories, the main complaint of the local community is not related to vehicle traffic and associated noise pollution. In fact, only 35% reported frequent traffic; 28% reported frequent sound pollution, but many criticized the cleanliness of the recycling factory: animal gathering (73%), littering of waste (85%), fly breeding (65%), and unpleasant smells (80%). As a result, 100% of the local community members characterized the recycling factory monitoring system as poor. They expressed a desire to move away. Observed migration trends remain low nonetheless because of local community poverty, which prevents them from moving away.

3.1.3. Health and Safety

The poor quality of WMS imposes burdens on the health of consumers and local community members. In fact, 87% of consumers and 80% of the local community members reported health problems attributable to WMS. Furthermore, 58% of consumers and 38% of the local community members reported accidents attributable to WMS. Also, 71% of consumers and 100% of the local community members considered that local government and the recycling factory do not assess or even monitor health and safety risks. Of consumers, 74% judged that no health and safety risk management system exists from the government, with 60% characterizing as poor the awareness programs of local officials. Of reporting consumers, 58% nonetheless considered positively the health and safety improvement actions taken by local government. All local community members considered the health and risk management system at the recycling factory as non-existent, with no awareness programs or actions taken to improve community health and safety.

3.2. Situation of Workers

3.2.1. Child Labor

Three indicators were used for characterizing child labor: percentage of child labor, existence of child labor policies, and existence of proof of age record upon employment recruitment. Indeed, garbage collection is categorized as "hazardous work"; the minimum legal work age is set as 18 years old by articles 13 and 120 of the Afghanistan's Labor Laws [34] and by article 182 of International Labor Organization (ILO) [35]. Child labor is not an issue for government workers or managers. Similarly,

child labor is not an issue for recycling workers and managers. However, 30% of surveyed recycling workers reported child labor as high as 60%–80%, explaining the lower score for recycling workers. Child labor is an issue for scavengers and recycling shops. 53% of scavengers reported 20–40% child labor, whereas as many as 40% of recycling shops reported 60%–80% child labor. All scavengers and all recycling shops recognized the absence of child labor policy and proof of age. Reasons for this situation are two: (1) scavengers are marginalized groups living outside Kabul city and the work of children is a necessary income for their family, and (2) recycling shops are family businesses, meaning that the working children are family members of the recycling shop owner.

3.2.2. Equal Opportunity, Discrimination, and Fair Income

Different ethnic groups and social status exist in Afghanistan. Equal treatment of different members of society is an important social performance measure. Results indicated that staff members are diverse for all stakeholders, except for recycling shops, which mainly recruit among family members. A difference in perception of staff diversity was found for government workers: 100% of public workers acknowledge the existence of staff diversity against 60% for public managers, explaining the lower score of the latter. No discrimination was reported related to equal pay for the same work. However, all stakeholders pointed out the absence of efforts from the government to change the bad reputation associated with waste handling jobs regarded as "dirty jobs" by the remainder of the population. Income reported by stakeholders was all following the legal framework, except scavengers. Income was also regular except for recycling shops because it varies with the sales of recycling materials. No non-agreed income deduction was reported by stakeholders. Results show that social performance associated with discrimination and fair income effect was observed as fair to very good (see Table 3).

3.2.3. Education, Training, Health and Safety

Because of their status, informal workers might be abused by recycling companies. Training from the local government to avoid such abuse is nonetheless absent, as reported by 100% of scavengers and recycling shops. Scavengers, recycling facility workers, and managers reported good social performance related to the existence of human-capacity building programs. 60% of public managers stated the existence of such programs: a statement denied by 100% of public workers. Regarding child attendance at school, results obtained for the child labor impact subcategory were confirmed. 90% of scavengers' children and 20% of recycling shop owners' children do not attend school, although 100% of formal workers' children do. As a reflection of the poor performance of the impact categories described in Section 3.2.1, recycling factory managers and public managers estimated as 14% the percentage of people with knowledge related to their activities against 50% for recycling shop owners. Contrary to recycling factory managers and workers, public managers and workers reported no training program related to health and safety. Scavengers considered that they had received a health and safety training program, although recycling shops stated that no training program exists. That would suggest that scavengers exchange knowledge among themselves and train newcomers. Regarding health and safety, recycling facility workers were those associating most of their health problems with the handling of waste (90%), followed by scavengers (47%), public workers (37%), recycling shops (30%), and recycling factory and public managers (20%). Scavengers were those reporting the highest occurrence of accidents (70%), whereas recycling shops reported the lowest (20%). Workers reported accidents more often than managers in recycling factories, but managers reported more severe accidents. The opposite was observed for public managers and workers, which suggests that managers in recycling factories are only concerned about severe accidents that would impede their activities, whereas public managers care more about accidents related to accidents in daily operations. Despite many reported accidents, no investigation to identify the cause of accidents was made by stakeholders. Overall, preventive and curative measures were characterized as poor: reported were absence of health risk assessment of chemicals used, absence of protective clothing except for public workers, absence of regular medical checkups, absence of vaccination programs, and absence of medical equipment for

first aid. This situation is worsened by the hygiene practices of stakeholders, except for public and recycling factory managers; workers took baths fewer than two times each week. Contrary to informal workers (S, RS), formal workers (PW, PM, RFW, RFM) are nonetheless able to obtain sick leave when ill.

3.2.4. Working Hours and Physical and Psychological Working Conditions

Working hours constitute an important issue for scavengers, recycling shops, and recycling factory workers and managers. Indeed, with 12 h per day, their number of working hours greatly exceeded the legal working time of 8 h per day (40 h/week). They also often work on weekends when public workers only work sometimes on weekends and always within legal working times. However, public workers complain most about the physical pain associated with the collection of waste despite access to appropriate equipment. Lack of appropriate equipment was indeed mainly reported by scavengers and recycling factory workers. It is particularly interesting that managers at recycling factories considered more positively the access to appropriate equipment than recycling factory workers, whereas public managers complain more than public workers about the lack of appropriate equipment. Public managers are indeed asking for better equipment to the municipality, but without success to date. This refusal of their requests engenders psychological stress because they feel that their superiors do not deal adequately with their complaints. In addition, public managers must manage relations with local residents, which can exacerbate their stress, explaining their low scores assigned to the "psychological working conditions" impact category. However, regarding the three impact categories, scavengers scored the lowest, followed by recycling facility workers, although circumstances were much better for public workers. Public managers were indeed found doing their best in protecting their workers from stress and overwork when recycling manager workers were found to be somewhat insensitive to complaints from recycling factory workers.

3.2.5. Job Satisfaction and Security

Stakeholders unsatisfied about their jobs are scavengers, recycling factory workers, and public managers. Those satisfied with their jobs are public workers, recycling shops, and recycling factory managers. This result confirms the findings described in Section 3.2.4 that public managers consider their workers better than recycling factory managers. Job security is not an important issue for stakeholders, except for recycling factory workers. No other people than scavengers are indeed willing to do their jobs. Recycling shop owners hire their own family. Public workers and managers are secured in their jobs as government workers.

3.3. System Approach of WMS

3.3.1. Job Creation, Contribution to Economic Development, and Technological Development

The job creation score combined information related to the number of jobs per kilogram of waste and related to the recruitment rate. No recruitment was reported by public workers, recycling factory workers, and most scavengers. Only eight public workers were necessary to collect 1 ton against on average of 77 scavengers. Also, 20 recycling factory workers, on average, were necessary to treat 1 ton of waste. These figures demonstrate that the higher efficiency of public workers and recycling factory workers come at the cost of a fewer number of people employed. Furthermore, scavengers are local human resources, partly explaining the high contribution to the economic development of recycling shop owners. Recycling shops are indeed rooted in the local economy because professional tools and vehicles which are used are produced within the country. The volumes treated in recycling factories and by the government are important; machinery produced in foreign countries is used, lowering their contribution to the economic development of Afghanistan. However, the advent of imported machinery also comes with new knowledge and skill transfer about new technologies, explaining the high score of recycling factories for technological development. Recycling factories nonetheless do not

develop their research, in contrast to the government, which develops its research but does not invest in technologies or its transfer, notably because of budget constraints.

3.3.2. End of Life Responsibility and Stakeholder Relations

End of life responsibility relates to the contribution of waste management to the reduce, reuse and recycle (3R) policy, notably through extended producer responsibility (EPR). Recycling shop owners and recycling factory managers reported no EPR policy and estimated as poor the contribution of existing WMS to 3R policy. Public managers had a better opinion on the current WMS contribution, probably because of their direct link with consumers and local government officials. Relations of stakeholders were characterized by scavengers as very poor and public managers and as poor by recycling shop owners and recycling factory managers. These results indicate a fragmented WMS with existing tension among stakeholders. Scavengers complained about the lack of cooperation of local authorities and reported being harassed by local officials to prevent them from scavenging by, for example, impounding their vehicles. Public managers accused scavengers of criminal actions and of spreading waste on the streets. Recycling shop owners claimed they needed to pay local officials to run their businesses, but this claim was denied by local officials. Recycling factory managers complained about the insufficient electricity supply from the government, the absence of tax reduction, and the fact that governments do not buy their products or provide them access to recyclable materials. Public managers did not refuse to cooperate with recycling factories, but they did insist on finding concrete solutions.

3.4. Recommendations to Improve Kabul's WMS

3.4.1. Improvements at the Operational Level

SLCA results indicated poor performance of the Kabul city waste management system. It seems nonetheless possible to improve the current system by making slight changes at the operational level. For example, redesigning the location of garbage bins to a maximum of 250 m from consumers' houses will not only improve the perception of consumers about the quality of waste collection management but also prevent overloading of nearby garbage bins and littering that engender health and safety issues. In Lahore, Pakistan, though adequate numbers of waste bin prevail in the city, due to inappropriate locations assigned for them, people only discharge into the nearest ones, even they do not have space for further waste [36]. However, in some other cities of Pakistan—Rawalpindi, there is the problem of being enough waste containers [37]. Efforts should be undertaken by recycling managers to ensure cleanliness around recycling factories and diminish the night working hours because it strongly bothers the local community. Results also emphasized that, for those handling the waste, protective clothing should be the norm for all of them and medical first aid should be available, at least at recycling factories and the public waste management department, because there have been discovered high potential risks of accidents and injuries during the operations. In Rawalpindi, due to lack of working equipment and facilities, individuals working in waste management have been suffering from various health and safety problems, something similar in Kabul [38].

3.4.2. Improvements at the System Level

A greatly improved WMS will nonetheless depend on the restructuring of the relations among stakeholders and the creation of internal guidelines at government waste collection departments and at recycling factories. In the current system, scavengers and public workers compete for waste collection. However, scavengers are only interested in recyclable materials. Therefore, a way to reorganize the system would be the introduction of a sorting system, for example at collection points, in which scavengers harvest recyclable materials, whereas public workers manage non-recyclable materials. Such an arrangement could be the object of a contract that would improve the economic conditions of scavengers—currently, around 5% of waste could have been recycled [26]. In southwestern

Lahore, Pakistan, scavengers have been asked to pay for their activities as bribe by police and solid waste management department; otherwise, they would not be allowed to collect the waste from the households and waste collection points [36]. Meanwhile, in Kabul, they are prohibited only at collection points, owing to scattering the waste and polluting the environment. Regarding the local community, many efforts must be pursued by the recycling factory managers to diminish the nuisance and invest in the local community. Recycling factory managers should seek to employ more local people because they are currently not perceived by the local community as value creators. Recycling factory managers and public managers should establish procedures to communicate regularly on their activities and to listen to complaints of consumers and the local community. These measures will not only improve the relationships among stakeholders but also raise the awareness of people and increase public involvement. Public awareness and their involvement can boost the recycling of materials and provide a healthy environment [39]. In terms of internal organization, both recycling factory managers and public managers must incorporate quality management measures such as the identification of the cause of accidents, the labeling of dangerous products, and access to appropriate preventive and curative medical assistance. Recycling factory managers should also consider their workers better by implementing feedback mechanisms. The municipality of Kabul should better consider the waste department and assessing the demands of public managers about equipment. Finally, child labor of scavengers and at recycling shops was demonstrated in our study as resulting from the poor socio-economic state of these stakeholders. Solving the issue of child labor first requires the improvement of their socio-economic conditions. Our results demonstrated the poor level of cooperation and communication of all the stakeholders in the current WMS of Kabul. In this context, a community-driven waste management system such as the waste bank system implemented in Indonesia could solve environmental issues while providing social and economic advantages. Wijayanti and Suryani [40] studied Surabaya's waste bank system and found the waste tonnage in landfill decreased by one third after the implementation of waste banks while providing economic and social benefits for lower-middle-class people. They emphasized the central role of the government as a regulator and facilitator of waste banks and recognized education and technology instruments as important drivers of community empowerment. By setting informal workers at the heart of the recycling system of Kabul city, a waste bank system could favor their social and economic integration as demonstrated in Indonesia.

4. Conclusions

The current study evaluated the social impacts of the current WMS of Kabul city. Relations among stakeholders were qualified as poor with no communication between informal and formal workers and an absence of feedback mechanisms to consumers and the local community. Consequences were a degraded waste management service marked by a lack of cleanliness and health and safety issues. Recycling factories were found to be disconnected from the local social and economic environment. Child labor was found an important issue for informal workers whereas working hours were the main issue for all workers. Important areas for improvement were identified both at operational and system levels. The location of garbage bins should be revised to ensure a better collection rate and prevent overloading. Recycling facilities should develop protocols to control dirtiness and odors around factories. At the system level, the integration of informal workers into the formal waste management system was identified as a core issue since such integration would not only enhance the quality of life of scavengers and recycling shops but also increase the recycling rate of Kabul waste management. The recyclable wastes' flow in Kabul WMS is indeed currently dependent on scavengers and recycling shops, the latter sending most of their wastes to neighboring Pakistan. Therefore, re-localizing recyclable waste materials in Kabul city was identified as a path to a circular economy and sustainable waste management for Kabul city. The role of government will be central in this transition as Kabul municipality could encourage the recovery of recyclable materials and local employment through policy programs such as tax incentives, financial aid, and technology and

community investment. However, recycling technologies such as compost and incineration are not yet developed in Afghanistan and may be difficult to develop immediately due to budget constraints. Our study, therefore, advocates to consider in priority the relocation of bins and the optimization of the collection routes to diminish open dumps, cover all wastes generated in Kabul, reduce nuisance during collection operations and liberate financial capacity. Future studies are needed to identify the best technological options for recycling in Kabul city and the barriers to the establishment of a waste bank system in Kabul city.

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Appendix A

Table A1. Literature analysis results.

		W	C	LC	S	VC	O
Impact categories	Health and safety	[1][2][4][6][8][10][11][12][13][17] [18][19][22][23][25][28][29][31] [32][34][36][37][39][41][42][43] [44][45][47][53][55]♦	[4][22][23][28][29] [32][34][38][41][42] [46][52][53][55]♦	[12][19][32][42][55]♦	[28][31]	[32]	[17][30][48] [49][51]
	fair income	[2][4][6][8][9][10][11][12][13][17] [19][22][23][25][28][29][31][34] [35][36][37][38][41][42][44][45] [46][47][50][53][55]♦					[16][48][49] [51][52]
	Equal opportunities/ discrimination	[2][4][8][11][12][13][19][22][23] [25][28][29][31][32][34][35][36] [37][38][39][41][42][43][45][47] [50][53][55]♦			[44]	[32]	[16][17][24] [30][48][49] [51][52]
	Freedom of association and collective bargain	[2][4][8][12][13][18][19][22][23] [25][26][28][29][32][34][35][36] [38][39][41][43][47][50][55]					[17][48][52]
	Child labor	[2][4][6][8][10][12][13][18][19] [22][23][26][28][29][32][34][36] [37][38][41][42][47][55]♦				[32]	[17][24][48] [49][51][52]
	working hours	[1][2][4][6][8][12][13][18][19][22] [23][25][26][28][29][32][34][35] [36][39][41][43][44][46][47][50] [55]♦					[16][48] [49]
	force labor	[2][4][10][12][13][22][23][25][26] [29][32][34][35][36][37][38][41] [42][47][55]					[17][24] [48][52]
	social benefits	[2][4][8][10][13][17][19][22][23] [25][26][27][28][29][34][35][38] [39][41][43][46][47][55]					[7][48][49]
	social security	[2][4][8][10][12][13][17][19][22] [23][25][26][27][28][29][34][35] [38][41][43][46][47][55]					[7][48][49]

Table A1. *Cont.*

		W	C	LC	S	VC	O
Impact categories	feedback mechanism		[4][22][23][26][29][36] [41][42][46][47]♦	♦			[48]
	consumer privacy		[4][22][23][26][32] [34][41][46][47]				[48]
	transparency	[39][43]	[4][22][23][26][28] [29][32][34][38] [41][46][47]	[42]			[17][48]
	end of life responsibility	♦	[4][22][23][26][28] [29][41][47]				[48]
	Access to material resources	[37]		[4][22][23][26][27][28] [29][32][36][41][42] [46][47][52][55]		[32]	[48]
	Access to immaterial resources	[37]		[4][22][23][26][27][29] [31][41][46][47][55]		[32]	[48]
	Delocalization and migration			[4][22][23][26][28] [29][41][46][47]			[48]
	Cultural heritage			[4][22][23][26][29] [39][41][43][46][47][52]			[48]
	Safe and healthy living conditions	[37]		[4][13][22][23][26][28] [29][34][36][41][42] [47][52][55]			[48]
	Respect of indigenous rights	[6][42]		[4][18][22][23][26] [28][29][41][47][55]			[48]
	Community engagement			[4][12][22][23][26][27] [29][32][34][39][41] [42][43][46][47][52]♦	[10][17]		[48]
	Local employment			[4][11][12][13][18][19] [22][23][26][28][29] [31][32][34][41][42] [46][47][52]♦			[7][30][48]
	Secure living conditions			[4][13][22][23][26] [29][41][47]			[48]
	Public commitments to sustainability issues				[4][12][17][22] [23][26][27][29][34] [38][39][41][43][47]		[48]

Table A1. *Cont.*

		W	C	LC	S	VC	O
Impact categories	Contribution to economic development				[4][10][12][13][17] [19][22][23][26] [27][28][29][31][34] [39][41][42][47][52]		[7][48]
	Prevention and mitigation of armed conflicts				[4][22][23][26] [28][29][41][47]		[48]
	Technology development	[45]♦	♦		[4][22][23][26][27] [29][34][39][41] [43][44][47][52]	[45]	[7][48]
	Corruption				[4][17][22][23][26] [29][36][38][41] [42][47]	[28]	[48]
	Fair competition					[4][12][22][23] [26][28][29][32] [34][39][41][42] [43][47][52]	[48]
	Promoting social responsibility					[4][12][22][23] [26][27][28][29] [39][41][43][47]	
	Supplier relationships				[52]	[4][9][22][23][26] [28][29][39][41] [42][43][45][47] [52]	
	Respect of intellectual property rights					[4][22][23][26] [29][34][41][47]	
	Others	[8][13][17][19][27][32][34][35] [38][39][43][44][45][53] [55]♦♦♦♦♦♦♦	[13][19][32][38][53] [55]♦♦♦	[1][13][19][31][39][42] [43][44][45]♦♦♦	[17][28][38][39] [43][44][45]	[9][32][35]	[7][17][24][26] [30][41][45] [49][51]

W, workers; C, consumers; LC, local community; S, society; VC, value chain actors; O, others. UNEP guidelines in red, other guidelines in blue, case studies in the waste management sector in green, case studies in other sectors in black, ♦ refers to the present study. Please note that [3], [5], [14], [15], [33], [40] and [54] did not have impact and stakeholder categories and were therefore not classified in the table.

Continued. References of Table A1

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Appendix B

Table A2. List of inventory indicators.

		C	PM	PW	S	RS	RFM	RFW	LC
What percentage of child labor does exist?	child labor		v	v	v	v	v	v	
Does the organization have policies against employing children under legal age?	child labor		v	v	v	v	v	v	
Does the company or organization record the proof of age upon recruitment?	child labor		v	v	v	v	v	v	
Corporate Social Responsibility fund spent on community projects	Community engagement								v
Direct community investment and organization level's support	Community engagement								v
Does waste management system play role in improvement of local sourcing and infrastructure, especially based on existing human resource and equipment aspects?	contribution to economic development		v			v	v		
Did the current waste management encourage local or foreign international organizations for investment?	contribution to economic development		v			v	v		

Table A2. *Cont.*

		C	PM	PW	S	RS	RFM	RFW	LC
Do you have any environmental awareness by local government or waste processing facilities?	Education /training								v
How do you rate raising awareness of the people based on the current waste management system?	Education /training		v			v	v		
Do you have any educational training by local government regarding waste handling?	Education /training	v							
Is there existence of educational and training programs for self-development and management for not to be abused by recycling companies through local government? (This question related to informal workers)	Education /training				v	v			
Facility conducts capacity building programs including opportunities to build human capacities?	Education /training		v	v	v	v	v	v	
No school absence of children from families of recyclers and/or waste collection workers?	Education /training		v	v	v	v	v	v	
Is there any policy of extended producer responsibility (EPR)?	end of life responsibility		v			v	v		
Existing waste management system improve 3Rs policy?	end of life responsibility		v			v	v		
Company or organization have goal for staff diversity?	Equal opportunities/ discrimination		v	v	v	v	v	v	
There are wage records of workers confirm equal pay for work of equal value?	Equal opportunities/ discrimination		v	v	v	v	v	v	
How do you rate government in relation to paying attention on social aspects and stigmatization of your status in the society?	Equal opportunities/ discrimination		v	v	v	v	v	v	
Average income is according to legal framework?	Fair income		v	v	v	v	v	v	
Do the workers receive regular payment?	Fair income		v	v	v	v	v	v	
Is there any absence of non-agreed income deductions policy due to disciplinary behavior?	Fair income		v	v	v	v	v	v	
Please rate your relationship with local government regarding problems for waste management?	Feedback mechanism	v							
Please rate your satisfaction feelings in relation to listening to complaints by the local bodies?	Feedback mechanism	v							
How do you rate the relationship with local government or waste processing organizations about your concerns related to waste management?	Feedback mechanism								v

Table A2. *Cont.*

		C	PM	PW	S	RS	RFM	RFW	LC
Please rate your satisfaction feelings in relation to listening to complaints by the local bodies?	Feedback mechanism								v
Does government consider your opinions regarding the waste management planning (kind of waste collection system, time schedule . . .)?	Feedback mechanism	v							
Does related facilities consider your opinions in planning?	Feedback mechanism								v
Local government have feedback mechanism of waste management?	Feedback mechanism	v							
Local government or private facilities have feedback mechanism?	Feedback mechanism								v
Do you have occupational accident?	Health and safety		v	v	v	v	v	v	
Do you suffer any health problems due to working or engaged with waste?	Health and safety		v	v	v	v	v	v	
Did you have occupational fatal accident?	Health and safety		v	v	v	v	v	v	
Do you suffer any health problems due to waste collection service in your neighborhood?	Health and safety	v							
Any accidents happening due to exiting of waste collection in your neighborhood?	Health and safety	v							
Do you suffer any health problems due existing of waste facility?	Health and safety								v
Do you have accident due to operations of the facility?	Health and safety								v
Is there any policy to investigate all accidents and incidents led to injury?	Health and safety		v	v	v	v	v	v	
Do you obtain easily the sick leave in case of having problems with the health?	Health and safety		v	v	v	v	v	v	
Is there medical equipment at the working place in case of emergency and first aid cases	Health and safety		v	v	v	v	v	v	
Does local government or waste collection company assess and monitor risks and impacts on community health and safety?	Health and safety	v							
Does local government or waste processing companies assess and monitor risks and impacts on community health and safety?	Health and safety								v
There are health risk assessments available for all concerned functions regarding the toxicity of all chemicals or products handled at the organization?	Health and safety		v	v	v	v	v	v	

Table A2. *Cont.*

		C	PM	PW	S	RS	RFM	RFW	LC
Do you have access to vaccination and regular medical checkups programs?	Health and safety		v	v	v	v	v	v	
Frequency of Baths/month	Health and safety		v	v	v	v	v	v	
Did you have training programs regarding occupational health and safety?	Health and safety		v	v	v	v	v	v	
Protective clothes are provided?	Health and safety		v	v	v	v	v	v	
Your living and working environment differ from each other?	Health and safety		v	v	v	v	v	v	
Do you have health and safety risk management system by local authorities?	Health and safety	v							
How do you rate the health and safety awareness programs by local officials?	Health and safety	v							
How do you rate proactive action to improve community health and safety?	Health and safety	v							
Do you have health and safety risk management system by local facilities?	Health and safety								v
How do you rate the health and safety awareness programs by related waste processing organizations?	Health and safety								v
How do you rate proactive action to improve community health and safety?	Health and safety								v
How many/or number of jobs created during existing waste management system for formal and informal workers, including scavengers, sanitation staff and recycling companies/ton of waste?	Job creation			v	v			v	
What is the percentage of the recruitment rate?	Job creation			v	v			v	
What is your satisfaction level to work in your current organization?	Job satisfaction		v	v	v	v	v	v	
How do you rate the job security?	Job security		v	v	v	v	v	v	
job creation or use of local labor	Local employment								v
Do you have access to appropriate and necessary working equipment?	Physical working conditions		v	v	v	v	v	v	
Loading waste physically demanding?	Physical working conditions		v	v	v	v	v	v	
How do you rate cooperation of local people in your activities?	Psychological working conditions		v	v	v				

Table A2. *Cont.*

		C	PM	PW	S	RS	RFM	RFW	LC
Does your manager or director deal with your complaints	Psychological working conditions		v	v	v	v	v	v	
Government provides opportunities for informal workers and recycling companies? (Establish links with the private companies, provide markets for recycled materials and pave the way for private companies to invest)	stakeholder relationships				v	v	v		
Local government is cooperative and supportive for your activities? (this question is for company and informal workers)	stakeholder relationships				v	v	v		
How do you rate the current waste management system based on establishment and improvement the relationships among stakeholders?	stakeholder relationships		v			v			
use and support of national suppliers	stakeholder relationships		v				v		
technology transfer	Technology development		v				v		
research and development	Technology development		v				v		
investment in technologies	Technology development		v				v		
Do you agree with the waste collection schedule?	Waste management planning	v							
The design and location of dustbin is convenient?	Waste management planning	v							
Do you agree with working schedules?	Waste management planning								v
The location setting of facilities is satisfactory.	Waste management planning								v
There is overflowing of waste containers in your neighborhood.	Waste management quality	v							
There is traffic volume of the waste collection fleets in your neighborhood.	Waste management quality								v
How often do you feel sound pollution during waste collection time?	Waste management quality	v							
How often do you observe animal gathering around waste collection points?	Waste management quality	v							
Do you observe littering of waste in your neighborhood?	Waste management quality	v							

Table A2. *Cont.*

		C	PM	PW	S	RS	RFM	RFW	LC
Do you suffer the unpleasant smells of waste?	Waste management quality	v							
There is fly breeding and existing mosquitoes due to being waste in the neighborhood?	Waste management quality	v							
How often do you feel sound pollution during operational times?	Waste management quality								v
How often do you observe animal gathering around waste facility?	Waste management quality								v
Do you observe littering of waste in your neighborhood?	Waste management quality								v
Do you suffer the unpleasant smells of waste?	Waste management quality								v
There is fly breeding and existing mosquitoes due to waste in the neighborhood?	Waste management quality								v
How do you rate local bodies related to measuring and monitoring system for waste management?	Waste management quality	v							
How do you rate local measuring and monitoring system by local government or processing companies?	Waste management quality								v
Does the facility cause migration trends?	Waste management quality								v
Does normal working hours exceed the legal arrangement?	Working hours		v	v	v	v	v	v	
Do you work on weekends and holidays?	Working hours		v	v	v	v	v	v	
		20	41	33	36	39	41	32	24

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