


Decentralization of solid waste management services in rural Lebanon: Barriers and opportunities

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Mary Abed Al Ahad¹ , Ali Chalak², Souha Fares³, Patil Mardigian¹ and Rima R Habib¹

Abstract

Rapid urbanization, closure of dumps, and insufficient infrastructure funding in Lebanon have resulted in improper municipal solid waste management (MSWM), creating a continuing trash crisis in recent years. In Beirut and Mount Lebanon, MSWM was carried out in centralized waste processing and disposal facilities operated by the government. The trash crisis and failure of the centralized system prompted several municipal authorities to decentralize MSWM by establishing local facilities, paid by the council taxes charged to beneficiary households. To study the feasibility of decentralized MSWM, a survey of 228 households in a rural village in Lebanon explored households' willingness to pay (WTP) for a local MSWM service. For data analysis, a multivariate Tobit model was used to examine the determinants of the WTP amount. Results showed that 79% of surveyed households in the studied village were willing to support local MSWM improvements by contributing an average yearly fee of US\$48, representing a 30% increase in their current council taxes. Analysis showed a significant positive association between the WTP amount and the household monthly income level, the residents perceived needs for urgency to act on solid waste management, and the households' responsibility to be involved in MSWM. An interview with the municipality mayor later revealed that financial, technical, and land resources are lacking to enable consideration of a decentralized project for MSWM in the village. Municipalities in rural areas have limited resources and are unable to sustain a decentralized MSWM service unless adjacent towns join effort in supporting and financing MSWM initiatives.

Keywords

Municipal solid waste management, rural areas, willingness to pay, decentralization, Lebanon, user fees

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Introduction

Solid waste generation has globally increased in the last few decades due to population growth, increased urbanization, economic growth, and changing lifestyles and consumption patterns (Minghua et al., 2009; Singh et al., 2014; Wilson and Velis, 2015). The enforcement of strict environmental protection laws and the deployment of generous funds to establish effective MSWM systems in high-income countries have been necessary to manage the increase in solid waste generation (Srivastava et al., 2015; Wilson and Velis, 2015). On the other hand, low- and middle-income countries (LMIC) have been generally unsuccessful in rising to the challenge and improving municipal solid waste management (MSWM) practices, due to the lack of financial, institutional, and technical resources, and the lack of the political will to enforce proper implementation (Chakrabarti and Sarkhel, 2003; McAllister, 2015; Ogwueleka, 2009).

Two of the most common waste disposal practices in LMIC are open dumping and open burning, both of which are associated with negative environmental and health outcomes. Open dumping and burning contribute to surface water, ground water,

and air pollution, with negative public health consequences (Alam and Ahmade, 2013; Ejaz et al., 2010).

The European Union has proposed a waste hierarchy for improving MSWM. This hierarchy prioritized waste prevention, preparing for reuse, recycling/composting, recovery, and disposal of residues as a last step. Implementing effective MSWM systems requires a holistic integration of economic, social, political, institutional, and technical considerations (European Union Directive, 2008).

The coordination of these elements is challenging, particularly in LMIC that lack sufficient financial, institutional, and

¹Department of Environmental Health, American University of Beirut, Beirut, Lebanon

²Department of Agriculture, American University of Beirut, Beirut, Lebanon

³Hariri School of Nursing, American University of Beirut, Beirut, Lebanon

Corresponding author:

Mary Abed Al Ahad, Department of Environmental Health, American University of Beirut, Bliss Street, Beirut, 1107 2020, Lebanon.
Email: mja52@mail.aub.edu

technical resources. The lack of central government coordination in LMIC encouraged the decentralization of MSWM services, transferring responsibilities over to municipal authorities (Oosterveer and Van Vliet, 2010; Ullrich, 2001). For instance, the government of Ghana approved the decentralization of the MSWM services in Berekum and Dormaa municipalities to promote accountability and compensate the failure of MSWM services provided previously by the national government (Kyerem, 2016). In the Philippines, their growing garbage crisis triggered passage of the Ecological Solid Waste Management Act of 2000, which assigned solid waste management to local government units aiming toward environmental sustainability, public health protection, and economic efficiency (Premakumara et al., 2014). Similarly, the Ministry of Environment in India established new MSWM regulations in 2000 followed by updates in 2016 to ensure proper waste management by assigning municipal authorities the responsibility of solid waste management activities within their jurisdiction (Kumar et al., 2017).

Decentralization of the MSWM services has a number of advantages, including: 1) creating local centers to provide MSWM services that are closer to the residents; 2) responding quicker and with greater flexibility to the resident's needs and expectations; and 3) making the MSWM more efficient through shortening bureaucratic procedures (Henry et al., 2006; Kyerem, 2016; Ullrich, 2001). Additionally, decentralization redistributes the political power by giving local stakeholders a greater role in the decision-making process, which can lead to greater public support for decisions that respond to specific local needs (Dhokhikah and Trihadiningrum, 2012; Oosterveer and Van Vliet, 2010). A potential limitation of decentralization are high operational costs and inefficiencies due to the relatively small amount of generated solid waste requiring small-scale operations. Lack of financial sustainability for these small-scale operations makes it difficult for local governments to attract bids and investments (Giannozzi, 2017; Ullrich, 2001). Therefore, in considering decentralization of MSWM services for a given community, local authorities and decision makers should engage in social, technical, and economic feasibility assessments (Han et al., 2019). An integral aspect of a feasibility assessment includes studying people's willingness to pay (WTP) for improved environmental services. Research has shown that a wide range of determinants affect the households' WTP for improved MSWM services. These include household floor space and ownership, number of family members living in the same household, age, gender, occupation, income, and educational level. Other determinants have been noted such as disease history due to poor environmental services, respondents' environmental health awareness, recycling/composting practices, and political-economic factors (Banga et al., 2011; Challcharoenwattana and Pharino, 2016; Zeng et al., 2016). Similar to other research pertaining to WTP (Ferreira and Marques, 2015; Wang et al., 2014; Whittington, 2002), this study applied the contingent valuation method to provide the

evidence base for environmental protection and resource policy and decision-making in MSWM in Lebanon.

Solid waste management in Lebanon

The amount of solid waste in Lebanon has drastically increased due to several factors, including population growth and the influx of Syrian refugees to Lebanon since the beginning of the conflict in Syria in 2011 (Sweep-Net, 2014). Lebanon is a developing Middle Eastern country that covers an area of 10,452 km² and is divided into eight governorates (or Mohafaza): Aakkar, Baalbeck-Hermel, Beirut, Beqaa, Mount Lebanon, Nabatiyeh, North Lebanon, and South Lebanon. Three operational sanitary landfills exist in the country: 1) the Naameh sanitary landfill in the Beirut governorate, 2) Bsalim sanitary landfill for inert material in the Mount Lebanon governorate, and 3) Zahle sanitary landfill in the Beqaa governorate (Figure 1) (Sweep-Net, 2014; MOE et al., 2011).

Solid waste management activities in the central governorates of Lebanon (Beirut and Mount Lebanon) are coordinated by the national government, while local authorities outside of these regions have been given the choice of localized waste management (Sweep-Net, 2014). Solid waste management, including collection, treatment, and final disposal in the Naameh landfill for Beirut and Mount Lebanon, have been operated by one publicly contracted company from 1994 through 2015 (Sweep-Net, 2014). The centralized MSWM services during that period were characterized by high dependence on landfilling with minor recycling and composting services as well as high net costs up to US\$130 per tonnes of solid waste (Sweep-Net, 2014). This was, in part, due to the low capacity of the waste sorting and composting facilities provided by the government compared to the actual quantity of waste generated in Beirut and Mount Lebanon.

On July 17, 2015, the Naameh landfill reached its full capacity and was closed without providing alternative locations for solid waste disposal. As a result, Lebanon experienced a protracted solid waste management crisis, which led to waste accumulating on sidewalks and adjacent to streets and in riverbanks of Beirut and Mount Lebanon, posing serious environmental and public health hazards (Massoud and Merhebi, 2016). The government responded to the crisis in March 2016, offering a temporary solution by collaborating with a different private company for the solid waste collection services and reopening the Costa Brava and Bourj Hamoud coastal dumps for solid waste disposal. However, these dumps will soon reach their maximum capacity, which likely will reignite the solid waste crisis (Khawaja, 2017).

In October 2018, the Lebanese parliament ratified a new law concerning integrated solid waste management (Law Number 80) (Ministry of Environment, 2018). The law established a National Solid Waste Management Authority operating in the Ministry of Environment. The Authority's primary role is to oversee the execution of central MSWM projects. The law also presents a process implementing local decentralized MSWM programs in areas that are not covered by the central projects. However, this policy does not provide a framework for the



Figure 1. A map of solid waste management facilities in Lebanon. Source: Derived from MOE et al. (2011).

administrative or funding processes to initiate these projects (Ministry of Environment, 2018). All this raises the question: how efficiently can MSWM services be decentralized in Lebanon and to what extent can the national government relinquish the ownership and operation of MSWM, replacing the centralized structure with smaller decentralized solid waste

management initiatives, each operated by one or a consortium of nearby municipalities?

In an effort to explore this question, we carried out a survey in a rural area in Mount Lebanon (Jdeidet Ghazir village) to measure households' WTP for a local MSWM service. The study also aimed to forecast whether decentralization is a viable potential

solution to avert future MSWM crises in rural Mount Lebanon after the failure of the pre-existing centralized solid waste management in Beirut and Mount Lebanon governorates. Jdeidet Ghazir is a village located in Keserwan district that belongs to the Mount Lebanon governorate. It is 31 km away from the capital Beirut, with an altitude of 540 m, and covers an area of 0.51 km². The village has a population of 1133 registered voters (over 21 years old) engaged in agricultural activities, small commercial businesses, grain milling, and quarries (Localiban, 2016).

Materials and methods

Study design and survey contents

A contingent valuation cross-sectional survey was developed to evaluate the public's WTP for a local MSWM, independent of the service provided by the government. The survey questionnaire included indicators on household demographics and socioeconomic characteristics, and questions on household knowledge about good waste management practices (such as recycling and composting). Respondents, one from each visited household, were also asked to list the two most important environmental problems that require immediate action. The questionnaire also included a vignette describing a MSWM initiative designed to improve MSWM services in the village. The hypothetical initiative included the following elements:

- 1) Source separation of the generated waste at the household level;
- 2) Frequency of solid waste collection six times per week;
- 3) Recycling and composting; and
- 4) Disposing of the remaining waste residues in sanitary landfills.

Respondents were asked about their WTP for such a service (yes/no question). Those who gave a positive response were asked to report on the maximum amount they are willing to pay on top of their current yearly council tax. A payment card was used to record the payment amount. Those who were not willing to pay were asked to report the reason for their answer.

Study population, setting, and data collection

The study population included all households in Jdeidet Ghazir. A cadastral map provided by the municipality was used to identify all the 334 households in the village.

Data collection was carried out from 23 March 2019 until 9 April 2018. Face-to-face interviews were conducted with an adult member of the household (mostly the female homemakers). The research was granted ethical approval from the Institutional Review Board of the American University of Beirut (FHS.RH1.10) following a review of the study protocol and the measures adopted by the researchers to ensure and maintain the dignity, rights, safety, and well-being of the study participants.

Data analysis and study variables

The outcome variable for this study was the households' maximum WTP amount for the improved MSWM service proposed in the survey vignette. The respondents who were not willing to pay any sum of money were considered to have a zero WTP amount.

The literature guided the selection of the factors that are likely to determine households' WTP for improved MSWM services. The factors included in the data analysis are: age, gender, education, income, occupation, household size, household floor space, household ownership, MSWM importance, nationality, waste generation, satisfaction with the current MSWM, preferable handling sector for MSWM, recycling awareness, composting awareness, MSWM household responsibility, and MSWM government responsibility.

Data analysis involved three stages. First, univariate Tobit regression models were estimated to examine the association between maximum WTP and each of the selected determinants. The Tobit model was chosen for data analysis since the outcome (maximum WTP amount) is continuous and censored at zero (Chib, 1992). The determinants that showed a statistical association with a *P*-value of 0.2 or less with the maximum WTP amount were selected for the second stage of the analysis.

Second, we examined the correlations between all pairwise combinations of determinants using Chi² and Cramer's V tests given their categorical nature. For pairwise combinations returning a Cramer's V coefficient of 0.5 or more and a Chi² *P*-value <0.05 (implying the presence of a moderate to strong correlation), we kept only the determinant that was more relevant to WTP, based on the literature, in the third stage of the analysis (Cohen, 1988; Mukaka, 2012).

Third, a multivariate Tobit regression model was estimated to assess the association between the remaining WTP determinants and maximum WTP. All the WTP determinants that are included in the final multivariate Tobit model are summarized in Table 1. Statistical significance for this model was considered at a *P*-value <0.05. All analyses were carried out using STATA (version 14.0).

Interview with the municipality mayor

A face-to-face semi-structured interview was conducted with the mayor of Jdeidet Ghazir following the household survey. The mayor was asked about the feasibility of a decentralized MSWM program in Lebanon's rural areas and about his willingness to support the implementation of the decentralized MSWM initiative proposed in the household survey.

Results

Socioeconomic characteristics

In total, 228 households out of 334 agreed to participate in the survey and gave complete information, yielding a response rate of 68%.

Table 1. Description of the independent variables in this study and their expected type of association with the households' maximum WTP amount.

Variable	Variable description	Variable measurement	Expected type of association with households' WTP (+ positive or - negative) based on the literature
Gender	Respondent's gender	Male = 0, female = 1	+ or -
Income	Household monthly income in Lebanese Lira (L.L.) 1500 L.L. = US\$1 (exchange rate at the time of the survey in 2018)	Low income: <2m L.L. = 1, middle to high income: ≥2m L.L. = 2	+ or -
Household size	Total number of individuals living in the same household	Low family size (<4) = 1, medium family size (4 ≤ size < 6) = 2, large family size: (≥6) = 3	+ or -
MSWM importance	Perceiving MSWM as an important issue in the village that requires immediate attention and action	No = 0, yes = 1	+
Composting awareness	Awareness of the concept of composting in the solid waste management	No = 0, yes = 1	+
Waste generation	Total number of solid waste bags generated per household per day	One bag or less = 1, more than one bag = 2	+
MSWM household responsibility	Perceiving the MSWM responsibility as a shared one between the residents and the local government	No = 0, yes = 1	+
MSWM government responsibility	Perceiving MSWM as a merely governmental responsibility	No = 0, yes = 1	-
Nationality	Nationality of respondents	Lebanese nationality = 1, otherwise = 0	+

Most of the surveyed participants were Lebanese ($n = 195$, 86%), females ($n = 135$, 59%), between 31 and 59 years ($n = 125$, 55%), and married ($n = 178$, 78%). A sizeable proportion of the respondents (mostly female homemakers: 84%) were not engaged in paid labor ($n = 99$, 43%) at the time of the interview. Around one third of the respondents were employed in the private sector ($n = 74$, 32%). Many of the respondents had a university level degree ($n = 101$, 44%) and a small number had an intermediary school certificate ($n = 72$, 32%). Moreover, almost half of the households were in the middle-income category ($n = 121$, 53%) (Table 2).

Respondents' environmental and solid waste management awareness and practices

The findings showed that the two most important environmental issues in the village that require immediate solutions as reported by the study participants were solid waste management ($n = 198$, 87%) and wastewater treatment ($n = 186$, 82%). The majority of respondents were aware of the concept of recycling ($n = 217$, 95%) and composting ($n = 207$, 91%). However, only 17% ($n = 38$) source-separated their refuse to isolate recyclables including plastic, glass, cans, paper, and cardboard, which they sent to private recycling companies and non-governmental organizations operating recycling programs. Most of those who did not recycle

($n = 176$, 93%) reported the redundancy of recycling given that there is no established solid waste source-separation/recycling program in the village and that all types of wastes will be transported to a landfill by the government-contracted company. Other reasons for not recycling include the lack of adequate garbage bins that facilitate recycling ($n = 143$, 75%) (Table 3).

Respondents' satisfaction with the current MSWM system

More than half of the respondents were not satisfied with the solid waste collection frequency and reported the accumulation of solid waste on the sides of the waste bins ($n = 127$, 56%). However, the majority of respondents reported that the solid waste containers were accessible and within walking distance to the households ($n = 147$, 64%).

Political corruption was reported by 93% of the respondents ($n = 211$) to be the major obstacle facing improvements in the MSWM in Lebanon (Table 4). The suggested improvements reported by the study participants included the establishment of a nearby solid waste management facility ($n = 153$, 67%), advocacy ($n = 137$, 60%), and raising awareness on source-separation of refuse ($n = 108$, 47%). In addition, the decentralization of MSWM by local municipalities ($n = 28$, 12%) was suggested as a potential solution for the current MSWM crisis. Most respondents ($n = 136$, 60%) suggested that MSWM should be a

Table 2. The socioeconomic characteristics of respondents and households ($N = 228$).

Variable	Category	Count	Percentage
Gender	Female	135	59.2
	Male	93	40.8
Marital status	Single	50	21.9
	Married	178	78.1
Age	30 years and below	58	25.4
	31–59	125	54.8
	60 and above	45	19.7
Employment	Private sector employees	74	32.5
	Own business	41	18.0
	Government employees	14	6.1
	Not working	99	43.4
Education	Intermediary school level	72	31.6
	Secondary and technical school level	55	24.1
	University level	101	44.3
Income	Low income (<2m L.L.)	95	41.7
	Middle income (2m to 5m L.L.)	121	53.1
	High income (>5m L.L.)	12	5.3
Household ownership	Privately owned	173	75.9
	Rented	55	24.1
Number of children living in the household	Households that have children aged below 15 years old	112	49.1
	Households that do not have children aged below 15 years old	116	50.9
Household size	Low (<4)	83	36.4
	Medium ($4 \leq \text{size} < 6$)	110	48.3
	Large (≥ 6)	35	15.4
Nationality	Lebanese	195	85.5
	Syrian	31	13.6
	Egyptian	1	0.4
	Indian	1	0.4

Table 3. Distribution of respondents' reasons for not source-separating their generated refuse ($N = 190^*$).

Respondents' reasons	Count	Percentage
Redundancy of refuse source-separation since solid waste is being mixed after collection	176	92.6
Lack of adequate garbage bins in the village that facilitate recycling	143	75.3
Lack of time to source-separate our generated solid waste	11	5.8
Source-separation is not a social norm in our society	10	5.3
Lack of knowledge regarding the correct methods of refuse source-separation	5	2.6
The source-separated solid waste ends up in open dumps without being recycled	5	2.6
Solid waste is being collected without the obligation of source-separation	2	1.1

* $N = 190$ including all respondents with a positive response regarding source-separation of their generated refuse. Percentages do not add up to 100% since multiple answers to the questions were allowed.

public–private partnership where the private sector provides efficient services, and the public sector monitors and controls these services. Moreover, around 45% ($n = 103$) of the respondents reported that MSWM is a shared responsibility between the residents and the municipal and governmental authorities.

Households' WTP

Our findings reveal that most of the study respondents ($n = 181$, 79%) were willing to pay ($WTP > 0$) for the improved MSWM service proposed in the survey. The mean of the WTP amount was 73,377 L.L. (US\$48) per household per year, which represents a

30% increase in their current annual general council fee. Therefore, the municipality would collect from the 334 surveyed households approximately 24,507,981 L.L. (US\$16,228) per year in addition to the current council tax money to fund a local MSWM initiative. On the other hand, 21% of respondents ($n = 47$) were not willing to pay anything ($WTP = 0$) for the proposed integrated MSWM service. Those who were not willing to pay reported that: proper solid waste management was the responsibility of the government ($n = 22$, 47%); they did not believe that an additional fee would yield improvements to municipal services ($n = 7$, 15%); the proposed integrated MSWM service would generate money from the sale of recyclables and, thus, households should not pay ($n = 4$,

9%); and respondents do not have money to pay for the proposed MSWM service ($n = 13, 28\%$).

The multivariate Tobit model showed that (1) respondents' nationality, (2) household income, (3) recognizing the urgency of MSWM improvements in the village, and (4) considering MSWM

as a shared responsibility between households, the municipality, and the government were significantly positively associated with the households' maximum WTP amount for the MSWM service proposed in the survey (Table 5). The marginal effect indicates that Lebanese respondents are willing to pay, on average, an additional amount of 31,760 L.L. (US\$21) per year for MSWM improvements as compared to non-Lebanese respondents. Those who perceive MSWM as a shared responsibility are willing to pay, on average, an extra amount of 39,335 L.L. (US\$26) per year for MSWM improvements in comparison to those who do not. On average, respondents that recognize the urgency of MSWM improvements showed an increase in respondents' maximum WTP amount by 26,049 L.L. (US\$17) per year. In addition, the marginal effect shows that as income level increases from the "low" category to the "medium to high" category, people are willing to pay, on average, an extra 22,701 L.L. (US\$15) per year. On the contrary, respondents who perceived MSWM as a governmental responsibility are willing to pay, on average, 27,951 L.L. (US\$19) less per year than those who did not (Table 5).

This study also revealed that participants' gender, household size, solid waste generation rate, and composting awareness were not significantly associated with the maximum WTP amount for the MSWM service.

Interview with the municipality mayor

The mayor discussed the problems of the current MSWM strategy: the inefficiency of solid waste collection frequency leading to the accumulation of solid wastes in the village and the

Table 4. Distribution of respondents' opinion about the obstacles that are hindering improvements in the MSWM sector in Lebanon ($N = 228$).

Obstacle	Count	Percentage
People do not care about the effects of poor solid waste management	5	2.2
Lack of public awareness regarding the negative effects of poor solid waste management	22	9.7
The urgency of other priority problems in the community such as electricity, water treatment, education, and health	1	0.4
No adequate action is taken by the municipality	11	4.8
Presence of political corruption in the country	211	92.5
Lack of financial resources	34	14.9
Lack of incentives for residents to practice proper solid waste management	7	3.1
The failure of the public-private partnerships regarding MSWM	8	3.5

Percentages do not add up to 100% since multiple answers to the questions were allowed.

Table 5. Results of the multivariate Tobit regression analysis ($N = 228$).

Independent variables		Adjusted coefficient	Standard error	Adjusted marginal effect	P-value	95% confidence interval
Gender	Male	Reference (Ref)				
	Female	-20,047	13,807	-14,300	0.148	(-47,259; 7165)
Income	Low (<2m L.L.)	Ref				
	Middle to high (2m to 5m L.L.)	32,378	12,699	22,701	0.011*	(7350; 57,405)
Household size	Low (<4)	Ref				
	Medium (4 ≤ size < 6)	11,987	12,565	8406	0.341	(-12,777; 36,751)
	Large (≥6)	12,170	19,910	8538	0.542	(-27,070; 51,410)
MSWM importance	No	Ref				
	Yes	39,504	17,654	26,049	0.026*	(4710; 74,298)
Nationality	Non-Lebanese	Ref				
	Lebanese	48,803	15,760	31,760	0.002**	(17,741; 79,864)
Waste generation	≤ 1 waste bag	Ref				
	> 1 waste bag	-7928	14,199	-5574	0.577	(-35,912; 20,056)
Composting awareness	No	Ref				
	Yes	29,061	16,193	19,417	0.074	(-2853; 60,975)
MSWM household responsibility	No	Ref				
	Yes	54,435	14,619	39,335	0.000**	(25,622; 83,249)
MSWM government responsibility	No	Ref				
	Yes	-41,303	17,267	-27,951	0.018*	(-75,335; -7271)

**P-value < 0.01; *P-value < 0.05.

large amount of money (US\$130,000 per year) paid for the MSWM, which is currently handled by a private company sub-contracted by the government. The mayor also noted the inability of individual municipalities to establish their own MSWM project. However, a joint venture of a consortium of municipalities will have a better chance to succeed in identifying suitable land to house a sanitary landfill, hiring the required technical expertise to manage such an initiative, and ensuring its financial sustainability.

Discussion

Despite their dissatisfaction with existing MSWM services, the findings showed that residents opted for a public–private partnership to handle MSWM since the private sector has the required competence, expertise, and reliability, while the public sector should monitor and control the private sector. This will ensure efficiency of the MSWM services and, at the same time, adequate and fair user fees to the public. Similarly, other studies showed that involving the private sector in delivering recycling and composting services would enhance the efficiency of the governmental MSWM services (Murad et al., 2007; Nkansah et al., 2015).

Similar to other WTP studies in developing countries, most of the respondents were willing to pay additional fees to improve MSWM services in their countries (Jones et al., 2010; Maskey and Singh, 2017; Nkansah et al., 2015). These findings demonstrate interest and incentives through which MSWM improvements can be effectively implemented, particularly by attending to the cost and other concerns of residents. As expected, Lebanese respondents showed more interest than non-Lebanese in investing in infrastructure, given that improvements affect their homeland. The average WTP amount for the proposed MSWM service in our survey was US\$48 per year per household, which constitutes a 30% increase in the current annual household council tax (the average annual council tax per household in Jdeidet Ghazir according to the residents is US\$160). In high-income countries where efficient MSWM exists, the council tax is more than 10 times this amount. For example, the average council tax in the UK in 2017 was £1530 (US\$2000) (Department for Communities and Local Government, 2017). However, comparing LMIC with high-income countries in terms of council tax is not informative given the large differences in salaries, infrastructure, and social benefits, enabling residents in high-income countries to pay higher tax amounts.

Similar to other WTP research, our results showed that respondents with higher monthly income are willing to pay higher amounts of money for MSWM improvements (Aproz and Masud, 2011; Alhassan et al., 2017; Zhang et al., 2012). This might suggest the need for a range of equitable service fees that take into consideration residents' ability to pay.

Our findings revealed that recognizing the urgency to improve the MSWM services was positively correlated with the respondents' WTP amount, as was shown in other studies (Alhassan and

Mohammed, 2013; Chalcharoenwattana and Pharino, 2016; Maskey and Singh, 2017).

In addition, households reporting MSWM as a shared responsibility between the government, the municipality, and the residents were willing to pay higher amounts for MSWM improvements. Similar research showed that households perceived that they are primary producers of solid waste and feel responsible for waste reduction and management (Hazra et al., 2013). In contrast, those perceiving MSWM to be a government responsibility showed a negative association with the households' WTP amount. Our study results reflect the respondents' general belief that the government is an inept service provider and that political corruption is the major obstacle facing improvements in the MSWM in Lebanon. In fact, political corruption, defined as politicians' lack of transparency and their use of public office power for personal benefit, is rampant in Lebanon (Chaaban, 2016; Farida and Ahmadi-Esfahani, 2008). This leads to diversion of the public funds assigned for MSWM improvements to the political elites' personal accounts, leaving the solid waste management sector in a drastic condition. Therefore, government agencies may have to engage in transparent public discussions to win community trust and support.

Our findings contribute to local and global debates on decentralization of MSWM services. One aspect of the Lebanese solid waste crisis is the unavailability of a national/regional recycling program. The participants in our study showed awareness of recycling and composting concepts and interest in implementing a local MSWM service that includes a recycling component. Implementing a decentralized recycling program may serve as a potential solution for the current solid waste crisis through the creation of recycling/composting markets. Studies in LMIC countries found that decentralized initiatives could improve service delivery and community participation, generate income, provide additional job opportunities to the local community, and reduce the costs associated with long-distance hauls of solid waste to the central MSWM facilities (Oosterveer and Van Vliet, 2010; Righi et al., 2013). In Lebanon, decentralization has long been viewed as a solution to local problems since the "Al Taif" constitutional agreement was established in 1989, marking the end of the Lebanese Civil War. Despite this view, the political elite have consistently hindered the development of practical decentralization policies, favoring their personal interests over the public interest (Joseph, 2017). However, the 2015 waste crisis and the massive social environmental protection movement that it inspired has raised public interest in decentralizing MSWM as a possible solution in Lebanon given the failure of the pre-existing centralized system (Giannozzi, 2017; Joseph, 2017). Nevertheless, to consider decentralization, municipalities must ensure that the provided MSWM services are simultaneously affordable and effective. To this end, collaboration between adjacent municipalities as suggested in the interview with the mayor may increase the cost efficiency of decentralized MSWM services.

Policy implications

The results of this contingent valuation study help urban planners and administrators in determining the optimal charges for proper MSWM services in Lebanese rural areas. Our results encourage local authorities to design decentralized MSWM initiatives targeting waste reduction, reuse, and recycling. To ensure the financial sustainability of decentralized MSWM projects, the collaboration of consortiums of municipalities is required. The study also revealed that many respondents preferred public–private cooperation in MSWM, which may help municipalities in negotiating contracts with private firms to improve the current MSWM situation.

Study limitations

Response bias is a common phenomenon in behavioral research where self-reported data are used (Rosenman et al., 2011). Therefore, some respondents during the face-to-face survey may have provided answers that they consider “socially desirable” and/or pleasing to the interviewer, resulting in response bias. Additionally, our study was limited to a rural village in the governorate of Mount Lebanon. However, the study results can be of benefit to other rural areas in Lebanon and potentially in other LMIC countries facing socioeconomic, political, institutional, and technical challenges in the management of solid waste. Therefore, national studies to assess WTP for MSWM services across Lebanon are recommended to allow representation of Lebanon’s urban and rural contexts.

Conclusion

The study findings showed that most residents in Jdeidet Ghazir are willing to pay for a local decentralized MSWM project. Moreover, the interview with the municipality mayor revealed local motivation and interest in improving the MSWM practices in the village. Government centralized services have been characterized by their high net cost, inefficiency, and prioritization of the political elites’ interests. However, the current ratification of the integrated solid waste management law (Law Number 80) pushed Lebanon toward further discussions relating to decentralization of the MSWM services. This study provides evidence of the viability of moving forward with decentralization of MSWM services through the cooperation of nearby villages, towns, and cities, while reinforcing the role of government in monitoring and oversight. This study also highlights the need for a reorientation of public resources to achieve accountability in planning, management, and improvement of MSWM systems.

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ORCID iD

Mary Abed Al Ahad  <https://orcid.org/0000-0002-9006-730X>

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