Determinants of household willingness to separate waste in Homs city, Syria

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Abstract
Municipal solid waste management was a recognised environmental problem in Syria even before the conflict started. As a consequence of the conflict that began in March 2011, the solid waste situation worsened when collection vehicles and waste containers were damaged or looted and workers were kidnapped and killed. The deficient municipal solid waste management system and the lack of waste management services have led to the accumulation of waste in various parts of Syrian cities, causing adverse health and environmental effects. Among various groups of waste generators, households contribute about 80% of the entire municipal waste generated in Syrian cities. Therefore, this study aimed to investigate the factors influencing household participation in waste separation programmes at source, focusing on socioeconomic characteristics of households, the availability of a waste collection service, knowledge of the benefits of waste separation, and environmental awareness and concern. The study was carried out in four zones in Homs city, Syria, and data were retrieved through a questionnaire survey of 300 households who participated in the study. The logit regression model was used in this study to explore the determinants of household willingness to practise waste separation at source if the authorities provide incentives to residents. This study found that monthly income, household size, age and gender of the head of the household, house ownership, knowledge of the benefits of waste separation, and environmental awareness and concern have a statistically significant influence on household willingness to separate waste.

Introduction

Municipal solid waste (MSW) creates diverse challenges that stem from improper management and indiscriminate disposal of generated waste (Gkoulias et al. 2021). However, municipal solid waste management (MSWM) is mostly considered the responsibility of municipal authorities, and the general public is not expected to contribute

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(Vidanaarachchi et al. 2006). Meanwhile, the operational efficiency of MSWM relies on the effective participation of both the local authorities and the residents (Moghadam et al. 2009; Sharholy et al. 2008). Thus, the engagement and effective participation of different stakeholders is vital, as no real changes can be made without the involvement of partners. Resident participation in the separation and recycling of household solid waste is critical to the success of municipal solid waste management (Meng et al. 2019). Abbott et al. (2011) indicated that when local authorities do not charge households sufficiently high waste disposal fees, people do not actively reduce the waste they produce or try their best to engage in waste separation and recycling activities. For instance, the "pay as you throw" policy automatically drives residents to reduce what they place in the bin, as it provides an incentive for residents to reuse and sort out recyclables, provided there are the required facilities (Akiyode and Sojinu 2006). Also, to increase recycling rates, the government should encourage markets for recycled

materials and increased professionalism in recycling companies (Minghua et al. 2009). Further, the government should offer financial support for recycling companies, recycling projects, and infrastructure (Henry et al. 2006), the informal sector organisations (Sharholy et al. 2008), and drop-off and buy-back centres (Matete and Trois 2008).

Since families are one of the primary sources of municipal solid waste (Dangi et al. 2011, 2008; Sujauddin et al. 2008; Yousuf and Rahman 2007), it is vital to explore how the socioeconomic characteristics of inhabitants influence their willingness to participate in waste separation programmes. Municipal solid waste separation at source is affected by several social, economic, and demographic factors (Anarfi 2013; Rousta and Bolton 2019; Rousta et al. 2015). Studies by Domina and Koch (2002), Hansmann et al. (2006), Troschinetz and Mihelcic (2009), Vassanadumrongdee and Kittipongvises (2018), and Yau (2012) have found significant relationships between socioeconomic factors (consumption patterns, household size, employment, education, gender, age, and income) and recycling behaviour. In addition to these socioeconomic characteristics, the probability that a family will participate in waste separation activities is related to a group of variables, including features related to waste management activities (Bennagen et al. 2002) and the existence of the infrastructure required for waste separation at source (Bernstad 2014). In this regard, Duffy and Verges (2009) and Sin-Yee and Sheau-Ting (2016) indicated that an area with well-equipped recycling containers at an accessible distance could enhance public participation in recycling programmes. Moreover, it has been mentioned that the existence of waste pickers in the area promotes waste separation practices at the household level (Guerrero et al. 2012).

In any case, investigations of the effect of sociodemographic factors on recycling behaviour, which strongly depends on the area in which the study is conducted, have pointed to both a causative relationship (Gilg et al. 2005) and inconsistent outcomes (Vicente and Reis 2008). It is worth mentioning that lifestyles, habits, cultural norms, and daily routines differ from one region to another, which may influence consumption rates and patterns and thus the population's attitude towards waste generation and handling practices (Purcell and Magette 2009). Consequently, we cannot generalise the sociodemographic variables that affect citizens' acceptance of waste sorting at source. According to Abd'Razack et al. (2017), Grazhdani (2016), Kamara (2009), Longe et al. (2009), Tsai (2008), and Zen et al. (2014), there is a positive relationship between the educational level of a family and their participation in municipal waste management activities and recycling programmes. In contrast, studies by Budak and Oğuz (2008), Do Valle et al. (2004), Momoh and Oladebeye (2010), Saphores et al. (2006), and Sidique et al. (2010) could not confirm the presence of a

positive correlation between education level and recycling participation.

Concerning family income, studies by Bandara et al. (2007), Jenkins et al. (2003), Kamara (2009), Longe et al. (2009), Matsumoto (2011), Sidique et al. (2010), and Tsai (2008) observed that the willingness of the community to take an interest in recycling programmes to save resources and protect the environment was strongly linked to people's incomes. On the other hand, Budak and Oğuz (2008) and Momoh and Oladebeye (2010) indicated that family income had no noteworthy impact on participation in recycling programmes.

Regarding household size, Abd'Razack et al. (2017), Nixon and Saphores (2009), Sidique et al. (2010), and Yau (2012) found a positive and direct relationship between household size and the intensity of waste recycling, where bigger households showed increased recycling participation. On the other hand, Budak and Oğuz (2008) and Valle et al. (2005) pointed out that household size does not influence recycling participation.

Turning to age as a factor, Atthirawong (2016), Barr and Gilg (2007), De Feo and De Gisi (2010), Steg and Vlek (2009), and Akil et al. (2015) found that age had a significant impact on recycling participation, and they concluded that older age groups were more likely to get involved in recycling activities. On the other hand, Abd'Razack et al. (2017), Budak and Oğuz (2008), Longe et al. (2009), and Momoh and Oladebeye (2010) indicated that age had no noteworthy impact on participation in recycling programmes.

In terms of gender, Li (2003), Longe et al. (2009), Matsumoto (2011), Otitoju (2014), and Poswa (2004) found that gender has a positive relationship with household attitudes, and they observed that women were more effective recyclers than men in the majority of families in the studied areas. On the contrary, Abd'Razack et al. (2017), Momoh and Oladebeye (2010), Steg and Vlek (2009), and Sidique et al. (2010) found that gender does not affect participation in recycling activities.

Also, inhabitants' attitudes regarding waste separation are influenced by the level of support for and investment in such activities by real estate firms, community residential committee involvement in public participation (Zhuang et al. 2008), and waste collection service fees based on volume or weight (Scheinberg et al. 2011). Tsai (2008) indicated that attitudes towards recycling are affected by opportunities, facilities, knowledge, and suitability. Zhang et al. (2015) found that subjective norms, intention, situational factors, and perceived behavioural control are critical factors influencing citizen behaviour. Also, social influences and altruistic and regulatory factors are some of the reasons why specific communities evolve well-established recycling habits where individuals who frequently take their waste to

containers are more likely to recycle some items at home (González-Torre and Adenso-Díaz 2005).

As for incentives, Wang et al. (2020) indicated that an incentive-based policy increases the probability that various actors will participate in recycling activities. Additionally, Yau (2012) indicated that the successful engagement of citizens in municipal solid waste management requires that authorities provide economic incentives to do so. Bilitewski (2008), Harder and Woodard (2007), Shaw and Maynard (2008), and Timlett and Williams (2008) found that a monetary incentive—where individuals who sort their waste pay less—may promote sorting behaviour. On the other hand, Abbott et al. (2013) found the opposite: that it was personal satisfaction—driven by personal altruistic values and a belief in positive behaviour—rather than an influence of monetary rewards that determined recycling behaviour.

Furthermore, the environmental awareness of citizens influences the success of municipal waste separation and recycling activities (Meen-Chee and Narayanan 2006; Miafodzyeva and Brandt 2013). Additionally, information on recycling is one of the most important drivers of public participation and consistent recycling behaviour (Iyer and Kashyap 2007; Otitoju 2014; Vicente and Reis 2008). In this regard, Barr and Gilg (2007) and Vicente and Reis (2008) indicated that increased awareness of the benefits of recycling and a greater understanding of the different classes of materials and proper disposal procedures lead to better participation in recycling activities by household members.

Syria is classified as a lower-middle-income developing country (Haydar and Pediaditi 2010), with a population of more than 18 million in 2017 and a total area of 185,180 km^2 (Almasri et al. 2011). Syria has been engaged in a protracted internal conflict since March 2011 that has resulted in the loss of human lives, significant displacement and migration, weakened social services, the destruction of basic social infrastructure, and losses of security and safety (JaberNoufal et al. 2020). Municipal solid waste management is becoming a troublesome issue for Syrian cities due to rapidly increasing waste generation and the complexity of the waste materials. The current situation presents clear problems such as rubbish accumulation, waste-clogged drains, illegal activities of waste pickers, a lack of waste containers, the dumping of waste on vacant lands, and damage to the waste management infrastructure in some areas. Additionally, a lack of research aimed at guaranteeing the efficiency of the waste management service has resulted in a lack of significant improvement in this service. The consequence of this is improper practices, such as an inability to gather enough waste and a strong dependence on dumpsites as a waste disposal method. This situation is made worse by financial limitations, the destruction of infrastructure, inadequate equipment, and low public awareness and participation. However, to adopt sustainable strategies for domestic

waste management, it is not enough to consider the technical dimensions of the problem; there is an urgent need to consider the different stakeholders involved, particularly households (JaberNoufal et al. 2020). Before the conflict, nearly all dumpsites in Syria were uncontrolled due to a lack of equipment, knowledge, and financial resources (Kasparek and Dimashki 2009). Generally speaking, there are no formal waste-sorting activities or formal recycling systems in Syrian cities. However, residents sometimes separate useful recyclable items (glass bottles, plastic containers, and metal cans) from daily domestic waste. On the other hand, the existing informal waste recycling system plays a significant role in the waste management system. Scavengers generally search for plastic bottles, cardboard, tins, and cans. However, the sorting of recyclable materials by scavengers at the dumpsite is performed in a primitive way and without any protective measures (Noufal et al. 2020b).

The active participation of different stakeholders in SWM is surely vital, as no real changes can be made without all of their involvement. Encouraging individuals or organisations to engage voluntarily and effectively in relevant initiatives is a big challenge that deserves further consideration from solid waste management authorities. In many regions of the world, communities still view themselves as passive recipients of municipal services, and are frequently ignored in decision-making processes at the local level. In the end, this methodology leads people to neglect the role they can play in the system. Despite the existence of many SWM techniques, public participation could be the missing piece needed to improve solid waste management. Although public participation may take a long time and is sometimes meaningless to people, it is difficult to achieve sustainable management without community participation. The economic and social situation of a household significantly influences its willingness to get involved in SWM. At various levels, the government must consider these factors before developing strategies to guarantee an acceptable degree of public participation. There has been no research to investigate the willingness of Syrian households to participate in waste separation programmes. This study aimed to explore the determinants of the willingness of household in Homs city (Syria) to practise waste separation at source if the authorities provide incentives to residents. However, the geographical scope of this study may be extended to other Syrian cities. Waste authorities and policymakers can take the outcomes of this paper into account when launching recycling programmes in Syria. The current study attempts to determine convenient strategies for SWM that suit the current circumstances in Syria, especially war-torn and postwar conditions. In addition, the study adds to the scarce scientific information on the sustainable management of municipal solid waste by the local population in the Syrian context. Thus, the study contributes to the application of

an integrated and sustainable approach to the SWM sector in developing countries. Therefore, this study should assist policymakers in formulating arrangements that effectively regulate SWM.

Materials and methods

Description of the research area

Homs city is the third-largest city in Syria; its population before the crisis was about 800,000 (UN-Habitat 2014). The city occupies a central and strategic location in the country's transportation network, linking all major urban centres, and is an important industrial centre. It is located in central-western Syria on the Orontes River about 192 km north of the capital Damascus and 96 km inland from the Mediterranean Sea, on a plateau 501 m above sea level. A Mediterranean climate characterised by a rainy winter and a hot, dry summer separated by two short transitional seasons generally prevails in Homs (WorldData.info 2019). Figure 1 shows the geographical location of Homs city.

In Homs city, both the public and the private sector collect municipal solid waste. According to Financing Law No. 1 for the year 1994, the cleanliness fee (garbage tax) for households in Homs city ranges between 1.50 and 6.00 USD/year (Antipolis 2000). The cleanliness fee for a household depends on the following considerations: (1) the district and level of income of the area in which the house is located; (2) the type and form of building that the household occupies; (3) the total tax income for the area; (4) ability to pay; and (5) the social level of the area. Waste collection is performed either communally or house to house. Waste service providers place containers/skips in various locations in the city. However, the number of bins provided is very small—not enough to cover all the residents in the city. Usually, people bring out their waste in plastic bags and bins and place it outside their house and at the sidewalk (Noufal et al. 2020a). In densely populated settlements in the city, common containers such as skip bins are used for the storage of waste. Figure 2 presents typical public collective containers that are currently in use in Homs city.

The city (in common with many Syrian cities) is one of the major urban centres affected by the crisis. The ongoing crisis is having a major impact on the city's housing, economy, infrastructure, and services. As usually happens in times of war, citizens from crisis hotspots and unsafe areas have been displaced to the city's safe districts (the same situation has occurred in other Syrian cities). The sudden increase in population in the city's secure areas has led to high waste generation in those areas, presenting a health issue and an environmental concern to the authorities (UN-Habitat 2014). The ongoing conflict has depleted the municipal solid waste management system due to the massive influx of displaced people and the devastation and destruction of the basic solid waste infrastructure. Heavy machines and equipment that were frequently used for waste management activities have been destroyed, looted, or have stopped working because of the need for maintenance or new spare parts. This has led to the accumulation of enormous
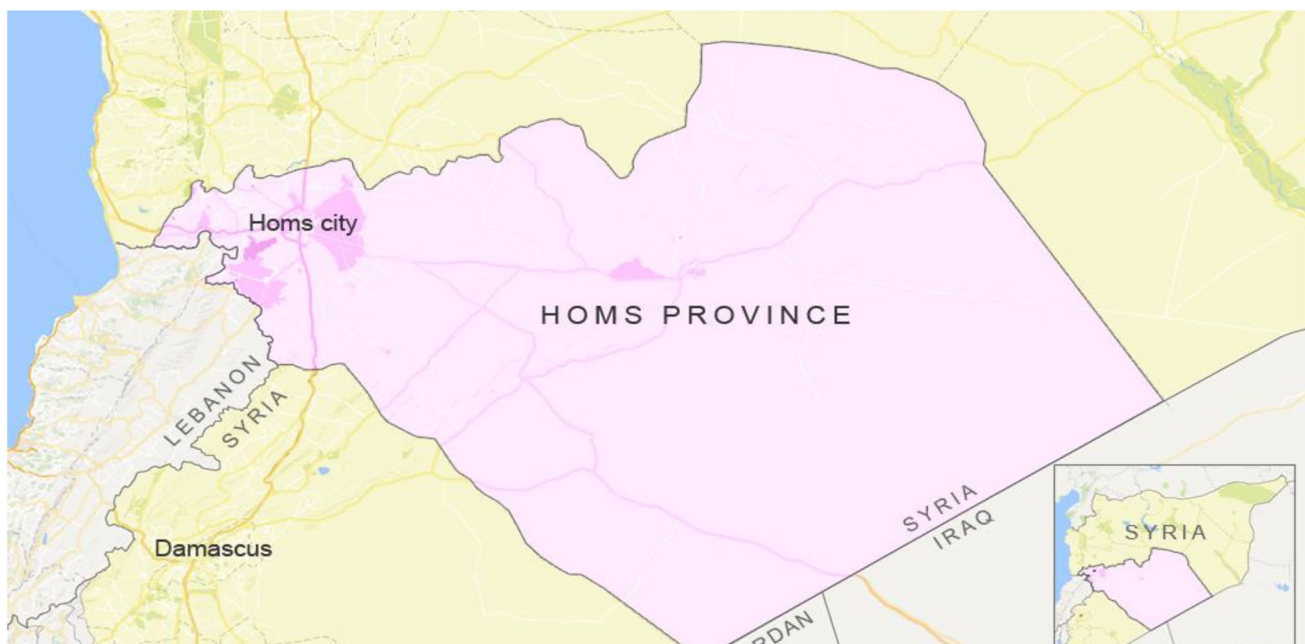

Fig. 1 The geographical location of Homs city (VOA News 2017)

Fig. 2 Typical public collective containers that are currently in use in Homs city (Noufal et al. 2020b)

quantities of garbage in roads and squares, exacerbating environmental and health concerns and further aggravating the harsh livelihood situation. Moreover, local authorities and residents have been forced to address the accumulation of waste through open burning or indiscriminate dumping (New Zealand Red Cross 2015). A Syrian multisector needs assessment indicated an increase in infectious diseases due to the breakdown in waste management services, as solid waste piles attract insects and lead to respiratory and skin problems (UN-OCHA 2014). Also, the mixing of the municipal waste with other kinds of wastes (medical and hazardous wastes) increases the risks to people dealing with the waste. The World Health Organization (WHO) confirmed these worries in 2013 when it declared that "waste accumulations in streets are breeding sites for pests such as mosquitoes, flies and mice that could transmit many diseases such as leishmaniasis, causing epidemics and outbreaks, particularly in emergency and conflict situations" (IRIN 2013).

Methodology

A questionnaire was employed to gather information related to the willingness of inhabitants of the study zone to participate in waste separation. The purpose was to gain in-depth knowledge of the socioeconomic characteristics of the households in the study zone and the availability of waste collection services there as well as to probe the knowledge of those households about the benefits of waste separation and their environmental awareness and concern. The questionnaire was initially written in English before being translated into Arabic to assist the respondents, enhance the response rate, and ensure that the answers given were exact. The questionnaire surveyed 300 families who participated in the study. The study targeted families residing in four zones (which were relatively safe during the study period) in Homs city, as shown in Table 1.

Empirical model

In our study, the logit regression model was used to explore the determinants of household willingness to practise waste separation at source if the authorities provide incentives to residents. To explain the variation in waste separation practices, a logistic regression model was used in which the dependent variable (household willingness to separate) was regressed as a function of demographic and social-cultural factors (the explanatory variables). The dependent variable

Table 1 Households selected for the study

Area	Neighbourhoods	Number of participants	Residential status
Zone 1	Al Sabil, Al-Muhajireen, Al Abbasiah, Al Zahra, and Al Arman	75	Low-income areas
Zone 2	Wadi Aldahab, New Akrama, Karam el-Zeitoun, and Karam el-Looz	75	Lower-middle-income areas
Zone 3	Al Inshaat, Al Mahatta, and Al Shammas	75	Upper-middle-income areas
Zone 4	Al Ghouta and Al Boughtassia	75	High-income areas

was designed to be dichotomous: willing to separate waste or not, according to the household's self-reported data on its waste segregation practices. Variables in the logistic regression were estimated using the maximum likelihood (ML) method. The likelihood ratio index was measured as an indicator of goodness of fit for the logistic regression model. The basic model for binary logistic analysis with only one predictor variable is as follows:

$$P_i = \frac{1}{1 + e^{-(\beta_0 + x_1\beta_1 + \varepsilon)}}.$$

As with linear regression, the simple logistic regression equation with only one independent variable can be extended to include many independent variables (Field 2005). Hence, the multivariate logistic regression equation can be specified as shown below:

$$P_i = \frac{1}{1 + e^{-(\beta_0 + x_i\beta_i + \varepsilon)}},$$

where P_i is the probability that the household will participate in domestic waste separation activities ($P_i = 1$ if the household is willing to participate in waste separation and $P_i = 0$ otherwise); β_0 is a constant, x_i represents a set of explanatory variables that can influence household willingness to participate in waste separation (i.e. the independent variables); β_i represents the set of coefficients for the predictors (the independent variables); i is the number of observations; and ε is the the residual term.

The independent variables used in this study were household size, monthly income, house ownership, education level, gender and age of the head of the household, availability of a waste collection service, knowledge about the benefits of waste separation, and environmental awareness and concern.

Data analysis

Data obtained from the questionnaire survey study were analysed using the Statistical Package for the Social Sciences (SPSS). Some of the data from the questionnaire survey were nominal in nature. As per Field (2000) and Tabachnick and Fidell (2001), such data are best analysed using inferential (correlation and regression models) and descriptive statistics. Initially, the data were subjected to a test for normality, which indicated whether the data were approximately normally distributed. Descriptive statistics were then assembled, as the variables were nominal and ordinal. The analysis of such rating data was done using parametric statistical tests (chi-square tests).

Moreover, binary logistic regression was applied to determine the factors that significantly influence household willingness to participate in waste separation activities at the source. Basically, our study focused on the variables that are expected to impact household willingness to participate in waste separation programmes. Other variables that were related to the self-reported environmental attitudes of the respondents and were derived from the survey data were also added to the model. The independent variables used in this study were household size, monthly income, house ownership, education level, gender and age of the head of the household, availability of a waste collection service, knowledge about the benefits of waste separation, and environmental awareness and concern. It has been suggested that logistic regression should be used to model the relationship between the results and the group of predictors because the dependent variable is binary (Hosner and Lemeshow 1989). When a dependent variable is binary, a nonlinear response is produced, violating the assumptions of classical linear regression (Field 2005). Besides, given its ability to model predictors with categorical responses, logistic regression is an attractive research method for researchers who often have to deal with discrete categories of phenomena rather than absolute numerical values (Agresti 2002).

Results and discussion

Socioeconomic characteristics of the target households

As shown in Table 2, 44 (14.67%) households consisted of 1–3 people, 135 (45.00%) households consisted of 4–6 people, and 121 (40.33%) households included more than 6 people. Concerning the monthly income, only 9 respondents (3.00%) earned less than 50,000 SYP per month, 135 respondents (45.00%) earned between 50,001 and 100,000 SYP per month, and 108 respondents (36.00%) earned between 100,001 and 150,000 SYP per month. On the other hand, 108 respondents (14.00%) earned between 150,001 and 200,000 SYP per month, and the remaining 6 respondents (2.00%) earned more than 200,000 SYP. Regarding education level, 156 (52.00%) respondents had a high school certificate or less. On the other hand, 129 (43.00%) respondents were educated to university or institute level, and only 15 (5.00%) participants were educated to postgraduate level.

The gender distribution of the head of the household in the sample was 179 (59.67%) males and 121 (40.33%) females. Turning to the age of the head of the household, 43 (14.33%) participants were aged between 18 and 30 years, 100 (33.33%) respondents were between 31 and 45 years old, 122 (40.67%) respondents were between 46 and 60 years old, and the remaining 35 (11.67%) respondents were more than 60 years old. Concerning house ownership, 45 (15.00%)

Table 2 Summary of the independent variables employed in this study

Variable	Description	Frequency	%
Household size (member)	1–3	44	14.67
	4–6	135	45.00
	>6	121	40.33
Monthly income (SYP)	Less than 50,000	9	3.00
	50,001–100,000	135	45.00
	100,001–150,000	108	36.00
	150,001–200,000	42	14.00
	More than 200,000	6	2.00
Education level	Until high school	156	52.00
	College/institute	129	43.00
	Postgraduate	15	5.00
Gender of the head of the household	Male	121	40.33
	Female	179	59.67
Age of the head of the household (years)	18–30	43	14.33
	31–45	100	33.33
	45–60	122	40.67
	>60	35	11.67
House ownership	Tenant	45	15.00
	Homeowner	255	85.00
Environmental awareness and concern	Yes	260	86.67
	No	40	13.33
Knowledge about the benefts of waste separation	Yes	126	42.00
	No	174	58.00
Availability of a waste collection service	Yes	255	85.00
	No	45	15.00

1 USD = 438 SYP (Central Bank of Syria 2019)

participants lived in a rented house and 255 (85.00%) respondents owned their own house.

Most of the respondents (260 or 86.67%) were aware of the negative impacts of inappropriate handling of waste. On the other hand, only 126 (42.00%) participants were aware of the benefits of waste separation. Moreover, the respondents were asked whether a waste collection service was available in their area. The answers revealed that a collection service was available to 85.00% of the respondents.

Chi-square test results

A chi-square test was carried out to define the degree of association between residential districts and other variables, including the socioeconomic characteristics of the

Table 3 Chi-square test results for the relationships between selected variables and residential district

Variables	Pearson's chi-square		
	Value	df	Asymptotic significance
Household size	0.67	6	0.99
Monthly income	19.92	12	0.06
Education level	3.37	6	0.76
Gender of the head of the household	48.57	3	0.00
Age of the head of the household	6.28	9	0.71
House ownership	4.05	3	0.25
Environmental awareness and concern	1.61	3	0.65
Knowledge about the benefits of waste separation	8.59	3	0.13
Availability of a waste collection service	6.14	3	0.10

target households. As shown in Table 3, there was a strong and statistically significant relationship between residential district and gender of the head of the household ($p > 0.05$). This can be attributed to the fact that there are many widows in zones 1 and 2 who lost their husbands during the crisis (their husbands were martyrs or were kidnapped), so many families are currently headed by women. On the other hand, there was no strong and statistically significant relationship between residential district and any other variable ($p > 0.05$).

Results of the logit regression analysis

The results from the logit regression model are presented in Table 4. The combined dataset included data from 300 households ($n = 300$). The log-likelihood for this fitted model is -185.590, and the likelihood ratio (LR) chi-square of 191.24 (df $= 16$) with a p value of 0.00 (significant at 1.00%) indicates that this model is statistically significant and as a whole fits the data significantly better than an empty model (i.e. one with only the dependent variable).

The variance explained by the predictors in the model was also high when using Cox and Snell and Nagelkerke pseudo-R^2 statistics (0.471 and 0.812, respectively). In other words, 47.10–81.20% of the variance in household willingness to

separate waste was explained by the explanatory variables. Also, the Hosmer and Lemeshow goodness-of-fit test (p value 0.98, i.e. > 0.05) confirmed that the model was significant, and the fit achieved by the model improved when the explanatory variables were included.

As shown in Table 4, monthly income, household size, age of the head of the household, gender of the head of the household, house ownership, knowledge about the benefits of waste separation, and environmental awareness and concern all statistically significantly influence household willingness to participate in waste separation activities. On the other hand, availability of a waste collection service and education level do not exert any statistically significant influence on household willingness to separate waste.

The effects of individual variables were examined by holding all covariates constant. Households with multiple occupants (4–6 persons) were found to be slightly (0.008 times) more likely to practise waste separation at source than households consisting of 1–3 persons (households with > 6 people were not statistically significant). Similarly, monthly income had a positive coefficient and was slightly statistically significant at the 10% level. Most of the household income groups were more likely to segregate waste than households with the lowest annual household income (the

Table 4 Results of the logistic regression analysis

	B	S.E.	df	Sig.	Exp(B)	95% CI for EXP(B)	
						Lower	Upper
Monthly income			4	0.06*			
Monthly income (1)	5.51	3.00	1	0.06*	247.98	0.68	90292.04
Monthly income (2)	5.90	2.69	1	0.02**	366.35	1.87	71699.01
Monthly income (3)	2.41	2.28	1	0.29	11.21	0.12	987.71
Monthly income (4)	4.89	2.68	1	0.06*	133.34	0.68	25916.79
Availability of a waste collection service	1.16	1.30	1	0.37	3.21	0.24	41.61
Household size			2	0.06*			
Household size (1)	4.80	2.06	1	0.02**	0.008	0.00	0.47
Household size (2)	1.28	0.84	1	0.12	0.27	0.05	1.44
Age			3	0.01**			
Age (1)	5.17	2.11	1	0.01**	177.28	2.81	11172.42
Age (2)	4.15	1.35	1	0.002**	63.76	4.48	907.18
Age (3)	3.41	1.07	1	0.002**	30.32	3.68	249.71
House ownership	4.47	1.19	1	0.000***	87.53	8.48	903.07
Knowledge about the benefits of waste separation	3.65	0.91	1	0.000***	38.49	6.43	230.35
Environmental awareness and concern	3.66	0.84	1	0.000***	39.05	7.53	202.43
Gender	3.13	0.87	1	0.000***	23.03	4.17	126.98
Education level			2	0.28			
Education level (1)	-3.13	4.24	1	0.46	0.04	0.00	179.04
Education level (2)	-1.42	4.09	1	0.72	0.24	0.00	739.04
Constant	-11.09	5.50	1	0.04	0.00		

Number of observations $= 300$; LR $\chi^2(16) = 191.24$, $P = 0.000 < 0.05$; log likelihood $= -69.21$; and pseudo-$R^2 = 0.812$

* Significant at 10%; ** significant at 5%; and *** significant at 1%

150,000–200,000 SYP income group was not statistically significant). This result can be attributed to the fact that households who earn a higher income tend to consume more products than those with low-income earners, thus producing more waste. However, those with higher-income earners are likely to access a wider range of media through which they become aware of environmental issues compared to low-income earners. Martin et al. (2006), Kamara (2009), and Lee and Paik (2011) also support the idea that there is a positive relationship between income and waste recycling behaviour. In addition, with regard to the predictive effect of family income on participation in environmental development programmes, several studies have shown that households with higher income levels are more likely to engage in environmental development programmes (Afroz et al. 2011).

Age has a positive coefficient and is statistically significant at the 5% level. Households headed by older people were more likely to separate waste than those headed by younger people. This can be linked to the opportunity and amount of time that old and retired people have to engage in waste separation practices, since recycling is a time-intensive activity. Martin et al. (2006), Lee and Paik (2011), and De Feo and De Gisi (2010) also supported the idea that there is a positive relationship between age and waste recycling behaviour.

Gender has a positive coefficient and is statistically significant at the 1% level, and this relationship was also reported by Otitoju (2014) and Lee and Paik (2011). This indicates that a female head of household is 23.03 times more likely to practise waste separation at source than a male head of household. Women engage more readily in pro-environment behaviour and are more involved in waste-related activities, so this result can be explained by the fact that females handle house duties and know and decide what is useful and what constitutes waste.

House ownership has a positive coefficient and is slightly statistically significant at the 10% level. In other words, families living in a residential property that they own were 87.53 times more likely to practise waste separation at source than those who live in rented houses. During the study, it was noticed that families living in their own homes cared more about their surroundings and are therefore more careful to maintain the cleanliness of those surroundings, which may affect their waste-related behaviour. On the contrary, tenants may not care much about their surroundings because they do not have a strong feeling of belonging to their residence; that they are only temporarily residing there.

Knowledge about the benefits of waste separation has a positive coefficient and is statistically significant at the 1% level. This implies that households with knowledge about the benefits of waste separation are 38.49 times more likely to practise waste separation at source than those who do not have that knowledge. Likewise, environmental awareness

has a positive coefficient and is statistically significant at the 1% level. This means that households that are aware of the harmful effects of solid waste on the environment are 39.05 times more likely to practice waste separation at source than those who are not aware of it. This result is consistent with the findings of Barr and Gilg (2001) and Do Valle et al. (2004). However, special knowledge in terms of an understanding of the different classes of materials and the benefits of waste separation is an important prerequisite for participating in recycling activities. When citizens receive information about the benefits of recycling and how waste is sorted, they are more likely to participate in recycling campaigns. The initiation of such programmes is essential to quickly educate the public and facilitate the development of environmentally friendly community waste behaviour. To be successful, beneficial programmes should be designed to increase not only the environmental knowledge of their target audiences but also their environmental attitudes, behaviour, and skills.

Likewise, environmental awareness has a positive coefficient and is statistically significant at the 1% level. Families that are aware of the harmful implications of waste for the environment are 39.05 times more likely to practise waste separation at source than those unaware of it. Environmental concern helps drive people to search for solutions to the ever-increasing problem of waste in their areas. Those individuals with more positive general environmental values and attitudes are more likely to express a higher level of recycling behaviour. This positive correlation is consistent with the results of Desa et al. (2011) and Miafodzyeva and Brandt (2013). Environmental awareness and concern influence people's recycling behaviour and therefore the success of a recycling programme, which could also affect waste separation at the household level.

Education level did not statistically significantly explain household willingness to be involved in waste segregation activities. In this context, higher education is usually related to a higher level of awareness of environmental issues. However, sometimes the opposite relation is observed because education is cumulative (it increases with the new graduates every year) whereas environmental awareness does not increase at the same pace (Oribe-Garcia et al. 2015). Moreover, some people may possess a high environmental awareness (for instance, the willingness to separate waste at source) despite having low educational attainment.

It is very useful to separate recyclable waste (at source) from mainstream waste, especially in developing countries, as this can provide income and reduce the burden on landfills in cities. The most popular recyclable materials are glass jars and plastic containers. Families believe that these materials could be reutilised, which is the primary motivation for separating them from the rest of the waste materials. A few households revealed that they set plastic and glass waste

aside for waste pickers so that waste pickers will not need to sort through the waste themselves, which can cause them to scatter other waste materials in the local area.

Waste separation at source (at the household level) is more straightforward, easier, and more effective than separation at the final disposal site. Also, it reduces both the cost of separation and the pollution of recyclable materials sent to the industrial facilities. Consequently, it is imperative to explore waste separation practices at source. As waste separation at source is a priority, monetary incentives should be given to encourage people to separate their waste. Reward plans and incentive systems contribute to people's awareness of and motivation for waste separation, reducing waste. Thus, the national government and local authorities need to work together to provide incentives and awareness programmes and improve waste separation practices at source. Also, policies and legislation should be formulated to raise awareness, enhance knowledge, and motivate residents regarding the environment and waste management practices. However, it is hard to measure the actual quantity of waste separation, as families were asked to separate their waste for the study. Moreover, real attitudes are tricky to detect in studies such as this, as households tend to separate their trash for the study period only. Thus, national and local authorities (through awareness campaigns) should strengthen the households' selfreported behaviour regarding waste separation at the source.

Conclusions

Like any other city in a developing country, Homs city is witnessing an increase in the amount of waste generated. However, there is a lack of the information, knowledge, infrastructure, and resources needed to establish an effective waste management strategy. This study was performed to highlight the importance of waste separation at source in effective waste management and to identify the determinants of household willingness to separate waste. The study utilised a questionnaire survey to identify the opinions of citizens in Homs city regarding public incentives as a means to encourage waste separation practices at the source. This study found that monthly income, household size, age of the head of the household, gender of the head of the household, house ownership, knowledge about the benefits of waste separation, and environmental awareness and concern statistically significantly influence household willingness to separate waste.

The Syrian government needs to move to a sustainable waste management approach and a circular economy, and the initial steps needed to achieve this are the implementation of waste separation and recycling programmes. The success of waste separation and recycling programmes depends not only on citizen participation but also on the availability of the necessary infrastructure and adequate information and the presence of a proper fee system. In this regard, it is important to have a well-designed charging system for a waste collection service, as economic instruments—especially charges—have been shown to motivate people to reduce, separate, and recycle waste around the world. In addition, it is proposed that municipal authorities should ask residents to separate their wastes into compostable materials and recyclable materials to improve existing recycling programmes and encourage composting practices. In this context, local authorities should facilitate the collection of recyclable materials and provide the necessary equipment; for example, colouring and tagging different bags, making selective boxes available, and setting up recycling points to avoid waste mixing and to conserve the separated recyclable materials. Also, it is vital to regulate and encourage the recycling industry, research the materials markets, and develop standards for necessary facilities and equipment. Moreover, an extensive awareness-raising programme for all citizens on good practices in solid waste management is needed. Preventive measures that consist of adopting eco-responsible behaviours and attitudes that make it possible to sort, selectively collect, and recover wastes are urgently needed. Hence, the authorities should raise citizens' environmental awareness through environmental education and training and awareness programmes that progressively instil ideas, which are trailed by actions. Local authorities can prioritise the implementation of waste separation strategies in regions where residents have high environmental awareness and good knowledge of the benefits of waste separation so that the policy will be supported by the people in those regions.

The current study covers a small part of a big challenge to study the options for improving municipal solid waste management in Syria; moreover, this research work points to opportunities for further research. Studies that summarise the barriers and challenges encountered when the private sector (formal and informal) and other actors (NGOs and CBOs) attempt to conduct suitable recycling practices are highly recommended, as the participation of these players is necessary if the system's effectiveness is to be improved. In addition, new studies are needed to identify sources that can be utilised to fund SWM activities. Moreover, it is vital to research why public participation in waste management is not common in Syrian culture.

Declarations

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