



# A review of residential solid waste management in the occupied Palestinian Territory: a window for improvement?

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Solid waste is considered an urgent environmental health issue in the Palestinian Territory. The aim of this paper was to analyse the current status of residential solid waste (RSW) management in the Palestinian Territory, with the objective of identifying windows for improvement. The study is based on a national household sample survey in the Palestinian Territory, which was conducted by the Palestinian Central Bureau of Statistics (PCBS). The results of this study revealed various interesting trends. For example, while about 90% of households in the Palestinian Territory receive solid waste collection service, about 50% of the households receive this service three times per week or less, leaving a chance for waste pile-up and litter generation. Organic waste (including food waste) was found to account for more than 90% of RSW, providing an opportunity for waste utilization through composting or biogas generation. Additional efforts are required, and some were suggested in this paper, in order to improve the current situation of Palestinian residential solid waste management.

**Keywords:** residential solid waste, waste management, waste composition, dumping sites, Palestinian territory

## Introduction

Municipal solid waste (MSW) refers to solid wastes from homes, streets and public places, shops, offices, and hospitals, which are very often the responsibility of municipal or other governmental authorities for collection, transport and final disposal. The source classification of other waste materials considers three divisions: urban, industrial and rural, where each one is represented as a discrete entity. From these divisions, several types of MSW can be derived which are: residential waste, commercial waste, institutional and service waste, construction-and-demolition waste, industrial waste, and agricultural and animal husbandry waste (Medina 2006, Vesilind *et al.* 2002). The handling and disposal of MSW is a growing concern as the global volume of waste increases continuously (Elliott *et al.* 2001, Berkun *et al.* 2005, Center for Sustainable Systems 2006). Increased urbanization, accelerated industrial growth, as well as the introduction of harmful wastes that are hazardous to public health and the environ-

ment, are the main factors providing the reason for the urgent need for MSW management at the local, regional, and global level (Mwanthi *et al.* 1997, Rushton 2003, Dyson & Chang 2005, Talahmeh 2005, Chung & Lo 2008, Batool & Ch 2009). Waste materials that are not properly managed, especially excreta and other liquid and solid waste materials from households, etc. are serious health hazards and lead to the spread of infectious diseases (Ayomoh *et al.* 2008). Unattended waste lying around attracts flies, rats, and other creatures that in turn spread disease (Sharholy 2008). Normally, wet exposed waste decomposes and releases a bad odour. This leads to unhygienic conditions and thereby to a rise in health problems (Edugreen 2006). Moreover, collection workers who work with uncontained waste containing chemicals and metals may experience toxic exposure or injuries (Edugreen 2006).

Solid waste management in developing countries has received less attention from policy makers and academics

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than that paid to other urban environmental problems. Collecting, transporting and disposing of MSW represent a major expenditure for Third World cities; waste management usually accounts for 30–50% of municipal operational budgets (Supriyadi & Kriwoken 2000, WHO 2002, Mbuligwe 2004, Zurbrugg *et al.* 2004, Abu Qdais 2007). Developing countries suffer solid waste management problems including a weak control system, lack of interest and concerns for the environmental situation and its relation to health in general, in addition to the spread of corruption – a matter which makes these countries the destination for waste from industrialized countries, whether by prior agreement and approval or not (Johannessen & Boyer 2000, Broomfield *et al.* 2006, Tinmaz & Demir 2006, Zurbrugg 2006). The waste stream of any city within the developing countries with low income levels contains a high proportion of organic material, which makes the composting options appear to be the most appropriate and economical solution (Augenstein *et al.* 1996, Venatasawm *et al.* 2000, Hehn *et al.* 2000).

The aim of this paper was to analyse the residential solid waste (RSW) management practices in the Palestinian Territory with regard to its generation rate, main components, level of waste collection service coverage, service providers, frequency of collection, and methods of final waste disposal. The occupied Palestinian territories, which had a projected population of about 4 016 000 in 2007 (PCBS 1999), has received little attention in the international waste management literature, despite its worse-than-ever solid waste problems, complicated by an array of economical, social and political conditions. Hence, it is hoped that the findings presented in this paper will identify windows of opportunity for RSW management improvement in this stressed part of the world.

## Methodology

This study was based on a national household sample survey in the Palestinian Territory, which was conducted by the Palestinian Central Bureau of Statistics (PCBS) in 2005 (PCBS 2005). In general, the survey provides basic statistics on various aspects of the Palestinian environment including solid waste. After conducting the survey, it is the PCBS policy to make the raw data available to local researchers who analyse and discuss the results in independent publications. The authors obtained the data presented in this study directly from PCBS.

The sample covered by the national survey was a two-stage stratified cluster random sample. The target population was all households in the Palestinian territory (West Bank and Gaza Strip). The sampling frame consisted of a master sample chosen from the Palestinian census of 1997. This master sample comprises geographical areas closed in size (number of households), which coincided with the enumeration of areas used in the census. This frame was used as the primary sampling units (PSUs) in the first stage of selection. In the second stage, a choice of a random uniform sample of households in each enumeration area was made, in

which 16 households were chosen in each. The total sample size for this study was 4073 Palestinian households in both the West Bank and Gaza Strip.

Fieldwork was the largest part in the cycle of the survey. It included providing logistical and technical support in order to ensure high-quality performance during the survey stages. Field operations started on 14 May and ended on 7 July 2005. The reference period was April 2005. The data collection tool was a questionnaire that included independent questions about the respondent's region followed by questions related to RSW management. The latter included questions on the household size (persons per household); daily RSW generation rates and main components of RSW collected (baby diapers, food waste, paper and cardboards, plastic, metals and agricultural waste); the party responsible for collection in the respondent's area [(household member, local Palestinian municipality, The United Nations Relief and Work Agency for Palestine Refugees in the Near East (UNRWA), household member in addition to one of the other parties, or private contractor]; frequency of collection; fate (i.e. disposal options) of RSW in areas not covered by a waste collection service; and the distance from the respondent's residence to the nearest waste collection container or dumping site. Analysis of data was performed by the use of Statistical Package for Social Sciences (SPSS) computer program version 11.0. Descriptive statistics such as means and ranges were computed.

## Results and discussion

### RSW generation and composition

Table 1 shows the daily generation rates for residential solid waste in various regions of the Palestinian territory. The average per capita RSW generation rate was 0.6–0.8 kg day<sup>-1</sup>, which is similar to those in other developing countries (Supriyadi & Kriwoken 2000, Zurbrugg *et al.* 2004). Households in the Gaza Strip, which have, on average, larger family sizes and lower income levels than their counterparts in the West Bank, were observed to produce less waste per capita, and more per household. The opposite was true for the middle and northern parts of the West Bank, with the highest income levels and smallest household size (PCBS 1999), where higher RSW generation rates per capita were observed. Other studies have shown that the municipal solid waste generation rate tends to go up as income increases (Medina 2006). Table 2 provides a break-down of RSW quantities produced daily per household by region. Approximately 36 to 54% of households in both West Bank and Gaza Strip produced more than 4 kg solid waste daily, whereas only 10% of all households produced more than 7 kg of waste per day. The greatest percentage (about 64% in the West bank and 46% in Gaza Strip) of households produced less than 4 kg of waste per day. It was interesting to see that in the southern part of the West bank, which has the second largest household size (Table 1) but is also known to be more economically-stressed than the rest of the West Bank, the amount of RSW produced was less than 4 kg day<sup>-1</sup> household<sup>-1</sup>, for the vast majority

Table 1: Daily generation rates for RSW in the Palestinian Territories.<sup>a</sup>

Region	Total population in 2005 <sup>b</sup>	Average household size <sup>b</sup> (persons)	Quantity of RSW produced daily (ton)	Average RSW produced daily per household (kg)	Average RSW produced daily per capita (kg)
Palestinian Territory	3 762 000	6.3	2728.30	4.6	0.7
West Bank	2 372 216	6.0	1722.10	4.4	0.7
North of West Bank	993 636	6.1	765.1	4.7	0.8
Middle of West Bank	704 683	5.8	556.7	4.5	0.8
South of West Bank	673 897	6.3	400.3	3.7	0.6
Gaza Strip	1 389 789	6.9	1006.20	5	0.7

<sup>a</sup>PCBS (2005).<sup>b</sup>PCBS (1999).Table 2: Distribution of daily generation rate of RSW of households in the Palestinian territory.<sup>a</sup>

Region	Percentage of households producing:			Total
	less than 4 kg RSW daily	4–7 kg RSW daily	more than 7 kg RSW daily	
Palestinian Territory	57.8	31.6	10.6	100.0
West Bank	63.8	27.0	9.2	100.0
North of West Bank	57.8	30.6	11.6	100.0
Middle of West Bank	63.2	25.3	11.5	100.0
South of West Bank	73.5	23.6	2.9	100.0
Gaza Strip	45.9	40.6	13.5	100.0

<sup>a</sup>PCBS (2005).Table 3: RSW composition in the Palestinian territory.<sup>a</sup>

Region	RSW components (%)				Total
	Baby napkins	Food waste	Paper and cardboard	Plastic	
Palestinian Territory	16.5	81.3	1.8	0.4	100
West Bank	18.5	78.3	2.7	0.5	100
North of West Bank	20.3	73.9	4.8	1	100
Middle of West Bank	22.2	76.2	1.5	0.1	100
South of West Bank	11.5	87.5	1.0	0	100
Gaza Strip	12.7	87.2	0.1	0	100

<sup>a</sup>PCBS (2005).

(74%) of households. Very few households (3% only) exceeded 7 kg day<sup>-1</sup> in this area.

As shown in Table 3, the most dominant component of RSW in both the West Bank and Gaza Strip was food waste which accounted for about 81% of RSW, followed by baby diapers (16.5% of RSW). This means that most Palestinian RSW is of organic origin. Similar findings were also highlighted in several studies in the literature, showing that waste generated in developing countries contains a large percentage of organic materials (Medina 2006). Paper/cardboard and plastic waste came in third and fourth place, with average fractions of 1.8 and 0.4% of all RSW, respectively. Although residential agricultural waste (waste from home-grown plants and home-raised animals) and metal waste were on the sur-

vey list of potential RSW components, a negligible fraction of respondents considered these two components to be of significance in their discarded RSW. It is likely that many Palestinian families generated residential agricultural waste (especially in villages), and so the data gathered clearly indicated that Palestinian residents disposed or recycled this waste in-house (e.g., animal manure used as fertilizer for home-grown plants). It is worthwhile noticing from Table 3 that food waste constituted a higher fraction of RSW in the two economically-stressed regions, southern West Bank and Gaza Strip. The food waste fraction in these two regions, about 87% in each, was higher than the overall average for the Palestinian territory (81%). Again, this conforms to a well known global trend of higher food waste content in

RSW, in comparison with paper, metal and plastics, in economically-disadvantaged regions. By contrast, in an earlier study on the Ramallah/Al-Bireh Governorate (the wealthiest governorates of the Palestinian territory), conducted by the German KfW organization (KfW 2005), it was found that waste composition was estimated to be 56% organics, 30% inorganics (glass, metals, plastics, paper, cardboard) and 14% fines and miscellaneous wastes (the latter could also include an organic fraction).

The high organic content of RSW in Palestine provides a window of opportunity for RSW recycling through composting and/or biogas production via anaerobic digestion. Compost can be made by aerobic processes as an end product and the volume of organic material in municipal solid waste can be significantly reduced, thus reducing the waste volume that needs to be landfilled (Massoud *et al.* 2003). Organic wastes are frequently recycled to produce compost products in many developing countries. For example, community-based organizations managed by women recycle market waste in Kenya to produce organic manure for sale (UNEP 2006). In recent years, some Palestinian farmers have experimented with the composting process, as individual initiatives, and produced good quality compost. Another pioneering project was launched by the Nablus municipality (northern West Bank), which started municipal solid waste segregation in 2008. Under this project, organic waste components are composted into soil enhancers and sold to Palestinian farmers, generating income for the municipality and significantly reducing the cost of waste landfilling. In fact, some non-profit organizations acting in the Palestinian territory, such as KfW (KfW 2005), have gone beyond suggesting the need for reuse/recycle options to providing preliminary plans for specific technologies to be used that suits the particular solid waste status. Unfortunately, the national policy and incentives regarding solid waste recycling in the occupied Palestinian Territory are poor. This contributes to an increase of solid waste problems; at a time when recycling of waste products including organics, paper, tyres, plastics, used clothes and metals is becoming increasingly popular throughout the world.

### RSW collection

Table 4 shows that local authorities collected solid waste from 68.9% of households in the Palestinian Territory, followed by the United Nations Relief and Works Agency for Palestinian Refugees in the Near East (UNRWA), which is responsible for waste collection from 11.9% of households, mainly in the refugee camps areas. It is noted that the activities of UNRWA were more widespread in the Gaza Strip than in the West Bank, which is attributed to the higher percentage of Palestinian refugees in the former. About 9% of households were not serviced by RSW collection and therefore the disposal of their waste was by a household member. A further 1.4% of all households were partially covered by waste collection services, bringing the total unserved or partially serviced households to about 10.7%. In the Middle West Bank region, about 34% of households were serviced by the Israeli Jerusalem Municipality. In some remote areas of the West Bank (1.7%) and Gaza Strip (0.8%) residents of villages hired private contractors to handle their RSW collection. The overall availability of RSW collection services in the Palestinian territory (89%) is reasonably good and is better than many other parts of the developing world. This was emphasized by World Resources Institute and United States Agency for International Development, as many local authorities in developing countries spend over 30% of their budgets on refuse collection and disposal but can only collect at most 50–70% of the municipal solid waste (Henry *et al.* 2006).

The frequency of solid waste collection varied widely in the Palestinian territory, as shown in Table 5. For example, while 50% of all Palestinian households received RSW collection service three times or less per week, 59% of households in Gaza Strip received waste collection service four to six times per week, whereas only 32% of households in West Bank were provided with a service at this frequency. This finding could be attributed to the overcrowding and population density in the Gaza Strip, meaning that frequent RSW collection is necessary to prevent rapid waste accumulation. Nearly 80% of households serviced by UNRWA for the collection of their RSW in both West Bank and Gaza Strip received this service four to six times per week, as shown in

Table 4: Parties in charge of RSW collection and transfer in the Palestinian territory.<sup>a</sup>

Region	Household member (%)	Local Palestinian municipality (%)	UNRWA <sup>b</sup> (%)	Household member in addition to one of the other parties (%)	Private contractor (%)	Other (%)	Total (%)
Palestinian Territory	9.3	68.9	11.9	1.4	1.4	7.1	100
West Bank	8.7	71.4	6.2	1.3	1.7	10.7	100
North of West Bank	10.9	78	7.6	2.5	1	0	100
Middle of West Bank	1.7	54	6.2	0.2	4.1	33.8 <sup>c</sup>	100
South of West Bank	13.4	81.7	4.1	0.8	0	0	100
Gaza Strip	10.4	63.9	23.1	1.8	0.8	0	100

<sup>a</sup>PCBS (2005).

<sup>b</sup>UNRWA, The United Nations Relief and Work Agency for Palestine Refugees in the Near East.

<sup>c</sup>The high percentage is because the Israeli Jerusalem municipality collects a major part of the households' solid waste in the central West Bank region.

Table 5: Frequency of weekly RSW collection in the Palestinian territory.<sup>a</sup>

Region	Number of collections			Total (%)
	3 or less per week (%)	4–6 per week (%)	7 per week (%)	
Palestinian Territory	49.5	40.4	10.1	100
West Bank	60.5	31.9	7.6	100
North of West Bank	55.1	29.2	15.7	100
Middle of West Bank	64.7	34.5	0.8	100
South of West Bank	65.2	33.7	1.1	100
Gaza Strip	25.3	59	15.7	100

<sup>a</sup>PCBS (2005).Table 6: Frequency of weekly RSW collection from households served by UNRWA in the Palestinian territory<sup>a</sup>

Region	Number of collections			Total (%)
	3 or less per week (%)	4–6 per week (%)	7 per week (%)	
Palestinian Territory	6.5	79.6	13.9	100
West Bank	6.3	87	6.7	100
North of West Bank	5.8	80.8	13.4	100
Middle of West Bank	2.5	97.5	0	100
South of West Bank	14.2	85.8	0.0	100
Gaza Strip	6.5	75.8	17.7	100

<sup>a</sup>PCBS (2005).

Table 6. The frequency of solid waste collection by UNRWA was approximately the same for both West Bank and Gaza Strip (as indicated by Table 6), which reflects the centralized decision-making mechanism of UNRWA in both areas, and the overall similarity of the environment in the refugee camps in both regions. Therefore, UNRWA's waste collection services tend to be similar in both regions to a certain extent.

One important factor in the management of residential waste is the spatial distribution of waste collection containers within a particular residential area. Maintaining a close proximity between the households and the waste containers helps to reduce littering (Arafat *et al.* 2007) and prevents waste accumulation inside the houses. It also discourages people from improper random disposal of their waste. On the other

hand, if the waste container is not designed, maintained, disinfected, and emptied properly, its proximity to households may become a nuisance or even a health hazard. These containers could cause serious complaints about leachate, odour and broken glass. Respiratory and digestive problems among children may become common, as school children passing through the dumpsites often pick up objects, which could be dangerous to their health (UNEP 2006). In areas where RSW is collected in open dumping sites within residential areas (either as a permanent disposal or awaiting transfer to final disposal sites), the proximity of such dumpsites to households becomes undesirable. Table 7 shows the distribution of Palestinian households according to distances from nearest waste collection container or open dump site. This table demonstrates that there are roughly as many house-

Table 7: Distribution of households in the Palestinian territory according to distance (in metres) from nearest common waste collection container or dumping site.<sup>a</sup>

Region	500 m or less (%)	More than 500 m (%)	Total (%)
Palestinian Territory	51.10	48.9	100
West Bank	29.90	70.1	100
North of West Bank	17.6	82.4	100
Middle of West Bank	54.6	45.4	100
South of West Bank	20	80	100
Gaza Strip	92.90	7.1	100

<sup>a</sup>PCBS (2005).

holds at 500 m or less from a container/dump site as there are at more than 500 m. The distance of the nearest container/dumping site from the household was found to be 500 m or less in about 93 and 30% of households in Gaza Strip and the West Bank, respectively. The high population density in the Gaza Strip, which leaves only narrow spaces between houses, may explain why most solid waste container/dumping sites are less than 500 m away from the households. For most residents, having to travel 500 m or more to dispose of their RSW is a burden. Alternatively, many households turn small open spaces close to their homes into makeshift waste disposal sites for their own use (as can be clearly seen throughout the Palestinian territory), thus complicating the waste management problem in their areas. Therefore, a well designed placement plan for waste collection containers is needed to alleviate this problem. Moreover, the open dumping phenomena within residential areas have to be eliminated.

### RSW disposal methods in areas not covered by collection services

As mentioned earlier, around 9% of Palestinian households were not covered by a waste collection service. Residents of these households had adapted to this situation by finding alternative methods to dispose of their RSW. Results in Table 8 show that out of the 9.3% of households in the Palestinian Territory that did not receive a solid waste collection service, about 36% transfer their waste to the nearest container (in a nearby serviced locality) in West Bank, while the percentage of those doing the same in Gaza Strip was approximately double that (73%). Open waste burning is the second most popular choice for waste disposal, and was practised by about one-fifth of un-serviced households, but slightly more so in the West Bank than Gaza Strip. Although open-air burning of solid waste is a technique to reduce the volume and odour of waste (WHO 2000, Al-Khatib & Abu Safieh 2003), it is known that open waste burning releases toxic and carcinogenic gases such as dioxins, especially if the waste contains plastic materials (Elliott *et al.* 2001).

The third choice for RSW disposal was found to be open dump sites, which the residents of a particular locality agree upon. Needless to say that neither the location nor the set-up

of these dumpsites (which were usually started as a convenient makeshift dump area by some residents and expanded thereafter) had ever been thoroughly examined to meet the minimum environmental or health standards. In 2002, the Palestinian Central Bureau of Statistics (PCBS 2002) reported that 137 dumpsites were randomly distributed in the Palestinian Territory; most of these (133) were located in the West Bank. The number has increased drastically since then (Al-Khatib *et al.* 2006) and at least 450 illegal dumps have been established even as municipalities are taking steps to rehabilitate established dumps (World Bank, 2004).

Although these dumping sites were once located in rural sections, urban areas have expanded and many of these sites are now situated near residential areas (Abu Thaher 2005). It is interesting to observe that while 30% of un-serviced households in the West Bank chose open dumping of waste in designated areas as a solution, none of the respondents in Gaza Strip was found to do so. The scarcity of land in the overcrowded Gaza Strip makes it very difficult to designate an area of land as a waste dump site.

Random open waste dumping (outside a designated dump-site) was practised on a smaller scale (by 10% of un-serviced respondents, Table 8). In this case, people disposed of their waste randomly wherever possible, including, for example, by the roadside, in small unpopulated land areas, public parks, behind building fences, on farmlands, etc. Eventually, most of this waste is spread out as litter by wind, animals, children playing and waste scavengers.

The current conditions with regard to the above-mentioned waste disposal techniques, especially the open dumping sites, emphasizes that they do not receive the proper care and monitoring that is needed. Such conclusions are supported by the absence of public environmental supervision over 79% of the dumping sites, in addition to the absence of any health control and monitoring in over 86% of them, while 77% of the dumping sites do not have the proper licence for construction (PCBS 2002). Additional problems regarding the designated dumping sites arise from the multiple responsible authorities in charge of giving licences and monitoring these sites, including the Palestinian Ministry of Health, Ministry of Local Government, as well as the Environment

Table 8: Fate of RSW in localities not covered by waste collection services in the Palestinian territory.<sup>a</sup>

Region	Transferred by household member to waste containers in another locality (%)	Burned (%)	Disposed in common open dump sites (%)	Dispersed by random open dumping (outside dump-sites) (%)	Used as animal food or fertilizers (%)	Other (%)	Total (%)
Palestinian Territory	49.6	19.3	18.7	10.2	0.7	1.5	100
West Bank	35.7	20.9	29.8	9.9	1.1	2.6	100
North of West Bank	44.6	32.3	14	7.6	1.5	0	100
Middle of West Bank	11.9	14.4	46.1	0	0	27.6	100
South of West Bank	29.3	6.6	47.8	15.5	0.8	0	100
Gaza Strip	72.7	16.7	0	10.6	0	0	100

<sup>a</sup>PCBS (2005).

Quality Authority. The inability of most of the local municipalities to collect fees for using these dumping sites leads to the lack of adequate financial resources and organizational management of them. Moreover, leachate from dumping sites may contaminate the groundwater, which is the primary drinking water source in all Palestinian towns and villages. Finally, the partial use of these dumping sites by the Israeli military occupation forces, and to a greater extent by the Israeli settlements, significantly contributes to their growing size and challenges (AL-Khatib & Abu Safieh 2003).

It is worth mentioning here that a legal framework through which to provide for effective waste management has not been adopted in Palestine, although an Environment Law was adopted in 1999 which provides a framework through which decrees could be issued to provide a legal framework for the sector. An environmental strategy that would articulate environmental priorities, including those related to solid waste management, has been drafted but has not been adopted. In the absence of environmental legal frameworks, the sector operates solely under municipal law that defines municipal responsibility for waste management services and which provides for municipalities to establish 'joint service councils' through which they may collaborate in the delivery of municipal services, including waste management; an increasing number of municipalities are participating in such initiatives (World Bank 2004).

### Opportunities for improvement

The study reveals that there is room for significant improvement in RSW management in the Palestinian territory. First, although the RSW collection service coverage was reasonable in the Palestinian territory (about 90%), the authors believe that expanding the waste collection service coverage to include all residents of the Palestinian territory would have a positive impact on eliminating the random open burning and dumping of waste, with all its significant health and environmental risks, as currently practised by more than 25% of unserved households. Additionally, there is a need to increase the frequency of RSW collection in some areas, given that 50% of Palestinian households received this service three times per week or less. This could well lead to over-filled waste containers, odour, rodents, and littering problems. Second, the study revealed that for more than 50% of the Palestinians the nearest waste collection containers were located more than 500 m away from their residence, which encourages littering and random waste dumping. Hence, there is a need to optimize the spatial distribution of waste

collection containers within residential areas, especially in the West Bank. Third, based on the finding that a high percentage (80% or more) of the RSW was of organic nature, the adoption of waste utilization initiatives, especially composting or biogas generation, should be encouraged.

Finally, while the average RSW generation rate was found to be around 0.8 kg capita<sup>-1</sup> day<sup>-1</sup>, which is around the lower end of the global range, it still varied according to the economic status of the area generating the waste, with wealthier areas generating more waste with less organic content. These variations should be taken into account when evaluating future final waste disposal options (e.g., landfilling) and waste recycling programmes.

### Conclusions

In this research the current status of residential solid waste (RSW) management in the Palestinian territory was studied, by surveying more than 4000 households in the territory (both in West Bank and Gaza Strip). The results showed that around 90% of households were covered by waste collection services, although the RSW collection frequency and collection provider varied considerably. The latter, for example, included local Palestinian municipalities, UNRWA, private contractors, and the Israeli Jerusalem Municipality in limited areas. The collection frequency was also dependent on the service provider. For example, UNRWA collected RSW more frequently in areas under its jurisdiction (refugee camps) than did the Palestinian municipalities. The Palestinian RSW generation rate, averaging 0.7–0.8 kg capita<sup>-1</sup> day<sup>-1</sup>, was found to be dependent on the economic status of the area, such that wealthier regions of the Palestinian territory were found to produce more waste. Furthermore, RSW composition was dominated (more than 95%) by organic waste (food waste and baby diapers), which presents an opportunity for waste utilization through composting or biogas generation. Unfortunately, Palestinian attempts in this direction are still marginal.

In areas where RSW collection services were unavailable, residents disposed of their waste using a variety of techniques. These include designated and random open dumping, waste burning, transfer to other areas, and usage as animal feed. Most of these methods encompass health and environmental risks, especially open burning or dumping. Moreover, about 50% of all respondents declared that the nearest waste collection container or designated dumpsite was 500 m or more from them, which further encourages random disposal and littering.

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