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Article *in* Waste Management · February 2007

DOI: 10.1016/j.wasman.2006.11.006 · Source: PubMed

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Trends and problems of solid waste management in developing countries: A case study in seven Palestinian districts

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Accepted 3 November 2006
Available online 16 January 2007

Abstract

There is a great interest in solving problems related to municipal solid waste (MSW) management in the Palestinian territory. However, few studies have been done to assess the extent of these problems and suggest the best alternative solutions. This study aims at assessing MSW conditions in the seven major districts in northern West Bank, Palestinian territory. The study focuses on comparing several MSW management elements (such as collection, budget, and disposal) in municipalities, village councils, and refugee camps in the studied districts and the problems faced by these institutions in handling the waste. It also provides information on MSW collection service availability and waste disposal practices in the districts studied.

It was found that, although MSW collection service was available for 98% of the residents in the areas surveyed, no proper treatment or landfill procedure was followed for the collected waste in most of these areas. Instead, waste burning in open dumpsites was the most common practice. Moreover, due to inefficient collection of waste disposal fees from the residents, municipalities were forced to sometimes cut the collection service and reduce its labor force, especially in villages. The budget for MSW management was between 2% and 8% of the total budget of the municipalities studied, indicating a low priority for this issue.

1. Introduction

Waste is anything discarded by an individual, household or organization. As a result waste is a complex mixture of different substances, only some of which are intrinsically hazardous to health (Rushton, 2003). The collection, processing, transport and disposal of solid waste are all important aspects of waste management for public health, aesthetic, and environmental reasons.

There is a growing concern for the insufficiencies of solid waste management in developing countries, and developing areas of countries with mixed economies. The reasons for waste storage, collection and sanitary disposal and the technology of waste landfilling are well accepted and understood in developed countries. Developed countries have established regulated programs for the disposal of solid wastes, while developing countries have generally continued to use unsophisticated methods such as open dumps (Berkun et al., 2005). In general, there is a lack of organization and planning in waste management due to insufficient information about regulations and due to financial restrictions in many developing countries (Tiynmaz and Demir, 2006; Vesilind et al., 2002). In most developed countries, workable legislation, regulations, and action plans are now in place. However, waste disposal in developing countries is still largely random and uncontrolled, and large quantities of waste go uncollected (Blight and Mbande, 1996). The problem of

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doi:10.1016/j.wasman.2006.11.006

upgrading policies and practices for the disposal of municipal solid waste are far more difficult in most developing countries than in developed countries. There are many reasons for these difficulties, but they all basically result from poverty and lack of education and opportunity and, in some cases, adherence to customs that do not easily fit into the modern world. It is only recently that the problems of waste management in developing areas are being seriously addressed. Reduction in solid waste generation, and reuse and recycling of waste are considered priority items in the management of MSW. Additionally, reducing quantities of waste generated is considered an educational and awareness task, which has to be promoted in all societies (Vencatasawm et al., 2000; Tchobanoglous et al., 1993).

In the Palestinian context, in addition to the reasons mentioned, the political situation is also one of the main factors slowing improvements in the sanitary disposal of solid wastes, in spite of having strategic and action plans in place (Ministry of Environmental Affairs, 2001; Musleh and Giacaman, 2001; Palestinian Central Bureau of Statistics (PCBS, 2001)). In the Palestinian territory and particularly in the West Bank, MSW disposal is considered a problem due to several reasons, including groundwater aquifer location, the small area of the West Bank, the lack of sanitary landfills, and the lack of any serious recycling programs (Talahmeh, 2005).

Developing countries have adopted various methods for final disposal of their MSW, including sanitary landfilling (Sufian and Bala, 2006). On the other hand, the West Bank still has a severe shortage of sanitary landfills. Until September 2000, there were 100 random unsanitary MSW dumpsites in the West Bank (Applied Research Institute-Jerusalem (ARIJ, 2002; Talahmeh, 2005)). These dumpsites were ''random'' in the sense that the decision to use these particular locations was part of a makeshift solution and not part of any long-term land use planning. As the second Palestinian uprising (Intifada) started in 2000, reaching the locations of these dumpsites has become harder than ever, due to military roadblocks and curfews, which has led to the establishment of emergency open dumps within the boundaries of Palestinian cities and villages. This situation has been further worsened by the rapid deterioration of MSW transfer trucks, which were forced to use unpaved side roads (avoiding roadblocks) to reach the MSW dumpsites. As a result, the number of random dumpsites in the West Bank surged to about 190 by the year 2003 (Abu Thaher, 2005). Another negative phenomenon that developed during the uprising is the frequent open burning of waste accumulated in MSW dumps within city boundaries, primarily to reduce waste volume. Additionally, frequent closures and roadblocks have resulted in a shortage of pesticides and insecticides needed to overcome the negative effects of MSW accumulation within residential areas (Abu Thaher, 2005).

Limited recycling initiatives have been put into practice in the West Bank in the past. These initiatives were mostly privately owned and focused mainly on metals, paper, and glass recycling. Metals and glass were locally utilized, whereas other items such as automobile scrap was sold to Israeli firms for utilization in Israel (Environmental Quality Authority, 2005).

The aim of this paper is to discuss and to draw attention to the vast environmental deterioration and, in some cases, health problems that currently exist in seven districts in the West Bank of the Palestinian territory as a developing area. It also explores MSW management trends (including collection, transport, treatment and disposal) in these areas.

2. Methodology

This study was conducted in seven districts in the West Bank (Palestinian territory), namely, ''Ramallah and Bireh'', ''Nablus'', ''Jenin'', ''Tubas'', ''Qalqilia'', ''Salfit'', and ''Tulkarem''. Fig. 1 shows the location of these districts within the West Bank. The target group in this study is the municipalities, village councils, and refugee camps councils in charge of MSW collection and disposal. A total of 132 municipalities and councils were chosen to be surveyed in this study, which are distributed as shown in Table 1. The total population in these municipalities and councils constitute about 70% of the total population in the seven districts. The selection of the residential areas to be surveyed was done randomly. However, care was taken during the selection process to ensure coverage of a wide range of geographical locations and socio-economic conditions of the residents. The MSW referred to in this study includes all types of solid waste that are usually collected by the Palestinian municipalities. This includes both residential and commercial waste. In some cases, the municipalities also collect industrial waste, mixed with residential solid waste, although this is not generally the case. Handling of construction and demolition (C&D) waste is the responsibility of the citizens in the West Bank and, therefore, C&D waste generally is not collected by the municipalities as MSW.

A survey was prepared for this study that included questions about: (1) the type of residential area (city, village, refugee camp); (2) the amounts of MSW collected; (3) MSW collection service availability; (4) frequency of MSW collection; (5) MSW collection equipment and vehicles; (6) details about the labor force in the MSW management section (including number of workers, salaries, and working hours); (7) MSW budget; (8) MSW collection fees; (9) MSW final disposal methods; (10) location of disposal sites; and (11) availability of MSW reuse or recycling options, as well as other general MSW issues and trends. In order to obtain responses to our survey, personal interviews were held with personnel in charge of MSW management in the municipalities or villages or camp councils of the selected residential areas. These individuals were either the heads of the ''health and environment'' departments in the larger municipalities, in which

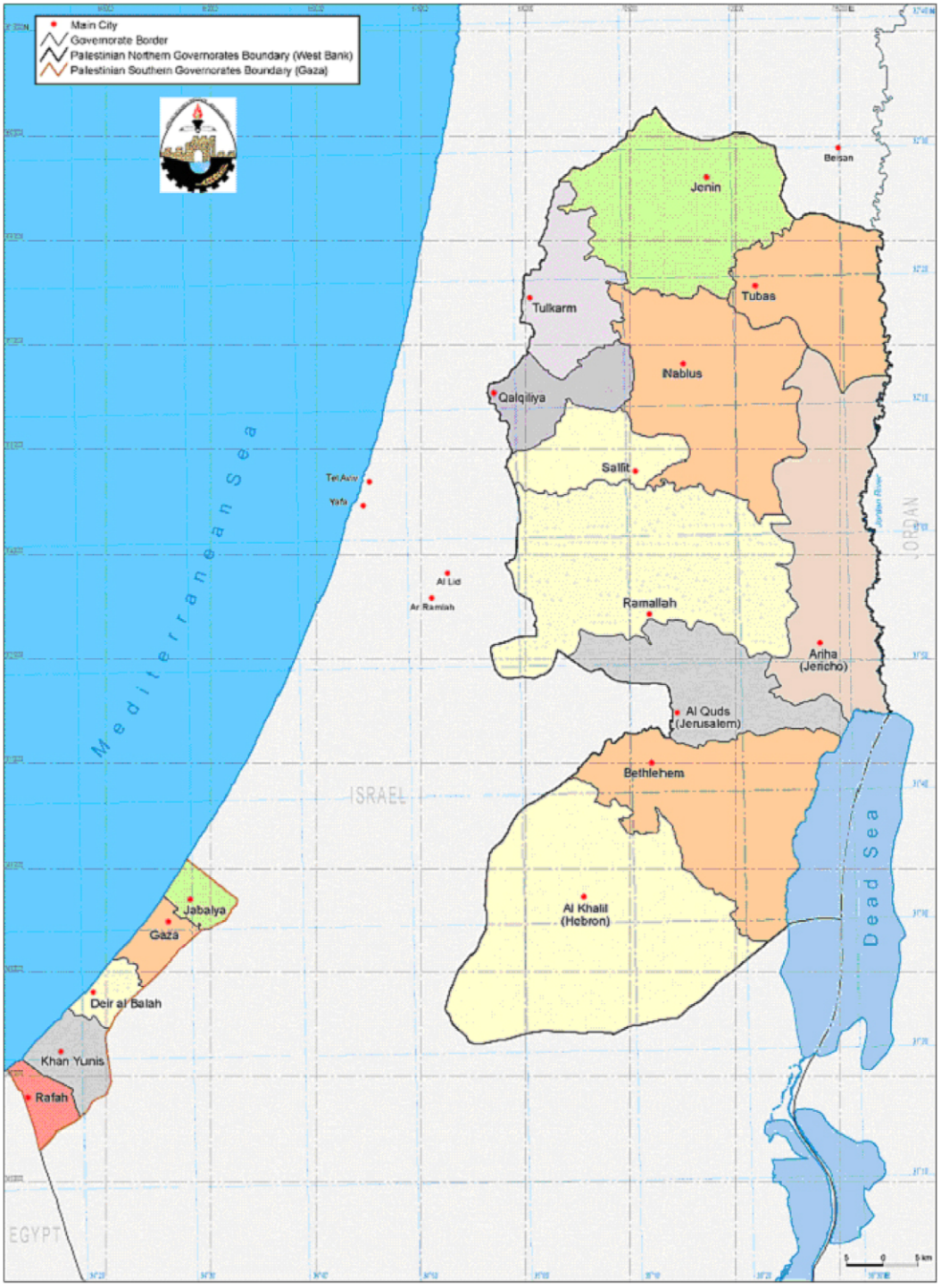

Fig. 1. West Bank and Gaza Strip Governorates including surveyed districts (ARIJ, 2005).

such departments exist, or the head of municipality or village council in the smaller areas. During the interviews, these individuals answered the questions included in our survey.

The average MSW generation rate per-capita was then calculated for each residential area by dividing the average daily amount of waste collected (obtained from the municipalities through the surveys) by the population size of that area, which was obtained from the Palestinian Central Bureau of Statistics (PCBS) (PCBS, 2005). For practicality, it was assumed that most of the waste generated was collected. This assumption is reasonable since none of the areas studied had any recycling programs, which makes the waste diversion rate negligible. Finally, field observations related to MSW and its management in the seven districts were also recorded. The interviewing process and field observations were conducted during the period of June through September of 2005.

Table 1
Distribution of surveyed residential areas

District(s)	Number of residential areas surveyed	Total population of the surveyed areas	Total district population	Fraction of district population surveyed[a]
Ramallah and Bireh	17	146,100	299,300	0.49
Nablus	29	240,300	348,800	0.69
Tulkarem	20	137,700	179,100	0.77
Qalqilia and Salfit	19	121,450	166,850	0.73
Tubas and Jenin	47	279,900	321,000	0.87
Total	132	925,450	1,315,050	0.70

[a] Equals column 3 divided by column 4.

3. Results and discussion

3.1. MSW collection

Table 2 shows the percentage of households covered by MSW collection services, the average number of collection times per week, and the average monthly salary of MSW collection employees (in New Israeli Shekels, NIS).

A wide variation is noted in the collection frequency, which ranges from 3 to 12 times per week (the latter is a twice-a-day collection, 6 days a week). The results in Table 2 reveal that, on average, 98% of the households surveyed were covered by MSW collection service, compared to only 67% in the year 2000 (Abu Thaher, 2005), in spite of the current difficult political and economic conditions. The lack of coverage of the remaining 2% of households is due to their remote locations and to the absence of paved roads to reach these households. The increase in collection service coverage from the year 2000 is due to the fact that most villages and small towns close to each other share their MSW collection vehicles and/or collection crew under a system known as the ''common service councils'', which alleviated some of the financial burden borne by the smaller villages in the past to provide these services to their citizens. On the other hand, in spite of this high coverage rate, the results in Table 2 show that MSW collection frequency in some areas is around or below 3 times per week, especially in the villages. This leads to the accumulation of waste between collection periods, resulting in negative health and environmental impacts, such as the spread of unpleasant odors (especially in the summer), insects, and rodents, which can be a major factor in the spread of insect-borne gastro-intestinal and parasitic diseases (such as gastroenteritis and malaria) in these crowded communities. It is common to see leachate dripping from waste collection containers during these accumulation periods. It is also common to see scattered garbage around full containers.

A solid waste problem that was encountered in many of the areas surveyed is the lack of collection services for

Table 2
MSW collection in surveyed residential areas

Residential Area	Average percentage of households covered by MSW collection service (%)	Average MSW collection frequency (times/week)	Average salary of MSW collection workers (NIS/month)
''Ramallah and Bireh'' city	98	6	1500
Villages of ''Ramallah and Bireh'' district	95.5	2.82	1440
Jenin city	100	12	1500
Villages of Jenin and Tubas districts	95.8	4	1180
Jenin district refugee camps	100	6	1750
Nablus City	90	7	1300
Villages of Nablus district	97.5	3.25	1142
Tulkarem city	100	12	1200
Villages of Tulkarem district	99.8	3.47	1285
Tulkarem district refugee camps	100	4	2000
Qalqilia city	100	7	1100
Villages of Qalqilia and Salfit districts	100	3.38	1302
Average	98%	5.91	1390

1 USD is equivalent to 4.3 New Israeli Shekels (NIS).

street litter. Street litter is particularly common in smaller towns and villages. This is due to the low MSW management budget in these villages and the prevailing negative public perception in the Palestinian territories about litter collection jobs, which is a cultural problem that has to be overcome. The average salary of solid waste collection workers varied widely from 1100 to 2000 NIS per month (approximately 256–465 USD/month), as seen in Table 2. Although this figure is not lower than the average salary of unskilled workers in the West Bank, solid waste collection is considered a low-status job by most Palestinians. Interviews with personnel in charge of MSW management in most of the residential areas surveyed revealed difficulties in finding workers who would accept long-term employment as MSW collection workers.

3.2. MSW generation rates

Table 3 shows the average per capita MSW generation rates for the seven districts studied. For each district, waste amounts were shown separately for the major city in the district and the smaller towns and villages. For three districts (Jenin, Tubas, and Tulkarem), average generation rates for refugee camps in the district are also shown in Table 3. It is systematically observed in Table 3 that MSW generation rates in the main cities of the districts are higher than the smaller villages in the corresponding districts, while the smallest rates are registered in the refugee camps. This is attributed to the higher living standards and economic activities in the cities, compared to the villages and refugee camps. Also, in the villages, a fraction of the waste is fed to farm animals and is, therefore, diverted from the MSW collection stream. The overall average MSW generation rates per capita for the cities, villages, and refugee camps are 1.51, 0.65, and 0.52 kg person^{-1} day^{-1}, respectively. These results are in agreement with global trends for developing countries, which also show an increase in MSW generation rate as the resident's economic conditions improve (Vesilind et al., 2002).

Two trends can be noticed in Table 3. First, Qalqilia city had the highest MSW generation rate among all areas studied. Qalqilia city is close to the border with Israel and is frequently accessed by Israeli citizens seeking lower prices and better bargains than those found in Israel. Therefore, Qalqilia city is an area of vigorous trading and commercial activities that resulted in higher income levels of the city residents, as well as larger amounts of MSW. Second, the Jenin refugee camps had the lowest MSW generation rate, which is only 20% of the generation rate of Qalqilia city for example. This is easily understandable in light of the devastated economic condition in these camps during the second Palestinian uprising, which led to weaker purchasing power, and therefore, lower waste generation rates.

3.3. Methods of final waste disposal

Table 4 shows a summary of the final disposal methods for MSW in all seven districts studied. Only five different disposal alternatives were encountered in these districts. These are:

1. Disposal in open random dumps outside the boundaries of the residential area with waste burning.
2. Disposal in open random dumps outside the boundaries of the residential area without waste burning.
3. Disposal in a random dump site inside the boundaries of the residential area.
4. Disposal in a random semi-covered dumping site (with occasional dirt cover) outside the boundaries of the residential area.
5. Transfer for landfilling in Israeli-controlled areas for a fee.

It is worrisome to see from the data in Table 4 that most cities and villages dispose of (and, in many cases, burn) their waste in random open dumps lacking proper health and safety requirements. The main justification why many areas use waste burning is volume reduction. However, 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). This is in addition to the long-term effects of these gases on the environment and on groundwater (World Health Organization (WHO), 2000; Fielder et al., 2000; Hehn et al., 2000; Harrad and Harrison, 1996; Al-Khatib and Abu Safieh, 2003). Moreover, leachate from random dumps may contaminate the

Table 3
MSW generation rates in surveyed residential areas

District(s)	MSW generation rate in the major city (kg person^{-1} day^{-1})	MSW generation rate in the villages (kg person^{-1} day^{-1})	MSW generation rate in the refugee camps (kg person^{-1} day^{-1})
Ramallah and Bireh	1.56	0.57	–
Nablus	1.38	0.84	–
Tulkarem	0.90	0.63	0.64
Qalqilia and Salfit	2.00	0.74	–
Tubas and Jenin	1.71	0.48	0.40
Total	1.51	0.65	0.52

Table 4
MSW disposal methods of surveyed residential areas

Residential area	Percentage of residential areas using this disposal method (%)				
	Open random dumps outside the boundaries of the residential area with waste burning	Open random dumps outside the boundaries of the residential area without waste burning	Open random dumping inside the boundaries of the residential area	Semi-covered dumping outside the boundaries of the residential area	Transfer for landfilling in Israeli-controlled areas for a fee
"Ramallah and Bireh" city	0	0	100	0	0
Villages of "Ramallah and Bireh" District	88	0	12	0	0
Jenin city	0	0	0	100	0
Villages of Jenin and Tubas districts	90	0	0	10	0
Jenin district refugee camps	50	0	0	50	0
Nablus City	0	0	0	0	100
Villages of Nablus district	70	18	12	0	0
Tulkarem city	100	0	0	0	0
Villages of Tulkarem district	58	42	0	0	0
Tulkarem district refugee camps	100	0	0	0	0
Qalqilia city	0	0	100	0	0
Villages of Qalqilia and Salfit districts	88	0	6	6	0

groundwater, which is the primary drinking water source in all Palestinian towns and villages. It comes as no surprise, then, that the residents in areas that practice waste burning and open dumping have constantly complained about the sensible negative effects of this practice. For example, in Ramallah city (which burns some of its waste in areas within the city limits before dumping it), large clouds of smoke are frequently spotted covering significant portions of the city especially when strong wind is blowing. It is worth mentioning here that the waste burning phenomena was very common in the West Bank in the mid 1990s. But as the Ministry of Environmental Affairs was established in 1998, it worked with the local governance bodies in limiting this practice and they had significantly succeeded. Unfortunately, this phenomena re-surfaced again with the outbreak of the Palestinian uprising in 2000, and was further enforced by the frequent military closures and curfews imposed on the Palestinian towns.

Generally speaking, none of the forms of waste disposal encountered during this study, except for the fee-based waste transfer to an Israeli-controlled area for landfilling (practiced only by the city of Nablus), are conducted according to acceptable standards. Moreover, most of the dumpsites visited during this study were not fenced and easily accessible. It was very common to see stray animals, waste scavengers, and children within the boundaries of waste disposal areas. This is a serious problem since many municipalities and village councils dispose of their medical waste in the same dumps mixed with MSW without the proper segregation and treatment, which puts the people and animals who come to contact with this waste under the risk of being infected with various diseases.

It is worth mentioning here that in 1987, a master plan for solid waste disposal sites was developed for the West Bank, which calls for the closure of all existing random dumpsites and the construction of engineered sanitary landfill sites for each district in the West Bank. The "Zahrat Finjan" was one of those landfill sites, which is located 11 km southwest of Jenin city (Jenin district). The site covers a total area of approximately 12 ha. The disposal site has been designed, partially implemented, and is to be operated in the future for the disposal of domestic and non-hazardous commercial and industrial wastes collected within the Jenin district. The site will be developed progressively and

Table 5
Average MSW monthly collection fees per household

District(s)	Average fees in major cities (USD/month)[a]	Average fees in district villages (USD/month)	Average fees in district refugee camps (USD/month)
"Ramallah and Bireh"	2.66	2.09	–
Nablus	1.81	1.33	–
Tulkarem	2.4	1.48	0
Qalqilia and Salfit	1.76	1.45	–
Tubas and Jenin	3.05	1.49	0
Average	2.34	1.57	0

[a] 1 USD is equivalent to 4.3 New Israeli Shekels (NIS).

operated in accordance with international sanitary landfilling techniques. Following waste deposition, the site will be restored and subject to ongoing aftercare. It is intended that the site will ultimately become a regional waste disposal facility for the wider Jenin/Tubas area and will receive waste from all the surrounding villages. In order to spread the investment costs over time and to avoid the need to develop a new site within a short time frame, the site will have an operational lifetime of 30 years (Al-Khatib and Shaheen, 2003).

3.4. MSW management budgets and disposal fees

Table 5 shows the average monthly residential solid waste collection fees per household for the major cities, villages, and refugee camps in the seven districts surveyed. As observed, the major cities charge higher MSW collection fees than the villages in the same district. This is attributed to the broader scale of services offered in the cities, including street cleaning and higher collection frequency. On the other hand, there are no fees collected from the people in the refugee camps, as the costs of this service are completely covered by the United Nations Relief and Works Agency (UNRWA).

Fig. 2 shows the percentage of total budget allocated by cities and villages in the seven districts for MSW management. "Ramallah and Bireh" city has the highest budget percentage, which is justifiable since Ramallah is the political capital housing all ministries and governmental institutions in the West Bank and, therefore, extra budget is allocated to give the city its appropriate face. This also explains the relatively high MSW collection fees in Ramallah, as is evident in Table 5.

On the other hand, Nablus city had the lowest MSW budget among all major cities, due to the continuous military closure imposed on the city for the last four years, which resulted in the shrinkage in municipality income in this city, which depends largely on commerce for its income. Additionally, the officials in Nablus city municipality, whom we interviewed during this study, revealed that the collection rate of MSW fees from city residents has been at a record low during the past five years, ranging from 30% to 60% (i.e., 40–70% of the residents did not pay their annual MSW fees). This reflected negatively on the level of services offered by the municipality to its residents as will be shown later in the discussion on MSW collection workers and equipment. Interestingly enough, on the other hand, the villages in Nablus district had the highest MSW management budget compared to all other villages in the seven districts studied. This is simply explained by the fact that many businesses that were originally hosted in Nablus city had relocated to nearby villages since the beginning of military closure imposed on Nablus city. One good example of that is the relocation of the crops market to the "Bita" village just outside the boundaries of the city of Nablus.

3.5. MSW collection workers and collection equipment

Table 6 shows the number of MSW workers per thousand citizens in the cities, villages, and refugee camps of the seven districts. Two trends are worth pointing out. First, the cities have larger number of employees per capita compared to the villages in the same district. This is due to the employment of street litter collectors by the cities, whereas villages hire workers for household waste collection only. Second, refugee camps have higher numbers of MSW workers per capita than the cities and villages in the same district. Several aspects of the daily life (including

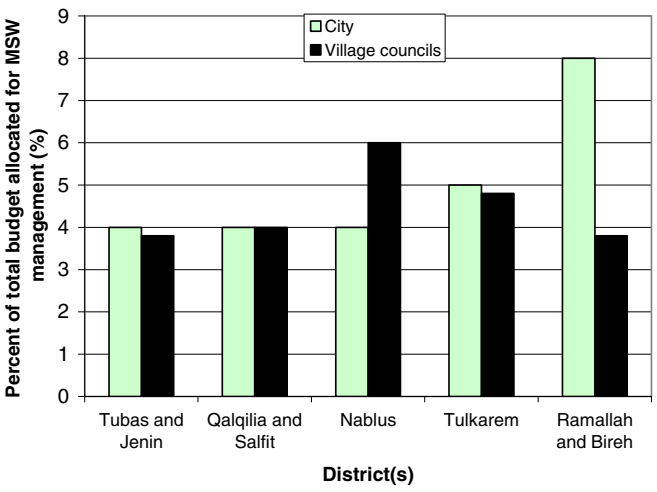

Fig. 2. Percentage of total budget allocated for MSW management in the seven districts.

Table 6
Average number of MSW management workers per thousand citizens

District(s)	Average number of workers in major cities	Average number of workers in district villages	Average number of workers in refugee camps
"Ramallah and Bireh"	1.17	0.66	–
Nablus	1.01	0.80	–
Tulkarem	1.90	0.99	1.18
Qalqilia and Salfit	2.51	0.82	–
Tubas and Jenin	2.71	0.84	3.58
Average	1.86	0.82	2.38

MSW collection) in Palestinian refugee camps are managed by the UNRWA and not local municipalities. Hence, the high employment figures of MSW collection workers in these camps are attributed to the "emergency employment" programs of UNRWA through which many unskilled workers were hired, especially during the recent Palestinian uprising (Intifada), regardless of actual employment needs. Sometimes, analysts regard these employment patterns as "masked unemployment", especially that the increased number of collection workers has not been reflected as a better solid waste conditions in most refugee camps, as revealed during interviews with MSW management personnel. Finally, it can also be observed from Table 6 that Nablus city has the lowest per-capita MSW worker employment for the same reasons mentioned earlier in the budget discussion.

Table 7 shows the average number of MSW collection vehicles per thousand citizens in the cities, villages, and refugee camps in the seven districts studied. Clearly, in the same district, a vehicle is capable of serving fewer people in the villages than in the city, due to the higher population density of the cities. Once again, it is observed that Nablus city has the smallest number of collection vehicles per capita, compared to all other cities and villages. This is due to the harsh economic conditions and high population density in Nablus city, in addition to low budget allocation, as discussed earlier. Moreover, Nablus city has a trend of using the larger collection vehicles capable of serving more people than the smaller vehicles used by the villages. Table 7 also indicates that the lowest number of vehicles per capita is in the villages of Ramallah and Bireh district. This is mainly attributed to the fact that most residents of Ramallah and Bireh district villages work in the cities of Ramallah and Bireh, not in their villages. As a result, the amount of waste generated in these villages during daytime is lower than in the villages of other districts. This is further supported by generation rate figures in Table 3, where the villages of Ramallah and Bireh district registered the second lowest MSW generation rate among villages from all districts.

3.6. Other general MSW issues and trends

By conducting personal interviews with employees responsible for MSW management in the cities and villages surveyed during this study, two noteworthy MSW issues were found to be common among a large number of residential areas:

First, several bad habits related to the handling of residential waste are common among Palestinians, which aggravate the problems of MSW management. Many people are accustomed to having their children take the trash bags out. Since many of these children are not tall enough to reach the openings of the waste containers, they leave the garbage bags next to the containers, where they can be later snatched open by street animals. Littering is another bad habit that contributes to the MSW problem in the Palestinian territories.

Second, it was noticed during the surveys conducted under this study that there were no comprehensive waste recycling and reuse programs in the areas visited. The only recycling practice encountered is the individual attempts to collect scrap metal from waste collection containers and dumps, which is then shipped to Israel for remanufacturing. Unfortunately, the individuals who work in this business usually hire poor children to scavenge the waste for trivial wages. The researchers concluded that the lack of any serious recycling program is attrib-

Table 7
Average number of MSW collection vehicles per thousand citizens

District(s)	Average number of vehicles in major cities	Average number of vehicles in district villages	Average number of vehicles in refugee camps
"Ramallah and Bireh"	0.13	0.19	–
Nablus	0.08	0.29	–
Tulkarem	0.18	0.30	0.12
Qalqilia and Salfit	0.18	0.24	–
Tubas and Jenin	0.17	0.26	0.14
Average	0.15	0.26	0.13

uted to the lack of incentives for such programs. Potential incentives include public environmental awareness, governmental support and sponsorship, and the acquirement of technical know-how needed to process the recycled materials.

It is worth mentioning here that, in recent years, some projects have been implemented in the West Bank to study the development of improved MSW management and disposal systems. For example, the "Save the Children" organization implemented a project between 1999 and 2001, which aimed at improving sanitation and environmental health in needy urban and rural communities in the northern and southern parts of the West Bank. This project assisted in the provision of the physical infrastructure needed to allow for the proper operation of a MSW management system and to support the newly established Joint Service Council (JSC) both in Anabta village (Tulkarem district) and Dura village (Hebron district, southern West Bank). Through implementation of the project, JSCs worked together in developing and implementing a solid waste collection system in an environmentally safe and cost-effective manner (Abu-Eisheh et al., 2002).

Other interesting projects include public awareness campaigns, capacity building programs, and the design of integrated solid waste management system for Tubas city and Wadi Alshir area (Tlkarem district). The latter clearly improved the coverage and quality of solid waste services in the target communities. General health conditions and quality of life have been also improved (Al-Khatib et al., 2001; El-Hamouz et al., submitted for publication; Ramahi et al., submitted for publication).

4. Conclusions

The quality of MSW management has been gradually deteriorating in the Palestinian districts since the start of the Palestinian uprising in 2000, due to several reasons including the current unstable political situation. In many localities, a high percentage of residents do not pay fees for MSW collection services and have continually complained about the haphazard heaps of uncollected garbage that are noticeable at the doorsteps and along the streets, mainly in the villages. Almost 98% of the surveyed municipalities and village councils mentioned that they provide MSW collection service for their residents. In spite of this high coverage rate, MSW collection frequency in some areas is around or below three times per week, especially in the villages.

Most cities and villages surveyed currently burn their waste in open dumps or use random open dumping, lacking proper health and safety requirements. None of the forms of waste disposal encountered during this study, except the MSW transfer to a landfill practiced by Nablus City, is conducted according to acceptable standards. As a result, there is no doubt that there is a considerable potential for hazardous exposure to occur through poor waste management in the Palestinian districts, including high levels of contamination of air, soil and water, particularly within communities living in proximity to waste dumping sites. The need to minimize the emission of pollutants and exposure to other nuisances arising from waste management operations is widely acknowledged.

Furthermore, several bad habits related to the handling of residential waste were found to be common among Palestinians, which aggravate the problems of MSW management. Additionally, there were no comprehensive waste recycling and reuse programs in any of the areas surveyed. The development of effective participatory programs is recommended to ensure that the public is effectively involved in the assessment and management of waste within the communities, leading hopefully to improved management action plans and strategies.

Based on the findings of this study, several recommendations can be made to improve the status of MSW management in the Palestinian territory. First, the budget allocated for MSW management in most municipalities and village councils has to be increased. This will facilitate hiring larger collection crews, procuring needed equipment, and increasing collection frequency. Many Palestinian citizens abstained from paying their waste collection fees during the recent uprising (2000-now). This situation has to be stopped to ensure the cash flow dearly needed for MSW management. Second, a national plan has to be enforced for the final disposal of solid waste in the West Bank, in order to end the random open waste dumping and waste burning practices. Speedy activation and implementation of such plans that have been developed so far (such as the "Zahrat Funjan" project) is needed. Third, public awareness can alleviate some of the problems related to MSW in the West Bank, especially the littering phenomenon.

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