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Residents' concerns and attitudes toward solid waste management facilities in Palestine: A case study of Hebron district

Issam A Al-Khatib[1], Hiba Ajlouny[2], Majed I Al-Sari'[3] and Stamatia Kontogianni[4]

Abstract

Because of many limitations, the siting, construction and operation of a new solid waste management (SWM) facility is a significant challenge in Palestine. A SWM facility should operate in a sustainable in all aspects, including social acceptance, environmental protection, financial equity, and, in this particular case study, the political acceptance of all regional parts is extremely important. This article presents the outcomes of an extended study that aimed to investigate the concerns and attitudes of the residents of Hebron governorate related to the entire lifecycle of SWM facilities. A structured questionnaire was developed based on literature reviews and was distributed to residents in three different communities in the same governorate with various lifestyle backgrounds. The overall investigation focused on the collection of raw data regarding citizens' levels of concern regarding the environmental impacts of SWM facilities, the general waste management aspects, the benefits gained by the operation of various types of SWM facilities and the attitudes during the construction period of each facility. The results show that concerns about water pollution are significant; the benefits gained as a result of the operation of SWM facilities, particularly the heat supply from incinerators, are welcomed; and 'not in my backyard' syndrome is highlighted. The outcomes of this research are input data for the development of a roadmap that may include educational programs, incentive schemes and active public involvement during all phases of the implementation of SWM facilities (planning, siting, operation), in order to also ensure public acceptance, participation and regional sustainable development.

Keywords

Solid waste management, facilities, developing countries, impacts, concerns

Introduction

Waste disposal in developing countries (DC) is still largely random and uncontrolled, and large quantities of waste remain uncollected (Blight and Mbande, 1996). Cities in DC are facing challenges related to the increasing amount of generated waste, which lead to problems associated with waste collection and disposal (Begum et al., 2007; Joel et al., 2012). Despite this situation, the management practices applied are not sufficient to reduce waste generation or minimize the impacts of waste disposal to the environment. Population growth, urbanization, rapid industrialization and economic development have been indicated as the main causes for the increase in solid waste (SW) generation (Sessa et al., 2009).

SW management (SWM) facilities are the key players in sustainable management of SW and, at the same time, the main contributors to environmental degradation. The latter is owing to the cases where their construction and operation does not take into consideration the potential sensitive environmental conditions of the siting area, environmental assessment reports have not been performed and local needs have not been precisely identified, and so on. The potential negative environmental impacts of the operation of any SWM facility are well documented (De Feo et al., 2013; El-Fadel et al., 1997; Lisk, 1991; Rabl et al., 2008): dispersion of pollutants and odors originating from waste treatment works (Baby et al., 2005; Rajamaki et al., 2005, Sironi et al, 2007) are posing serious environmental problems and are endangering the health status of citizens. In the European Union (EU), before the implementation of any SWM facility and the development of environmental assessment reports, a consultation meeting with interested local parties (citizens, stakeholders, authorities) is implemented; understanding the public's views

[1]Institute of Environmental and Water Studies, Birzeit University, West Bank, Palestine
[2]Faculty of Graduate Studies, Birzeit University, West Bank, Palestine
[3]The Joint Services Council for Solid waste Management for Hebron and Bethlehem Governorate (HSC-H&B), West Bank, Palestine
[4]Laboratory of Heat Transfer and Environmental Engineering, Department of Mechanical Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece

Corresponding author:
Issam A Al-Khatib, Institute of Environmental and Water Studies, Birzeit University, PO Box 14, Birzeit, 00972 West Bank, Palestine.
Email: ikhatib@birzeit.edu

and concerns on the environmental issues related to SWM facilities is important in order to ensure community cooperation and sustainability.

Citizens worldwide are concerned about environmental degradation and are willing to participate in programs aiming for source separation of waste and recycling, despite the existence of obstacles (Junquera et al., 2001) related to the lack of initiatives on offer, or the lack of information and low levels of environmental education. Taking into account citizens' concerns, perceptions and attitudes toward municipal wastes (MSW) treatment and disposal plants is a necessary preliminary step in making a final decision on the planning and siting of a new SWM facility (Al-Yaqout et al., 2002; De Feo et al., 2013). Success is linked to residents having adequate information on issues related to the environment and the specific characteristics of the SWM facility being implemented (De Feo et al., 2013), as not knowing the features of the facility that is to be implemented makes it susceptible to opposition (Rahardyan et al., 2004).

Sustainable waste management and waste quantity minimization efforts are necessary to reduce the volume of waste managed in some facilities, as well as to reduce handling and disposal expenses (Alago and Kocasoy, 2007). Waste management planning strategies should support the implementation of such programs and the adaptation of clean technologies that result into the promotion of waste recycling and recovery, the application of sustainable treatment technology appropriate for the type of generated waste and final disposal of only the residuals of waste treatment (Rossel and Jorge, 1999). The introduction of up-to-date technology in waste management could assist in overcoming many waste management problems and achieve maximum efficiency in the utilization of resources. Several methodologies exist to divert SW typically destined for sanitary landfilling, such as incineration with energy production, composting of organic wastes and material recovery through recycling—all have the potential to sustainably manage MSW (Troschinetz and Mihelcic, 2009), as indicated in the EU waste hierarchy pyramid. The '3Rs' principle (reduce, reuse, recycle) has been promoted worldwide to tackle increasing problems with MSW. Based on the 3Rs principle, such programs should be implemented with the cooperation of the government and private sector from social, technological, economic, public health and political perspectives (Weng and Fujiwara, 2001).

There is an increasing level of awareness on the impact of SWM practices on the environment (ISWA and UNEP, 2002). Recent studies have revealed that waste management is an issue of concern for householders (EPA, 2006). SWM is receiving increasing attention owing to its impact on public concern about the environment (De Oliveria Simonetto and Borenstein et al., 2007); collection, processing, transport and disposal of SW are all important aspects of waste management for public health, aesthetic and environmental reasons (Al-Khatib et al., 2007). Beliefs that waste mismanagement may be linked to health diseases (e.g. cancer) was associated with the risk perception of developing the corresponding disease owing to the application of immature or incorrect application of management practices (e.g. incineration); such information is the major concern for citizens. It was noted that those who had received a low level education were more likely to be concerned about the aforementioned risks (Sessa et al., 2009).

In general, there is a lack of organization and planning in waste management owing to insufficient information on regulations and to financial restrictions in most DC (Tiynmaz and Demir, 2006). Developing and implementing public health strategies aiming at 'educating' parents may be of great importance in achieving a positive influence on the attitude of children (Sessa et al., 2009). Collaboration between policy makers and public health professionals is critical in educating the general population and in providing innovative, accurate and detailed information (Sessa et al., 2009). Mass media are the main source of information; scientific journals, educational courses and meetings and specialists, such as healthcare professionals, which may provide accurate and reliable information, are judged as being less effective in terms of information provision to citizens (Sessa et al., 2009). However, it is important to update scientific information and focus it regionally as it is the factor that influences the application of successful waste strategies in order to be inclusive and fully integrated with economic and social practices, and to incorporate all sectors of society (Purcell and Magette, 2010).

As is widely recognized, MSW management is not only a technical problem, but is strongly influenced by political, legal, socio-cultural, environmental and economic parameters, as well as being constrained by the available resources (Kum et al., 2005). In the residential sector, socio-economic status and housing characteristics affect not only the amount of municipal waste generated, but also how it is managed (Emery et al., 2003) or how to achieve effective management.

In Palestine, SWM is summarized by as collect – transfer – random disposal. Only limited recycling initiatives have been put into practice in the West Bank region. These initiatives are mostly privately owned and focus mainly on metals, paper and glass recycling (Al-Khatib and Arafat, 2010; Al-Khatib et al., 2010). Recently, SWM has gained significant attention by the Palestinian National Authority (PNA) owing to its environmental, social and economical implications. The PNA has managed to take the following actions: passage of local authorities' law No. (1) 1997, the environmental law No. (7) 1999, public health law of 2004 and medical waste management regulations. In addition, the PNA has launched a number of regional sanitary landfill facilities: one in the north of the West Bank (constructed and operational), the second in the southern West Bank (constructed) and the third in the middle of the West Bank (in the planning phase).

To date, there is no official waste management system that incorporates the 3Rs principle of waste management. In southern West Bank, Hebron governorate, a pilot program of waste segregation at the source (wet and dry) is currently implemented in a specific suburb of the Hebron city, but the expansion of the project cannot be implemented until the first phase evaluation is performed by those responsible from the community. The Joint

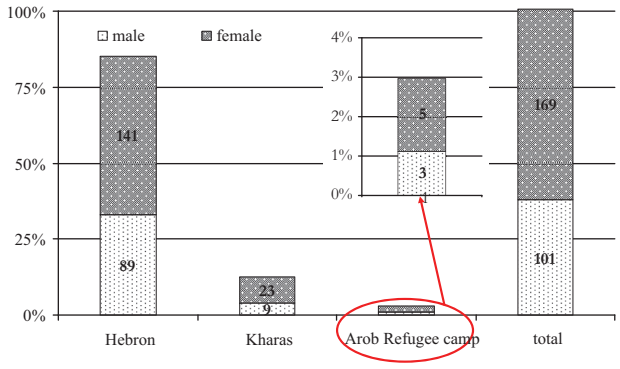

Figure 1. Demographics of the study area; the exact number of participants is indicated in the chart per research area.

Service Council for Solid Waste Management in Hebron and Bethlehem has taken steps toward improving SWM, including the construction of two SW transfer stations, cardboard and plastic separation and bailing facilities, and medical waste treatment facility.

Currently, SW generated in southern West Bank (Hebron and Bethlehem governorate) amounts to 629 tons per day (IFC, 2012) and a sanitary landfill is being constructed to serve a 25 ha region of the southern part of the West Bank within the framework of the southern West Bank SWM project.

The overall objective of this study was to investigate the concerns of citizens related to SWM facilities and to identify which of the given concerns constituted the most influential parameter on the formation of attitudes about the implementation and operation of SWM facilities in Hebron District in Palestine. The significance of this study lies in the fact that Palestine combines the characteristics of a DC together with the specific political constraints and the fragile stability of the wider area (social and political disorder, wars, etc.). Decision making is rather difficult under these circumstances and the acquisition of geographical-specific facts is greatly warranted. This need was partly fulfilled by the survey we conducted.

Methodology

Based on the literature review mentioned earlier, a structured questionnaire was developed to assess citizens' concerns and attitudes related to SWM facilities. The questionnaire consisted of three parts, each of which aimed to assess the level of:

- concern about various aspects of SWM (first);
- perception regarding the benefits of the construction of SWM facilities (second);
- 'not-in-my-backyard' (NIMBY) syndrome (third).

Each of the interviewed citizens was contacted by scientific personnel and was requested to present their view after supposing that 'a SWM facility is to be constructed near his/her town'. The type of facility was not specified (incinerator, landfill, recycling facility, etc.).

The questionnaire was sent to residents of three localities, namely Hebron city, Kharas village and Al-Aroub refugee camp, which represent the existing communities in Palestine, as well as three different lifestyles in the study area. Prior to the implementation of the field research, the local population in each district was studied and categorized based on educational, financial and other socio-economic factors in order to ensure that the research sample was representative to local population in those districts. More specifically, the sample size was selected based on the scientific methodology existing for selection of the appropriate sample size in survey research as follows:

$$n = \frac{N}{1 + Ne^2} \quad (1)$$

where n is the sample size, N is the number of households in the targeted area (Hebron, Kharas and Aroub refugee camp) and e is the level of precision.

The level of precision or sampling error was assumed to be ±8%, the confidence or risk level was selected as 2% (indicating the maximum variability in a population). This gives the following sample size:

$$n = \frac{87656}{1 + (87656 * 0.06^2} \quad (2)$$

The result was n ~277, representing 277 households, which were selected from the local population (presented in Figure 1, which is based on the demographic features of the study area); most of the surveyed population were residents of Hebron city, and about two thirds were women (i.e. 169). Therefore, there were more women in the research sample with the same characteristics as the total population, which follows the local distribution rate.

Once all answered questionnaires were gathered and raw data were available, statistical analysis was carried out using SPSS v. 17 and Microsoft Excel 2010. The analysis was performed taking into consideration parameters such as sex, age and location, which were linked to parameters such as importance, risk, future aspect and fairness of SWM facilities.

Results and discussion

Overall attitude towards SWM facilities

Air pollution. The results revealed that 48.1% of the surveyed population in the study area are extremely concerned about the air pollution caused by SWM facilities, while 7.4% are not preoccupied at all. Women in the study area expressed more concerns than men. Overall, the results showed a significant relationship between level of concern and sex ($P < 0.05$). The respondents' concerns about air pollution were cross-tabulated by age and sex, and the results are shown in Figure 2. However, the age parameter presented no significant relationship ($P > 0.05$).

Water pollution. The vast majority of the respondents (84.1%) expressed concerns about water pollution caused by SWM

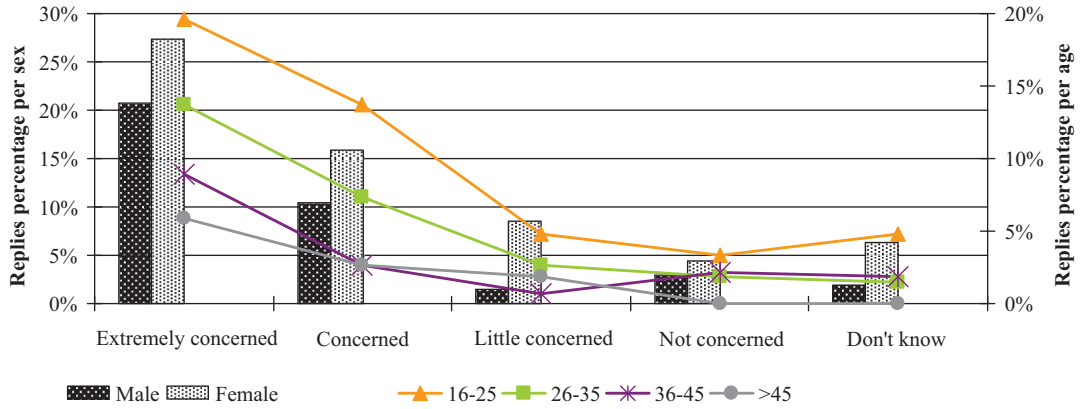

Figure 2. Air pollution concern (i) by sex (χ^2= 9.878, P = 0.043), (ii) by age (χ^2 = 15.918, P = 0.195)

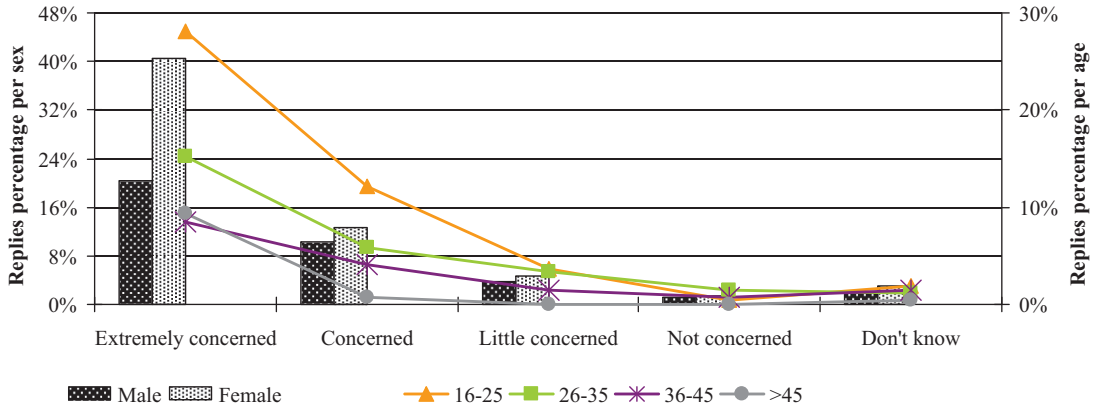

Figure 3. Water pollution concern (i) by sex (χ^2 = 3.219, P = 0.522), (ii) by age (χ^2 = 19.266, P = 0.082).

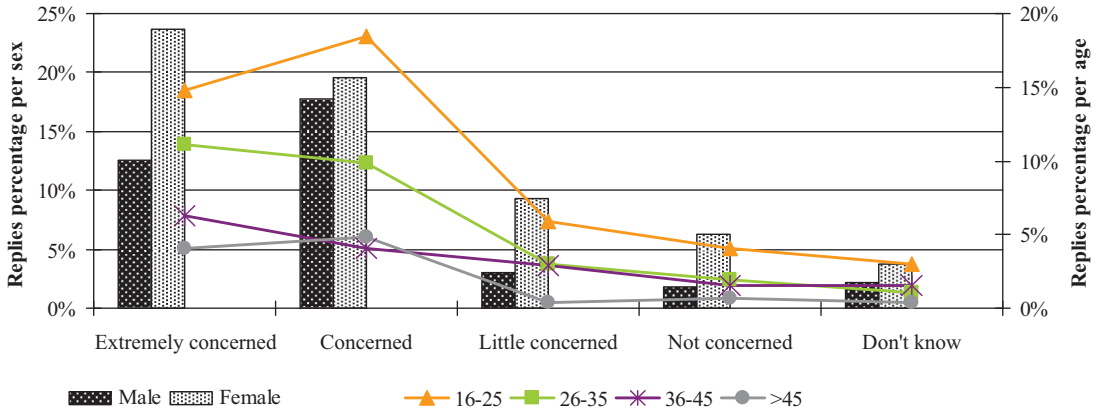

Figure 4. Concerns about soil pollution (i) by sex (χ^2 = 9.191, P = 0.056), (ii) by age (χ^2 = 8.763, P = 0.723).

facilities (61.1% stated that they are 'extremely concerned' and 23.0% that they are 'concerned'), as shown in Figure 3. Although the results revealed that women are more concerned about air pollution, there is no significant effect of sex in the case of wastewater pollution ($P > 0.05$). In addition, the age of the respondents has no effect on the results ($P > 0.05$), although the group of the young people (aged 16–25 years) expressed a much higher level of concern than older people, as shown in Figure 3.

Soil pollution. Both parameters, namely sex and age, have no significant impact on the level of concerns expressed about soil pollution caused by SWM facilities, as shown in Figure 4. The results showed that respondents are relatively less concerned about soil pollution than water or air pollution because soil pollution is (incorrectly) believed to be limited to the area surrounding the facility. This highlights the insufficient information and low-level environmental education provided to citizens.

Fauna and flora damage. People are concerned about the damage of fauna and flora; the level of concern was assessed by the factors sex and age, and the results are shown in Figure 5. The majority of the respondents are 'extremely concerned' (47.8%)

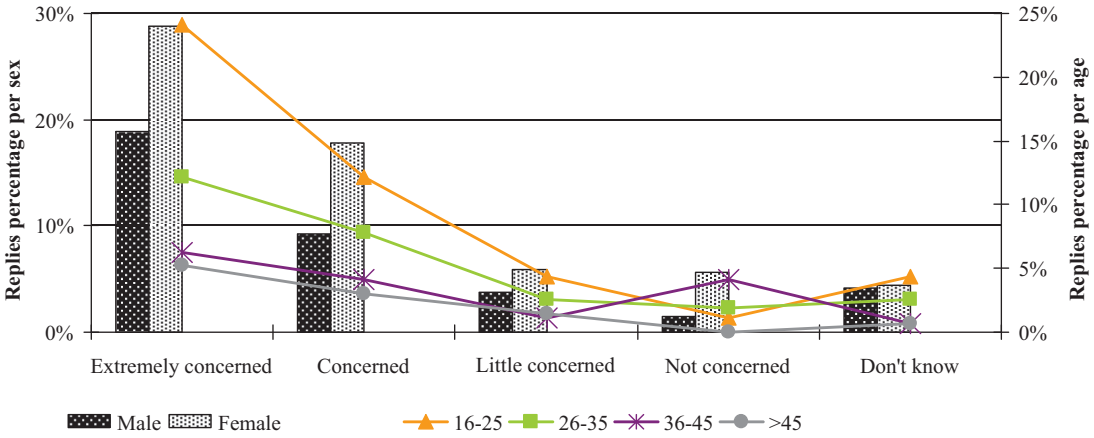

Figure 5. Fauna and flora damage concern (i) by sex ($\chi^2 = 3.810$, $P = 0.432$), (ii) by age ($\chi^2 = 29.665$, $P = 0.003$).

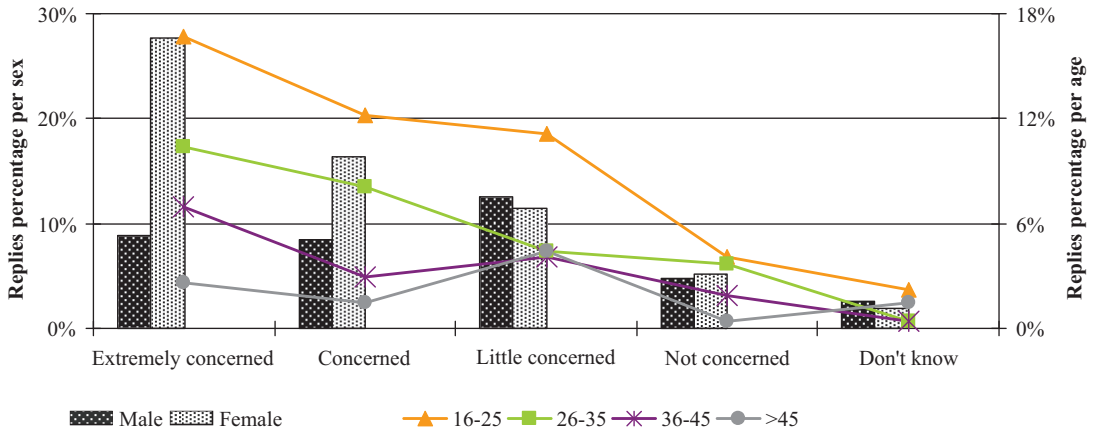

Figure 6. Concerns about truck accidents (i) by sex ($\chi^2 = 17.337$, $P = 0.002$), (ii) by age ($\chi^2 = 21.073$, $P = 0.049$).

and 'concerned' (27%) about the damage of fauna and flora as a result of the operation of a SWM facility, and this outcome is not influenced by the sex parameter ($P > 0.05$). On the contrary, the age parameter has a clear effect on the level of concern expressed ($P < 0.05$); middle-aged people (~45 years of age) are the group least concerned compared with younger and older age groups. The reason could be that young people are significantly more informed on environmental issues; they could suffer from internal conflict between living in the village or camps and entering into a new life and urbanization. The older respondents are very linked and connected spiritually to their lands and livestock as it is a source of income, and the concerns expressed by them originate from the risk of losing their livestock and fields through the operation of a SWM facility.

Truck accidents. The results revealed that sex and age affect the respondents' concerns about truck accidents during waste transportation to the corresponding facility, as shown in Figure 6. However, while women are 'extremely concerned' about truck accidents compared with males, the young (aged 16–25 years) are more concerned compared with other age groups.

Comparing the abovementioned variables in terms of 'extremely concerned', the results show that concern about water pollution is highest (61.1%) followed by air pollution (48.1%), fauna and flora damage (47.8%), truck accidents c(36.7%) and soil pollution (36.3%). The frequency and gravity of truck accidents vary by geographical region and are mainly linked directly to the training and the behavior of the driver. Rahardyan et al. (2004) found that concern about air pollution and the effect on health was the highest-rating group of concerns in Japan. The latter is owing to the fact that air pollution dispersion is linked with odors and visible gaseous emissions, and is noticed sooner by local residents compared with water/soil pollution.

Importance of benefits from SWM facilities

Importance to supply heat from incinerators. As MSW can be incinerated, the heat generated may be recovered by the overall process. The respondents' views were assessed to discover the importance of supplying heat from such facilities. In general, the respondents were interested in the benefit of utilizing SW as a heat resource through incineration as 59.7% of them highlighted the importance of this resource (23% rated it 'extremely important' and 36.7% rated it as 'important'). The responses received (influenced either by sex or age parameter) correlate well with this variable ($P < 0.05$), and the outcome is shown in Figure 7.

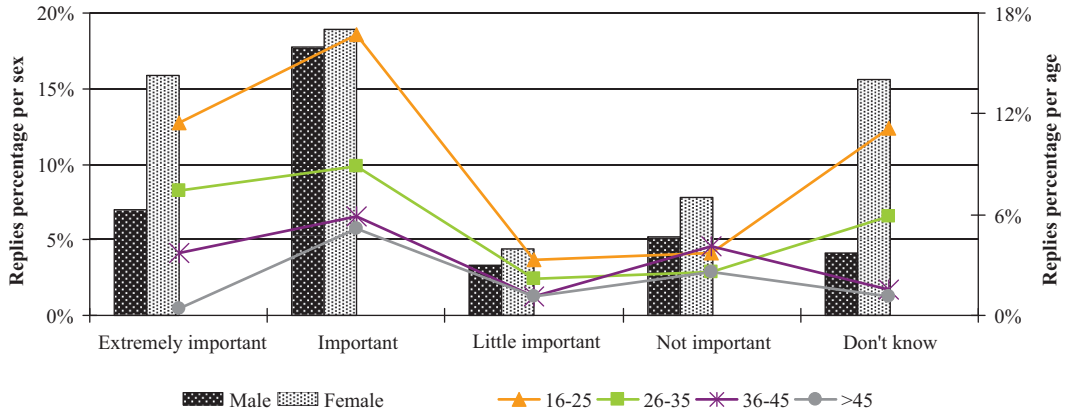

Figure 7. Views regarding the supply of heat from incinerators (i) by sex ($\chi^2 = 13.043$, $P = 0.011$) and (ii) by age ($\chi^2 = 23.587$, $P = 0.023$).

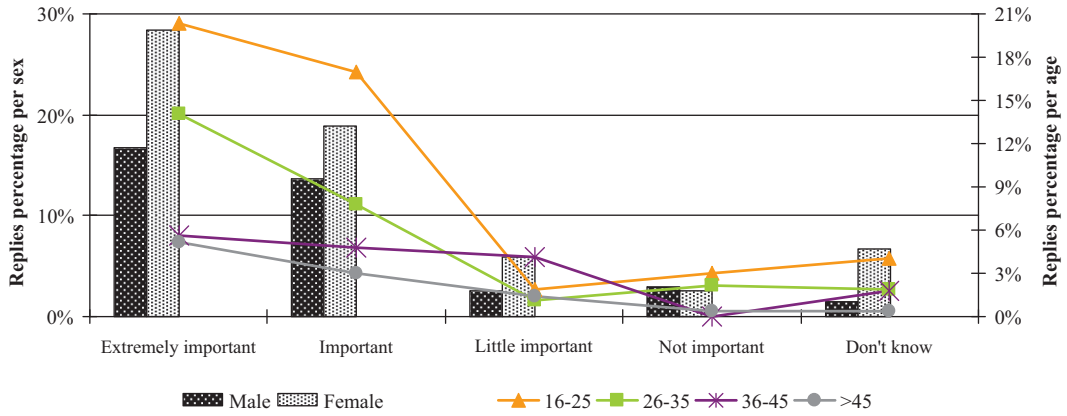

Figure 8. Views regarding the importance of information credibility in terms of operation and maintenance (i) by sex ($\chi^2 = 6.398$, $P = 0.171$) and (ii) by age ($\chi^2 = 28.43$, $P = 0.005$).

However, the percentage of the respondents who 'don't know' about this option/benefit is relatively high (19.6%), mainly owing to the fact that this technology is not widespread in the region and that people are unfamiliar with incineration plants given the low level of information provided to them.

Information credibility in term of management and operation. Although the majority of the respondents highlighted the information credibility in terms of management and operation as 'extremely important' (45.2%) and as 'important' (32.6%), there is no significant relationship regarding the sex of the respondent ($P > 0.05$; Figure 8). Nevertheless, age (also shown in Figure 8) has a significant effect on respondents' views regarding the importance of information credibility in terms of the operation and maintenance of a SW facility.

Technology credibility. Views regarding the importance of the credibility of technology applied in SWM facilities showed that the predominant answer was 'extremely important' followed by 'important' (Figure 9). The sex of the respondent has no significant statistical relationship with this variable ($P > 0.05$), but age does ($P < 0.05$) (Figure 9).

Importance of receiving information. The importance of receiving information related to the operation and management of SWM facilities was mostly rated as 'extremely important' and 'important', as shown in Figure 10. The sex of the respondent was statistically significant ($P < 0.05$), but age was not ($P > 0.05$; Figure 10).

Acceptance of building facilities 1 km from houses

Incinerators. In general, more than two thirds of respondents are against the building of an incinerator 1 km from their houses (Figure 11), in agreement with NIMBY syndrome, which has been noted in almost all research internationally the last 50 years. As the population of Palestine is not familiar with this technology, the views of the respondents were opposed the construction of such facility. Both parameters (sex and age) have no significant statistical effect on the results ($P > 0.05$; Figure 11).

Sanitary landfills. More than half of responders in the study area (city, village and refugee camp) are against building a sanitary landfill 1 km from their houses (Figure 12). Young people (aged 16–25 years) represent the highest resistance group (Figure 12). The odor from landfilling may be the main reason, followed by lack of knowledge regarding the construction of this type of facility, and, additionally, the technical potential of the collection of biogas and leachate for energy recovery. The answer is mainly

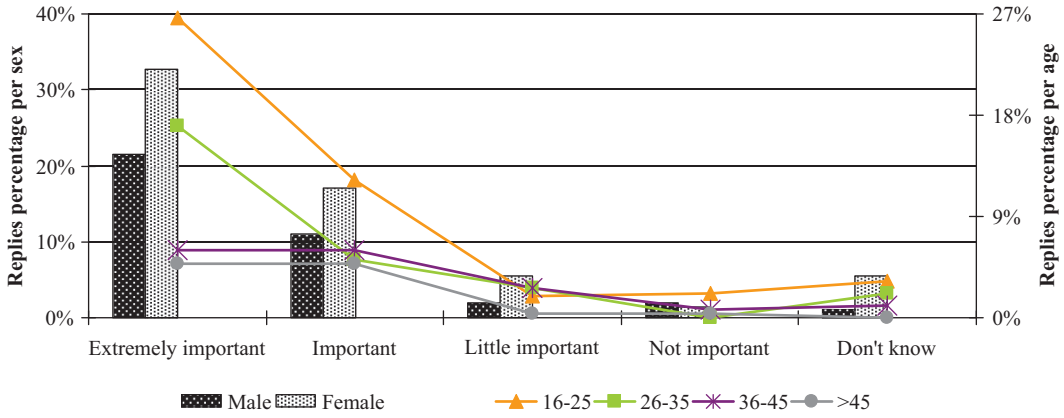

Figure 9. Importance of technology credibility (i) by sex (χ^2 = 6.290, P = 0.179) and (ii) by age (χ^2 = 23.689, P = 0.022).

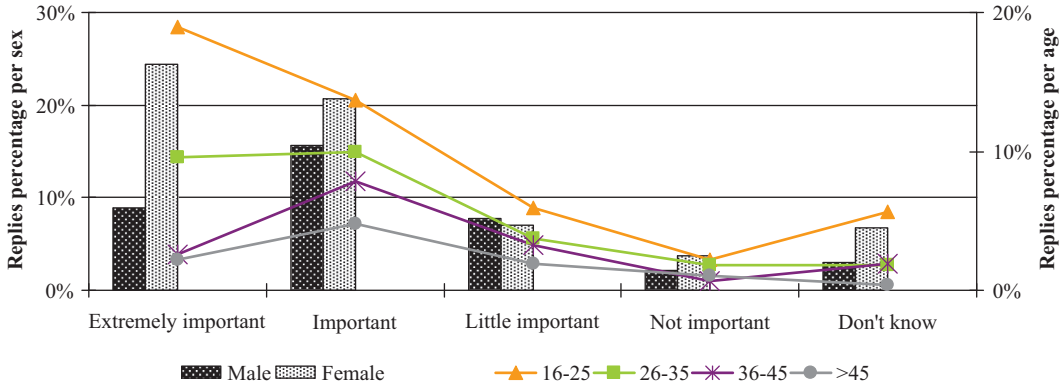

Figure 10. Importance of received information (i) by sex (χ^2 = 10.058, P = 0.039) and (ii) by age (χ^2 = 16.973, P = 0.151).

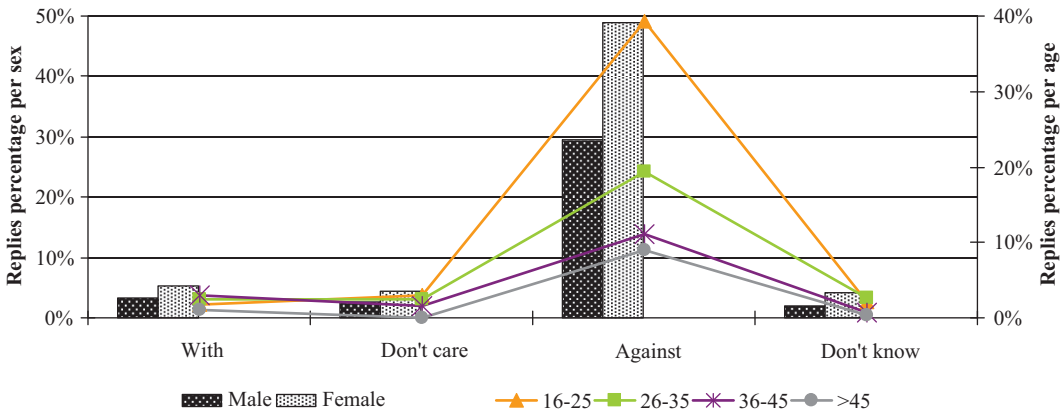

Figure 11. Views regarding building an incinerator 1 km from houses (i) by sex (χ^2 = 0.301, P = 0.960), (ii) by age (χ^2 = 15.287, P = 0.083).

based on the dispersion of pollutants, and expected health and environmental impacts. The age of the respondents has a significant statistical effect on this variable ($P < 0.05$).

Recycling facility. More than two thirds of respondents are against the building of a waste recycling facility at a distance of 1 km from their houses (Figure 13). The absence of such facilities in Palestine, as well as the minimal provision of information, form negative public opinion based on people being unfamiliar of the potential impacts on health and the environment. As shown in Figure 13, young people represent the main group opposing the construction of such facilities (Figure 13), indicating the urgent need for the introduction of environmental education in schools and universities.

Conclusions and recommendations

In this study, people's concerns regarding the siting and operation of SWM facilities was recorded and analyzed. A structured questionnaire was the main tool for the collection of raw data. The

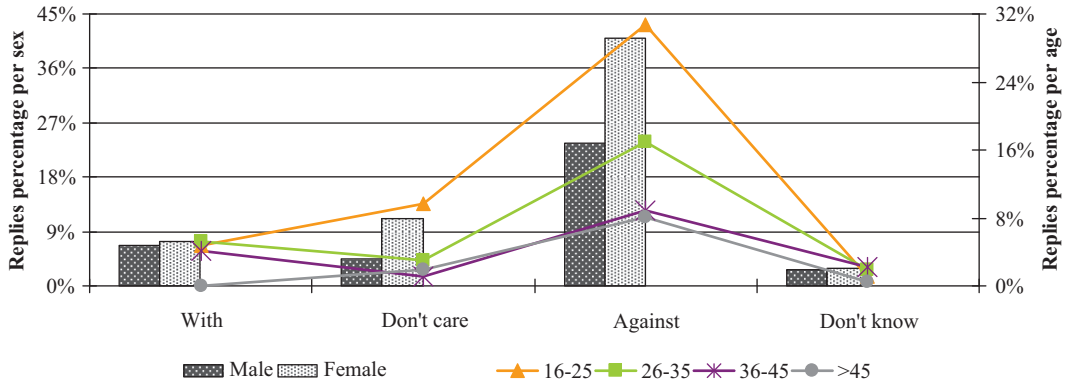

Figure 12. Views regarding the building of a sanitary landfill near houses (i) by sex ($\chi^2 = 3.612$, $P = 0.306$) and (ii) by age ($\chi^2 = 25.128$, $P = 0.003$).

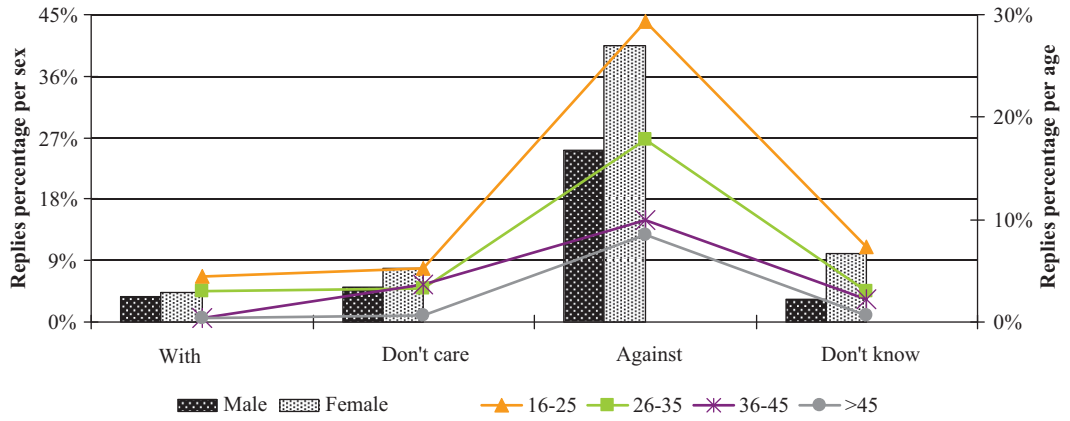

Figure 13. Views regarding the building of a recycling facility near houses (i) by sex ($\chi^2 = 3.153$, $P = 0.369$) and (ii) by age ($\chi^2 = 11.088$, $P = 0.270$).

questions were related to the potential impacts by a SWM facility operation, its benefits and aspects of its management aspects, as well as the siting of the facility and attitudes towards the construction of a facility and general aspects related to SWM. Citizens from three different communities participated in the field research; in each region the needs in the field of waste management are of various levels and the citizens who participated had a range of lifestyles, financial status and waste management-related education. The main outcomes are as follows.

- Responders (both men and women) from different communities are concerned about the operational impacts of SWM facilities.
- Water pollution is the highest-rated source of concern for respondents.
- Respondents are interested in supplying their homes and houses with heat from incinerators, although the majority of them are against the construction of an incineration facility 1 km from their homes.
- There is a negative attitude toward the building of any SWM facility 1 km from respondents' homes.

Researchers in the field of SWM worldwide may be familiar with some of these outcomes. The significant outcome of this study is the level of gravity given by people to local and geographically-specific parameters. In Palestine, where both political and financial aspects play a significant role, it is reasonable that the governmental authorities consider it of high importance to set appropriate foundations as SWM is at an early stage.

Based on the above results, we present the following recommendations.

- The implementation of awareness programs towards building and operating SWM facilities in Hebron governorate. Environmental education should be introduced in schools; this way, children can 'carry' the knowledge home and assist in raising adult awareness in a more efficient way than adult training by governmental or local authority stakeholders.
- An environmental and social impact assessment should be conducted prior to the design and construction of such facilities in order to identify any potential significant impacts at an earlier stage, and prepare an environmental and social management plan to mitigate these impacts.
- Incentive schemes should be developed to raise residents' acceptance of SWM facilities.
- A promotion program is recommended to benefit SWM facilities. Study tours for community representatives to other

built-up facilities will increase knowledge and understanding of their function and improve attitudes.
- Upgrade Palestinian environmental policy to regulate, environmentally and socially, the siting and operations of such facilities.
- Public consultation is a key element criterion when planning the construction of a SWM facility. The residents of the area near the facility should be involved in the preliminary discussions during the planning phases in order to build an early and consistent consensus for the acceptance of the facility and its sustainability.

The outcomes presented here constitute the primary results of an extended investigation currently being conducted composed of several stages and involving, apart from citizens, administration personnel and academics in higher education, stakeholders and decision makers in the field of SWM, and so on. We aim to compile an integrated road map that will ultimately offer the appropriate directions for the implementation of SWM programs in order to bridge the gap between environmental sustainability and modern technology application. The identified know-how gaps, and the needs and constraints of the geographic area, will point to a strategy through which the appropriate information and education will be provided in order local population to be able to make judgments without prejudice. Overall, the results aim to influence national strategy and provide an opportunity for a sustainable future in the region.

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Declaration of conflicting interest

The authors do not have any potential conflicts of interest to declare.

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